

Travel Management Subcommittee
November 27, 2007
Item – 3

TERMs SECTION
OF
CALL FOR PROJECTS
2008 CLRP & FY 2009-2014 TIP

DRAFT

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TERM EMISSIONS REDUCTION CALCULATIONS

This section of the solicitation document contains instructions for analyzing transportation emissions reduction measure (TERM) projects. In addition to estimating the ozone precursor (VOC and NOx) emissions reductions we will estimate fine particulate matter (PM 2.5) emissions reduction benefits. Section I provides information to estimate VOC and NOx, and Section II provides the necessary information to estimate PM 2.5 emissions.

Section I

Table 1 provides an overview of the three emissions components, namely Start-up (Cold Start), Running, and Hot Soak. The methodology that will be used to analyze TERMS for the 2008 CLRP and FY 2009 - 2014 TIP utilizes the latest travel demand results from the Version 2.1D travel demand model and emissions rate data from the Mobile 6.2 emissions model.

The introduction of the Mobile 6 emissions model offered the potential for a more disaggregate emissions reduction analysis of TERMS. Instead of the 8 different vehicle classes used in the Mobile 5b model, the Mobile 6 model utilizes 28 vehicle classes (the current model version is Mobile 6.2). Four categories of TERMS have been developed utilizing the disaggregate nature of the vehicle classes. The four categories are:

- TERMS impacting the traffic stream (all vehicle types), such as the Signal Optimization TERM, will continue to be analyzed using a regional composite vehicle emissions factor. Tables 2, 3, 4, 5, and 6 display emissions factors for analysis years 2008, 2009, 2010, 2020 and 2030. Weighted average of arterial and freeway emissions factors are shown in the tables; these factors are plotted in the exhibit 1 and 2.
- TERMS impacting commute trips, such as the Employer Outreach and Telework Resources Center TERM (item # 75 and # 90 on the TERM tracking sheet, page 1-2), will be analyzed using an average light duty vehicle emissions factor composed of emissions factors for several classes of light duty vehicles and for motorcycles. Tables 7, 8, 9, 10, and 11 display emissions factors for commuting vehicle trips for analysis years 2008, 2009, 2010, 2020 and 2030. Weighted average of arterial and freeway emissions factors are shown in the tables; these factors are plotted in the exhibit 3 and 4.
- TERMS impacting all types of heavy duty diesel vehicles, such as a Diesel Fuel Additive TERM, are considered as engine technology (heavy duty diesel vehicles) category.
- TERMS impacting an individual heavy duty vehicle type of a specific weight class, are categorized as a specific vehicle type, such as school buses, transit buses, tractor trailers. Emissions rates for specific weight classes can be generated as needed.

- TERMS impacting vehicle idling such as roundabouts in place of traffic signals can be analyzed using the individual vehicle type idling emissions factors or the traffic stream idling emissions factors for year 2010, 2020, and 2030 shown in Table 12.

Tables 2 through 11 show Cold Start, Running, Hot Soak emissions factors for VOC and NOx for the analysis years 2010, 2020 and 2030 to be used for analyzing “Traffic Stream” and “Commute” TERMS. Exhibits 1 through 4 show the plots of NOx and VOC running emissions factors for these years. Table 12 shows idling emissions factors for NOx and VOC for different vehicle types and PM factors for heavy duty vehicles for all three analysis year. Table 13 shows the 2005 regional average speeds generated by the post-processor which are used to compute hourly speeds for emissions calculations. Since there is little variation through time, the 2005 speeds may be used for any of the analysis years; use specific speeds for each application, where available. Table 14 provides the Mobile 6 vehicle classifications. Tables 15, 16, and 17 show summary travel demand data such as person trips, transit trips, average occupancy and VMT

The cost effectiveness calculation methodology is explained following the emissions factors tables and is a primary criterion used to select TERMS. The final section provides an example of a commuting vehicle TERM analysis using the emissions factors included in the tables.

For purpose of determining emissions reductions, the start-up, running, and hot soak portions of each trip must be considered. Table 1 shows the procedure to use in the analysis.

