

Technical Report No. 2

**Air Emissions Inventory
for the Greater Metropolitan Region in
New South Wales**

2008 Calendar Year

**Biogenic and Geogenic Emissions:
Results**



ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

An air emissions inventory project for biogenic and geogenic sources has taken over 2 years to complete. The base year of the biogenic and geogenic inventory represents activities that took place during the 2008 calendar year. The area included in the inventory covers the greater Sydney, Newcastle and Wollongong regions, known collectively as the Greater Metropolitan Region (GMR).

The inventory region defined as the GMR measures 210 km (east–west) by 273 km (north–south). The inventory region is defined in Table ES-1 and shown in Figure ES-1.

Table ES-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

Region	South-west corner MGA ¹ coordinates		North-east corner MGA coordinates	
	Easting (km)	Northing (km)	Easting (km)	Northing (km)
Greater Metropolitan	210	6159	420	6432
Sydney	261	6201	360	6300
Newcastle	360	6348	408	6372
Wollongong	279	6174	318	6201

The biogenic and geogenic air emissions inventory includes emissions from the following sources/activities:

- Agricultural burning;
- Bushfires;
- Prescribed burning;
- Fugitive/windborne from agricultural lands and unpaved roads;
- Microbial activity and chemical processes of nitrification and denitrification in soil;
- Fertiliser application to agricultural lands;
- Tree canopy and grass (i.e. cut and uncut); and
- Marine aerosol.

The pollutants inventoried include criteria pollutants specified in the Ambient Air Quality NEPM (NEPC, 2003), air toxics associated with the National Pollutant Inventory NEPM (NEPC, 2008) and the Air Toxics NEPM (NEPC, 2004), and any other pollutants associated with state-specific programs, i.e. Load Based Licensing (Protection of the Environment Operations (General) Regulation 2009 (PCO, 2010)) and the Protection of the Environment Operations (Clean Air) Regulation 2010 (PCO, 2011).

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Figure ES-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

Table ES-2 presents total estimated annual emissions (for selected substances) from all biogenic and geogenic sources in the whole GMR and the Sydney, Newcastle and Wollongong regions. Total estimated annual emissions are also presented for the region defined as Non Urban. This region is the area of the GMR minus the combined areas of the Sydney, Newcastle and Wollongong regions. The selected substances were chosen because they:

- Are the most common air pollutants found in airsheds according to the National Pollutant Inventory NEPM (NEPC, 2008);
- Are referred to in National Environment Protection Measures (NEPMs) for Ambient Air Quality (NEPC, 2003) and Air Toxics (NEPC, 2004); and
- Have been classified as priority air pollutants (NEPC, 2006).

Table ES-2: Total estimated annual emissions from biogenic and geogenic sources in each region

Substance	Emissions (tonne/year)				
	Newcastle	Non Urban	Sydney	Wollongong	GMR
1,3-BUTADIENE	0.24	23	4.39	0.48	28
ACETALDEHYDE	16	865	201	14	1,095
CARBON MONOXIDE	301	28,545	5,484	603	34,934
LEAD & COMPOUNDS	0.10	2.16	0.46	8.89×10^{-3}	2.73
OXIDES OF NITROGEN	126	8,319	1,296	71	9,811
PARTICULATE MATTER $\leq 10 \mu\text{m}$	689	28,719	3,901	327	33,635
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	121	6,176	951	90	7,338
POLYCYCLIC AROMATIC HYDROCARBONS	8.44×10^{-2}	7.41	1.37	0.14	9.00
SULFUR DIOXIDE	2.72	259	50	5.49	317
TOTAL SUSPENDED PARTICULATE	2,422	99,401	12,940	1,096	115,859
TOTAL VOLATILE ORGANIC COMPOUNDS	3,404	130,284	32,468	3,482	169,637

Figure ES-2 shows the proportions of total estimated annual emissions (for selected substances) from biogenic and geogenic sources in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.



Figure ES-2: Proportions of total estimated annual emissions from biogenic and geogenic sources in each region

Table ES-3, Table ES-4, Table ES-5, Table ES-6 and Table ES-7 present total estimated annual emissions (for selected substances) from each biogenic and geogenic source type in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.

