1.0 BACKGROUND

The Ministry of Environment & Forests, Government of India, notified the Hazardous Waste (Management & Handling) Rules on July 28, 1989 under the provisions of the Environment (Protection) Act, 1986, which was further amended in the year 2000 and 2003 for effective management of hazardous waste (HW), mainly solids, semi-solids and other industrial wastes, which do not come under the purview of the Water (Prevention and Control of Pollution) Act and the Air (Prevention and Control of Pollution) Act and also to enable the Authorities to control storage, transportation, treatment and disposal of waste in an environmentally sound manner.

Hazardous waste has been defined in Rule 3 of the Hazardous Wastes (Management and Handling) Amendment Rules, 2003, which came into force with effect from May 20, 2003, as any waste, which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include:

a. Wastes listed in Column 3 of Schedule-1;
b. Wastes having constituents listed in Schedule-2, if their concentration is equal to or more than the limit indicated in the said schedule; and
c. Wastes listed in List 'A', and 'B' of Schedule-3 (Part-A) applicable only in case(s) of import and export of hazardous wastes in accordance with to Rules 12, 13 and 14 if they possess any of the hazardous characteristics listed in Part-B of Schedule-3.

Schedule-I & Schedule-II are given in **Annexure I.**

The amendments made to the Hazardous Waste (Management and Handling) Rules, 1989 in the year 2000 and 2003 for focused attention and distinct categorization based on characterization of the waste, necessitated re-inventorisation of the hazardous waste by the State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs), which in any case is an on-going process. The new inventorisation exercise will bring out more detailed

information in terms of the total quantum of waste generated vis-a-vis its composition in terms of recyclable/reusable, land-disposable and incinerable components to form the basis for planning treatment and disposal facilities to be developed. There has been considerable delay in notifying sites for hazardous waste disposal. Such common facilities need to be planned based on reliable estimate of the current waste generation and projections for the future.

Reasonably reliable estimates based on process and product-wise generation of waste will facilitate planning the type of on-site and off-site storage/treatment to be provided before disposal of waste in an environment friendly manner depending on the characteristics and quantity of waste generation.

With this backdrop, the Delhi pollution Control Committee took-up the task to inventories the hazardous waste in the State of Delhi and entrusted the task to the Ramky infra consulting Pvt Ltd. In association with Smeaton Engineering Consultants Pvt Ltd.

2.0 STATE OF DELHI AT A GLANCE

2.1 Location

The National Capital Territory of Delhi is spread over an area of 1483 square kilometers. It has a maximum length of 51.9 kilometer and the maximum width of 48.48 kilometer. Out of the total area of 1483 square kilometer, 783 square kilometer is rural and 700 square kilometers is urban. There are three local bodies (statutory towns) namely, Municipal Corporation of Delhi (area is 1397.3 square kilometer), New Delhi Municipal Committee (42.7 square kilometer) and Delhi Cantonment Board (43 square kilometers).It is surrounded on 3 sides by Haryana and to the east, across the river Yamuna by Uttar Pradesh. The major part of the territory lies on the western side of the river Yamuna, only some villages and the urban area of Shahdara lie on the eastern side of the river. Its greatest length is around 33 miles and the greatest breadth is 30 miles. Delhi's altitude ranges between 213 to 305 metres above the sea level.

2.2 Geography and Climate

Delhi is located at 28°61′N, 77°23′E, and lies in northern India. It borders the Indian state of Uttar Pradesh on the south and Haryana on the west. Delhi lies almost entirely in the Gangetic plains. Two prominent features of the geography of Delhi are the Yamuna flood plain and the Delhi ridge. The low-lying Yamuna flood plains provide fertile alluvial soil suitable for agriculture. However, these plains are prone to recurrent floods. Reaching up to a height of 318 m (1043 ft), the ridge forms the most dominating feature in this region. It originates from the Aravalli Range in the south and encircles the west, northeast and northwest parts of the city. Yamuna, a sacred river in Hinduism, is the only major river flowing through Delhi. Most of the city, including New Delhi, lies west of the river. East of the river is the urban area of Shahdara. Delhi falls under seismic zone-IV, making it vulnerable to major earthquakes.

Delhi has a semi-arid climate with high variation between summer and winter temperatures. Summers are long, from early April to October, with the monsoon season in between. During the summer season, the city faces

extreme power and water shortages. Many people die every year owing to the summer heat wave. Winter starts in November and peaks in January. Delhi is notorious for its heavy fog during the winter season. In December, reduced visibility leads to disruption of road, air and rail traffic. Extreme temperatures range from − 0.6 °C (30.9 °F) to 47 °C (116.6 °F). The annual mean temperature is 25 °C (77 °F); monthly mean temperatures range from 14 °C to 33 °C (58 °F to 92 °F). The average annual rainfall is approximately 714 mm (28.1 inches), most of which is during the monsoons in July and August. The average date of the advent of monsoon winds in Delhi is 29 June.

2.3 Environmental Governance

The rapid growth of Delhi has resulted in significant increase in **Environmental Pollution** causing great concern. The growing influx of population into the urban city from the neighboring states and also from the other parts of the country has resulted in increasing air, water, noise pollution and also the pollution due to the solid wastes. The Govt. of Delhi is concerned with the alarming pollution scenario and has taken a number of steps to control and reduce the environmental pollution.

Delhi Pollution Control Committee by virtue of delegation of statutory powers and functions by Central Board has to carry out all the duties cast upon it under Water Act and Air Act. It has also been entrusted with statutory duties under Water (Prevention and Control of Pollution) Cess Act, 1977 for assessment/levy/collection of Cess from local authorities and specified industries.

Besides, Delhi Pollution control Committee has been vested with statutory powers, functions and duties under Section 5 of Environment Protection Act, 1986 as also under various Rules issued under Environment Protection Act, 1986 viz.

- ✓ Environment Protection Act, 1986.
- ✓ Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996.
- ✓ Hazardous Waste (Management & Handling) Rules, 2003.
- ✓ Noise Pollution (Regulation & Control) Rules, 2000.
- ✓ Bio-Medical Waste (Management & Handling) Rules, 1998.
- ✓ Manufacture, Storage & Import of Hazardous Chemical Rules, 1989.
- ✓ Recycled Plastic Manufacture & Usage Rules, 1999.

3.0 OBJECTIVES

I. To inventorise hazardous waste generation in the State of Delhi, as per the Hazardous waste (Management and Handling) Rules, 1989 and amendment thereof in 2003.

II. Strategies for the safe disposal of hazardous waste generated in Delhi accordance with the provisions of Hazardous Waste (Management & Handling) Rules, 1989.

III. Identification of illegal Dump sites in NCT of Delhi and Strategies for their rehabilitation.

4.0 SCOPE OF WORK:

I. To estimate as correctly as possible the nature and quantity of the hazardous waste generating units in Delhi identified by DPCC.

II. To relate the above-mentioned data to the schedules of waste defined in Hazardous (Management & handling) Rules, 2003.

III. To assess the waste in relation to the authorization and also to reconcile and streamline if any anomaly has crept into the counting/quantification of waste.

