

**Appendix A: Estimated Annual Emissions of all Substances from Biogenic and Geogenic Sources**

**Table A1: Agricultural burning emissions by source type**

Substance	Emissions (kg/year)			
	Newcastle	Non Urban	Sydney	GMR
<b>Summer Crop</b>				
1,3-BUTADIENE	0.75	36	3.46	40
1-BUTENE	1.17	55	5.37	62
1-PROPYLENE	0.59	28	2.72	31
2-METHYLNAPHTHALENE	$5.12 \times 10^{-2}$	2.43	0.24	2.72
2-METHYLPROPANE; ISOBUTANE	0.16	7.58	0.74	8.48
3-METHYL-1-BUTENE	0.25	12	1.14	13
ACENAPHTHENE	$1.50 \times 10^{-2}$	0.71	$6.90 \times 10^{-2}$	0.80
ACENAPHTHYLENE	$1.15 \times 10^{-2}$	0.54	$5.29 \times 10^{-2}$	0.61
ACETYLENE	12	575	56	643
AMMONIA (TOTAL)	11	533	52	596
ANTHRACENE	$4.73 \times 10^{-3}$	0.22	$2.18 \times 10^{-2}$	0.25
ANTIMONY & COMPOUNDS	$5.84 \times 10^{-3}$	0.28	$2.69 \times 10^{-2}$	0.31
ARSENIC & COMPOUNDS	$8.01 \times 10^{-4}$	$3.80 \times 10^{-2}$	$3.69 \times 10^{-3}$	$4.25 \times 10^{-2}$
BENZO(A)ANTHRACENE	$4.28 \times 10^{-3}$	0.20	$1.97 \times 10^{-2}$	0.23
BENZO(A)PYRENE	0.18	8.42	0.82	9.41
BENZO(B)FLUORANTHENE	$8.74 \times 10^{-2}$	4.15	0.40	4.64
BENZO(E)PYRENE	0.21	9.92	0.96	11
BENZO(G,H,I)PERYLENE	$1.10 \times 10^{-2}$	0.52	$5.05 \times 10^{-2}$	0.58
BENZO(K)FLUORANTHENE	$5.32 \times 10^{-2}$	2.52	0.24	2.82
BROMINE AND COMPOUNDS	0.10	4.91	0.48	5.49
CADMIUM & COMPOUNDS	$5.72 \times 10^{-3}$	0.27	$2.64 \times 10^{-2}$	0.30
CARBON DIOXIDE	25,240	1,198,109	116,306	1,339,655
CARBON MONOXIDE	711	33,732	3,274	37,717
CHLORINE	20	939	91	1,050
CHROMIUM (III) COMPOUNDS	$1.99 \times 10^{-3}$	$9.46 \times 10^{-2}$	$9.18 \times 10^{-3}$	0.11
CHROMIUM (VI) COMPOUNDS	$4.10 \times 10^{-4}$	$1.95 \times 10^{-2}$	$1.89 \times 10^{-3}$	$2.18 \times 10^{-2}$
CHRYSENE	$5.91 \times 10^{-3}$	0.28	$2.72 \times 10^{-2}$	0.31
COBALT & COMPOUNDS	$3.43 \times 10^{-4}$	$1.63 \times 10^{-2}$	$1.58 \times 10^{-3}$	$1.82 \times 10^{-2}$
COPPER & COMPOUNDS	$1.49 \times 10^{-3}$	$7.06 \times 10^{-2}$	$6.85 \times 10^{-3}$	$7.90 \times 10^{-2}$
DIBENZO(A,H)ANTHRACENE	$1.05 \times 10^{-2}$	0.50	$4.82 \times 10^{-2}$	0.56
ETHANE	15	717	70	801
ETHYLENE	28	1,308	127	1,462
FLUORANTHENE	$1.67 \times 10^{-2}$	0.79	$7.70 \times 10^{-2}$	0.89
FLUORENE	$3.19 \times 10^{-3}$	0.15	$1.47 \times 10^{-2}$	0.17
INDENO(1,2,3-CD)PYRENE	0.18	8.52	0.83	9.52
ISOMERS OF BUTENE	1.33	63	6.11	70
ISOMERS OF PENTANE	0.22	10	0.99	11
LEAD & COMPOUNDS	$1.37 \times 10^{-3}$	$6.52 \times 10^{-2}$	$6.33 \times 10^{-3}$	$7.29 \times 10^{-2}$
MANGANESE & COMPOUNDS	$5.39 \times 10^{-2}$	2.56	0.25	2.86
MERCURY & COMPOUNDS	$1.49 \times 10^{-3}$	$7.06 \times 10^{-2}$	$6.85 \times 10^{-3}$	$7.90 \times 10^{-2}$
METHANE	35	1,648	160	1,843