Table 1: Mobile Source Emissions Overview

$$\text{Emissions} = \text{Start up emissions} + \text{Running emissions} + \text{Soak emissions}$$

$$\text{Start-up emissions} = \text{Vehicle Trip Origin} \times \text{Start up emissions rate (Cold start in Grams/Trip)}$$

$$\text{Running emissions} = \text{VMT} \times \text{Running emissions rate (Grams/Mile)}$$

$$\text{Hot Soak emissions} = \text{Trip Destination} \times \text{Hot Soak emission rate (Grams/Trip)}$$

Emissions factors were obtained from the Mobile 6.2 model and are contained herein. NOx emissions do not occur in the hot soak portion of the trip, therefore only VOC factors are shown for this category.

It may be noted that the running emissions factors and cold start/hot soak emissions factors shown in the attached tables were generated using the Mobile 6.2 emissions model with the latest VMT and vehicle registration data as input to the model. These are the factors that were used in the conformity analysis of the 2006 CLRP and FY 2007-2012 TIP. Running emissions factors for speed ranges 1 to 65 mph are shown in the emissions factor tables. If the actual speed for a TERM is known use the appropriate emissions factors, otherwise use emissions factors for average travel speed.

Table 2: 2008 Running, Cold Start, and Hot Soak Average Emissions Factors for "Traffic Stream" TERMs (Mobile6.2)