IV. To determine the total hazardous waste generation in NCT of Delhi based on the individual quantification

V. To determine the total hazardous waste stored in NCT of Delhi based on the individual storage quantification.

VI. To classify the quantities of hazardous waste generated/ stored as land disposable, recyclable and incinerable.

VII. To identify the illegal dumpsites in Delhi.

VIII. To evolve strategies for the rehabilitation of the illegal hazardous waste dumpsites in Delhi.

5.0 METHODOLOGY

I. List of industries producing hazardous waste in Delhi obtained from DPCC.

II. Training of the personnel carrying out survey in Delhi area. A detailed two days programme have been conducted for all the survey personnel's which include brief idea about type of hazardous waste, their categories, the industries generating hazardous waste, process generating hazardous waste and the subsequent amendment in the rules.

III. Prepared a questionnaire format with consultation of DPCC

IV. Received final format from DPCC.

V. Prepared about 10 teams (2 personnel in one team to conduct the survey and identifying geographical location for each team.

VI. Daily meeting of the survey team in the office to identifying their problems and progress achieved.

VII. Meeting with DPCC officials on regular basis and discussion with them regarding progress and problems.

VIII. Categorization and classification of hazardous waste started.

IX. Compilation of data received from the field on daily basis.

X. Identifying illegal dumpsites on daily basis by survey teams and inspection of these sites by Sr. Manager level people and the photographs taken during the survey.

XI. Validation of the result based on standard data available.

XII. Detailed sample study of some of the units in each type of industry.

XIII. Illegal dumpsites are also identified by

- ✓ Survey of the area
- ✓ Questioning to the local people
- ✓ Assistance to the industrial associations.

6.0 Hazardous waste, its impact on environment and strategies to be adopted for safe disposal

Industrial and hospital wastes are considered hazardous, as they may contain toxic substances. Even commercial establishments such as dry cleaners, machine shops and automobile repair shops, generate some hazardous waste. Certain types of household waste are also hazardous.

Hazardous waste differs from other waste in form as well as behavior. They often are generated as liquids, but they can occur as solids, sludge or gases.

Hazardous wastes include substances that are toxic, corrosive, and highly inflammable. These can result in serious illness, injury, or even death of the individuals and population exposed to them. The waste are often contained and confined in metal drums and cylinder. There are hundred incidents on records in which illegal or inadequate handling and disposal of such hazardous wastes caused harm to the public and the environment. Many cases involved surface and ground water contamination, including public water supplies. Other incidents involved the emission of harmful substances in atmosphere.

Improper storage, handling, transportation, treatment, and disposal of hazardous wastes results in an adverse impact on the ecosystem including the human environment. When discharged on land, heavy metals and certain organic compounds are phototoxic and, at relatively low levels of concentration, can adversely affect soil productivity for an extended period of time. Waste from pesticide and herbicide manufactures as well as that from other biocides has been linked to reduction in the number of species in affected areas, and chronic toxic effects on subsequent generations of birds and other animals.

Discharge of acidic and alkaline waste affects the natural buffer capacity of surface waters and soils and may result in reduction of the number of species as a whole.

Strategies to be adopted for safe disposal

Today, it is widely recognized that even strict controls on land disposal coupled with modern treatment technology cannot fully solve the nation's hazardous waste problem. It is imperative that the amounts of hazardous waste generated in the first place be reduced and wherever feasible, completely eliminated.

Several options are available for hazardous waste management and disposal. In order of preference, these can be summarized as follows:

- ✓ ***Eliminate or reduce waste quantities*** at their source by modifying industrial processes and other techniques.

- ✓ ***Reclaim and recycle the waste***, using it as a resource for some other industrial or manufacturing processes.

- ✓ ***Stabilize the waste, rendering its non hazardous***, by using appropriate chemical, biological, or physical processes.

- ✓ ***Incinerate the waste***, at temperature high enough to destroy or detoxify it.

- ✓ ***Apply modern land disposal methods***, preferably after providing some form of containerization or appropriate treatment.

Please refer **Annexure IV**, in which all the identified hazardous waste streams in the Schedule I have been analyzed for their recyclability, incinerability and the secured land-disposability on priority

7.0 STUDY FINDINGS

7.1 Hazardous Waste Generating Units and Their Distribution

7.1.1 Industries Relevant to Hazardous Waste Management Rules

In Delhi, there are nine districts, North, East, West, South, Central, North-East, South-West, North-West and New Delhi, where about 25000 existing industries are located. From these industries 2689 are those which are found to be relevant as per Hazardous Waste (Management and Handling Rules), 2003. From these some of industries are found to be closed or shifted, or not generating hazardous waste.

District wise no of hazardous waste generating industries in a particular industrial area as well type of industries located in these areas has been given in Table I**.**

Sector specific break-up of industries present in Delhi has been provided in Table I.

Table I: Location wise no. of Hazardous Waste Generating Industries

Sr.No	Districts	No. of Industries	Type of industries
	East Delhi		
1	Patparganj Industrial Area	73	Printing, metal finishing, automobile servicing and pharmaceutical units
	West Delhi		
2	Anand Parbat Industrial area	124	Metal finishing, printing, wire drawing and dyeing units
3	Udyog Nagar Industrial area	17	Automobile servicing, metal finishing, poly bag printing, wire drawing and pharmaceuticals units
4	Kirti Nagar Industrial area	56	Printing, dyeing, automobile servicing and wire drawing units.
5	Nariana Industrial area Ph-II	108	Automobile servicing, metal finishing, poly bag printing, wire drawing and pharmaceuticals units
6	Najafgarh industrial area	80	Metal treatment, printing and paints units
7	Nangloi industrial	17	Printing, metal finishing and service

	area		station units
Sr.No	**Districts**	**No. of Industries**	**Type of industries**
8	Tilak nagar industrial area	3	Printing and automobile servicing units
9	NC-W	11	Workshops and automobile service station
	North Delhi		
10	Shahzadabagh industrial area	34	Printing, dyeing and metal finishing units
11	NC-N	5	Service station
	South Delhi		
12	Okhla industrial area (Phase-I, II, II)	231	Metal finishing, dyeing, pharmaceuticals, cosmetics, service station and paint units.
13	MCIA (Mohan Co-operative Industrial Area)	11	Automobile servicing, metal finishing, poly bag printing, wire drawing and pharmaceuticals units
14	NC-S	23	Workshops and service stations
	North-East Delhi		
15	Dilshad Garden Industrial Area	37	Wire drawing, metal finishing and printing units
16	New Friends Colony industrial Area	130	Metal finishing, wire drawing and printing units
17	Jhilmil industrial area	90	Wire drawing, printing, metal finishing, service station and textiles units
18	NC-NE	4	Automobile Service station
	North-West Delhi		
19	SMA industrial area	32	Automobile servicing, metal finishing, poly bag printing, wire drawing and pharmaceuticals units
20	Rajasthani Udyog nagar industrial area	13	Printing, pharmaceuticals and metal finishing units
21	SSI Industrial Area	29	Dyeing, printing and wire drawing units
22	Narela industrial area	67	Metal finishing. Dyeing, servicing station, pharmaceuticals, plastics
23	Mangolpuri industrial area (Phase-I,II)	25	Metal finishing, printing, service station and plastic units
24	Badli Industrial Area	66	Printing, wire drawing, metal finishing and dyeing units
25	GTK road Industrial area	66	Printing, automobile servicing, metal finishing, adhesives and dyeing units
26	Samaypur industrial area	51	Printing, metal finishing and wire drawing units.
27	Wazirpur industrial Area	203	Metal finishing, dyeing, service station, printing, CETP and dyeing units.