Substance	Emissions (kg/year)			
	Newcastle	Non Urban	Sydney	GMR
MOLYBDENUM	$1.03 \times 10^{-3}$	$4.89 \times 10^{-2}$	$4.75 \times 10^{-3}$	$5.47 \times 10^{-2}$
NAPHTHALENE	0.16	7.75	0.75	8.67
N-BUTANE	0.34	16	1.58	18
NICKEL & COMPOUNDS	$1.03 \times 10^{-3}$	$4.89 \times 10^{-2}$	$4.75 \times 10^{-3}$	$5.47 \times 10^{-2}$
NITRIC OXIDE	20	965	94	1,079
NITROGEN DIOXIDE	1.64	78	7.56	87
NITROUS OXIDE	1.99	95	9.18	106
OXIDES OF NITROGEN	33	1,558	151	1,742
PARTICULATE MATTER $\leq 10 \mu\text{m}$	113	5,350	519	5,982
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	108	5,113	496	5,717
PERYLENE	$3.87 \times 10^{-2}$	1.84	0.18	2.06
PHENANTHRENE	$3.62 \times 10^{-2}$	1.72	0.17	1.92
PHOSPHORUS	$3.44 \times 10^{-2}$	1.63	0.16	1.83
POLYCHLORINATED DIOXINS AND FURANS	$1.59 \times 10^{-8}$	$7.54 \times 10^{-7}$	$7.32 \times 10^{-8}$	$8.43 \times 10^{-7}$
POLYCYCLIC AROMATIC HYDROCARBONS	1.09	52	5.04	58
PROPANE	0.50	24	2.32	27
PROPYLENE	5.66	269	26	301
PYRENE	$1.60 \times 10^{-2}$	0.76	$7.37 \times 10^{-2}$	0.85
SELENIUM & COMPOUNDS	$6.87 \times 10^{-4}$	$3.26 \times 10^{-2}$	$3.16 \times 10^{-3}$	$3.64 \times 10^{-2}$
SULFUR DIOXIDE	3.84	182	18	204
TIN & COMPOUNDS	$2.98 \times 10^{-3}$	0.14	$1.37 \times 10^{-2}$	0.16
TOTAL SUSPENDED PARTICULATE	114	5,432	527	6,073
TOTAL VOLATILE ORGANIC COMPOUNDS	66	3,120	303	3,488
VANADIUM & COMPOUNDS	$1.26 \times 10^{-3}$	$5.97 \times 10^{-2}$	$5.80 \times 10^{-3}$	$6.68 \times 10^{-2}$
ZINC & COMPOUNDS	$1.93 \times 10^{-2}$	0.92	$8.91 \times 10^{-2}$	1.03
Winter Crop				
1,3-BUTADIENE	4.46	212	21	237
1-BUTENE	6.93	329	32	368
1-PROPYLENE	3.51	167	16	186
2-METHYLNAPHTHALENE	0.18	8.78	0.85	9.82
2-METHYLPROPANE; ISOBUTANE	0.95	45	4.37	50
3-METHYL-1-BUTENE	1.47	70	6.78	78
ACENAPHTHENE	0.14	6.86	0.67	7.67
ACENAPHTHYLENE	0.24	12	1.12	13
ACETYLENE	72	3,415	332	3,819
AMMONIA (TOTAL)	86	4,063	394	4,543
ANTHRACENE	$9.47 \times 10^{-2}$	4.50	0.44	5.03
ANTIMONY & COMPOUNDS	$3.51 \times 10^{-2}$	1.66	0.16	1.86
ARSENIC & COMPOUNDS	$4.81 \times 10^{-3}$	0.23	$2.22 \times 10^{-2}$	0.26
BENZO(A)ANTHRACENE	$7.85 \times 10^{-2}$	3.73	0.36	4.17
BENZO(A)PYRENE	0.15	7.06	0.69	7.89
BENZO(B)FLUORANTHENE	0.14	6.81	0.66	7.62
BENZO(E)PYRENE	0.18	8.62	0.84	9.63

2008 Calendar Year Biogenic and Geogenic Emissions: Results

Appendix A. Estimated Annual Emissions of all Substances from Biogenic and Geogenic Sources

Substance	Emissions (kg/year)			
	Newcastle	Non Urban	Sydney	GMR
BENZO(G,H,I)PERYLENE	6.21 × 10 <sup>-2</sup>	2.95	0.29	3.29
BENZO(K)FLUORANTHENE	6.65 × 10 <sup>-2</sup>	3.16	0.31	3.53
BROMINE AND COMPOUNDS	0.62	29	2.86	33
CADMIUM & COMPOUNDS	3.44 × 10 <sup>-2</sup>	1.63	0.16	1.82
CARBON DIOXIDE	100,437	4,767,608	462,812	5,330,858
CARBON MONOXIDE	5,417	257,154	24,963	287,535
CHLORINE	119	5,642	548	6,309
CHROMIUM (III) COMPOUNDS	1.20 × 10 <sup>-2</sup>	0.57	5.52 × 10 <sup>-2</sup>	0.64
CHROMIUM (VI) COMPOUNDS	2.46 × 10 <sup>-3</sup>	0.12	1.13 × 10 <sup>-2</sup>	0.13
CHRYSENE	8.69 × 10 <sup>-2</sup>	4.13	0.40	4.61
COBALT & COMPOUNDS	2.06 × 10 <sup>-3</sup>	9.79 × 10 <sup>-2</sup>	9.50 × 10 <sup>-3</sup>	0.11
COPPER & COMPOUNDS	8.94 × 10 <sup>-3</sup>	0.42	4.12 × 10 <sup>-2</sup>	0.47
DIBENZO(A,H)ANTHRACENE	7.15 × 10 <sup>-3</sup>	0.34	3.29 × 10 <sup>-2</sup>	0.38
ETHANE	90	4,258	413	4,761
ETHYLENE	164	7,770	754	8,688
FLUORANTHENE	0.23	11	1.04	12
FLUORENE	5.67 × 10 <sup>-2</sup>	2.69	0.26	3.01
INDENO(1,2,3-CD)PYRENE	0.16	7.57	0.73	8.46
ISOMERS OF BUTENE	7.88	374	36	418
ISOMERS OF PENTANE	1.28	61	5.90	68
LEAD & COMPOUNDS	8.25 × 10 <sup>-3</sup>	0.39	3.80 × 10 <sup>-2</sup>	0.44
MANGANESE & COMPOUNDS	0.32	15	1.49	17
MERCURY & COMPOUNDS	8.94 × 10 <sup>-3</sup>	0.42	4.12 × 10 <sup>-2</sup>	0.47
METHANE	202	9,579	930	10,711
MOLYBDENUM	6.19 × 10 <sup>-3</sup>	0.29	2.85 × 10 <sup>-2</sup>	0.33
NAPHTHALENE	10	482	47	539
N-BUTANE	2.04	97	9.40	108
NICKEL & COMPOUNDS	6.19 × 10 <sup>-3</sup>	0.29	2.85 × 10 <sup>-2</sup>	0.33
NITRIC OXIDE	115	5,448	529	6,092
NITROGEN DIOXIDE	9.26	440	43	492
NITROUS OXIDE	11	520	50	581
OXIDES OF NITROGEN	185	8,793	854	9,832
PARTICULATE MATTER ≤ 10 µm	676	32,089	3,115	35,880
PARTICULATE MATTER ≤ 2.5 µm	644	30,563	2,967	34,173
PERYLENE	4.91 × 10 <sup>-2</sup>	2.33	0.23	2.61
PHENANTHRENE	0.46	22	2.11	24
PHOSPHORUS	0.21	9.82	0.95	11
POLYCHLORINATED DIOXINS AND FURANS	6.86 × 10 <sup>-8</sup>	3.26 × 10 <sup>-6</sup>	3.16 × 10 <sup>-7</sup>	3.64 × 10 <sup>-6</sup>
POLYCYCLIC AROMATIC HYDROCARBONS	13	604	59	675
PROPANE	2.99	142	14	159
PROPYLENE	34	1,597	155	1,786
PYRENE	0.17	8.27	0.80	9.24
SELENIUM & COMPOUNDS	4.12 × 10 <sup>-3</sup>	0.20	1.90 × 10 <sup>-2</sup>	0.22
SULFUR DIOXIDE	30	1,417	138	1,585