Figure ES-3, Figure ES-4, Figure ES-5, Figure ES-6 and Figure ES-7 show the proportions of total estimated annual emissions (for selected substances) from each biogenic and geogenic source type in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.

Table ES-3: Total estimated annual emissions by biogenic and geogenic source type in the GMR

Substance	Emissions (tonne/year)										
	Agricultural burning	Bushfires	Prescribed burning	Agricultural lands (fugitive/windborne)	Unpaved roads (fugitive/windborne)	Soil nitrification and denitrification	Tree canopy	Uncut grass	Cut grass	Marine aerosol	Biogenic and Geogenic Total
1,3-BUTADIENE	0.28	5.87	22	-	-	-	-	-	-	-	28
ACETALDEHYDE	-	-	-	-	-	-	-	1,009	86	-	1,095
CARBON MONOXIDE	325	7,338	27,271	-	-	-	-	-	-	-	34,934
LEAD & COMPOUNDS	5.11×10^{-4}	7.37×10^{-2}	0.27	1.55×10^{-2}	2.36	-	-	-	-	-	2.73
OXIDES OF NITROGEN	12	217	806	-	-	8,778	-	-	-	-	9,811
PARTICULATE MATTER $\leq 10 \mu\text{m}$	42	739	2,747	114	1,559	-	-	-	-	28,435	33,635
PARTICULATE MATTER $\leq 2.5\mu\text{m}$	40	627	2,331	20	206	-	-	-	-	4,114	7,338
POLYCYCLIC AROMATIC HYDROCARBONS	0.73	1.75	6.52	-	-	-	-	-	-	-	9.00
SULFUR DIOXIDE	1.79	67	248	-	-	-	-	-	-	-	317
TOTAL SUSPENDED PARTICULATE	43	752	2,796	250	2,624	-	-	-	-	109,395	115,859
TOTAL VOLATILE ORGANIC COMPOUNDS	24	514	1,909	-	-	-	160,150	5,007	2,033	-	169,637