Sr.No	Districts	No. of Industries	Type of industries
28	Lawrence Road Industrial Area	26	Plastics, printing, metal finishing and pharmaceuticals unit.
29	Bawana Industrial area	2	Printing units
30	NC-NW	8	Automobile service station
	South-West Delhi		
31	Naraina Ph-I	89	Printing, automobile servicing, metal finishing, adhesives and dyeing units
32	Mayapuri industrial Area (Phase-I,II)	213	Automobile servicing, metal finishing, poly bag printing, wire drawing and pharmaceuticals units
33	NC-SW	27	Automobile service station
	New Delhi		
34	NC-ND	9	Automobile service station and electricity distribution units
	Central Delhi		
35	NC-C	15	Printing, power generation and automobile servicing units

Sector wise break-up of industries has been given in Table II.

Table II: Sector-Specific Break-up of Industries

Sr. No.	Sector	*No. of Industries*			
		Large	**Medium**	**Small**	**Total**
1.	Printing units	-	-	423	423
2.	Dyeing units	-	-	86	86
3.	Thermal power plant	4	-		4
4.	Metal surface treatment units	-	-	574	574
5.	Wire drawing units	-	-	258	258
6.	Chemical units	-	-	10	10
7.	Adhesives and Paints unit	-	-	24	24
8.	Engineering works	-	-	22	22
9.	Gas manufacturing industry	-	-	2	2
10.	Pharmaceuticals and cosmetics units	-	-	47	47
11	Service station	-	-	239	239
13	Power distribution	2	-	-	2
14	CETP	11	-	-	11
15	Other	-	-	293	293

7.2 Questionnaire survey

For data collection a format of questionnaire was prepared in consultation with the officials of DPCC. Format of the questionnaire is given in **Annexure II**, which was being filled up by the team personnel during the survey.

8.0 OVERALL SUMMARY FINDINGS

For inventorization of hazardous waste generation from Delhi, data for 2686 industries is being compiled as per the guidelines with DPCC in MS- Access form. Compiled data is attached with **Annexure V**.

In Delhi, Majority of industries is small scale, which are generating hazardous waste. Here maximum no. Of industries are printing, metal surface treatment, pharmaceuticals, vehicle service centers, dyeing, textiles and some of the electronic units. Some of large-scale units like thermal power plant, power distribution station and CETPs are also located here.

8.1 Type of waste generation:

Wastes generated by these units are waste and residues containing ink, off specification medicines, waste and residues generated from the pharmaceuticals units, used oil, waste containing oil, and spent resins from thermal power plants, sludge from the metal surface treatments, process waste sludge from dyeing units, electronic waste and CETP sludge.

9.0 PRACTICES TO BE ADOPTED FOR WASTE DISPOSAL:

With respect to schedule 1 of hazardous waste (Management and Handling) amended in 2003 as well nature of the waste; it has been classified into recyclable, land disposable and incinerable waste.

9.1 Recyclable waste:

Used oil generated from the service station and the diesel generators used in the industries are taken into recyclable in nature because of its reusability as well economic value.

9.2 Land disposable waste:

Waste generated from metal surface treatment like, acid residues, phosphate sludge, spent bath, copper etching residues, sludge from the staining bath, plating metal sludge, chemical sludge from waste water treatment, ETP sludge containing inorganic constituents, CETP sludge generated from common effluent treatment plants and electronic waste are found to be fit for land disposal.

Hazardous waste generated from the dyeing units in the form of process waste sludge, residues and waste generated from production/formulation of drugs/pharmaceuticals, after chemical and physical treatment should be sent to secured landfill for treatment and disposal.

9.3 Incinerable waste:

Waste generated from printing, pharmaceuticals, service stations are considered to be incinerable in nature,

Waste that are generated from these units are waste and residues containing ink, off specification products, residues of plasticizers, spent solvents form production or industrial use of solvents, waste containing oil from the service stations are considered to be incinerable in nature.

10.0 Hazardous waste generation and its scenario:

Total quantity of waste generated from nine districts is 5281 TPA, from which 201.30 TPA is recyclable in nature, 1740 TPA is incinerable and about 63 % of the waste is fit for land disposal which constitute quantity of 3340 TPA.

Graphical representation for methods that should be adopted for disposal of the hazardous waste generated is shown in Fig 1.

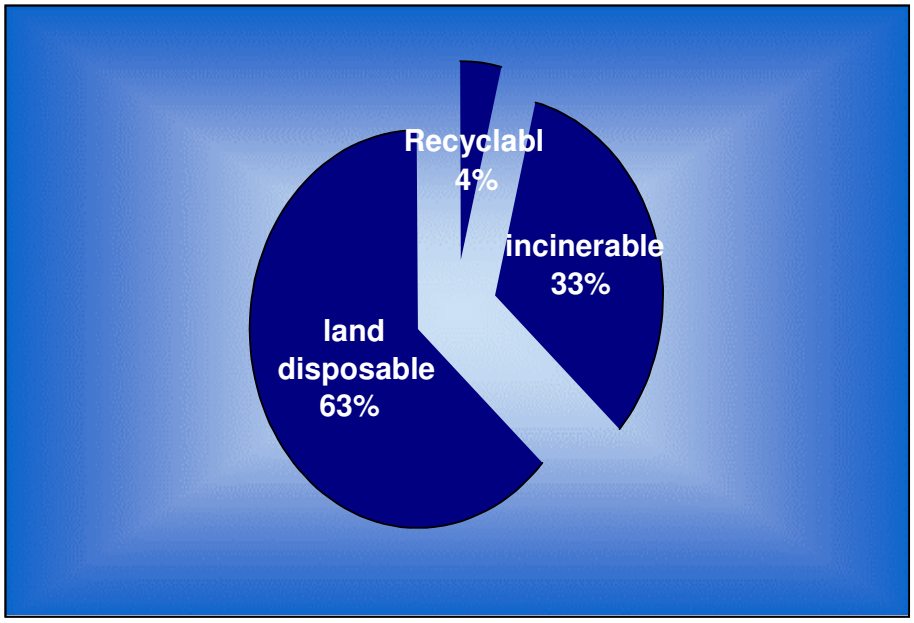

Figure 1: Graphical representation of distribution of hazardous waste disposal methods in Delhi

10.1 Quantum of waste generation from districts:

After compilation of data it has been found that, total quantum of hazardous waste generation from 35 industrial areas is about 5281 TPA.
Land disposable waste generation in delhi is about 3340 TPA, which is 63% of total waste generation.

Recyclable waste generation in Delhi is quite less, about 201 TPA which is about 4% of the total hazardous waste generation.

Incinerable waste generation in Delhi is about 1740 TPA, which is about 33% of the total hazardous waste generation.

District wise waste generation from industries and CETPs are given in Table III.

Table III: District wise hazardous waste generation from Industries and CETPs

District	Total waste generated (TPA)	Recyclable (TPA)	Incinerable (TPA)	Land disposable (TPA)
East	91.654	5.46	59.194	27
West	368.064	28.674	176.304	163.086
North	40.992	-	21.54	19.452
South	1320.11	72.708	595.134	652.268
North-East	291.433	5.53	111.703	174.2
North-West	2546.173	36.446	458.306	2051.421
South-West	581.218	21.08	307.964	252.174
New Delhi	8.994	3.564	5.43	-
Central Delhi	33.165	27.837	5.328	-
Total	***5281.803***	***201.299***	***1740.903***	***3339.601***

District wise hazardous waste generation has been shown in Figure II.