Substance	Emissions (kg/year)			
	Newcastle	Non Urban	Sydney	GMR
TIN & COMPOUNDS	$1.79 \times 10^{-2}$	0.85	$8.23 \times 10^{-2}$	0.95
TOTAL SUSPENDED PARTICULATE	687	32,626	3,167	36,481
TOTAL VOLATILE ORGANIC COMPOUNDS	390	18,536	1,799	20,726
VANADIUM & COMPOUNDS	$7.56 \times 10^{-3}$	0.36	$3.48 \times 10^{-2}$	0.40
ZINC & COMPOUNDS	0.12	5.51	0.54	6.17

**Table A2: Bushfires and prescribed burning emissions by source type**

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
<b>Bushfires</b>					
1,3-BUTADIENE	60	5,159	645	5.22	5,868
1-BUTENE	93	8,012	1,001	8.11	9,115
1-PROPYLENE	47	4,061	507	4.11	4,620
2-METHYLNAPHTHALENE	1.46	125	16	0.13	143
2-METHYLPROPANE; ISOBUTANE	13	1,098	137	1.11	1,249
3-METHYL-1-BUTENE	20	1,701	213	1.72	1,935
ACENAPHTHENE	1.32	114	14	0.11	129
ACENAPHTHYLENE	1.15	99	12	0.10	113
ACETYLENE	968	83,196	10,395	84	94,645
AMMONIA (TOTAL)	751	64,506	8,060	65	73,382
ANTHRACENE	0.35	30	3.73	$3.02 \times 10^{-2}$	34
ANTIMONY & COMPOUNDS	0.32	28	3.47	$2.81 \times 10^{-2}$	32
ARSENIC & COMPOUNDS	$3.08 \times 10^{-2}$	2.65	0.33	$2.68 \times 10^{-3}$	3.01
BENZO(A)ANTHRACENE	0.11	9.42	1.18	$9.54 \times 10^{-3}$	11
BENZO(A)PYRENE	$1.63 \times 10^{-2}$	1.40	0.17	$1.42 \times 10^{-3}$	1.59
BENZO(B)FLUORANTHENE	$2.80 \times 10^{-2}$	2.41	0.30	$2.44 \times 10^{-3}$	2.74
BENZO(E)PYRENE	$2.35 \times 10^{-2}$	2.02	0.25	$2.04 \times 10^{-3}$	2.30
BENZO(G,H,I)PERYLENE	$1.51 \times 10^{-3}$	0.13	$1.62 \times 10^{-2}$	$1.31 \times 10^{-4}$	0.15
BENZO(K)FLUORANTHENE	$5.27 \times 10^{-2}$	4.53	0.57	$4.59 \times 10^{-3}$	5.15
BROMINE AND COMPOUNDS	4.33	372	46	0.38	423
CADMIUM & COMPOUNDS	0.22	19	2.31	$1.87 \times 10^{-2}$	21
CARBON DIOXIDE	938,918	80,661,234	10,078,675	81,645	91,760,472
CARBON MONOXIDE	75,087	6,450,621	806,009	6,529	7,338,247
CHLORINE	753	64,669	8,080	65	73,568
CHROMIUM (III) COMPOUNDS	$7.02 \times 10^{-2}$	6.03	0.75	$6.10 \times 10^{-3}$	6.86
CHROMIUM (VI) COMPOUNDS	$1.45 \times 10^{-2}$	1.24	0.16	$1.26 \times 10^{-3}$	1.41
CHRYSENE	$9.55 \times 10^{-2}$	8.21	1.03	$8.31 \times 10^{-3}$	9.34
COBALT & COMPOUNDS	$1.54 \times 10^{-2}$	1.32	0.17	$1.34 \times 10^{-3}$	1.50
COPPER & COMPOUNDS	0.15	13	1.57	$1.27 \times 10^{-2}$	14
ETHANE	1,207	103,721	12,960	105	117,993
ETHYLENE	2,203	189,277	23,650	192	215,322
FLUORANTHENE	0.94	81	10	$8.17 \times 10^{-2}$	92
FLUORENE	0.46	40	4.97	$4.03 \times 10^{-2}$	45
ISOMERS OF BUTENE	106	9,110	1,138	9.22	10,363
ISOMERS OF PENTANE	17	1,482	185	1.50	1,686
LEAD & COMPOUNDS	0.75	65	8.10	$6.56 \times 10^{-2}$	74
MANGANESE & COMPOUNDS	1.89	163	20	0.16	185
MERCURY & COMPOUNDS	$4.62 \times 10^{-2}$	3.97	0.50	$4.02 \times 10^{-3}$	4.51
METHANE	3,003	258,025	32,240	261	293,530
MOLYBDENUM	$3.85 \times 10^{-2}$	3.31	0.41	$3.35 \times 10^{-3}$	3.76
NAPHTHALENE	9.20	790	99	0.80	899