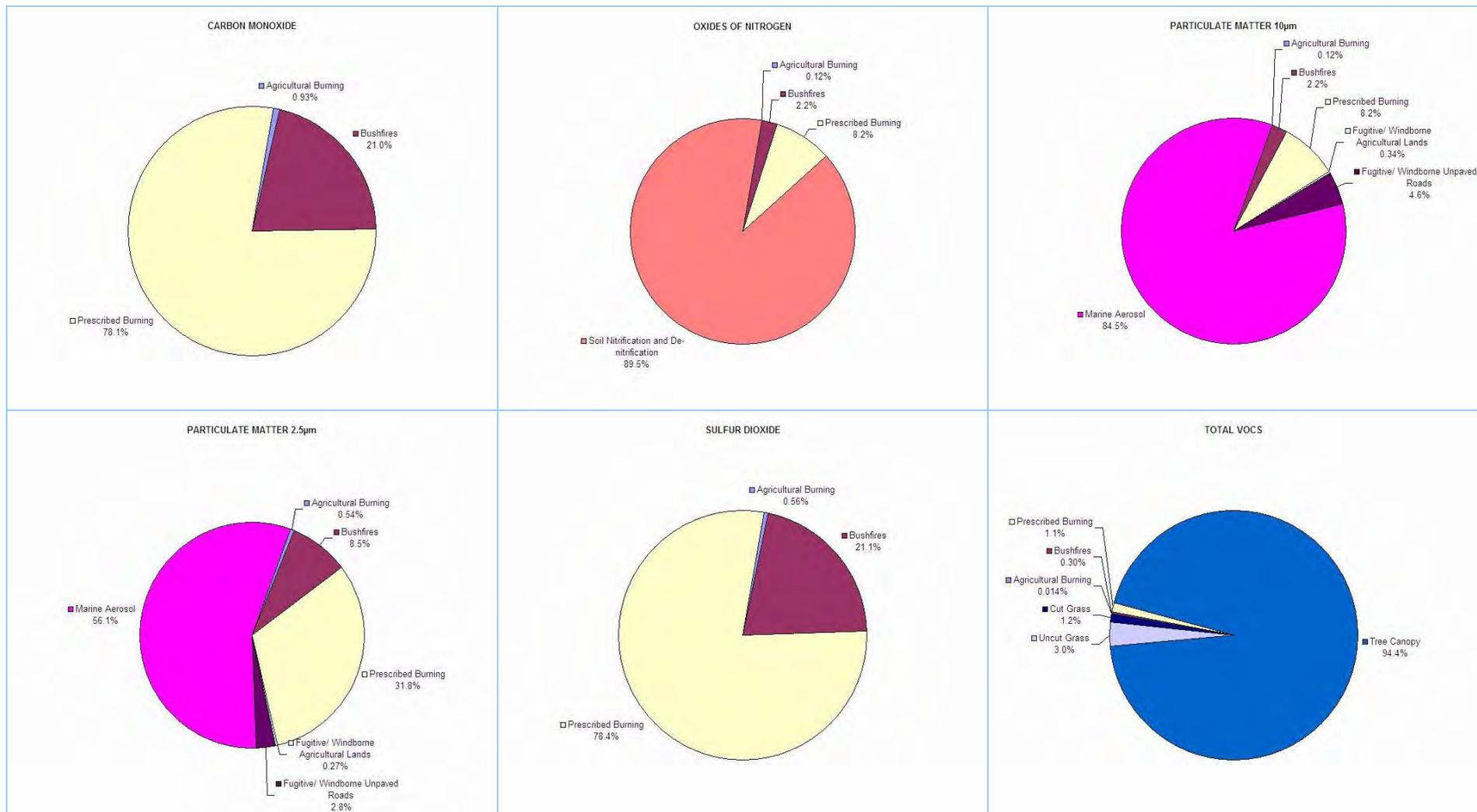


Figure ES-3: Proportions of total estimated annual emissions by biogenic and geogenic source type in the GMR

Table ES-4: Total estimated annual emissions by biogenic and geogenic source type in the Sydney region

Substance	Emissions (tonne/year)										
	Agricultural burning	Bushfires	Prescribed burning	Agricultural lands (fugitive/windborne)	Unpaved roads (fugitive/windborne)	Soil nitrification and denitrification	Tree canopy	Uncut grass	Cut grass	Marine aerosol	Biogenic and Geogenic Total
1,3-BUTADIENE	2.40 × 10 ⁻²	0.64	3.72	-	-	-	-	-	-	-	4.39
ACETALDEHYDE	-	-	-	-	-	-	-	136	64	-	201
CARBON MONOXIDE	28	806	4,650	-	-	-	-	-	-	-	5,484
LEAD & COMPOUNDS	4.43 × 10 ⁻⁵	8.10 × 10 ⁻³	4.67 × 10 ⁻²	1.40 × 10 ⁻³	0.40	-	-	-	-	-	0.46
OXIDES OF NITROGEN	1.00	24	137	-	-	1,133	-	-	-	-	1,296
PARTICULATE MATTER ≤ 10 µm	3.63	81	468	10	263	-	-	-	-	3,074	3,901
PARTICULATE MATTER ≤ 2.5µm	3.46	69	397	1.77	35	-	-	-	-	445	951
POLYCYCLIC AROMATIC HYDROCARBONS	6.37 × 10 ⁻²	0.19	1.11	-	-	-	-	-	-	-	1.37
SULFUR DIOXIDE	0.16	7.34	42	-	-	-	-	-	-	-	50
TOTAL SUSPENDED PARTICULATE	3.69	83	477	23	443	-	-	-	-	11,912	12,940
TOTAL VOLATILE ORGANIC COMPOUNDS	2.10	56	326	-	-	-	29,881	677	1,526	-	32,468

Air Emissions Inventory for the Greater Metropolitan Region of New South Wales
Executive Summary