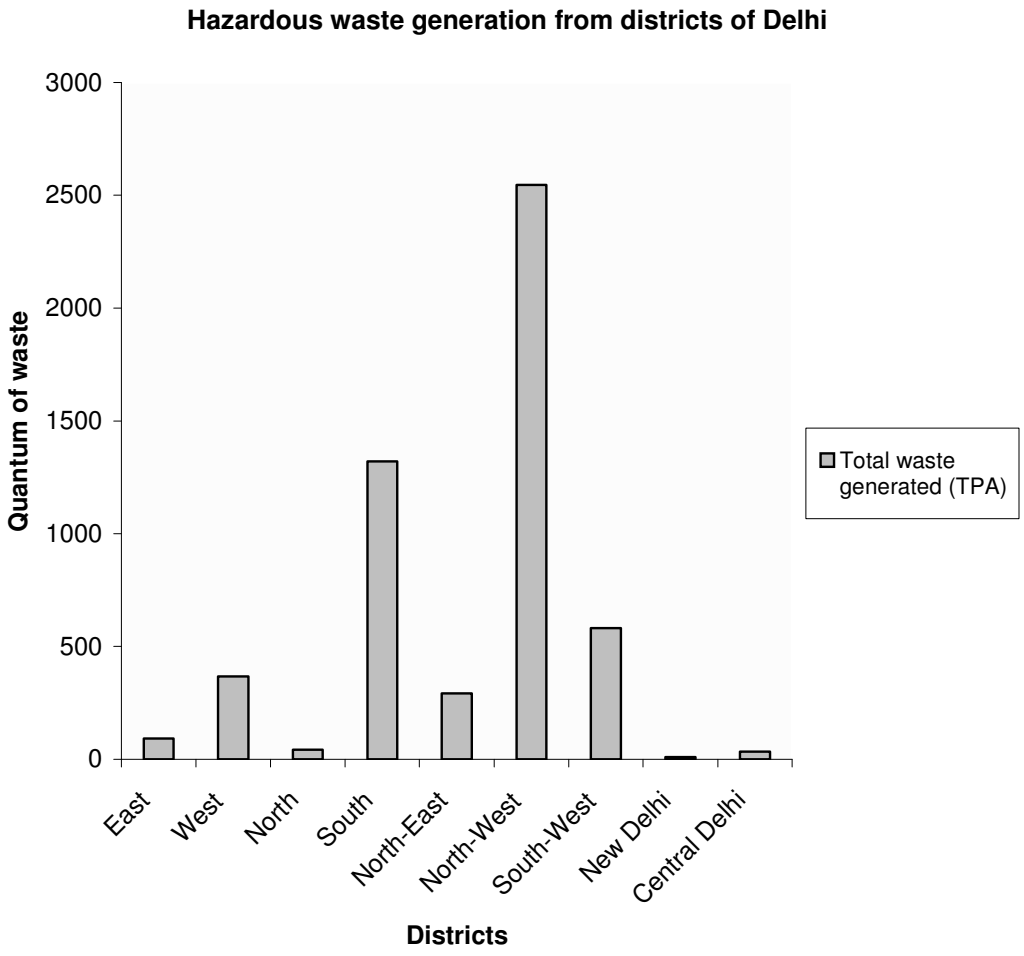

Figure II: District wise Hazardous Waste generation

10.2 Nature of waste generating form districts:

Through the data it has been found that North-West Delhi is generating maximum 2051 TPA land disposable waste, which is 62 % of the total land disposable waste generated from varios industrial location in Delhi.

About 595 TPA incinerable hazardous waste and About 73 TPA of recyclable waste is generted from South Delhi, which is about 34 % of the total incinerable waste genertion and 12% of the total recyclabe waste generation.

Nature of hazardous waste generation from these districts has been shown in Figure III

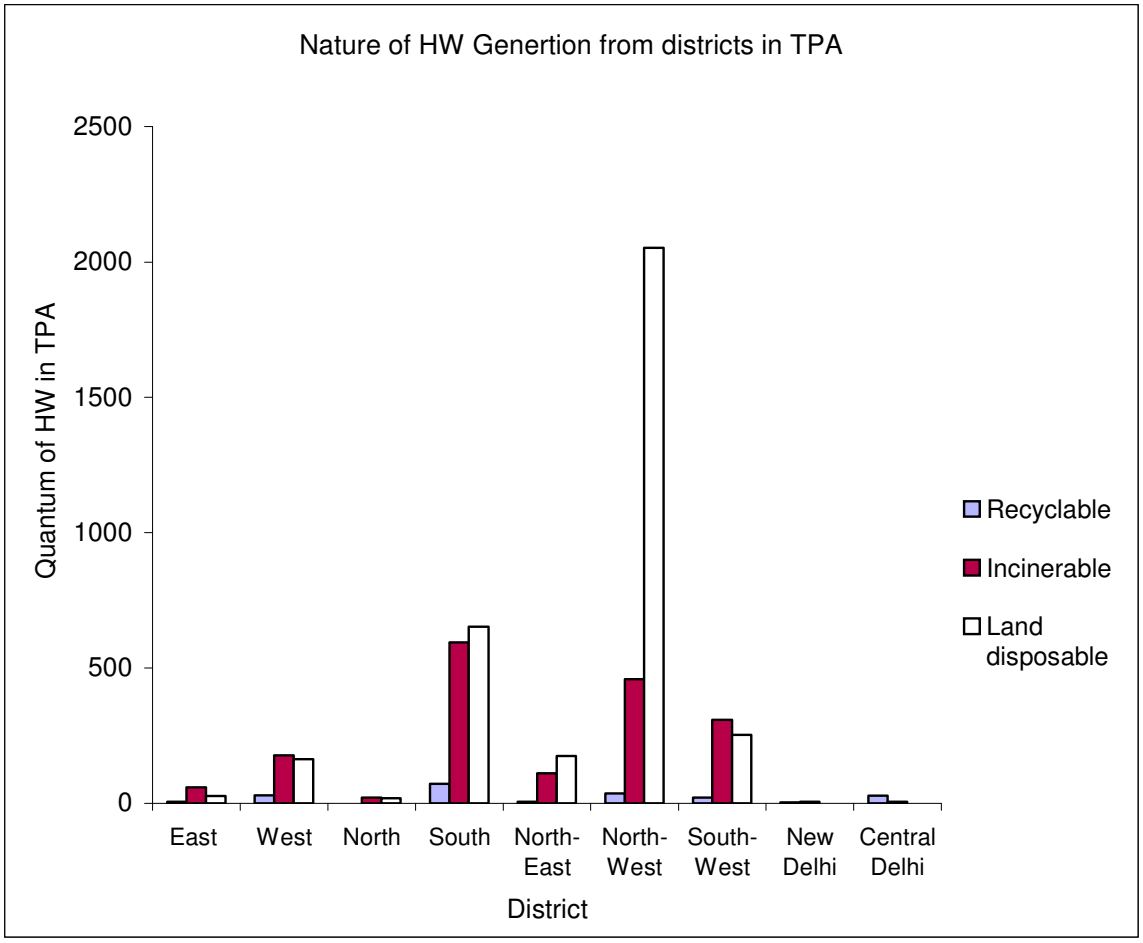

Figure III: **District wise Nature of Hazardous Waste generation**

10.3 Quantum of waste generation from various industrial areas.

Waste generated from various industrial areas constitute the hazardous waste streams like, metal finishing sludge, waste containing oil, waste and residues from dyeing and printing industries, ETP sludge generation, CETP sludge etc. In Wazirpur, 203 industries including CETP plant is generating maximum amount of hazardous waste about 790 TPA which is 15 % of total HW generated.

