

# Appendix E. Diagnostic Ratios

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**Table E-1. Diagnostic Ratios Identified in Literature Review**

Diagnostic Ratios	Ratio Value Range	Emission Source	Literature Review Reference
2-methylnaphthalene/phenanthrene	<1	Combustion	Tobiszewski and Namiesnik, 2012
	2.0-6.0	Fossil Fuel Combustion	
anthracene/anthracene + phenanthrene	<0.1	Petrogenic	Tobiszewski and Namiesnik, 2012; Sulej et al., 2011, Ray et al., 2008
	>0.1	Pyrogenic	
benzo(a)anthracene/(benzo(a)anthracene + chrysene)	<0.2	Petrogenic	Tobiszewski and Namiesnik, 2012
	0.2-0.35	Coal or Petroleum Combustion	
	0.3-0.6	Cement Production	
	>0.35	Combustion; Vehicular Emissions	Tobiszewski and Namiesnik, 2012; Zeng and Vista, 1997
benzo(a)anthracene/chrysene	0.9	Pyrogenic	Sulej et al., 2011
	<0.4	Petrogenic; Crude Oil	
	<1	Petrogenic	
	>1	Pyrogenic	
	0.47-0.59	Petroleum Combustion	
	1.05-1.17	Coal Combustion	
	>0.35	Combustion (Coal, Wood, Grass, etc.)	Zeng and Vista, 1997
benzo(a)pyrene/(benzo(a)pyrene + benzo(e)pyrene)	~0.5	Fresh Particles	Tobiszewski and Namiesnik, 2012
	<0.5	Aged Particles	
benzo(a)pyrene/benzo(g,h,i)perylene	<0.6	Non-traffic Emissions	Tobiszewski and Namiesnik, 2012
	>0.6	Vehicular Emissions	
benzo(b)fluoranthene/benzo(k)fluoranthene	2.5-2.9	Aluminum Smelter Emissions	Tobiszewski and Namiesnik, 2012
fluorene/(fluorene + pyrene)	<0.5	Petroleum Combustion	Tobiszewski and Namiesnik, 2012
	>0.5	Diesel Combustion	
fluoranthene/(fluoranthene + pyrene)	<0.4	Petrogenic	Tobiszewski and Namiesnik, 2012; Sulej et al., 2011
	<0.5	Petroleum Combustion	Sulej et al., 2011
	>0.5	Grass, Wood, Coal Combustion	Tobiszewski and Namiesnik, 2012
		Pyrogenic; Diesel Combustion	Sulej et al., 2011
	0.4-0.5	Cement Production, Metal Manufacturing, Fertilizer Production, Diesel Combustion, and Road Dusts	Tobiszewski and Namiesnik, 2012
		Petroleum Combustion	Ray et al., 2008
		Fossil Fuel Combustion	Tobiszewski and Namiesnik, 2012
Pyrogenic		Sulej et al., 2011	

**Table E-1. Diagnostic Ratios (Cont.)**

Diagnostic Ratios	Ratio Value Range	Emission Source	Literature Review Reference
fluoranthene/pyrene	0.9	Fuel Oil	Sulej et al., 2011
	<1	Petrogenic; Crude Oil	
	>1	Pyrogenic	
	>1	Pyrogenic (Automobile Traffic and Residential Heating)	Zeng and Vista, 1997
	1.5	Creosote	Sulej et al., 2011
indeno(1,2,3-c,d)pyrene/ (indeno(1,2,3-c,d)pyrene + benzo(g,h,i)perylene)	<0.2	Petrogenic	Tobiszewski and Namiesnik, 2012
	0.2-0.5	Petroleum Combustion	
	>0.5	Grass, Wood, Coal Combustion	
	0.09	Crude Oil	Sulej et al., 2011
	0.18	Petroleum Combustion	
	0.56	Coal Soot	
naphthalene/phenanthrene	0.48.-0.57	Coal Combustion	
	<1	Petrogenic	Sulej et al., 2011
>1	Pyrogenic		
phenanthrene/anthracene	4.13	Creosote	Sulej et al., 2011
	<10	Pyrogenic	
	>10	Petrogenic	
	>15	Crude Oil	
	>25	Petrogenic	
	50	Fuel Oil	
	>5	Petrogenic	Zeng and Vista, 1997
retene/chrysene	~1	Wood burning	Tobiszewski and Namiesnik, 2012
(sum of (Σ) fluoranthene + pyrene + benzo[a]anthracene + chrysene + benzo[k]fluoranthene + benzo[b]fluoranthene + benzo[a]pyrene + indeno[1,2,3-c,d]pyrene + benzo[g,h,i]perylene)/(ΣPAHs)	~1	Combustion	Tobiszewski and Namiesnik, 2012
Σlow molecular weight/Σhigh molecular weight	<1	Pyrogenic	Tobiszewski and Namiesnik, 2012
	>1	Petrogenic	
	>1	Diesel Combustion	

**Table E-2. Diagnostic Ratios Applied to Dry Weather PAH Transport Study-Dry Weather Data**

Site	Ratio	Potential Source Identified
<b>2-Methylnaphthalene/Phenanthrene</b>		
CNM_mean	0.81	Combustion
CNM_median	0.63	Combustion
FD07_mean	2.26	Fossil Fuel Combustion
FD07_median	2.42	Fossil Fuel Combustion
FD11_mean	2.34	Fossil Fuel Combustion
FD11_median	2.66	Fossil Fuel Combustion
FD12_mean	1.57	No source identified by ratio
FD12_median	1.29	No source identified by ratio
<b>Fluorene/(Fluorene + Pyrene)</b>		
CNM_mean	0.96	Diesel combustion
CNM_median	1	Diesel combustion
FD07_mean	0.95	Diesel combustion
FD07_median	1	Diesel combustion
FD11_mean	0.93	Diesel combustion
FD11_median	1	Diesel combustion
FD12_mean	0.92	Diesel combustion
FD12_median	1	Diesel combustion
<b>Fluoranthene/(Fluoranthene + Pyrene)</b>		
CNM_mean	0.44	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
CNM_median	denominator zero	N/A
FD07_mean	0.79	Grass, Wood, Coal combustion; Diesel combustion
FD07_median	denominator zero	N/A
FD11_mean	0.48	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
FD11_median	denominator zero	N/A
FD12_mean	0.62	Grass, Wood, Coal combustion; Diesel combustion
FD12_median	denominator zero	N/A
<b>Fluoranthene/Pyrene</b>		
CNM_mean	0.79	Petrogenic, Crude oil
CNM_median	denominator zero	N/A
FD07_mean	3.66	Pyrogenic
FD07_median	denominator zero	N/A
FD11_mean	0.93	Petrogenic, Crude oil
FD11_median	denominator zero	N/A
FD12_mean	1.62	Pyrogenic
FD12_median	denominator zero	N/A
<b>Indeno(1,2,3-c,d)pyrene/(Indeno(1,2,3-c,d)pyrene + Benzo(g,h,i)perylene)</b>		
CNM_mean	0.45	Petroleum combustion
CNM_median	denominator zero	N/A
FD07_mean	0.43	Petroleum combustion
FD07_median	denominator zero	N/A
FD11_mean	0.43	Petroleum combustion
FD11_median	denominator zero	N/A
FD12_mean	0.46	Petroleum combustion
FD12_median	denominator zero	N/A

**Table E-2. Diagnostic Ratios Applied to Dry Weather PAH Transport Study-Dry Weather Data  
 (Cont.)**

Site	Ratio	Potential Source Identified
<b>Naphthalene/Phenanthrene</b>		
CNM_mean	1.76	Pyrogenic
CNM_median	1.35	Pyrogenic
FD07_mean	3.76	Pyrogenic
FD07_median	3.83	Pyrogenic
FD11_mean	4.06	Pyrogenic
FD11_median	4.3	Pyrogenic
FD12_mean	2.72	Pyrogenic
FD12_median	2.24	Pyrogenic
<b><math>\Sigma</math> Low Molecular Weight Compounds / <math>\Sigma</math> High Molecular Weight Compounds</b>		
CNM_mean	62.36	Petrogenic
CNM_median	denominator zero	N/A
FD07_mean	42.77	Petrogenic
FD07_median	denominator zero	N/A
FD11_mean	63	Petrogenic
FD11_median	denominator zero	N/A
FD12_mean	32.92	Petrogenic
FD12_median	denominator zero	N/A
<b>Pyrene Index</b>		
CNM_mean	0.05	Petrogenic
CNM_median	0	Petrogenic
FD07_mean	0.1	Pyrogenic
FD07_median	0.07	Pyrogenic
FD11_mean	0.05	Pyrogenic
FD11_median	0	Petrogenic
FD12_mean	0.1	Pyrogenic
FD12_median	0.07	Pyrogenic

**Table E-3. Diagnostic Ratios Applied to Dry Weather PAH Transport Study-Wet Weather Data**

Site	Ratio	Potential Source Identified
<b>2-Methylnaphthalene/Phenanthrene</b>		
CNM_mean	0.73	Combustion
CNM_median	0.53	Combustion
FD07_mean	0.4	Combustion
FD07_median	0.37	Combustion
FD11_mean	0.67	Combustion
FD11_median	0.65	Combustion
FD12_mean	0.54	Combustion
FD12_median	0.61	Combustion
<b>Fluorene/(Fluorene + Pyrene)</b>		
CNM_mean	0.25	Petroleum combustion
CNM_median	0.3	Petroleum combustion
FD07_mean	0.21	Petroleum combustion
FD07_median	0.22	Petroleum combustion
FD11_mean	0.31	Petroleum combustion
FD11_median	0.33	Petroleum combustion
FD12_mean	0.49	Petroleum combustion
FD12_median	0.5	Diesel combustion
<b>Fluoranthene/(Fluoranthene + Pyrene)</b>		
CNM_mean	0.3	Petrogenic Petroleum combustion
CNM_median	0.35	Petrogenic Petroleum combustion
FD07_mean	0.48	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
FD07_median	0.49	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
FD11_mean	0.41	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
FD11_median	0.41	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
FD12_mean	0.45	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
FD12_median	0.46	Petroleum combustion Cement production, metal manufacturing, fertilizer production, diesel combustion, road dusts
<b>Fluoranthene/Pyrene</b>		
CNM_mean	0.43	Petrogenic, Crude oil
CNM_median	0.53	Petrogenic, Crude oil
FD07_mean	0.91	Petrogenic, Crude oil
FD07_median	0.97	Petrogenic, Crude oil
FD11_mean	0.7	Petrogenic, Crude oil
FD11_median	0.69	Petrogenic, Crude oil
FD12_mean	0.83	Petrogenic, Crude oil
FD12_median	0.86	Petrogenic, Crude oil

**Table E-3. Diagnostic Ratios Applied to Dry Weather PAH Transport Study-Wet Weather Data (Cont.)**

Site	Site	Site
<b>Indeno(1,2,3-c,d)pyrene/(Indeno(1,2,3-c,d)pyrene + Benzo(g,h,i)perylene)</b>		
CNM_mean	0	Petrogenic
CNM_median	denominator zero	N/A
FD07_mean	0.22	Petroleum combustion
FD07_median	0.17	Petrogenic
FD11_mean	0.23	Petroleum combustion
FD11_median	0	Petrogenic
FD12_mean	0.2	Petroleum combustion
FD12_median	0.1	Petrogenic
<b>Naphthalene/Phenanthrene</b>		
CNM_mean	1.51	Pyrogenic
CNM_median	0.62	Petrogenic
FD07_mean	0.9	Petrogenic
FD07_median	0.68	Petrogenic
FD11_mean	1.08	Pyrogenic
FD11_median	0.89	Petrogenic
FD12_mean	0.9	Petrogenic
FD12_median	1.04	Pyrogenic
<b>Σ Low Molecular Weight Compounds / Σ High Molecular Weight Compounds</b>		
CNM_mean	2.03	Petrogenic
CNM_median	1.94	Petrogenic
FD07_mean	0.88	Pyrogenic
FD07_median	0.81	Pyrogenic
FD11_mean	1.05	Petrogenic
FD11_median	1.19	Petrogenic
FD12_mean	1.7	Petrogenic
FD12_median	1.81	Petrogenic
<b>Pyrene Index</b>		
CNM_mean	0.56	Pyrogenic
CNM_median	0.61	Pyrogenic
FD07_mean	0.86	Pyrogenic
FD07_median	0.88	Pyrogenic
FD11_mean	0.85	Pyrogenic
FD11_median	0.78	Pyrogenic
FD12_mean	0.59	Pyrogenic
FD12_median	0.51	Pyrogenic