



November 10, 2003

MEMORANDUM

To: Mike Zatz

From: Mariana Arcaya, Hannah Arnold

Subject: Remaining landfill capacity in the United States

The purpose of this memorandum is to present information on the capacity remaining in the nation's Low Level Radioactive Waste (LLW), Subtitle C and Subtitle D landfill facilities. The memorandum contains three parts. The first section will examine LLW facilities, the second section will examine remaining capacity in the nation's subtitle C landfills and the third section of the memorandum will present information on remaining subtitle D landfill and Municipal Solid Waste (MSW) capacity.

Included in the findings of this memo are the following estimates of remaining capacity:

- 10,420,518.5 cubic yards for LLW facilities
- Between 135.9 and 161 million cubic yards for Subtitle C landfills
- Between 10,970,420,034 and 46,094,201,825 cubic yards for Subtitle D Landfills MSW Incinerators

1. Estimated Remaining Landfill Capacity

1.1 Low Level Radioactive Waste (LLW) Facilities

Three facilities in the country currently accept LLW. Their total remaining capacity is roughly 10.4 million cubic yards, which is explained in the following table.

Facility	Remaining Volume	Notes
Envirocare - Clive, UT	2.712 million cubic yards	Remaining capacity as of 12/02.
Barnwell Disposal Facility - Barnwell, SC	8,518.5 cubic yards	Reported as 230,000 cubic feet. This only accounts for non-regional* waste. Barnwell will stop accepting non-regional waste in 2008.
Hanford Off-Site LLW Disposal Facility - Hanford, WA	7.7 million cubic yards	Excluding CERCLA facilities.
Total	10,420,518.5 cubic yards	

* Non-regional waste is anything generated outside the Atlantic Compact, which includes South Carolina, New Jersey, and Connecticut.

The Barnwell Disposal Facility is not included in our capacity analysis due to the fact that non-regional waste will only be accepted until 2008.

1.2 RCRA Subtitle C Landfills

Based on available information on subtitle C landfills nationwide, it is estimated that there is between 135.9 and 161 million cubic yards of capacity remaining in the nation's commercial hazardous waste landfills. Research has also shown the potential for subtitle C landfill space to increase slightly due to the approved expansion of some facilities. The chart below contains data collected from the country's 18 active subtitle C facilities.¹

Facility Name	City	State	Remaining Volume Constructed	Remaining Volume Permitted
Laidlaw	Waynoka	OK	6-7 million cubic yards	1.5 million cubic yards
CWM	Model City	NY	1.3 million cubic yards	
Envirosafe	Oregon	OH	1 million cubic yards	1.3 million cubic yards
Waste Control Specialists	Andrews	TX	~ 600,000 cubic yards	
CWM	Arlington	OR	100 million cubic yards	
US Ecology Idaho, Inc.	Grandview	ID	1.3 million cubic yards	6.8 million cubic yards
Wayne Disposal	Belleville	MI	2 million cubic yards	
US Ecology Texas	Beatty	NV	500,000 cubic yards	
Clean Harbors	Buttonwillow	CA	10.7 million cubic yards	
CWM Kettleman Hills	Kettleman City	CA	5 million cubic yards	
CWM Lake Charles Facility	Carlyss/Sulfur	LA	7 million cubic yards	
CWM	Emelle	AL	3.59 million cubic yards ²	
Laidlaw	Westmoreland	CA	3.59 million cubic yards ²	

¹ We believe that this is the total number of active subtitle C landfills in the United States. This figure cannot be verified, however, due to the lack of a comprehensive list of these facilities.

² Data was not available for this facility. Therefore, capacity was estimated as the average of remaining volume constructed figures for those facilities for which information was available. CWM's Arlington, OR facility was not included in this calculation, however, given that its remaining capacity constructed exceeds all of the other facilities combined. With the removal of CWM Arlington, the average remaining volume constructed was 3.59 million cubic yards. When this estimate is applied to those facilities for which we have information, an additional 25,130,000 cubic yards is added bring the total capacity constructed to 161 million cubic yards.

Clean Harbors	Deer Trail	CO	3.59 million cubic yards ²	
Clean Harbors	Salt Lake City	UT	3.59 million cubic yards ²	
Peoria Disposal	Peoria	IL	3.59 million cubic yards ²	
Envirosafe	Oregon	OH	3.59 million cubic yards ²	
Texas Ecologists	Robstown	TX	3.59 million cubic yards ²	
Total			161 million cubic yards	11.8 million cubic yards

The nation's active subtitle C landfills can be found in every region of the country, but are predominantly located in the mid-west and western region of the country. In contrast, few subtitle C landfills exist in the eastern portion of the United States. Chemical Waste Management's (CWM) Model City, NY facility is the only commercial hazardous waste facility in the east. The southern portion of the country has the second fewest number of subtitle C facilities. The following table illustrates the geographic distribution of subtitle C landfills.³

Region	Number of Active Subtitle C Landfills
East (NY)	1
South (LA, AL, TX)	3
Mid-west (OH, OK, MI, IL)	5
West (ID, UT, NV, CO, CA, OR)	8

1.3 RCRA Subtitle D Landfills and Municipal Solid Waste (MSW) Incinerators:

Capacity estimates for Subtitle D Landfills come from "The State of Garbage in America", a report on municipal solid waste published annually in *Biocycle*. EPA does not collect information on remaining Subtitle D landfill capacity nationally, and uses data from "The State of Garbage in America" on its webpage. *Biocycle* bases the report on detailed surveys completed by the states.

1.3.1 Landfills

States report remaining landfill capacity in years. In order to convert years to tons, for each state we multiplied total waste generated (tons per year) by percent waste landfilled. We then added waste imported and subtracted waste exported (tons) to get total waste landfilled (tons per year). Finally, we

³ Information on subtitle C landfill capacity was collected using a variety of different research methods. While some of the facilities were called directly, regional offices of the U.S. Environmental Protection Agency as well as State environmental agencies were useful resources for learning about the management of hazardous waste at specific facilities. City and County government offices also provided information critical to our research. Customer Service representatives, facility managers, compliance specialists and EPA officials responsible for permitting these facilities each contributed to our research.

multiplied waste landfilled per year by years of remaining capacity, resulting in total remaining capacity (tons).⁴

Study year	Remaining landfill capacity (tons)
1998	4,292,505,695
1999	5,016,256,036
2000	6,985,681,722
2001	6,584,885,975

The conversion of remaining landfill capacity from tons to cubic yards is dependent on the density of waste and how tightly it is compacted. A wide range of MSW conversion factors are used by landfill operators to estimate remaining capacity⁵. Using low, middle, and high end regular MSW conversions produces a range of possible volume remaining in landfills in 2001:

Remaining capacity in tons (2001)	Cubic Yards per ton	Cubic Yards of remaining capacity
6,584,885,975	1.66	10,970,420,034
6,584,885,975	4.33	28,512,556,272
6,584,885,975	7	46,094,201,825

1.3.2 Incinerators

For incinerator capacity, states reported daily capacity. Per *Biocycle's* methodology, we multiplied incinerator capacity (tons per day) by 300 operating days per year for total capacity (tons per year).⁶

Study year	Incinerator capacity (tons/year)
1998	29,982,296
1999	34,282,200
2000	35,322,058
2001	33,791,899

1.3.3 Landfill and Incinerator Capacity QA/QC

Because information was not available for 2003 landfill and incinerator capacity, we estimated total national landfill and incinerator capacity for four years using the most recent available "The State of

⁴ Where "percent landfilled" was not given, we extrapolated from the previous years' data to estimate a percent. If only one year of previous data was available, we adjusted that number by the rise or fall in the national landfill rate average. Where remaining years of capacity was not given or specific, we used the average of the two years if a range was given, and extrapolated from previous years' data if no information was given. If no information was given on waste imported/exported, we used zero.

⁵ We used online searches and interviews with randomly chosen landfill operators to find standard "tons to cubic yards" conversions. Conversions used in Delaware, Virginia, California, Mississippi, North Carolina, and Colorado ranged from 1.66 cubic yards per ton to 7 cubic yards per ton, depending on the compaction rate for regular MSW and density of waste. While only two sources cited conversion factors between 4 and 7 cubic yards per ton, many more cited factors between 1.66 and 3.33 cubic yards per ton. Soil and construction and demolition materials are sometimes deposited in MSW landfills and are more dense than household materials, filling .75 cubic yards to 1 cubic yard per ton.

⁶ Where daily capacity was not given, we multiplied the national average daily capacity per incinerator for that year by the number of incinerators maintained by the state.

Garbage in America" reports. This allowed us to use trends in the data to estimate the data missing from the 2001 report and to estimate current remaining capacity.

In 2001, three states reported their landfill capacities in tons, which we used for QA/QC. California's estimated capacity is 665,280,000 tons and its reported capacity is 677 million tons. Massachusetts' estimated capacity is 1,883,320 tons and its reported capacity is 1,808,669. New York's estimated capacity is 64,074,500 tons and its reported capacity is 68 million tons.

To make sure incinerator capacities were reasonable, we compared our calculated capacity against percent of MSW incinerated each year. Data from the 1998 report found that incinerators were running at around 100% capacity. Data from the 1999 report showed that incinerators were running at 82% capacity, which reflects a decline in the percent of waste incinerated nationally in those years from 9% to 7.5%. The data from the 2000 and 2001 reports show incinerators operating at 75% and 84% capacity, respectively. In those years, the percent of waste incinerated remained steady at 7%, while total waste stream increased. The drop from incinerators operating at 82% to 75% capacity, derived from the 1999 and 2000 reports, also corresponds to a drop in percent of waste incinerated from 7.5% to 7%.

2. Landfill Capacity Analysis

2.1 Projected Material Release

Alternative 4 entails disposing of materials in EPA regulated landfills. Under this alternative four dose levels are considered under which materials would be released. The following table indicates the type of landfill that would receive the material as well as the amount and activity of that material. For industrial landfills:

- 0.03 mrem/yr - 7.8 million cubic yards
- 0.1 mrem/yr - 9.4 million cubic yards
- 1 mrem/yr - 11 million cubic yards
- 10 mrem/yr - 11.3 million cubic yards

For subtitle D landfills:

- 0.03 mrem/yr - 8.4 million cubic yards
- 0.1 mrem/yr - 9.9 million cubic yards
- 1 mrem/yr - 11.1 million cubic yards
- 10 mrem/yr - 11.3 million cubic yards

Industrial Landfill		Total Cubic Yards of Material Released
0.03 mrem/yr Total: 7.8 mill. Cubic Yards	Ferrous Metals	1,345,567
	Concrete	6,413,333
	Trash	35,556
0.1 mrem/yr Total: 9.4 mill. Cubic Yards	Ferrous Metals	1,990,600
	Concrete	7,358,889
	Trash	53,333
1 mrem/yr Total: 11 Mill. Cubic Yards	Ferrous Metals	2,768,833
	Concrete	8,098,889
	Trash	100,000

10 mrem/yr Total: 11.3 Mill. Cubic Yards	Ferrous Metals	3,027,833
	Concrete	8,140,000
	Trash	155,556
Subtitle D Landfill		Total Cubic Yards of Material Released
0.03 mrem/yr Total: 8.4 Mill. Cubic Yards	Ferrous Metals	1,927,700
	Concrete	6,413,333
	Trash	355,556
0.1 mrem/yr Total: 9.9 Mill. Cubic Yards	Ferrous Metals	2,443,233
	Concrete	7,358,889
	Trash	53,333
1 mrem/yr Total: 11.1 Mill. Cubic Yards	Ferrous Metals	2,916,833
	Concrete	8,098,889
	Trash	100,000
10 mrem/yr Total: 11.3 Mill. Cubic Yards	Ferrous Metals	3,037,700
	Concrete	8,140,000
	Trash	155,556

2.2 Adequacy of Current Capacity

The following table outlines the estimated remaining capacity in the nation's LLW, subtitle C, industrial, and subtitle D landfills as well as the projected amount of cleared material to be released under Alternative Four.