While Okhla, Mayapuri, SMA, GTK and Samaypur industrial areas are also generating significant amount of Hazardous waste.

- Okhla region (Phase I,II,III)= 1246.613 TPA
- SMA = 400.544 TPA
- GTK = 322.192 TPA
- Mayapuri = 294.58 TPA
- Samaypur = 244.768 TPA
- Naraina Ph-I= 249.334 TPA
- Badli= 222.192 TPA

Industrial area wise hazardous waste generation and disposal methods are given in Table IV.

Table IV: Hazardous waste generation and Disposal methods w.r.t various industrial areas including CETPs

Districts	Industrial areas	Waste generation (TPA)	Recyclable (TPA)	Incinerable (TPA)	Land disposable (TPA)
East	Patparganj	91.654	5.46	59.194	27
West	Anand Parbat	61.662	0.924	12.676	48.062
	Kirti nagar	64.246	0	26.032	38.214
	Najafgarh	64.42	0	50.718	13.702
	Nangloi	53.658	0	5.064	48.594
	Naraina Ph-II	78.728	0	68.654	10.074
	NC-W	33.95	25.95	8	-
	Tilak nagar	1.884	1.2	0.684	-
	Udyog nagar	9.516	0.6	4.476	4.44
North	NC-N	14.7	-	14.7	-
	Shahzadabagh	26.292	-	6.84	19.452
South	MCIE	44.624	33.752	3.06	7.812
	NC-S	28.873	21.644	7.229	-
	Okhla Ph-I	565.048	7.052	134.566	423.43
	Okhla Ph-II	678.733	9.3	448.959	220.474
	Okhla Ph-III	2.832	0.96	1.32	0.552
North-East	Dilsahd garden	34.914	-	14.28	20.634
	Jhilmil	184.954	0.13	86.708	98.116
	NC-NE	6.455	5.4	1.055	-

Districts	Industrial areas	Waste generation (TPA)	Recyclable (TPA)	Incinerable (TPA)	Land disposable (TPA)
	New friends colony	65.11	-	9.66	55.45
North-West	Badli	222.192	0.18	5.22	216.792
	Bawana	1.08	-	1.08	-
	GTK road	322.192	1.032	48.214	272.946
	Lawerance road	66.52	0.456	23.642	42.422
	Mangolpuri Ph-I	23.124	-	6.48	16.644
	Mangolpuri Ph-II	9.456	0.216	8.28	0.96
	Narela	188.798	-	51.99	136.808
	NC-NW	8.024	4.1	3.924	-
	Rajasthani Udyog nagar	75.282	-	2.082	73.2
	Samaypur	244.768	3.9	194.844	46.024
	S.M.A	400.544	-	35.52	365.024
	SSI	193.53	-	24.96	168.57
	Wazirpur	790.663	26.562	52.07	712.031
South-West	Mayapuri Ph-I	225.22	-	31.546	193.674
	Mayapuri Ph-II	69.36	0.6	34.512	34.248
	Naraina Ph-I	249.334	-	225.082	24.252
	NC-SW	37.304	20.48	16.824	-
New Delhi	NC-ND	8.994	3.564	5.43	-
Central Delhi	NC-C	33.165	27.837	5.328	-
	Total	***5281.803***	***201.299***	***1740.903***	***3339.601***

Graphical representation for hazardous waste generation at various locations has been shown at figure IV

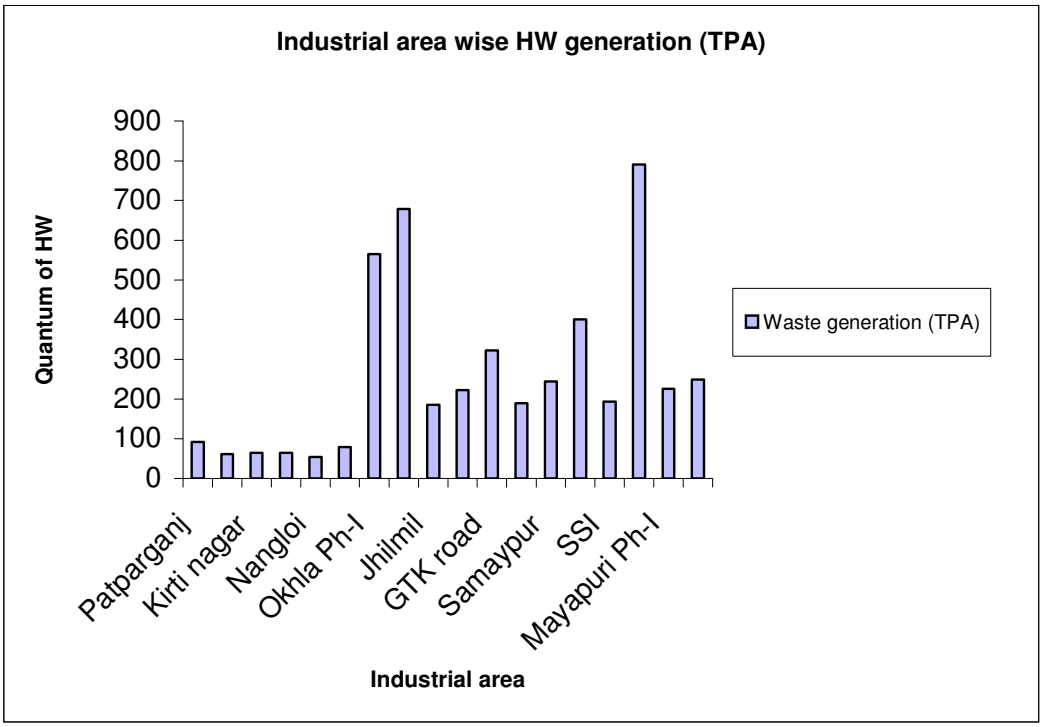

Figure IV: **Graphical representation for hazardous waste generation at various industrial areas.**

10.4 Disposal practice for waste generating from Various Industrial Locations:

By the quantification of waste through the data that has been collected through survey from various industries of different locations, it has been found that, quantity of waste generated MCIE region attains high creditability of recyclable waste about 33.752 TPA which is 17% of total recyclable waste generated i.e. 202 TPA because of the generation of used oil through automobile service stations.

Wazirpur is generating 791 TPA of land disposable waste because of the presence of number of metal surface treatment units.

Okhla Phase II is generating 448 TPA which is 26 % of total incinerable waste generated i.e 1740 TPA.

Nature of Hazardous waste generting from various industrial areas of Dellhi has been graphically represented in figure V.