Emission Type	Speed (mph)	Average 2008 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway- 40%			Arterial - 60%, Freeway- 40%
Running (g/mi)	1	3.4615	3.4615	3.4615	1.7672	1.8363	1.7948
Running (g/mi)	2	3.4615	3.4615	3.4615	1.7672	1.8363	1.7948
Running (g/mi)	3	2.7086	2.7086	2.7086	1.6943	1.7634	1.7219
Running (g/mi)	4	1.7673	1.7673	1.7673	1.6032	1.6723	1.6308
Running (g/mi)	5	1.2022	1.2022	1.2022	1.5486	1.6178	1.5763
Running (g/mi)	6	0.9955	0.9860	0.9917	1.4505	1.4847	1.4642
Running (g/mi)	7	0.8476	0.8313	0.8411	1.3806	1.3896	1.3842
Running (g/mi)	8	0.7367	0.7153	0.7281	1.3281	1.3184	1.3242
Running (g/mi)	9	0.6505	0.6254	0.6405	1.2875	1.2630	1.2777
Running (g/mi)	10	0.5815	0.5532	0.5702	1.2548	1.2186	1.2403
Running (g/mi)	11	0.5356	0.5057	0.5236	1.2037	1.1608	1.1865
Running (g/mi)	12	0.4974	0.4659	0.4848	1.1611	1.1127	1.1417
Running (g/mi)	13	0.4651	0.4324	0.4520	1.1251	1.0719	1.1038
Running (g/mi)	14	0.4372	0.4040	0.4239	1.0943	1.0372	1.0715
Running (g/mi)	15	0.4133	0.3789	0.3995	1.0674	1.0069	1.0432
Running (g/mi)	16	0.3897	0.3597	0.3777	1.0407	0.9956	1.0226
Running (g/mi)	17	0.3687	0.3429	0.3584	1.0172	0.9855	1.0045
Running (g/mi)	18	0.3502	0.3280	0.3413	0.9960	0.9764	0.9882
Running (g/mi)	19	0.3338	0.3146	0.3261	0.9775	0.9684	0.9739
Running (g/mi)	20	0.3187	0.3024	0.3122	0.9605	0.9613	0.9608
Running (g/mi)	21	0.3063	0.2928	0.3009	0.9450	0.9544	0.9488
Running (g/mi)	22	0.2950	0.2838	0.2905	0.9308	0.9482	0.9377
Running (g/mi)	23	0.2852	0.2756	0.2813	0.9178	0.9422	0.9276
Running (g/mi)	24	0.2757	0.2684	0.2728	0.9060	0.9368	0.9183
Running (g/mi)	25	0.2672	0.2616	0.2650	0.8951	0.9319	0.9098
Running (g/mi)	26	0.2596	0.2548	0.2577	0.8861	0.9284	0.9030
Running (g/mi)	27	0.2525	0.2488	0.2510	0.8778	0.9253	0.8968
Running (g/mi)	28	0.2457	0.2431	0.2447	0.8702	0.9221	0.8909
Running (g/mi)	29	0.2397	0.2376	0.2389	0.8630	0.9193	0.8855
Running (g/mi)	30	0.2341	0.2329	0.2336	0.8563	0.9168	0.8805
Running (g/mi)	31	0.2286	0.2276	0.2282	0.8531	0.9157	0.8781
Running (g/mi)	32	0.2233	0.2225	0.2230	0.8503	0.9146	0.8760
Running (g/mi)	33	0.2185	0.2180	0.2183	0.8476	0.9137	0.8740
Running (g/mi)	34	0.2140	0.2134	0.2138	0.8451	0.9127	0.8721
Running (g/mi)	35	0.2096	0.2096	0.2096	0.8428	0.9121	0.8705
Running (g/mi)	36	0.2062	0.2062	0.2062	0.8468	0.9162	0.8745
Running (g/mi)	37	0.2030	0.2030	0.2030	0.8507	0.9198	0.8783
Running (g/mi)	38	0.2000	0.2000	0.2000	0.8543	0.9236	0.8820
Running (g/mi)	39	0.1972	0.1972	0.1972	0.8579	0.9271	0.8856
Running (g/mi)	40	0.1944	0.1944	0.1944	0.8612	0.9306	0.8889
Running (g/mi)	41	0.1919	0.1919	0.1919	0.8690	0.9381	0.8966
Running (g/mi)	42	0.1891	0.1891	0.1891	0.8764	0.9457	0.9041
Running (g/mi)	43	0.1870	0.1870	0.1870	0.8836	0.9527	0.9112
Running (g/mi)	44	0.1846	0.1846	0.1846	0.8904	0.9595	0.9181
Running (g/mi)	45	0.1822	0.1822	0.1822	0.8968	0.9660	0.9245
Running (g/mi)	46	0.1801	0.1801	0.1801	0.9084	0.9776	0.9361
Running (g/mi)	47	0.1777	0.1777	0.1777	0.9195	0.9887	0.9472
Running (g/mi)	48	0.1757	0.1757	0.1757	0.9301	0.9994	0.9578
Running (g/mi)	49	0.1739	0.1739	0.1739	0.9403	1.0094	0.9679
Running (g/mi)	50	0.1721	0.1721	0.1721	0.9502	1.0193	0.9778
Running (g/mi)	51	0.1701	0.1701	0.1701	0.9664	1.0357	0.9941
Running (g/mi)	52	0.1683	0.1683	0.1683	0.9821	1.0513	1.0097
Running (g/mi)	53	0.1666	0.1666	0.1666	0.9973	1.0666	1.0250
Running (g/mi)	54	0.1649	0.1649	0.1649	1.0119	1.0810	1.0396
Running (g/mi)	55	0.1633	0.1633	0.1633	1.0258	1.0953	1.0536
Running (g/mi)	56	0.1625	0.1625	0.1625	1.0486	1.1180	1.0763
Running (g/mi)	57	0.1616	0.1616	0.1616	1.0706	1.1400	1.0983
Running (g/mi)	58	0.1606	0.1606	0.1606	1.0918	1.1609	1.1195
Running (g/mi)	59	0.1599	0.1599	0.1599	1.1123	1.1814	1.1399
Running (g/mi)	60	0.1590	0.1590	0.1590	1.1321	1.2014	1.1598
Running (g/mi)	61	0.1584	0.1584	0.1584	1.1638	1.2331	1.1915
Running (g/mi)	62	0.1580	0.1580	0.1580	1.1948	1.2638	1.2224
Running (g/mi)	63	0.1574	0.1574	0.1574	1.2245	1.2938	1.2522
Running (g/mi)	64	0.1569	0.1569	0.1569	1.2534	1.3225	1.2811
Running (g/mi)	65	0.1565	0.1565	0.1565	1.2815	1.3505	1.3091

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	1.1235	0.6291
Hot Soak Loss (g/trip end)	0.6196	-
Hot Start (g/trip start, Light Duty Only)	0.1932	0.1386

Table 3: 2009 Running, Cold Start, and Hot Soak Average Emissions Factors for "Traffic Stream" TERMs (Mobile6.2)