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
N-BUTANE	27	2,360	295	2.39	2,685
NICKEL & COMPOUNDS	$3.08 \times 10^{-2}$	2.65	0.33	$2.68 \times 10^{-3}$	3.01
NITRIC OXIDE	1,374	118,059	14,752	119	134,304
NITROGEN DIOXIDE	111	9,528	1,190	9.64	10,839
NITROUS OXIDE	131	11,244	1,405	11	12,791
OXIDES OF NITROGEN	2,218	190,551	23,809	193	216,771
PARTICULATE MATTER $\leq 10 \mu\text{m}$	7,563	649,721	81,183	658	739,125
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	6,418	551,357	68,892	558	627,226
PHENANTHRENE	1.97	169	21	0.17	192
PHOSPHORUS	2.27	195	24	0.20	222
POLYCHLORINATED DIOXINS AND FURANS	$2.65 \times 10^{-7}$	$2.28 \times 10^{-5}$	$2.85 \times 10^{-6}$	$2.31 \times 10^{-8}$	$2.59 \times 10^{-5}$
POLYCYCLIC AROMATIC HYDROCARBONS	18	1,542	193	1.56	1,754
PROPANE	40	3,457	432	3.50	3,933
PROPYLENE	453	38,909	4,862	39	44,263
PYRENE	0.76	66	8.20	$6.64 \times 10^{-2}$	75
SELENIUM & COMPOUNDS	$3.08 \times 10^{-2}$	2.65	0.33	$2.68 \times 10^{-3}$	3.01
SULFUR DIOXIDE	683	58,709	7,336	59	66,788
TIN & COMPOUNDS	0.19	17	2.07	$1.67 \times 10^{-2}$	19
TOTAL SUSPENDED PARTICULATE	7,698	661,294	82,629	669	752,290
TOTAL VOLATILE ORGANIC COMPOUNDS	5,256	451,543	56,421	457	513,677
VANADIUM & COMPOUNDS	$5.39 \times 10^{-2}$	4.63	0.58	$4.69 \times 10^{-3}$	5.27
ZINC & COMPOUNDS	15	1,277	160	1.29	1,453
Prescribed Burning					
1,3-BUTADIENE	176	17,436	3,719	477	21,808
1-BUTENE	274	27,082	5,776	741	33,873
1-PROPYLENE	139	13,727	2,928	376	17,168
2-METHYLNAPHTHALENE	4.28	424	90	12	530
2-METHYLPROPANE; ISOBUTANE	37	3,710	791	102	4,640
3-METHYL-1-BUTENE	58	5,750	1,226	157	7,192
ACENAPHTHENE	3.88	384	82	11	480
ACENAPHTHYLENE	3.38	335	71	9.17	419
ACETYLENE	2,840	281,209	59,976	7,695	351,719
AMMONIA (TOTAL)	2,202	218,035	46,502	5,966	272,705
ANTHRACENE	1.02	101	22	2.76	126
ANTIMONY & COMPOUNDS	0.95	94	20	2.57	117
ARSENIC & COMPOUNDS	$9.03 \times 10^{-2}$	8.94	1.91	0.24	11
BENZO(A)ANTHRACENE	0.32	32	6.79	0.87	40
BENZO(A)PYRENE	$4.77 \times 10^{-2}$	4.73	1.01	0.13	5.91
BENZO(B)FLUORANTHENE	$8.22 \times 10^{-2}$	8.14	1.74	0.22	10
BENZO(E)PYRENE	$6.89 \times 10^{-2}$	6.83	1.46	0.19	8.54
BENZO(G,H,I)PERYLENE	$4.42 \times 10^{-3}$	0.44	$9.33 \times 10^{-2}$	$1.20 \times 10^{-2}$	0.55

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Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
BENZO(K)FLUORANTHENE	0.15	15	3.27	0.42	19
BROMINE AND COMPOUNDS	13	1,256	268	34	1,571
CADMIUM & COMPOUNDS	0.63	63	13	1.71	78
CARBON DIOXIDE	2,753,502	272,639,536	58,148,052	7,460,670	341,001,760
CARBON MONOXIDE	220,202	21,803,463	4,650,202	596,643	27,270,510
CHLORINE	2,208	218,586	46,620	5,982	273,394
CHROMIUM (III) COMPOUNDS	0.21	20	4.35	0.56	25
CHROMIUM (VI) COMPOUNDS	$4.24 \times 10^{-2}$	4.20	0.90	0.11	5.26
CHRYSENE	0.28	28	5.92	0.76	35
COBALT & COMPOUNDS	$4.51 \times 10^{-2}$	4.47	0.95	0.12	5.59
COPPER & COMPOUNDS	0.43	42	9.06	1.16	53
ETHANE	3,541	350,583	74,772	9,594	438,489
ETHYLENE	6,461	639,768	136,448	17,507	800,184
FLUORANTHENE	2.76	273	58	7.46	341
FLUORENE	1.36	135	29	3.68	168
ISOMERS OF BUTENE	311	30,792	6,567	843	38,513
ISOMERS OF PENTANE	51	5,008	1,068	137	6,264
LEAD & COMPOUNDS	2.21	219	47	5.99	274
MANGANESE & COMPOUNDS	5.55	550	117	15	688
MERCURY & COMPOUNDS	0.14	13	2.86	0.37	17
METHANE	8,808	872,139	186,008	23,866	1,090,820
MOLYBDENUM	0.11	11	2.38	0.31	14
NAPHTHALENE	27	2,672	570	73	3,342
N-BUTANE	81	7,976	1,701	218	9,976
NICKEL & COMPOUNDS	$9.03 \times 10^{-2}$	8.94	1.91	0.24	11
NITRIC OXIDE	4,030	399,045	85,108	10,920	499,102
NITROGEN DIOXIDE	325	32,204	6,868	881	40,278
NITROUS OXIDE	384	38,006	8,106	1,040	47,536
OXIDES OF NITROGEN	6,505	644,073	137,367	17,625	805,569
PARTICULATE MATTER $\leq 10 \mu\text{m}$	22,179	2,196,095	468,379	60,095	2,746,749
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	18,821	1,863,619	397,469	50,997	2,330,906
PHENANTHRENE	5.77	572	122	16	715
PHOSPHORUS	6.66	659	141	18	825
POLYCHLORINATED DIOXINS AND FURANS	$1.50 \times 10^{-6}$	$1.49 \times 10^{-4}$	$3.17 \times 10^{-5}$	$4.07 \times 10^{-6}$	$1.86 \times 10^{-4}$
POLYCYCLIC AROMATIC HYDROCARBONS	53	5,211	1,111	143	6,517
PROPANE	118	11,686	2,492	320	14,616
PROPYLENE	1,328	131,515	28,049	3,599	164,491
PYRENE	2.24	222	47	6.07	277
SELENIUM & COMPOUNDS	$9.03 \times 10^{-2}$	8.94	1.91	0.24	11
SULFUR DIOXIDE	2,004	198,441	42,323	5,430	248,199
TIN & COMPOUNDS	0.56	56	12	1.53	70
TOTAL SUSPENDED PARTICULATE	22,574	2,235,211	476,722	61,166	2,795,673

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
TOTAL VOLATILE ORGANIC COMPOUNDS	15,414	1,526,242	325,514	41,765	1,908,936
VANADIUM & COMPOUNDS	0.16	16	3.34	0.43	20
ZINC & COMPOUNDS	44	4,316	921	118	5,398

**Table A3: Agricultural lands and unpaved roads emissions by source type**

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
<b>Summer Crop</b>					
ANTIMONY & COMPOUNDS	$3.27 \times 10^{-3}$	$3.60 \times 10^{-2}$	$3.90 \times 10^{-3}$	-	$4.32 \times 10^{-2}$
ARSENIC & COMPOUNDS	$8.73 \times 10^{-3}$	$9.61 \times 10^{-2}$	$1.04 \times 10^{-2}$	-	0.12
BROMINE AND COMPOUNDS	$1.25 \times 10^{-2}$	0.14	$1.50 \times 10^{-2}$	-	0.17
CADMIUM & COMPOUNDS	$1.09 \times 10^{-2}$	0.12	$1.30 \times 10^{-2}$	-	0.14
CHLORINE	1.67	18	2.00	-	22
CHROMIUM (III) COMPOUNDS	$9.44 \times 10^{-2}$	1.04	0.11	-	1.25
CHROMIUM (VI) COMPOUNDS	$1.95 \times 10^{-2}$	0.21	$2.32 \times 10^{-2}$	-	0.26
COBALT & COMPOUNDS	$4.75 \times 10^{-2}$	0.52	$5.66 \times 10^{-2}$	-	0.63
COPPER & COMPOUNDS	$3.65 \times 10^{-2}$	0.40	$4.36 \times 10^{-2}$	-	0.48
LEAD & COMPOUNDS	$3.38 \times 10^{-2}$	0.37	$4.03 \times 10^{-2}$	-	0.45
MANGANESE & COMPOUNDS	0.52	5.72	0.62	-	6.86
MERCURY & COMPOUNDS	$6.0 \times 10^{-3}$	$6.61 \times 10^{-2}$	$7.16 \times 10^{-3}$	-	$7.92 \times 10^{-2}$
MOLYBDENUM	$2.73 \times 10^{-3}$	$3.0 \times 10^{-2}$	$3.25 \times 10^{-3}$	-	$3.60 \times 10^{-2}$
NICKEL & COMPOUNDS	$2.73 \times 10^{-2}$	0.30	$3.25 \times 10^{-2}$	-	0.36
PARTICULATE MATTER $\leq 10 \mu\text{m}$	248	2,728	296	-	3,272
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	43	472	51	-	566
PHOSPHORUS	0.68	7.50	0.81	-	8.99
SELENIUM & COMPOUNDS	$1.09 \times 10^{-3}$	$1.20 \times 10^{-2}$	$1.30 \times 10^{-3}$	-	$1.44 \times 10^{-2}$
TIN & COMPOUNDS	$7.64 \times 10^{-3}$	$8.41 \times 10^{-2}$	$9.11 \times 10^{-3}$	-	0.10
TOTAL SUSPENDED PARTICULATE	545	6,005	651	-	7,201
VANADIUM & COMPOUNDS	0.15	1.64	0.18	-	1.97
ZINC & COMPOUNDS	$8.95 \times 10^{-2}$	0.98	0.11	-	1.18
<b>Winter Crop</b>					
ANTIMONY & COMPOUNDS	0.11	1.22	0.13	-	1.46
ARSENIC & COMPOUNDS	0.29	3.24	0.35	-	3.88
BROMINE AND COMPOUNDS	0.42	4.66	0.50	-	5.58
CADMIUM & COMPOUNDS	0.37	4.05	0.44	-	4.85
CHLORINE	56	622	67	-	745
CHROMIUM (III) COMPOUNDS	3.16	35	3.79	-	42
CHROMIUM (VI) COMPOUNDS	0.65	7.23	0.78	-	8.67
COBALT & COMPOUNDS	1.59	18	1.91	-	21
COPPER & COMPOUNDS	1.22	14	1.47	-	16
LEAD & COMPOUNDS	1.13	13	1.36	-	15
MANGANESE & COMPOUNDS	17	193	21	-	231
MERCURY & COMPOUNDS	0.20	2.23	0.24	-	2.67
MOLYBDENUM	$9.13 \times 10^{-2}$	1.01	0.11	-	1.21
NICKEL & COMPOUNDS	0.91	10	1.10	-	12
PARTICULATE MATTER $\leq 10 \mu\text{m}$	8,295	92,022	9,959	-	110,275
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	1,435	15,921	1,723	-	19,079
PHOSPHORUS	23	253	27	-	303

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
SELENIUM & COMPOUNDS	3.65 × 10 <sup>-2</sup>	0.41	4.38 × 10 <sup>-2</sup>	-	0.49
TIN & COMPOUNDS	0.26	2.84	0.31	-	3.40
TOTAL SUSPENDED PARTICULATE	18,258	202,557	21,922	-	242,737
VANADIUM & COMPOUNDS	4.98	55	5.98	-	66
ZINC & COMPOUNDS	2.99	33	3.60	-	40
<b>Unpaved Roads</b>					
ANTIMONY & COMPOUNDS	0.75	14	3.10	2.20 × 10 <sup>-2</sup>	18
ARSENIC & COMPOUNDS	1.61	31	6.64	4.71 × 10 <sup>-2</sup>	39
BROMINE AND COMPOUNDS	2.26	43	9.30	6.59 × 10 <sup>-2</sup>	55
CADMIUM & COMPOUNDS	2.69	52	11	7.84 × 10 <sup>-2</sup>	66
CHLORINE	140	2,696	576	4.09	3,416
CHROMIUM (III) COMPOUNDS	22	420	90	0.64	533
CHROMIUM (VI) COMPOUNDS	4.50	87	19	0.13	110
COBALT & COMPOUNDS	16	308	66	0.47	391
COPPER & COMPOUNDS	9.36	180	39	0.27	228
LEAD & COMPOUNDS	97	1,865	399	2.83	2,364
MANGANESE & COMPOUNDS	113	2,176	465	3.30	2,757
MERCURY & COMPOUNDS	1.61	31	6.64	4.71 × 10 <sup>-2</sup>	39
MOLYBDENUM	0.43	8.28	1.77	1.26 × 10 <sup>-2</sup>	10
NICKEL & COMPOUNDS	6.78	130	28	0.20	165
PARTICULATE MATTER ≤ 10 µm	63,960	1,230,373	263,056	1,865	1,559,254
PARTICULATE MATTER ≤ 2.5 µm	8,459	162,725	34,791	247	206,221
PHOSPHORUS	172	3,317	709	5.03	4,203
SELENIUM & COMPOUNDS	0.11	2.07	0.44	3.14 × 10 <sup>-3</sup>	2.62
TIN & COMPOUNDS	0.54	10	2.21	1.57 × 10 <sup>-2</sup>	13
TOTAL SUSPENDED PARTICULATE	107,622	2,070,290	442,631	3,138	2,623,681
VANADIUM & COMPOUNDS	34	646	138	0.98	819
ZINC & COMPOUNDS	67	1,288	275	1.95	1,632

**Table A4: Soil nitrification and denitrification emissions by source type**

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
<b>Agricultural</b>					
AMMONIA (TOTAL)	10,640	370,827	140,859	-	522,325
NITRIC OXIDE	8,633	300,885	114,291	-	423,809
NITROUS OXIDE	1,509	52,598	19,979	-	74,086
OXIDES OF NITROGEN	13,237	461,357	175,246	-	649,841
<b>Forest</b>					
AMMONIA (TOTAL)	12,561	537,219	130,032	13,687	693,500
NITRIC OXIDE	6,020	257,483	62,323	6,560	332,386
NITROUS OXIDE	20,945	895,787	216,822	22,823	1,156,377
OXIDES OF NITROGEN	9,231	394,807	95,562	10,059	509,659
<b>Grassland</b>					
AMMONIA (TOTAL)	7,676	724,045	59,070	3,591	794,382
NITRIC OXIDE	44,749	4,221,061	344,368	20,933	4,631,111
NITROUS OXIDE	24,728	2,332,503	190,293	11,567	2,559,091
OXIDES OF NITROGEN	68,616	6,472,294	528,030	32,097	7,101,037
<b>Urban</b>					
AMMONIA (TOTAL)	1,728	9,748	22,358	704	34,537
NITRIC OXIDE	16,867	95,147	218,237	6,867	337,120
NITROUS OXIDE	10,256	57,855	132,702	4,176	204,989
OXIDES OF NITROGEN	25,863	145,893	334,631	10,530	516,917
<b>Wetland</b>					
AMMONIA (TOTAL)	-	-	-	-	-
NITRIC OXIDE	-	43	-	-	43
NITROUS OXIDE	-	-	-	-	-
OXIDES OF NITROGEN	-	65	-	-	65

**Table A 5: Tree canopy, uncut grass and cut grass emissions by source type**

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
<b>Tree Canopy</b>					
ISOPRENE	2,692,015	104,472,883	25,726,066	2,792,476	135,683,440
MONOTERPENES	515,081	19,283,055	4,154,660	514,082	24,466,878
TOTAL VOLATILE ORGANIC COMPOUNDS	3,207,096	123,755,940	29,880,726	3,306,558	160,150,320
<b>Uncut Grass</b>					
ACETALDEHYDE	10,745	851,781	136,401	10,240	1,009,167
ACETONE	10,323	818,274	131,036	9,837	969,469
ETHYL ALCOHOL	13,815	1,095,146	175,373	13,166	1,297,501
ISOPRENE	2,273	180,144	28,848	2,166	213,430
METHYL ALCOHOL	13,882	1,100,437	176,221	13,230	1,303,769
MONOTERPENES	2,273	180,197	28,856	2,166	213,492
TOTAL VOLATILE ORGANIC COMPOUNDS	53,311	4,225,977	676,735	50,805	5,006,828
<b>Cut Grass (Domestic)</b>					
1-OCTEN-3-OL	1,073	2,692	12,835	708	17,308
ACETALDEHYDE	4,422	11,099	52,920	2,920	71,362
ACETONE	1,620	4,065	19,381	1,070	26,135
C5H10O	1,153	2,893	13,796	761	18,604
CIS-2-HEXEN-1-OL	465	1,168	5,570	307	7,512
CIS-3-HEXEN-1-OL	8,286	20,796	99,154	5,472	133,707
CIS-3-HEXENAL	11,585	29,077	138,641	7,651	186,955
CIS-3-HEXENYL ACETATE	39,155	98,274	468,568	25,858	631,855
DIETHYL KETONE	96	241	1,150	63	1,550
ETHYL ALCOHOL	642	1,612	7,686	424	10,365
HEXANAL (HEXANALDEHYDE)	1,490	3,739	17,826	984	24,038
METHYL ALCOHOL	16,797	42,159	201,014	11,093	271,063
METHYL ETHYL KETONE (MEK) (2-BUTANONE)	603	1,514	7,218	398	9,734
NONANAL	705	1,770	8,438	466	11,379
N-PROPYL ALCOHOL	1,005	2,524	12,032	664	16,225
TOTAL VOLATILE ORGANIC COMPOUNDS	105,100	263,786	1,257,727	69,407	1,696,020
TRANS-2-HEXENAL	6,842	17,172	81,875	4,518	110,406
TRANS-2-HEXENYL ACETATE	793	1,990	9,490	524	12,797
<b>Cut Grass (Public Open Space)</b>					
1-OCTEN-3-OL	175	400	2,739	130	3,444
ACETALDEHYDE	721	1,650	11,293	535	14,199
ACETONE	264	604	4,136	196	5,200
C5H10O	188	430	2,944	139	3,702

2008 Calendar Year Biogenic and Geogenic Emissions: Results

Appendix A. Estimated Annual Emissions of all Substances from Biogenic and Geogenic Sources

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
CIS-2-HEXEN-1-OL	76	174	1,189	56	1,495
CIS-3-HEXEN-1-OL	1,351	3,092	21,159	1,002	26,604
CIS-3-HEXENAL	1,889	4,323	29,585	1,402	37,199
CIS-3-HEXENYL ACETATE	6,383	14,612	99,991	4,737	125,723
DIETHYL KETONE	16	36	245	12	308
ETHYL ALCOHOL	105	240	1,640	78	2,062
HEXANAL (HEXANALDEHYDE)	243	556	3,804	180	4,783
METHYL ALCOHOL	2,738	6,268	42,896	2,032	53,935
METHYL ETHYL KETONE (MEK) (2-BUTANONE)	98	225	1,540	73	1,937
NONANAL	115	263	1,801	85	2,264
N-PROPYL ALCOHOL	164	375	2,568	122	3,228
TOTAL VOLATILE ORGANIC COMPOUNDS	17,134	39,221	268,395	12,715	337,465
TRANS-2-HEXENAL	1,115	2,553	17,472	828	21,968
TRANS-2-HEXENYL ACETATE	129	296	2,025	96	2,546

**Table A6: Marine aerosol emissions by source type**

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
Marine Aerosol					
PARTICULATE MATTER ≤ 10 µm	84,741	3,546,495	444,783	38,215	4,114,234
PARTICULATE MATTER ≤ 2.5 µm	585,671	24,510,801	3,074,017	264,111	28,434,601
TOTAL SUSPENDED PARTICULATE	2,264,165	94,187,920	11,911,676	1,030,846	109,394,607