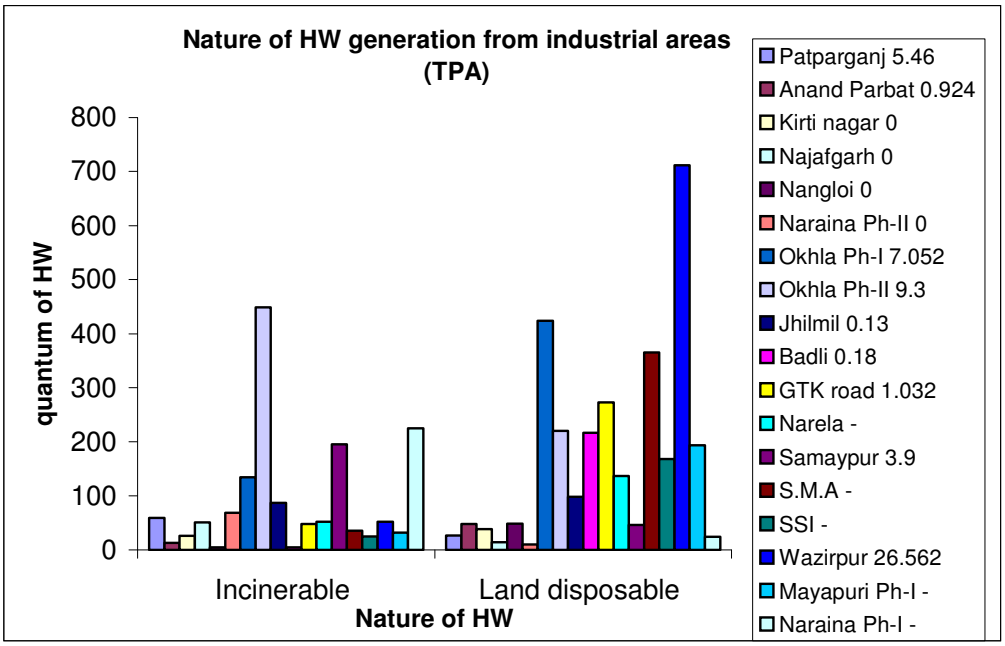

Figure V: **Nature of HW generation from various industrial areas**

10.5 Hazardous waste generating streams as per schedule 1 , nature and their quantification

Waste streams generated from industrial areas their nature and quantum of generation has been shown in Table V.

Maximum hazardous waste generating streams found to be generated from printing, metal surface finishing units and CETPs

Waste and residues generated through printing units are incinerable in nature, while sludge generating from metal surface finishing units and the CETP sludge are land disposable**.**

***Table V*: Waste streams as per schedule 1**

Sr. No	Streams of waste as per schedule 1 of hazardous waste(Management and Handling) Rule, Amended in 2003	Category	Nature of waste	Quantity generated (TPA)
1	Acid Residue	12.1	Land disposable	9.65
2	CETP Sludge	34.4	Land disposable	1424
3	Chemical sludge form waste water treatment (metal treatment)	12.9	Land disposable	20.05
4	Chemical sludge form waste water treatment (Dyeing unit)	26.2	Land disposable	1.25
5	Copper etching residue	12.7	Land disposable	163.794
6	ETP sludge	34.4	Land disposable	564.422
7	ETP sludge(generating from service stations	34.4	Incinerbale	26.706
8	Flue gas cleaning residue	34.1	Land disposable	0.36
9	Flue gas dust and other particulates (Aluminium Coating)	11.4	Recyclable	0.5
10	Off specification products	28.3	Incinerbale	0.83
11	Phosphate sludge	12.5	Land disposable	16.014

Sr. No	Streams of waste as per schedule 1 of hazardous waste(Management and Handling) Rule, Amended in 2003	Category	Nature of waste	Quantity generated (TPA)
12	Plating metal sludge	12.8	Land disposable	261.364
13	Process waste sludge	26.1	Land disposable	125.13
14	Residue of plasticisers	22.2	Incinerbale	59.04
15	Residues and wastes(Pharmaceuticals)	28.1	Land disposable	67.164
16	Residues and waste (Electronic unit)	31.1	Land disposable	8.706
17	Sludge and filter cake	8.2	Land disposable	39.36
18	Sludge from staining bath	12.6	Land disposable	429.157
19	Spent acid from batteries	36.3	Land disposable	11.7
20	Spent bath	12.3	Land disposable	223.744
21	Spent hardening salt	14.2	Land disposable	1.92
22	Spent resin (from electricity production and distribution)	34.2	Land disposable	0.324
23	Spent solvents	20.2	Incinerbale	4.8
24	Textile chemical residue	24.1	Land disposable	62.04
25	Used oil	5.1	Recyclable	326.547
26	Waste and residue	21.1	Incinerbale	1139.097
27	Waste and residue (Adhesive unit)	23.1	Incinerbale	11.31
28	waste containing oil	5.2	Incinerbale	300.006
29	Wet scrubber sludge	36.1	Land disposable	0.95
30	Zinc dust	6.2	Land disposable	4.8

10.6 Storage of Hazardous waste

From the data gathered from industries during the survey it has been found that about 7584 T of the hazardous waste is stored on site that includes about 5769 T of CETPs sludge stored at their premises and 1814 T stored inside the premises of various industrial units. It may be noted that hazardous waste generated from various industrial units and CETP is being stored in drums or under covered shed depending upon its quantity.

11.0 Waste generation through CETPs

Out of 11 Common Effluent Treatment Plants (CETP) in Delhi that includes one CETP based on biological treatment mode at Mangolpuri Industrial Area are generating 4316 Kg per day (1424.28 TPA) of hazardous waste.

* The Mangolpuri Industrial Area CETP is generating about 35-40 Kg of biological sludge per day. Small quantity of it is being used as manure while rest quantum is stored under shed.

CETP facility of SMA industrial area is generating maximum amount of hazardous waste about 1000 Kg PD, while CETPs of Wazirpur, Okhla, Mangolpuri, Nangoli, Mayapuri and Narela are also generating significant quantity of hazardous waste.

Sludge generated from the CETPs is stored under covered concrete shed. About 5770 T of sludge is being stored in their own premises.

In SMA industrial area CETP, it has been found that, sludge generated per day is stored in open area. While storage of sludge generated in previous years is being stored under shed.

Waste generated by different CETPs is shown in Table No VI

Table VI: List of the CETPs

Name of the CETP	Location	Address of correspondence	Hazardous waste generation		On site storage
			(KgPD)	TPA	
Wazirpur Industrial Area (CETP plant)	Wazirpur Industrial Area	Wazirpur industrial pollution control company, Adarsh Complex, community Centre, Wazirpur Ind. Area. Delhi-52	800	264	2300 T

Name of the CETP	Location	Address of correspondence	Hazardous waste generation		On site storage
			(KgPD)	TPA	
*Mangolpuri Effluent Treatment plant	Mangolpuri Industrial area	CETP Society T-2/167, Mangolpuri ind. Area ND-83	40	13.2	30 T
GTK road Industrial Area (CETP Plant)	GTK ROAD Industrial area	CETP Society, A-6 GT Karnal Road ind. Area. Delhi-33	850	280.5	327.45 T
Mayapuri Industrial Area (CETP plant)	MAYAPURI INDUSTRIAL AREA	CETP Society, MIWA Bhawan, Central park, B-Block, Mayapuri Ind. Area. Ph-I. ND-33	150	45	78 T
Lawrence Road Industrial Area (CETP Plant)	LAWRENCE ROAD INDUSTRIAL AREA	DSIDC, TECH CENTRE BUILDING, Wazirpur	125	49.5	69.085 T
Nangloi Industrial Area (CETP plant)	NANGLOI INDUSTRIAL AREA	J-23, udhyog nagar industrial complex, Delhi- 41	150	49.5	50 T
Jhilmil Industrial Area (CETP Plant)	JHILMIL INDUSTRIAL AREA	CETP Society B-Block, Jhilmil Ind. Area Delhi-95	84	27.72	18 T
SMA Industrial Area CETP plant	SMA INDUSTRIAL AREA	CETP Society 118, SMA Industrial Estate.	1000	330	225 T
Okhla Industrial Area (CETP plant)	, Okhla Ph I Industrial Area	CETP Society D-79, Okhla ind. Area Ph-I, ND-20	567	187.11	170 T
Narela industrial Area (CETP Plant)	NARELA INDUSTRIAL AREA	DSIDC, TECH CENTRE BUILDING, Wazirpur	200	66	120 T
Badli industrial Area (CETP plant)	CETP LANT BEHIND SURAJ PARK, NC-NW	Badli Ind. Estate Association, Administrative block, Delhi-42	350	115.5	2381.53 T