Emission Type	Speed (mph)	Average 2009 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway- 40%	NOx		Arterial - 60%, Freeway- 40%
Running (g/mi)	1	3.1310	3.1310	3.1310	1.5925	1.6508	1.6158
Running (g/mi)	2	3.1310	3.1310	3.1310	1.5925	1.6508	1.6158
Running (g/mi)	3	2.4518	2.4518	2.4518	1.5269	1.5852	1.5502
Running (g/mi)	4	1.6029	1.6028	1.6028	1.4450	1.5033	1.4683
Running (g/mi)	5	1.0934	1.0934	1.0934	1.3959	1.4539	1.4191
Running (g/mi)	6	0.9059	0.8971	0.9024	1.3074	1.3343	1.3182
Running (g/mi)	7	0.7722	0.7571	0.7662	1.2443	1.2488	1.2461
Running (g/mi)	8	0.6718	0.6520	0.6639	1.1971	1.1847	1.1921
Running (g/mi)	9	0.5937	0.5699	0.5842	1.1603	1.1348	1.1501
Running (g/mi)	10	0.5313	0.5049	0.5207	1.1309	1.0947	1.1164
Running (g/mi)	11	0.4894	0.4616	0.4783	1.0848	1.0427	1.0680
Running (g/mi)	12	0.4546	0.4253	0.4429	1.0464	0.9993	1.0276
Running (g/mi)	13	0.4253	0.3947	0.4131	1.0138	0.9626	0.9933
Running (g/mi)	14	0.4000	0.3686	0.3874	0.9862	0.9312	0.9642
Running (g/mi)	15	0.3781	0.3460	0.3652	0.9618	0.9038	0.9386
Running (g/mi)	16	0.3564	0.3285	0.3452	0.9378	0.8933	0.9200
Running (g/mi)	17	0.3374	0.3131	0.3277	0.9163	0.8843	0.9035
Running (g/mi)	18	0.3206	0.2996	0.3122	0.8974	0.8761	0.8889
Running (g/mi)	19	0.3055	0.2875	0.2983	0.8805	0.8688	0.8758
Running (g/mi)	20	0.2919	0.2765	0.2857	0.8651	0.8622	0.8639
Running (g/mi)	21	0.2806	0.2675	0.2754	0.8512	0.8559	0.8531
Running (g/mi)	22	0.2706	0.2596	0.2662	0.8382	0.8500	0.8429
Running (g/mi)	23	0.2612	0.2524	0.2576	0.8267	0.8446	0.8338
Running (g/mi)	24	0.2527	0.2455	0.2498	0.8159	0.8396	0.8254
Running (g/mi)	25	0.2449	0.2394	0.2427	0.8059	0.8353	0.8177
Running (g/mi)	26	0.2380	0.2336	0.2362	0.7980	0.8320	0.8116
Running (g/mi)	27	0.2314	0.2279	0.2300	0.7906	0.8291	0.8060
Running (g/mi)	28	0.2254	0.2229	0.2244	0.7835	0.8263	0.8006
Running (g/mi)	29	0.2199	0.2178	0.2190	0.7771	0.8238	0.7958
Running (g/mi)	30	0.2146	0.2136	0.2142	0.7710	0.8213	0.7911
Running (g/mi)	31	0.2098	0.2088	0.2094	0.7683	0.8203	0.7891
Running (g/mi)	32	0.2048	0.2043	0.2046	0.7655	0.8194	0.7871
Running (g/mi)	33	0.2004	0.2000	0.2002	0.7632	0.8185	0.7853
Running (g/mi)	34	0.1964	0.1961	0.1963	0.7610	0.8178	0.7837
Running (g/mi)	35	0.1923	0.1923	0.1923	0.7587	0.8170	0.7820
Running (g/mi)	36	0.1894	0.1894	0.1894	0.7624	0.8207	0.7857
Running (g/mi)	37	0.1867	0.1867	0.1867	0.7661	0.8245	0.7894
Running (g/mi)	38	0.1837	0.1837	0.1837	0.7693	0.8277	0.7926
Running (g/mi)	39	0.1813	0.1813	0.1813	0.7724	0.8308	0.7958
Running (g/mi)	40	0.1789	0.1789	0.1789	0.7755	0.8338	0.7988
Running (g/mi)	41	0.1763	0.1763	0.1763	0.7827	0.8409	0.8060
Running (g/mi)	42	0.1741	0.1741	0.1741	0.7893	0.8477	0.8126
Running (g/mi)	43	0.1720	0.1720	0.1720	0.7958	0.8541	0.8191
Running (g/mi)	44	0.1699	0.1699	0.1699	0.8021	0.8602	0.8253
Running (g/mi)	45	0.1678	0.1678	0.1678	0.8079	0.8663	0.8313
Running (g/mi)	46	0.1661	0.1661	0.1661	0.8183	0.8766	0.8416
Running (g/mi)	47	0.1637	0.1637	0.1637	0.8286	0.8868	0.8519
Running (g/mi)	48	0.1622	0.1622	0.1622	0.8383	0.8965	0.8616
Running (g/mi)	49	0.1606	0.1606	0.1606	0.8474	0.9057	0.8707
Running (g/mi)	50	0.1586	0.1586	0.1586	0.8564	0.9147	0.8797
Running (g/mi)	51	0.1570	0.1570	0.1570	0.8716	0.9298	0.8949
Running (g/mi)	52	0.1555	0.1555	0.1555	0.8858	0.9439	0.9090
Running (g/mi)	53	0.1540	0.1540	0.1540	0.8996	0.9579	0.9229
Running (g/mi)	54	0.1525	0.1525	0.1525	0.9129	0.9710	0.9362
Running (g/mi)	55	0.1513	0.1513	0.1513	0.9258	0.9838	0.9490
Running (g/mi)	56	0.1503	0.1503	0.1503	0.9463	1.0047	0.9697
Running (g/mi)	57	0.1493	0.1493	0.1493	0.9664	1.0248	0.9898
Running (g/mi)	58	0.1492	0.1492	0.1492	0.9858	1.0441	1.0091
Running (g/mi)	59	0.1482	0.1482	0.1482	1.0045	1.0628	1.0278
Running (g/mi)	60	0.1474	0.1474	0.1474	1.0225	1.0808	1.0458
Running (g/mi)	61	0.1471	0.1471	0.1471	1.0515	1.1099	1.0749
Running (g/mi)	62	0.1467	0.1467	0.1467	1.0798	1.1380	1.1031
Running (g/mi)	63	0.1464	0.1464	0.1464	1.1069	1.1653	1.1303
Running (g/mi)	64	0.1460	0.1460	0.1460	1.1333	1.1916	1.1566
Running (g/mi)	65	0.1452	0.1452	0.1452	1.1589	1.2172	1.1822

