

A8.6 Worksheets for the waste sector

Module **2004 Waste (New Zealand)**
Submodule **Methane emissions from solid waste disposal sites**
Worksheet **6.1A (supplemental)**

Total population ¹	MSW generation rate ² (kg/cap/day)	Annual MSW generated (Gg/yr)	Fraction of MSW to SWDs	Total MSW to SWDs (Gg)
4039400	2.07	3045	1.00	3,045

¹ Statistics New Zealand "100 years of population growth"

² Solid Waste Analysis Protocol (2003 results), Ministry for the Environment

Module **2004 Waste (New Zealand)**
Submodule **Methane emissions from solid waste disposal sites (tier 2)**
Worksheet **6.1**

Year	Total annual MSW disposed to SWDs (Gg MSW)	Methane generation potential (L _o)	Methane generation rate constant (k)	Gross annual methane generation (model output)	Total annual MSW disposed to SWDs with LFG systems (Gg MSW)	Percentage of MSW with LFG systems (%)	Estimated average LFG system collection efficiency (%)	Recovered methane per year (Gg CH ₄)	Net methane generation (Gg CH ₄)	One minus methane oxidation correction factor	Net methane emissions (Gg CH ₄)
1990	2,977	69.55	0.06	115.3	1050.1	35.80	0.00	0.00	115.3	0.9	103.8
1991	3,069	69.55	0.06	116.8	1089.3	35.72	0.00	0.00	116.8	0.9	105.1
1992	3,101	69.55	0.06	118.2	1138.9	36.95	0.09	3.53	114.7	0.9	103.2
1993	3,141	69.55	0.06	119.5	1230.6	39.47	0.09	3.95	115.5	0.9	104.0
1994	3,185	69.55	0.06	120.9	1410.2	44.64	0.10	6.59	114.3	0.9	102.9
1995	3,184	69.55	0.06	122.2	1511.1	47.13	0.23	18.46	103.7	0.9	93.4
1996	3,161	68.84	0.06	123.3	1649.3	50.64	0.23	19.16	104.1	0.9	93.7
1997	3,138	68.13	0.06	124.2	1842.5	55.84	0.28	21.11	103.1	0.9	92.8
1998	3,116	67.42	0.06	124.9	1827.1	54.89	0.33	25.32	99.6	0.9	89.7
1999	3,093	66.71	0.06	125.4	1911.2	57.09	0.40	32.88	92.5	0.9	83.3
2000	3,070	66.01	0.06	125.8	1939.2	59.58	0.38	32.56	93.2	0.9	83.9
2001	3,047	65.30	0.06	125.9	1915.3	60.55	0.39	35.87	90.0	0.9	81.0
2002	3,024	64.59	0.06	126.0	2013.9	65.10	0.42	39.13	86.9	0.9	78.2
2003	3,001	63.88	0.06	125.9	2117.1	69.88	0.42	41.21	84.7	0.9	76.2
2004	3,034	64.05	0.06	125.8	2192.9	71.44	0.44	46.00	79.8	0.9	71.9

Information in this table based on SCS Wetherill 2002, Solid Waste Analysis Protocol (2003 results), 2002 Landfill Review and Audit and Waste Management New Zealand 2005.

2004 Calculations of DOC and L_o New Zealand DOC Estimate Worksheet

Waste category (NZ WAP)	Waste Quantity (tonnes)	Waste composition (% by weight)	Fraction DOC (by weight)
Paper	386,697	13	0.4
Plastic	207,050	7	0
Glass	82,211	3	0
Ferrous Metal	140,063	5	0
Non ferr metal	33,493	1	0
Organic	752,080	25	0.17
Rubble/concrete	496,312	16	0
Timber	380,607	13	0.3
Rubber	39,583	1	0
Nappies/Sanitary	60,897	2	0
Textiles	115,705	4	0
Pot Haz	353,203	12	0
Total	3,044,857	100	

Methane Generation Potential Calculation by Using Waste Type Data in 2004

Methane correction factor (MCF)	Degradable organic carbon (DOC)	Fraction of DOC (DOC _F)	Fraction by volume of CH ₄	Conversion from C to CH ₄	Methane Generation Potential (L _o)	Methane Generation Potential (L _o)
	GgC/Gg waste				GgCH ₄ /Gg waste	m ³ CH ₄ /Mg waste
0.984	0.1303	0.50	0.50	1.3333	0.0427	64.06

Module 2004 Waste (New Zealand)
Submodule Methane emissions from domestic and commercial wastewater treatment
Worksheet NZ 6.2
Sheet Estimation of emission factor for wastewater handling systems

Wastewater handling system ¹	Fraction of wastewater treated by the handling system ¹ (percent)	Methane conversion factor for the handling system	Product	Maximum methane producing capacity (kg CH ₄ /kg BOD _o)	Emission factor for domestic/commercial wastewater (kg CH ₄ /kg BOD)
Anaerobic pond	1.7	0.65	0.01105	0.375	0.00415
Imhoff tank	0.3	0.55	0.00186	0.375	0.00070
Septic tank	7.4	0.40	0.02974	0.375	0.01115
Oxidation pond	10.7	0.20	0.02131	0.375	0.00799
Facultative aerated pd	1.8	0.10	0.00181	0.375	0.00068
Fully mixed aerated pd	1.6	0	0	0.375	0
Activated sludge	31.2	0	0	0.375	0
Other aerobic plant	12.6	0	0	0.375	0
Milliscreening ²	24.0	0	0	0.375	0
Aerobic ³	8.4	0.10	0.00836	0.375	0.00313
Aggregate MCF					0.0278

- 1 SCS Wetherill 2002
 2 Milliscreening or no treatment
 3 Methane from sludge

Module 2004 Waste (New Zealand)
Submodule Waste sector summary

	CH ₄ (Gg/year)	N ₂ O (Gg/year)
Solid waste	71.86	
Wastewater - dom	3.98	0.30
Wastewater - ind	3.97	0.23
Total	79.80	0.54

Module 2004 Waste (New Zealand)
Submodule Methane emissions from domestic and commercial wastewater and sludge treatment
Worksheet NZ 6.2
Sheet Estimation of methane emissions from domestic/commercial wastewater and sludge

	Total organic product ¹ (kg BOD/yr)	Emission factor (kg CH ₄ /kg BOD)	CH ₄ emissions without recovery/flaring (kg CH ₄ /yr)	CH ₄ recovered and/or flared ² (kg CH ₄ /yr)	Net CH ₄ emissions (Gg CH ₄ /yr)
Wastewater	143,033,614	0.0278	3,976,137	0	4.0
Sludge ²					0.0
Total					4.0

- 1 SCS Wetherill 2002
 2 Almost all CH₄ generated from aerobic sludge handling is collected therefore does not contribute to methane emissions, thus emissions from sludge have not been estimated; after methane recovery net emissions of methane from sludge are zero.

Module 2004 Waste (New Zealand)
Submodule Indirect nitrous oxide emissions from human sewage
Worksheet 6.4 (adapted)

Per capita wastewater N (kg/person/year) ¹	Total Population ²	Emission factor (EF ₆) (kg N ₂ O-N/kg sewage-N produced)	Total N ₂ O emissions (Gg)
4.75	4,083,900	0.01	0.30

- ¹ SCS Wetherill 2002
² Statistics New Zealand.