Graphical representation of hazardous waste from CETPs is shown in figure VI

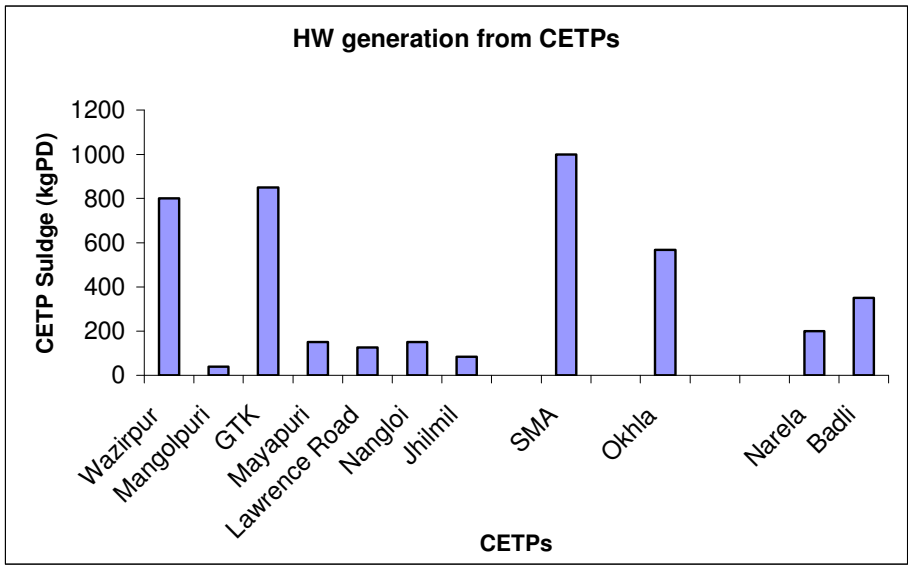

Figure VI: Graphical representation of hazardous waste from CETPs

Common effluent treatment plants (CETPs) of various industrial areas

Okhla Phase I Industrial Area

Okhla Phase I Industrial Area

Lawerence Road Industrial area

Jhilmil Industrial Area

Wazirpur Industrial Area

Storage of sludge under shed

Storage in open Area

SMA Industrial area

Badli industrial Area

Mangolpuri Industrial Area
(Biological effluent treatment plant)

12.0 IDENTIFICATION OF ILLEGAL DUMPSITES:

During the survey it has been found that no. of places, industrial hazardous waste was dumped indiscriminately on the open ground. Samples from 47 such locations of various industrial areas were collected by the team personnel. Locations from where samples have been collected are given been in Table VII.

Table VII: Locations of sample collection

Sr. No.	Industrial Area	Location
1	Wazirpur Industrial Area	C-58/1, ESSCO Sanitahans
2	Wazirpur Industrial Area	PoliceChowki
3	Nerala Industrial Area	G-1031, 1032, 1033, 1034
4	Dilshad Garden Industrial Area	Ajit Printers B- 58 Damoder Park
5	Samaypur Industrial Area	Plot No. - 1, Gali No. - 8
6	Nangloi Industrial Area	G- 1
7	Nerala Industrail Area	F- 2739
8	Mangolpuri Industrial Area	T 1/108
9	Nerala Industrail Area	G- 951
10	Rajasthani Udyog Nagar Industrial Area	27, 36A
11	S.S.I Industrial Area	48
12	Lawerance Road Industrial Area	C-32, C- Block Rodham, Roller Floor Mill
13	Badli Industrial Area	S-50
14	Lawerance Road industrial Area	A-5
15	Lawerance Road industrial Area	B- 53
16	Anand Parphat Industrial Area	18 Gali No.-3 Railway line
17	Anand Parphat Industrial areas	18/32 Gali No.-5 near Railway line

Sr. No.	Industrial Area	Location
18	Nerala Industrial Area	G- 1104, G- 1101
19	Nagloi Industrial Area	A-1
20	S.M.A. Industrial Area	C-19
21	Nerala Industrial Area	G- 1142
22	New Friends colony Industrial Area	J- 12 Gali No. 5
23	Nerala Industrial Area	G- 1024
24	Patparganj Industrial Area	165
25	New Friends colony Industrial Area	28/2 Railway Crossing
26	Patparganj Industrial Area	N- 10 FIE
27	New Friends colony Industrial Area	Gali No.-I Pashupati Printers, 1/429/16
28	Dilshad Garden Industrial Area	56- B, Capital Transformer (P) Ltd
29	Patparganj Industrial Area	366
30	Patparganj Industrial Area	A-22 Hyundai Service Station
31	Okhla Phase-II Industrial Area	N. Chand Narayan F-32/5
32	Okhla Phase-I Industrial Area	Block-D
33	Mangolpuri Industrial Area	T- 1/116, 1/113- 114
34	S.S.I. Industrial Area	77
35	Nerala Industrial Area	G- 1122
36	Nerala Industrial Area	G- 1160
37	G.T.K. Industrial Area	A-45
38	S.S.I. Industrial Area	13
39	DSIDC Nagloi Ind. Area	SFS- 3

Sr. No.	Industrial Area	Location
40	Lawerance Road Industrial Area	Nafed A- 6, 7, 8
41	Lawerance Road Industrial Area	E- 5
42	Kirti Nagar Industrial Area	Avinash steel works 2/90 W.H.S.
43	Naraina Industrial Area	A-15/1, Vipin Print Service
44	Kirti Nagar Industrial Area	Shivam sales Copr. 2/50/1 W.H.S
45	Mayapuri Industrial Area	WH- 118, Phase-I, Mayapuri
46	Mayapuri Industrial Area	3/10 Phase II
47	Shajadabad Bagh Industrial Area	SB- 107

Samples collected from various industrial locations were sent to M/s Delhi Test House, Azadpur for analysis.

From the analysis report, 23 sites are found to be contaminated with Chromium (VI) whose permissible limit is 50 mg/ Kg as per Schedule 2 of Hazardous Waste (Management & Handling) rule, 2003. Site found to be contaminated with hazardous waste are as following:

1. ESSCO, Wazirpur Ind. Area
2. Near police station, Wazirpur Ind. Area
3. G- 1031 Narela Industrial Area
4. Dilshad Garden
5. Nangloi Industrial Area
6. Mangol Puri Industrial Area
7. Rajasthani Udyog Nagar Industrial Area
8. C- 32, Roller floor mill,Lowarance Road Industrial Area
9. A-5, Lawarance Road Industrial Area.
10. 18 Street no 3, Anand Parphat Industrial Area
11. 18/32, Street no. 5, Anand Parphat Industrial Area
12. New friends colony industrial area.
13. 165, Patparganj Industrial Area
14. 366, Patparganj Industrial Area
15. S.S.I Industrial Area
16. G-1122, Narela Industrial Area
17. GTK Industrial Area

18. DSIDC Nangloi Industrial Area
19. E-5, Lawerence road Industrial Area
20. 2/90, Kirtinagar Industrial Area
21. Nariana Industrial area
22. 2/50/1, Kirtinagar industrial area
23. Mangolpuri Industrial Area

Analysis report of 47 samples collected from various locations is enclosed with Annexure III.