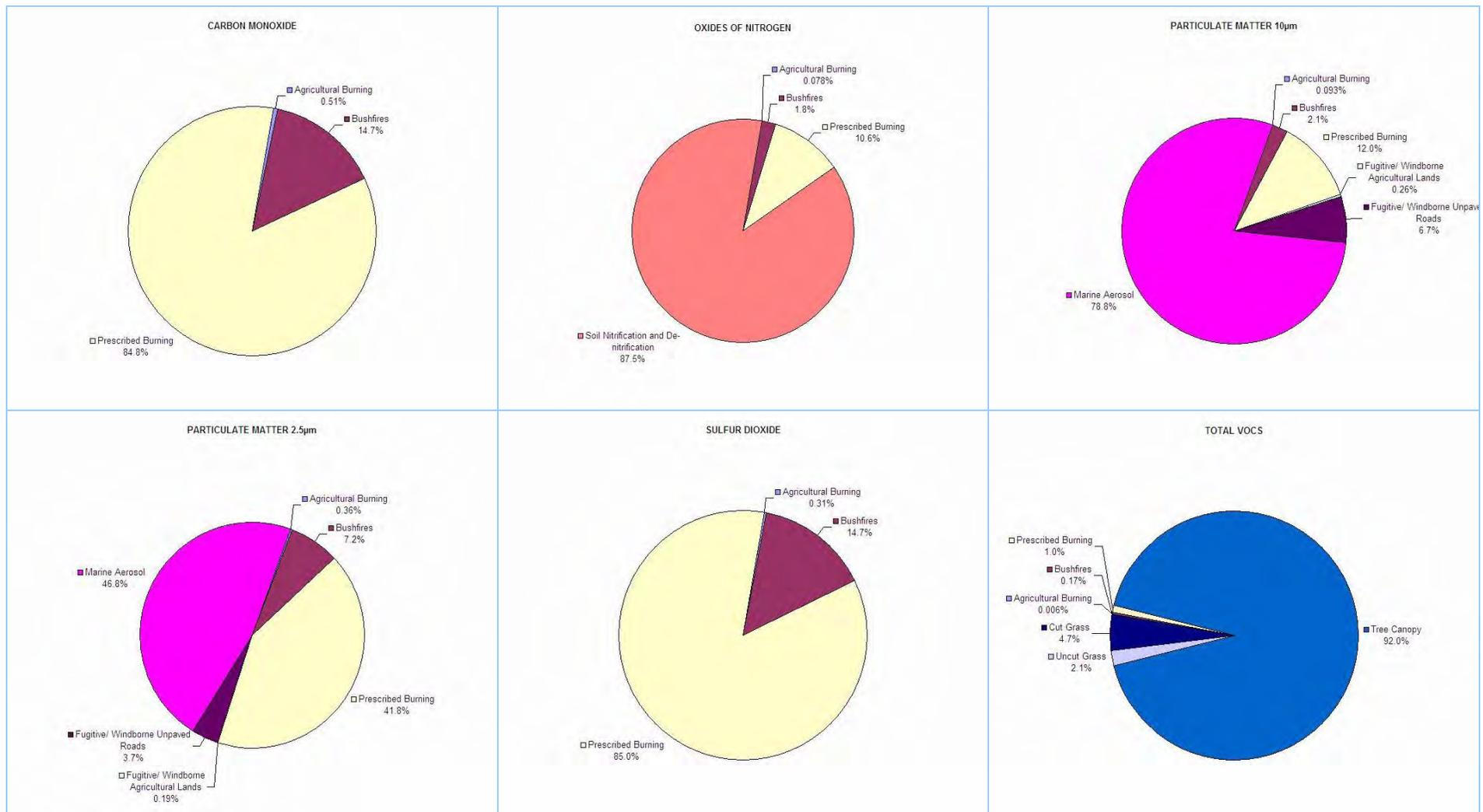


Figure ES-4: Proportions of total estimated annual emissions by biogenic and geogenic source type in the Sydney region

Table ES-5: Total estimated annual emissions by biogenic and geogenic source type in the Newcastle region

Substance	Emissions (tonne/year)										
	Agricultural burning	Bushfires	Prescribed burning	Agricultural lands (fugitive/windborne)	Unpaved roads (fugitive/windborne)	Soil nitrification and denitrification	Tree canopy	Uncut grass	Cut grass	Marine aerosol	Biogenic and Geogenic Total
1,3-BUTADIENE	5.21×10^{-3}	6.0×10^{-2}	0.18	-	-	-	-	-	-	-	0.24
ACETALDEHYDE	-	-	-	-	-	-	-	11	5.14	-	16
CARBON MONOXIDE	6.13	75	220	-	-	-	-	-	-	-	301
LEAD & COMPOUNDS	9.62×10^{-6}	7.54×10^{-4}	2.21×10^{-3}	1.17×10^{-3}	9.70×10^{-2}	-	-	-	-	-	0.10
OXIDES OF NITROGEN	0.22	2.22	6.50	-	-	117	-	-	-	-	126
PARTICULATE MATTER $\leq 10 \mu\text{m}$	0.79	7.56	22	8.54	64	-	-	-	-	586	689
PARTICULATE MATTER $\leq 2.5\mu\text{m}$	0.75	6.42	19	1.48	8.46	-	-	-	-	85	121
POLYCYCLIC AROMATIC HYDROCARBONS	1.38×10^{-2}	1.79×10^{-2}	5.26×10^{-2}	-	-	-	-	-	-	-	8.44×10^{-2}
SULFUR DIOXIDE	3.37×10^{-2}	0.68	2.00	-	-	-	-	-	-	-	2.72
TOTAL SUSPENDED PARTICULATE	0.80	7.70	23	19	108	-	-	-	-	2,264	2,422
TOTAL VOLATILE ORGANIC COMPOUNDS	0.46	5.26	15	-	-	-	3,207	53	122	-	3,404

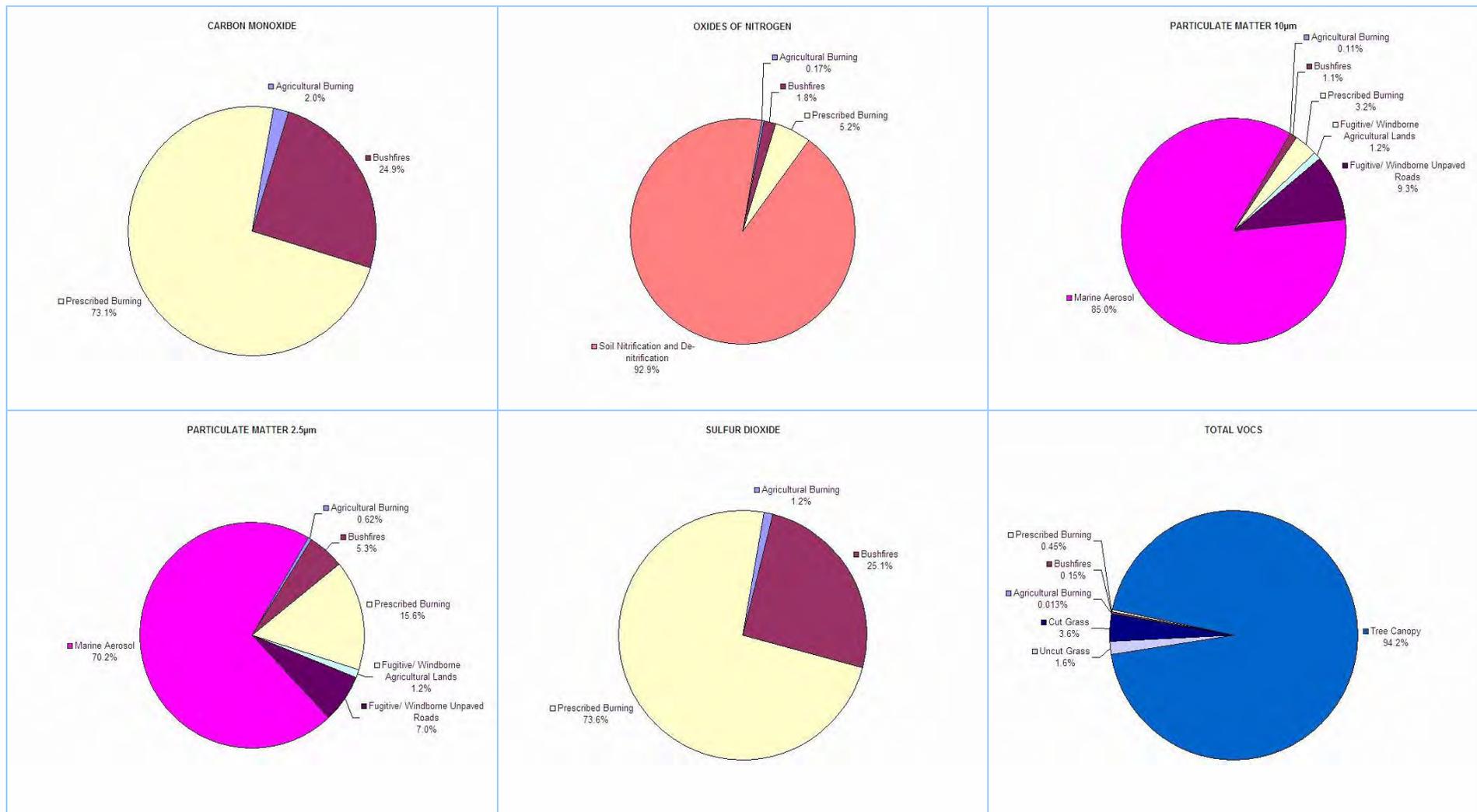


Figure ES-5: Proportions of total estimated annual emissions by biogenic and geogenic source type in the Newcastle region

Table ES-6: Total estimated annual emissions by biogenic and geogenic source type in the Wollongong region

Substance	Emissions (tonne/year)								
	Bushfires	Prescribed burning	Unpaved roads (fugitive/windborne)	Soil Nitrification and denitrification	Tree canopy	Uncut grass	Cut grass	Marine aerosol	Biogenic and Geogenic Total
1,3-BUTADIENE	5.22×10^{-3}	0.48	-	-	-	-	-	-	0.48
ACETALDEHYDE	-	-	-	-	-	10	3.46	-	14
CARBON MONOXIDE	6.53	597	-	-	-	-	-	-	603
LEAD & COMPOUNDS	6.56×10^{-5}	5.99×10^{-3}	2.83×10^{-3}	-	-	-	-	-	8.89×10^{-3}
OXIDES OF NITROGEN	0.19	18	-	53	-	-	-	-	71
PARTICULATE MATTER $\leq 10 \mu\text{m}$	0.66	60	1.86	-	-	-	-	264	327
PARTICULATE MATTER $\leq 2.5\mu\text{m}$	0.56	51	0.25	-	-	-	-	38	90
POLYCYCLIC AROMATIC HYDROCARBONS	1.56×10^{-3}	0.14	-	-	-	-	-	-	0.14
SULFUR DIOXIDE	5.94×10^{-2}	5.43	-	-	-	-	-	-	5.49
TOTAL SUSPENDED PARTICULATE	0.67	61	3.14	-	-	-	-	1,031	1,096
TOTAL VOLATILE ORGANIC COMPOUNDS	0.46	42	-	-	3,307	51	82	-	3,482

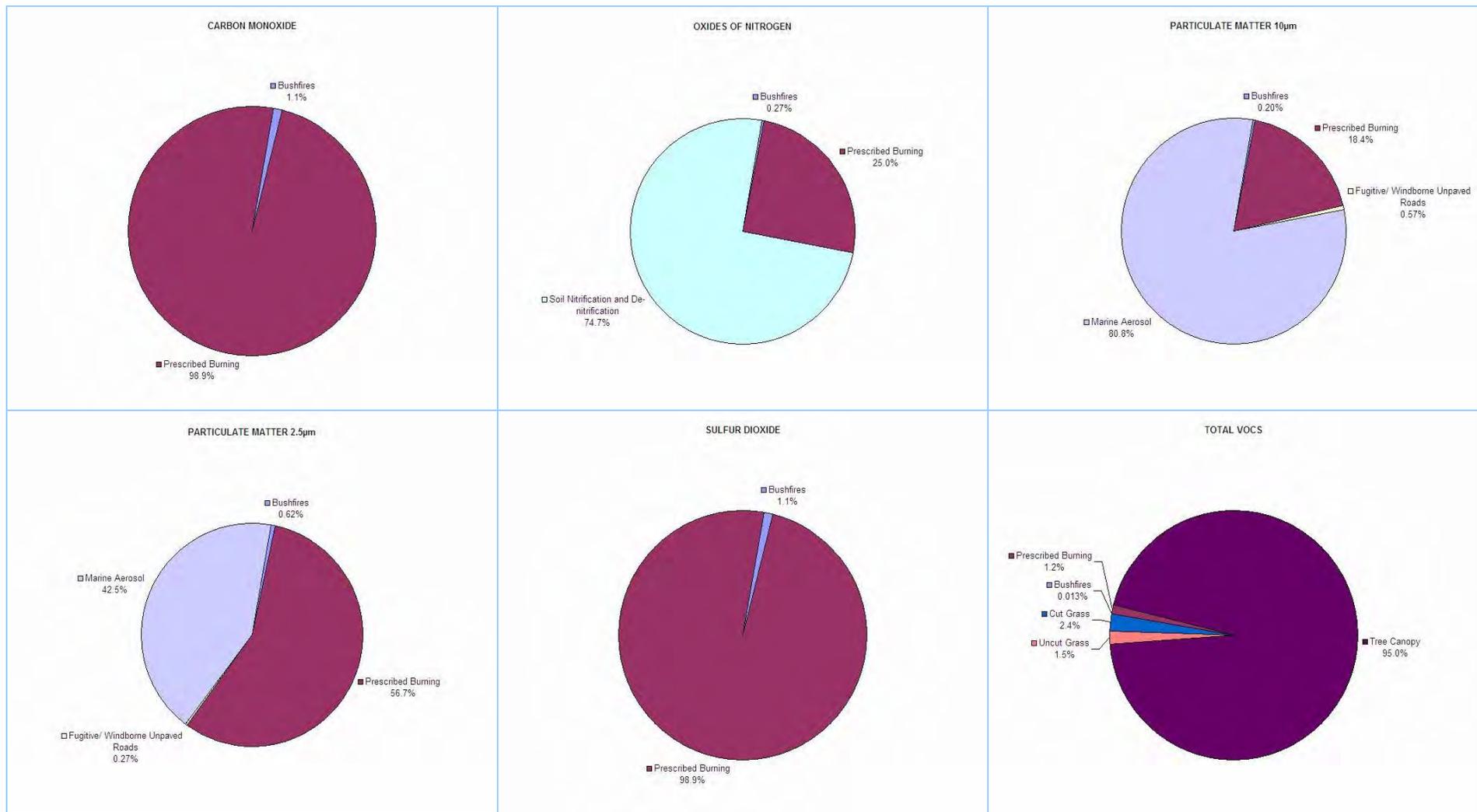


Figure ES-6: Proportions of total estimated annual emissions by biogenic and geogenic source type in the Wollongong region

Table ES-7: Total estimated annual emissions by biogenic and geogenic source type in the Non Urban region

Substance	Emissions (tonne/year)										
	Agricultural burning	Bushfires	Prescribed burning	Agricultural lands (fugitive/windborne)	Unpaved roads (fugitive/windborne)	Soil nitrification and denitrification	Tree canopy	Uncut grass	Cut grass	Marine aerosol	Biogenic and Geogenic Total
1,3-BUTADIENE	0.25	5.16	17	-	-	-	-	-	-	-	23
ACETALDEHYDE	-	-	-	-	-	-	-	852	13	-	865
CARBON MONOXIDE	291	6,451	21,803	-	-	-	-	-	-	-	28,545
LEAD & COMPOUNDS	4.57×10^{-4}	6.48×10^{-2}	0.22	1.29×10^{-2}	1.87	-	-	-	-	-	2.16
OXIDES OF NITROGEN	10	191	644	-	-	7,474	-	-	-	-	8,319
PARTICULATE MATTER $\leq 10 \mu\text{m}$	37	650	2,196	95	1,230	-	-	-	-	24,511	28,719
PARTICULATE MATTER $\leq 2.5\mu\text{m}$	36	551	1,864	16	163	-	-	-	-	3,546	6,176
POLYCYCLIC AROMATIC HYDROCARBONS	0.66	1.54	5.21	-	-	-	-	-	-	-	7.41
SULFUR DIOXIDE	1.60	59	198	-	-	-	-	-	-	-	259
TOTAL SUSPENDED PARTICULATE	38	661	2,235	209	2,070	-	-	-	-	94,188	99,401
TOTAL VOLATILE ORGANIC COMPOUNDS	22	452	1,526	-	-	-	123,756	4,226	303	-	130,284

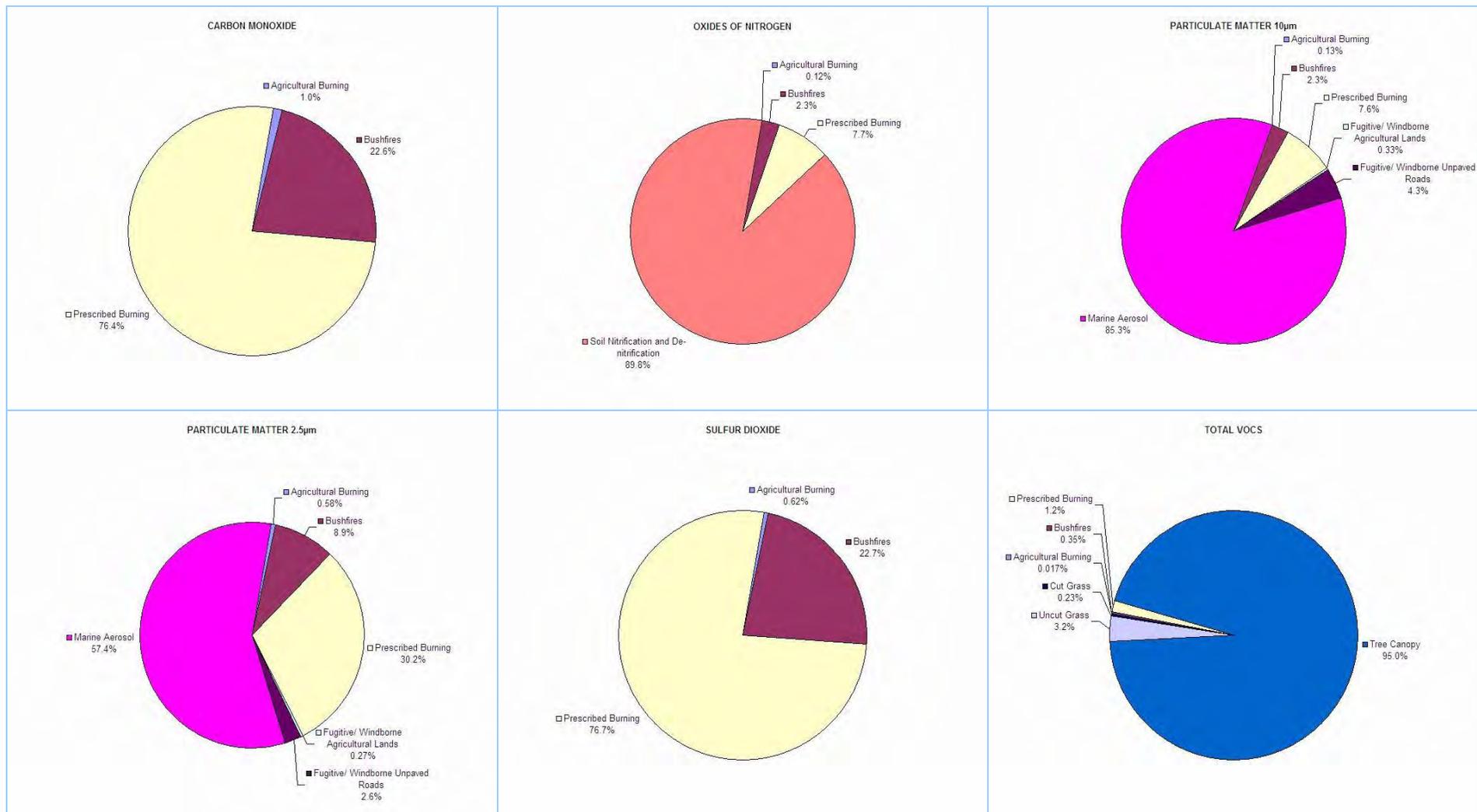


Figure ES-7: Proportions of total estimated annual emissions by biogenic and geogenic source type in the Non Urban region