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	1.0373	0.5761
Hot Soak Loss (g/trip end)	0.5929	-
Hot Start (g/trip start, Light Duty Only)	0.1789	0.1267

Table 4: 2010 Running, Cold Start, and Hot Soak Average Emissions Factors for "Traffic Stream" TERMs (Mobile6.2)

Emission Type	Speed (mph)	Average 2010 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway - 40%	NOx		Arterial - 60%, Freeway - 40%
Running (g/mi)	1	2.8327	2.8327	2.8327	1.3837	1.4276	1.4012
Running (g/mi)	2	2.8327	2.8327	2.8327	1.3837	1.4276	1.4012
Running (g/mi)	3	2.2207	2.2207	2.2207	1.3262	1.3701	1.3437
Running (g/mi)	4	1.4556	1.4556	1.4556	1.2543	1.2984	1.2720
Running (g/mi)	5	0.9963	0.9963	0.9963	1.2113	1.2553	1.2289
Running (g/mi)	6	0.8264	0.8183	0.8232	1.1340	1.1498	1.1403
Running (g/mi)	7	0.7050	0.6912	0.6995	1.0788	1.0748	1.0772
Running (g/mi)	8	0.6139	0.5955	0.6066	1.0372	1.0183	1.0296
Running (g/mi)	9	0.5434	0.5216	0.5347	1.0049	0.9743	0.9927
Running (g/mi)	10	0.4867	0.4622	0.4769	0.9791	0.9392	0.9631
Running (g/mi)	11	0.4485	0.4224	0.4381	0.9386	0.8934	0.9205
Running (g/mi)	12	0.4167	0.3897	0.4059	0.9051	0.8555	0.8852
Running (g/mi)	13	0.3897	0.3616	0.3784	0.8766	0.8232	0.8552
Running (g/mi)	14	0.3669	0.3379	0.3553	0.8523	0.7956	0.8296
Running (g/mi)	15	0.3468	0.3171	0.3349	0.8311	0.7716	0.8073
Running (g/mi)	16	0.3271	0.3012	0.3167	0.8098	0.7627	0.7910
Running (g/mi)	17	0.3095	0.2870	0.3005	0.7911	0.7548	0.7765
Running (g/mi)	18	0.2940	0.2746	0.2862	0.7746	0.7477	0.7638
Running (g/mi)	19	0.2802	0.2633	0.2734	0.7598	0.7416	0.7525
Running (g/mi)	20	0.2677	0.2530	0.2618	0.7465	0.7359	0.7423
Running (g/mi)	21	0.2573	0.2453	0.2525	0.7340	0.7304	0.7326
Running (g/mi)	22	0.2482	0.2379	0.2441	0.7229	0.7253	0.7239
Running (g/mi)	23	0.2398	0.2314	0.2364	0.7126	0.7207	0.7158
Running (g/mi)	24	0.2320	0.2251	0.2292	0.7033	0.7168	0.7087
Running (g/mi)	25	0.2246	0.2194	0.2225	0.6948	0.7129	0.7020
Running (g/mi)	26	0.2184	0.2140	0.2166	0.6878	0.7101	0.6967
Running (g/mi)	27	0.2126	0.2089	0.2111	0.6810	0.7075	0.6916
Running (g/mi)	28	0.2069	0.2041	0.2058	0.6749	0.7052	0.6870
Running (g/mi)	29	0.2017	0.1997	0.2009	0.6692	0.7029	0.6827
Running (g/mi)	30	0.1970	0.1958	0.1965	0.6640	0.7010	0.6788
Running (g/mi)	31	0.1923	0.1913	0.1919	0.6615	0.7000	0.6769
Running (g/mi)	32	0.1880	0.1875	0.1878	0.6594	0.6994	0.6754
Running (g/mi)	33	0.1840	0.1836	0.1839	0.6571	0.6985	0.6736
Running (g/mi)	34	0.1802	0.1799	0.1801	0.6550	0.6977	0.6721
Running (g/mi)	35	0.1764	0.1764	0.1764	0.6531	0.6971	0.6707
Running (g/mi)	36	0.1740	0.1740	0.1740	0.6564	0.7004	0.6740
Running (g/mi)	37	0.1713	0.1713	0.1713	0.6594	0.7035	0.6771
Running (g/mi)	38	0.1689	0.1689	0.1689	0.6623	0.7061	0.6798
Running (g/mi)	39	0.1667	0.1667	0.1667	0.6651	0.7092	0.6827
Running (g/mi)	40	0.1644	0.1644	0.1644	0.6678	0.7117	0.6853
Running (g/mi)	41	0.1622	0.1622	0.1622	0.6742	0.7178	0.6916
Running (g/mi)	42	0.1602	0.1602	0.1602	0.6798	0.7238	0.6974
Running (g/mi)	43	0.1583	0.1583	0.1583	0.6855	0.7294	0.7031
Running (g/mi)	44	0.1562	0.1562	0.1562	0.6909	0.7348	0.7085
Running (g/mi)	45	0.1546	0.1546	0.1546	0.6958	0.7401	0.7135
Running (g/mi)	46	0.1529	0.1529	0.1529	0.7050	0.7490	0.7226
Running (g/mi)	47	0.1511	0.1511	0.1511	0.7138	0.7578	0.7314
Running (g/mi)	48	0.1493	0.1493	0.1493	0.7223	0.7663	0.7399
Running (g/mi)	49	0.1478	0.1478	0.1478	0.7303	0.7743	0.7479
Running (g/mi)	50	0.1464	0.1464	0.1464	0.7382	0.7820	0.7557
Running (g/mi)	51	0.1449	0.1449	0.1449	0.7509	0.7949	0.7685
Running (g/mi)	52	0.1437	0.1437	0.1437	0.7634	0.8073	0.7810
Running (g/mi)	53	0.1424	0.1424	0.1424	0.7754	0.8193	0.7930
Running (g/mi)	54	0.1411	0.1411	0.1411	0.7868	0.8308	0.8044
Running (g/mi)	55	0.1398	0.1398	0.1398	0.7979	0.8420	0.8156
Running (g/mi)	56	0.1391	0.1391	0.1391	0.8160	0.8600	0.8336
Running (g/mi)	57	0.1387	0.1387	0.1387	0.8333	0.8773	0.8509
Running (g/mi)	58	0.1381	0.1381	0.1381	0.8502	0.8940	0.8677
Running (g/mi)	59	0.1376	0.1376	0.1376	0.8662	0.9101	0.8837
Running (g/mi)	60	0.1370	0.1370	0.1370	0.8820	0.9258	0.8995
Running (g/mi)	61	0.1367	0.1367	0.1367	0.9071	0.9509	0.9246
Running (g/mi)	62	0.1364	0.1364	0.1364	0.9313	0.9754	0.9490
Running (g/mi)	63	0.1361	0.1361	0.1361	0.9549	0.9988	0.9725
Running (g/mi)	64	0.1357	0.1357	0.1357	0.9777	1.0217	0.9953
Running (g/mi)	65	0.1355	0.1355	0.1355	0.9998	1.0437	1.0173