12.1 Rehabilitation of illegal dumpsites

Out of 47 dump site from where samples were collected, 23 are found to be contaminated with Hexavalent chromium whose concentrations are found to be higher then the limit as prescribed in the schedule 2 of Hazardous waste (Management and Handling) Rule, 2003. Locations of these illegal dumpsites have already been earmarked in the report.

There is a need to carry out another survey to quantify the amount of waste which is illegally dumped on these sites. Depending upon the quantum waste, strategy can be worked out about its management and disposal.

Waste, found illegally dumped on these locations was mainly containing waste and residues from printing, dyeing, metal finishing, textile, chemical and plastic and paint manufacturing industries.

The possibility of taking this waste to the Common TSDF should be worked out and cost incurred in this management and disposal should be born by association of industries of that area. These areas need to be clean as earlier as possible so as to reduce the possibility of ground water contamination.

A detailed ground water quality survey is also required to check out its quality and stringent action need to be taken from DPCC against those industries which are violating the provisions of Management and Handling rules of hazardous waste.

The basic objective of the site remediation and rehabilitation is to eliminate any immediate danger caused by the spread or migration of the waste material as well as remove long term threat to public health and environmental quality (especially to ground water quality). The required course of action depend upon the type of waste material, the extent of existing contamination, the location of the site, and other factors.

A site specific goal regarding the appropriate degree of remediation is necessary, but there is no general method of determining 'how clean is clean'. Some states simply require that site cleanups achieve background level of waste contaminants.

12.1.1 Removal of the waste:

One possible course of action is to physically remove the waste material from the site by excavation or dredging and transport it to some other location for treatment, incineration or final disposal in secure land fill. Moving of the waste form one location to another location still involves some risk of environment pollution. Contaminated soil may be removed by using standard earth moving equipment. Extreme care must be taken to prevent release of contaminants during the excavation or removal operation.

12.1.2 On-Site Remediation:

On site remediation, in which the waste is not removed to another location, generally focuses on the need to minimize the production of leachate and to eliminate ground water pollution. Another primary goal is to prevent further migration of any ground water pollution that may already occur. This could involve the temporary removal of the waste, construction of lined secured landfill on the same site, or replacement of the waste in the other landfill. It could involve the extraction of soil or ground water, treatment or destruction of the pollutants, and replacement or reinjection of the cleaned soil or ground water. Finally, on-site actions could involve the isolation and containment of waste of the waste, without moving it, by the construction of impermeable barriers to block the flow of water or other liquids.

12.1.3 Extraction treatment and replacement:

Ground water at an old waste site may be pumped or extracted to lower the water table below the waste material. In many cases, the ground water is extracted from the contaminated area or plume or treated to remove the pollutants. The treated water may be discharged on the ground surface or reinjected around the perimeter of the plume.

Toxic and flammable soil gas generated from the anaerobic decomposition or volatization of the buried waste can be removed using an induced draft extraction fan and treated using granular activated carbon adsorption. The cases can be destroyed by using flares or combustion devices. Contaminated soil can also be excavated from the hazardous waste site, treated and replaced on site.

12.2 Landfill Capping

Landfill capping is by far the most common method of site remediation. There are many types of landfill caps on the market, ranging from the ultra-sophisticated, ultra-expensive to the simplest coverings of plastic and canvas. Landfill caps are designed to do just what their name says, they 'cap' the landfill so that contaminants contained within are not released into the environment. They are most effective when the landfill or dump site in question has a viable bed liner that is still functioning and where most of the waste is above the water table. In these situations, a cap functions to keep water from entering the waste matrix, thus reducing leachate contamination. Caps usually are formed of a combination of compacted clay and soil in combination with a semi-permeable membrane (either plastic or some other composite).

The most sophisticated caps are called RCRA "C" or "D" caps, but caps of all types can be created by contractors with the unique needs of each site in mind.

12.3 Landfill Gas Collection

This type of pollution control actually evolved as a means to make money off of omnipresent landfill gas. Scientists learned early on that LFG was over 50% methane, the main component of natural gas. Today, the technology exists to 'harvest' the gas and (after filtering and cleaning it) burn that gas to make electricity. A side effect of this process is that landfill gas that once was released directly into the atmosphere, can now be collected, lessening the environmental and aesthetic impact of the gas.(EREN, 2000) A number of successful electric utilities have already been constructed on retired and active landfills throughout the US. (Ewall, 1999)

12.4 Natural remediation:

Naturally occurring micro organisms can degrade contaminants in the subsurface environment. Studies have shown that plumes of the dissolved hydrocarbons will eventually degrade without human intervention. The natural assimilative capacity of an aquifer will depends on the local hydrogeology, the geochemistry and the metabolic characteristics of indigenous microorganisms. In some cases, removal of leaking tanks or contaminated soil may be all that is necessary for natural bioremediation to complete the cleanup. In most cases though, natural bioremediation is used only to supplement the methods discussed previously.

Depending on site conditions, problems related to risk analysis, property rights, third party liability and the possible need for variance from existing regulations will have to be considered if natural bioremediation is used.

In some cases particularly for chlorinated contaminants, the inoculation or addition of non indigenous microorganisms in to the ground can sped up the rate of microbial actions.






Scenario of Illegal Dump site

13.0 Conclusion

As per the information provided by DPCC, data for 2689 industries is compiled, from which it has been found that , 1747 industries have been given authorization by DPCC.

From the total industries, 349 are found to be closed, 84 got shifted from NCT region, and 261 are not generating hazardous waste. Details of these industries has been given in **Annexure V.**

Rest of the industries i.e. 1995 including 11 CETPs, are found to be generating about 5300 TPA of hazardous waste. Through CETPS about 4316 Kg PD (1424.28 TPA) of hazardous waste is generated which is being stored in their own premises.

CETPs are not operating to the full capacity; the generation of hazardous waste is likely to increase after full capacity utilization of CETPs

During the survey, data for the 35 industrial areas is compiled, and found that Wazirpur industrial area is generating highest quantum of waste about 790 TPA, industrial regions like Okhla, GTK, Nariana, SMA and Samaypur are also generating significant quantity of hazardous waste.

About 7584 T of hazardous waste is stored in NCT region of Delhi, out of which 5769 T of hazardous waste is stored by CETPs, 1814 T is being stored by rest of industries at various industrial areas.

To identify the illegal dumpsites, 47 samples were collected from various areas in Delhi region and analyzed for the various parameter as given in the schedule 2 of Hazardous waste (Management and Handling) Rules, 2003 , 23 sites were found to be containing Hexavalent chromium which exceeds the limit prescribed in schedule 2 of HW.

The quantification of hazardous waste lying at illegal dump sites need to be assessed before rehabilitation of the dump site.

Further study is required to be carried out to work out detailed strategy for rehabilitation of these illegal dump sites.

Since the quantity of the hazardous waste generated from Delhi area is not very high as compare to other states and availability of the land is also not easily available for the disposal of hazardous waste hence it is suggested, the possibility of transferring the hazardous waste to the near by states shall also be worked out.

Photographs during the survey: