Appendix H - Waste

INPUT Data from State Inventory Tool:

Table H-1 *Annual Population and Waste Disposal Data*

Year	Population	Disposal (tons)
1960	3,952,000	
1961	4,009,000	1,824,000
1962	4,049,000	1,904,673
1963	4,112,000	1,999,907
1964	4,165,000	2,094,381
1965	4,232,000	2,200,241
1966	4,274,000	2,297,434
1967	4,303,000	2,391,464
1968	4,345,000	2,496,700
1969	4,378,000	2,600,975
1970	4,417,821	2,713,642
1971	4,462,155	2,806,402
1972	4,502,412	2,899,421
1973	4,524,244	2,983,135
1974	4,545,782	3,068,995
1975	4,578,986	3,165,321
1976	4,595,904	3,252,971
1977	4,626,514	3,352,925
1978	4,646,108	3,447,626
1979	4,682,811	3,557,937
1980	4,705,767	3,660,857
1981	4,726,343	3,689,082
1982	4,728,870	3,703,319
1983	4,721,438	3,709,784
1984	4,735,563	3,733,246
1985	4,747,767	3,755,304
1986	4,755,618	3,774,012
1987	4,777,919	3,804,309
1988	4,822,388	3,852,474
1989	4,856,574	3,892,676
1990	4,891,769	3,933,914
1991	4,952,675	3,893,577
1992	5,004,636	4,172,590
1993	5,055,318	4,283,546
1994	5,095,504	4,306,922
1995	5,137,004	3,546,292
1996	5,173,828	4,344,421
1997	5,200,235	5,094,214
1998	5,222,124	5,050,790
1999	5,250,446	5,413,566
2000	5,363,675	5,636,427

Table H-2

State Landfills

Year	Total # of Landfills	# of Large Landfills
1990	465	16
1991	88	16
1992	54	16
1993	55	16
1994	53	14
1995	51	17
1996	51	19
1997	46	18
1998	44	16
1999	45	20
2000	44	19

Table H-3

30-Year Wisconsin Waste in Place (tons)

Year	Total WiP	WiP (Large Landfills*)	WiP (Small Landfills)
1990	92,567,127	74,979,373	17,587,754
1991	94,636,705	76,655,731	17,980,974
1992	96,904,621	78,492,743	18,411,878
1993	99,188,260	80,342,491	18,845,769
1994	101,400,802	82,134,649	19,266,152
1995	102,746,853	83,224,951	19,521,902
1996	104,793,839	84,883,010	19,910,829
1997	107,496,589	87,072,237	20,424,352
1998	110,050,680	89,141,050	20,909,629
1999	112,863,270	91,419,249	21,444,021
2000	115,786,055	93,786,705	21,999,350

Table H-4

Methane Recovered from Flaring (short tons)

Year	Data Used
1990	0
1991	2,935
1992	10,504
1993	24,148
1994	35,200
1995	41,634
1996	70,321
1997	69,923
1998	59,210
1999	66,755
2000	27,240

Table H-5

Methane Recovered from Landfill-Gas-to-Energy Projects (short tons)

Year	Data Used
1990	69,720
1991	79,425
1992	85,050
1993	85,050
1994	85,050
1995	96,705
1996	86,288
1997	88,088
1998	98,258
1999	101,093
2000	142,268

Table H-6

Data for Calculation of Methane Emissions from Municipal Wastewater

	State Population	Per Capita BOD_5 (kg/day)	Emission Factor (Gg CH_4/Gg BOD_5	WW BOD_5 anaerobically digested
1990	4,891,769	0.0650	0.60	16.25%
1991	4,952,675	0.0650	0.60	16.25%
1992	5,004,636	0.0650	0.60	16.25%
1993	5,055,318	0.0650	0.60	16.25%
1994	5,095,504	0.0650	0.60	16.25%
1995	5,137,004	0.0650	0.60	16.25%
1996	5,173,828	0.0650	0.60	16.25%
1997	5,200,235	0.0650	0.60	16.25%
1998	5,222,124	0.0650	0.60	16.25%
1999	5,250,446	0.0650	0.60	16.25%
2000	5,363,675	0.0650	0.60	16.25%

Table H-7

Data for Calculation of Nitrous Oxide Emissions from Municipal Wastewater

	State Population	Protein (kg/person/year)	$Frac_{NPR}$ (kg N/kg protein)	Emission Factor (kg N_2O-N/kg sewage N-produced)	N_2O/N_2
1990	4,891,769	39.24	16%	0.01	1.571
1991	4,952,675	39.79	16%	0.01	1.571
1992	5,004,636	40.04	16%	0.01	1.571
1993	5,055,318	40.19	16%	0.01	1.571
1994	5,095,504	41.17	16%	0.01	1.571
1995	5,137,004	40.52	16%	0.01	1.571
1996	5,173,828	40.66	16%	0.01	1.571
1997	5,200,235	40.95	16%	0.01	1.571
1998	5,222,124	41.14	16%	0.01	1.571
1999	5,250,446	41.94	16%	0.01	1.571
2000	5,363,675	41.94	16%	0.01	1.571

Table H-8 *Data for Calculation of Methane Emissions from Industrial Wastewater (Fruits & Vegetables)*

	Amount Processed (metric tons)	**WW Outflow** (m^3/metric ton)	**COD** (g COD / l)	**Emission Factor** (g CH_4/g COD)	**COD Degraded**
1990	2,800,000	5.6	5	0.25	5%
1991	2,800,000	5.6	5	0.25	5%
1992	2,800,000	5.6	5	0.25	5%
1993	2,800,000	5.6	5	0.25	5%
1994	2,800,000	5.6	5	0.25	5%
1995	2,800,000	5.6	5	0.25	5%
1996	2,800,000	5.6	5	0.25	5%
1997	2,738,867	5.6	5	0.25	5%
1998	2,799,594	5.6	5	0.25	5%
1999	3,006,866	5.6	5	0.25	5%
2000	2,911,621	5.6	5	0.25	5%

Table H-9 *Data for Calculation of Methane Emissions from Industrial Wastewater (Red Meat & Poultry)*

	Amount Processed (metric tons)	**WW Outflow** (m^3/metric ton)	**COD** (g COD / l)	**Emission Factor** (g CH_4/g COD)	**COD Degraded**
1990	396,417	13	4.1	0.25	77%
1991	383,810	13	4.1	0.25	77%
1992	435,057	13	4.1	0.25	77%
1993	456,236	13	4.1	0.25	77%
1994	450,249	13	4.1	0.25	77%
1995	460,998	13	4.1	0.25	77%
1996	506,576	13	4.1	0.25	77%
1997	531,111	13	4.1	0.25	77%
1998	557,460	13	4.1	0.25	77%
1999	593,288	13	4.1	0.25	77%
2000	611,383	13	4.1	0.25	77%

Table H-10 *Data for Calculation of Methane Emissions from Industrial Wastewater (Pulp & Paper)*

	Amount Processed (metric tons)		**Wastewater Outflow**	**BOD Degraded**	**Emission Factor**	**Fraction BOD Anaerobically Degraded**
	Wood Pulp	Paper & Paperboard	(m^3/metric ton)	(g BOD / l)	(g CH_4/g BOD)	(percent)
1990	638,560	5,532,000	85	0.4	0.6	10.3%
1991	638,560	5,329,000	85	0.4	0.6	10.3%
1992	638,560	5,547,000	85	0.4	0.6	10.3%
1993	638,560	5,797,000	85	0.4	0.6	10.3%
1994	638,560	6,132,000	85	0.4	0.6	10.3%
1995	638,560	5,932,000	85	0.4	0.6	10.3%
1996	551,026	5,797,000	85	0.4	0.6	10.3%
1997	638,560	6,086,000	85	0.4	0.6	10.3%
1998	587,402	6,374,000	85	0.4	0.6	10.3%
1999	628,062	6,429,000	85	0.4	0.6	10.3%
2000	575,809	6,476,000	85	0.4	0.6	10.3%

OUTPUT:

Table H-11 *Total Emissions from Landfills and Waste Combustion (MMTCO2E)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CH_4	3.373	3.237	3.100	2.955	2.734	2.654	2.539	2.561	2.553	2.721	2.748
CO_2	0.034	0.038	0.035	0.038	0.038	0.039	0.041	0.042	0.043	0.045	0.018
N_2O	0.026	0.026	0.025	0.025	0.025	0.025	0.025	0.024	0.025	0.025	0.025
Total	3.433	3.301	3.160	3.018	2.797	2.717	2.605	2.627	2.621	2.791	2.791

Table H-12 *CH_4 Emissions from Landfills (MTCO2E)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Potential CH_4	5,075,699	5,165,712	5,264,352	5,363,675	5,328,702	5,584,053	5,804,288	5,856,238	5,836,119	6,220,858	6,282,377
MSW Generation	4,743,644	4,827,769	4,919,955	5,012,781	4,980,095	5,218,741	5,424,568	5,473,119	5,454,317	5,813,886	5,871,381
Small Landfills	902,988	923,177	945,300	967,577	989,160	1,002,291	1,022,259	1,048,624	1,073,539	1,100,976	1,129,487
Large Landfills	3,840,656	3,904,592	3,974,655	4,045,204	3,990,935	4,216,451	4,402,309	4,424,495	4,380,778	4,712,910	4,741,893
Industrial Generation	332,055	337,944	344,397	350,895	348,607	365,312	379,720	383,118	381,802	406,972	410,997
CH_4 Avoided	(1,328,220)	(1,569,022)	(1,820,378)	(2,080,307)	(2,290,856)	(2,635,466)	(2,983,524)	(3,010,233)	(2,999,888)	(3,197,635)	(3,229,260)
Flare	-	(55,914)	(200,109)	(460,038)	(670,587)	(793,160)	(1,339,670)	(1,332,088)	(1,127,997)	(1,271,735)	(518,943)
Landfill Gas-to-Energy	(1,328,220)	(1,513,108)	(1,620,269)	(1,620,269)	(1,620,269)	(1,842,306)	(1,643,854)	(1,678,145)	(1,871,892)	(1,925,901)	(2,710,316)
Oxidation at MSW Landfills	341,542	325,875	309,958	293,247	268,924	258,328	244,104	246,289	245,443	261,625	264,212
Oxidation at Industrial Landfills	33,206	33,794	34,440	35,089	34,861	36,531	37,972	38,312	38,180	40,697	41,100
Total CH_4 Emissions	3,372,731	3,237,021	3,099,576	2,955,031	2,734,061	2,653,728	2,538,688	2,561,404	2,552,608	2,720,900	2,747,806

Table H-13 *CO_2 and N_2O Emissions from Waste Combustion (MTCO2E)*

Gas/Waste Product	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2	34,101	37,851	35,417	38,047	37,831	38,581	41,234	41,664	43,366	45,384	17,633
Plastics	22,812	25,378	23,604	25,434	24,997	25,660	27,474	28,072	29,273	31,041	2,134
Synthetic Rubber in MSW	5,007	5,409	4,875	5,113	5,019	4,611	4,845	4,714	4,818	4,797	5,208
Synthetic Fibers	6,283	7,064	6,937	7,499	7,815	8,310	8,915	8,878	9,275	9,546	10,291
N_2O	25,856	25,856	24,651	24,651	24,651	24,651	24,651	24,346	24,798	24,967	25,332
Total CO_2 and N_2O Emissions	59,957	63,707	60,067	62,698	62,482	63,232	65,885	66,011	68,164	70,351	42,965

Table H-14

Wastewater Emissions

Emissions ($MMTCO_2E$)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Municipal CH_4	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26
Municipal N_2O	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.18
Industrial CH_4	0.38	0.37	0.39	0.40	0.42	0.41	0.41	0.43	0.45	0.46	0.46
Fruits & Vegetables	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Red Meat & Poultry	0.09	0.08	0.09	0.10	0.10	0.10	0.11	0.11	0.12	0.13	0.13
Pulp & Paper	0.27	0.26	0.27	0.28	0.30	0.29	0.28	0.30	0.31	0.31	0.31
Total Emissions	0.77	0.76	0.79	0.81	0.83	0.82	0.83	0.85	0.87	0.89	0.90

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