**Table A7: Estimated annual emissions of all substances from biogenic and geogenic sources**

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
1,3-BUTADIENE	241	22,842	4,387	482	27,954
1-BUTENE	375	35,479	6,814	749	43,417
1-OCTEN-3-OL	1,247	3,092	15,574	838	20,752
1-PROPYLENE	190	17,982	3,454	380	22,006
2-METHYLNAPHTHALENE	5.97	560	107	12	685
2-METHYLPROPANE; ISOBUTANE	51	4,860	933	103	5,948
3-METHYL-1-BUTENE	80	7,533	1,447	159	9,219
ACENAPHTHENE	5.36	505	97	11	618
ACENAPHTHYLENE	4.79	446	85	9.27	545
ACETALDEHYDE	15,888	864,530	200,615	13,696	1,094,729
ACETONE	12,206	822,943	154,552	11,103	1,000,804
ACETYLENE	3,893	368,395	70,758	7,779	450,825
AMMONIA (TOTAL)	35,654	1,928,976	407,327	24,013	2,395,971
ANTHRACENE	1.46	135	26	2.79	165
ANTIMONY & COMPOUNDS	2.18	139	27	2.62	171
ARSENIC & COMPOUNDS	2.04	46	9.26	0.29	58
BENZO(A)ANTHRACENE	0.51	45	8.35	0.88	55
BENZO(A)PYRENE	0.39	22	2.68	0.13	25
BENZO(B)FLUORANTHENE	0.34	22	3.10	0.23	25
BENZO(E)PYRENE	0.48	27	3.51	0.19	32
BENZO(G,H,I)PERYLENE	$7.90 \times 10^{-2}$	4.03	0.45	$1.21 \times 10^{-2}$	4.57
BENZO(K)FLUORANTHENE	0.33	26	4.38	0.42	31
BROMINE AND COMPOUNDS	20	1,711	328	35	2,093
C5H10O	1,341	3,324	16,740	901	22,305
CADMIUM & COMPOUNDS	3.95	139	27	1.81	172
CARBON DIOXIDE	3,818,098	359,266,487	68,805,845	7,542,315	439,432,745
CARBON MONOXIDE	301,417	28,544,970	5,484,449	603,172	34,934,008
CHLORINE	3,297	293,172	55,985	6,051	358,505
CHROMIUM (III) COMPOUNDS	25	483	99	1.20	609
CHROMIUM (VI) COMPOUNDS	5.23	100	20	0.25	125
CHRYSENE	0.47	40	7.37	0.77	49
CIS-2-HEXEN-1-OL	541	1,342	6,759	364	9,006
CIS-3-HEXEN-1-OL	9,636	23,888	120,313	6,474	160,311
CIS-3-HEXENAL	13,474	33,401	168,226	9,052	224,154
CIS-3-HEXENYL ACETATE	45,539	112,886	568,559	30,595	757,578
COBALT & COMPOUNDS	18	333	69	0.59	420
COPPER & COMPOUNDS	11	250	51	1.45	313
DIBENZO(A,H)ANTHRACENE	$1.76 \times 10^{-2}$	0.84	$8.12 \times 10^{-2}$	-	0.93
DIETHYL KETONE	112	277	1,395	75	1,859
ETHANE	4,853	459,279	88,215	9,699	562,045
ETHYL ALCOHOL	14,562	1,096,998	184,700	13,668	1,309,928
ETHYLENE	8,856	838,123	160,980	17,699	1,025,657

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
FLUORANTHENE	3.94	365	69	7.55	446
FLUORENE	1.88	177	34	3.72	217
HEXANAL (HEXANALDEHYDE)	1,732	4,294	21,630	1,164	28,820
INDENO(1,2,3-CD)PYRENE	0.34	16	1.56	-	18
ISOMERS OF BUTENE	426	40,339	7,748	852	49,365
ISOMERS OF PENTANE	69	6,561	1,260	139	8,029
ISOPRENE	2,694,288	104,653,027	25,754,914	2,794,641	135,896,870
LEAD & COMPOUNDS	101	2,163	455	8.89	2,728
MANGANESE & COMPOUNDS	139	3,105	626	19	3,889
MERCURY & COMPOUNDS	2.01	51	10	0.42	64
METHANE	12,048	1,141,391	219,338	24,127	1,396,904
METHYL ALCOHOL	33,418	1,148,864	420,130	26,354	1,628,766
METHYL ETHYL KETONE (MEK) (2-BUTANONE)	702	1,739	8,759	471	11,671
MOLYBDENUM	0.68	24	4.71	0.32	30
MONOTERPENES	517,354	19,463,251	4,183,516	516,248	24,680,370
NAPHTHALENE	47	3,952	716	74	4,789
N-BUTANE	110	10,449	2,007	221	12,787
NICKEL & COMPOUNDS	7.85	153	31	0.45	192
NITRIC OXIDE	81,809	5,398,136	839,701	45,400	6,365,045
NITROGEN DIOXIDE	447	42,249	8,109	891	51,696
NITROUS OXIDE	57,966	3,388,607	569,366	39,618	4,055,557
NONANAL	820	2,033	10,239	551	13,643
N-PROPYL ALCOHOL	1,169	2,899	14,600	786	19,453
OXIDES OF NITROGEN	125,888	8,319,391	1,295,650	70,504	9,811,433
PARTICULATE MATTER ≤ 10 µm	688,704	28,719,180	3,900,524	326,729	33,635,137
PARTICULATE MATTER ≤ 2.5 µm	120,669	6,176,265	951,173	90,016	7,338,123
PERYLENE	$8.78 \times 10^{-2}$	4.17	0.40	-	4.66
PHENANTHRENE	8.24	764	145	16	934
PHOSPHORUS	205	4,443	903	23	5,575
POLYCHLORINATED DIOXINS AND FURANS	$1.85 \times 10^{-6}$	$1.76 \times 10^{-4}$	$3.50 \times 10^{-5}$	$4.09 \times 10^{-6}$	$2.16 \times 10^{-4}$
POLYCYCLIC AROMATIC HYDROCARBONS	84	7,408	1,368	144	9,005
PROPANE	162	15,309	2,940	323	18,735
PROPYLENE	1,820	172,290	33,092	3,638	210,841
PYRENE	3.19	297	56	6.14	362
SELENIUM & COMPOUNDS	0.27	14	2.75	0.25	18
SULFUR DIOXIDE	2,721	258,750	49,814	5,490	316,775
TIN & COMPOUNDS	1.58	87	17	1.56	106
TOTAL SUSPENDED PARTICULATE	2,421,664	99,401,336	12,939,926	1,095,818	115,858,744
TOTAL VOLATILE ORGANIC COMPOUNDS	3,403,768	130,284,367	32,467,620	3,481,706	169,637,460
TRANS-2-HEXENAL	7,957	19,725	99,346	5,346	132,374
TRANS-2-HEXENYL ACETATE	922	2,286	11,515	620	15,343

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Appendix A. Estimated Annual Emissions of all Substances from Biogenic and Geogenic Sources

Substance	Emissions (kg/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
VANADIUM & COMPOUNDS	39	724	148	1.41	912
ZINC & COMPOUNDS	129	6,922	1,360	121	8,531