Facility Type	Estimated Remaining Capacity (million cubic yards)	Projected Material Released (million cubic yards) ⁷			
		Alternative 4 (per mrem/yr level)			
		.03	.1	1	10
LLW	10.4	8.4*			11.3*
Subtitle C Landfill	135.9 to 161	8.4*			11.3*
Industrial Landfill		7.8	9.4	11	11.3
Subtitle D Landfill	10.9 to 46.1	8.4	9.9	11.1	11.3

⁷ Figures for "projected material released" apply to the period of 2003 to 2049.

*In conducting our capacity analysis, we assumed the amount of material released for disposal in LLW and subtitle C landfills would be the same as the amount of material released for disposal in subtitle D landfills. This assumption was made based on the fact that SC&A has not yet calculated projected material release figures for LLW and subtitle C facilities.

2.2.1 LLW Capacity

A comparison of projected material released and estimated capacity indicates that LLW capacity will likely be insufficient.⁸ Although in theory LLW facilities could accommodate the release of 8.4 million cubic yards predicted under the 0.03 mrem/yr threshold, this assumes that LLW facilities will not be accepting waste from any other sources. If NRC were to raise the threshold to 10 mrem/yr it would be impossible to accommodate the estimated release of 11.1 million cubic yards of material. Under this scenario, the estimated remaining capacity would be used up by 2039 at which point new LLW facilities would have to be permitted and in operation.

2.2.2 Subtitle D Capacity

By 2049 an estimated 6.4 million cubic yards of concrete and 1.9 million cubic yards of iron could be released for disposal in subtitle D landfills under the 0.03 mrem/yr threshold. This 8.3 million cubic yards of material could fit within the estimated remaining capacity of subtitle D landfills in the United States although this statement is based on the assumption that waste going to subtitle D landfills from other sources would be minimal. Capacity becomes a greater concern, however, when the threshold is increased to 10 mrem/yr, which would allow an estimated 11.1 million cubic yards of material to go to subtitle D landfills. If we assume subtitle D landfill capacity to be around 10.9 million cubic yards, additional capacity would have to be permitted by 2038, when the amount of material released for disposal would reach 10.8 million cubic yards.

2.2.3 Subtitle C Capacity

Subtitle C landfill capacity is the most likely to accommodate the amount of material released under both the 0.03 mrem/yr and 10 mrem/yr thresholds. With an estimated remaining capacity of between 135 and 161 million cubic yards, subtitle C landfills have the most space available of all disposal options. Even the estimated release of 11.3 million cubic yards of material under the 10 mrem/yr threshold would fit in the remaining space available.

2.2.4 Industrial Landfill Capacity

Remaining industrial landfill capacity is currently undetermined. It is known, however, that an estimated 7.8 to 11.3 million cubic yards of material is expected to be released between 2003 and 2049.

2.2.5 Summary

The following synopsis of the data indicates where capacity will be exceeded and by how much.

- ▶ LLW facilities: Projected release exceeds capacity by 900,000 cubic yards.
- ▶ Subtitle C Landfills: Projected release does not exceed estimated remaining capacity.
- ▶ Industrial Landfills:
- ▶ Subtitle D Landfills: Projected release could exceed estimated remaining capacity by 400,000 cubic yards if the threshold is set at 10 mrem/yr and capacity is 10.9 million cubic yards.

⁸ Estimates were made based on 0.03 mrem/yr and 10 mrem/yr levels to provide a range.