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	0.9434	0.5180
Hot Soak Loss (g/trip end)	0.5663	-
Hot Start (g/trip start, Light Duty Only)	0.1631	0.1150

Table 5: 2020 Running, Cold Start, and Hot Soak Average Emissions Factors for "Traffic Stream" TERMs (Mobile6.2)

Emission Type	Speed (mph)	Average 2020 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway- 40%	NOx		Arterial - 60%, Freeway- 40%
Running (g/mi)	1	1.5727	1.5727	1.5727	0.4705	0.4743	0.4720
Running (g/mi)	2	1.5727	1.5727	1.5727	0.4705	0.4743	0.4720
Running (g/mi)	3	1.2443	1.2443	1.2443	0.4495	0.4532	0.4509
Running (g/mi)	4	0.8338	0.8338	0.8338	0.4230	0.4265	0.4244
Running (g/mi)	5	0.5876	0.5876	0.5876	0.4068	0.4104	0.4082
Running (g/mi)	6	0.4918	0.4867	0.4897	0.3785	0.3695	0.3749
Running (g/mi)	7	0.4234	0.4146	0.4199	0.3585	0.3405	0.3513
Running (g/mi)	8	0.3723	0.3608	0.3677	0.3433	0.3186	0.3334
Running (g/mi)	9	0.3325	0.3186	0.3269	0.3315	0.3016	0.3195
Running (g/mi)	10	0.3005	0.2851	0.2943	0.3221	0.2881	0.3085
Running (g/mi)	11	0.2775	0.2610	0.2709	0.3076	0.2711	0.2930
Running (g/mi)	12	0.2582	0.2409	0.2512	0.2955	0.2570	0.2801
Running (g/mi)	13	0.2417	0.2239	0.2346	0.2854	0.2452	0.2693
Running (g/mi)	14	0.2279	0.2097	0.2206	0.2765	0.2349	0.2599
Running (g/mi)	15	0.2157	0.1967	0.2081	0.2691	0.2263	0.2520
Running (g/mi)	16	0.2028	0.1865	0.1963	0.2618	0.2244	0.2468
Running (g/mi)	17	0.1918	0.1773	0.1860	0.2554	0.2228	0.2423
Running (g/mi)	18	0.1817	0.1695	0.1768	0.2496	0.2212	0.2383
Running (g/mi)	19	0.1730	0.1619	0.1685	0.2446	0.2201	0.2348
Running (g/mi)	20	0.1649	0.1557	0.1612	0.2402	0.2190	0.2317
Running (g/mi)	21	0.1586	0.1507	0.1554	0.2358	0.2180	0.2287
Running (g/mi)	22	0.1530	0.1464	0.1504	0.2318	0.2171	0.2259
Running (g/mi)	23	0.1482	0.1423	0.1458	0.2285	0.2161	0.2235
Running (g/mi)	24	0.1436	0.1389	0.1417	0.2255	0.2150	0.2213
Running (g/mi)	25	0.1391	0.1357	0.1377	0.2225	0.2144	0.2192
Running (g/mi)	26	0.1354	0.1320	0.1340	0.2199	0.2137	0.2174
Running (g/mi)	27	0.1316	0.1289	0.1305	0.2175	0.2132	0.2158
Running (g/mi)	28	0.1280	0.1261	0.1272	0.2154	0.2125	0.2142
Running (g/mi)	29	0.1250	0.1234	0.1244	0.2134	0.2123	0.2129
Running (g/mi)	30	0.1217	0.1207	0.1213	0.2114	0.2118	0.2115
Running (g/mi)	31	0.1190	0.1183	0.1187	0.2104	0.2113	0.2107
Running (g/mi)	32	0.1164	0.1159	0.1162	0.2094	0.2113	0.2101
Running (g/mi)	33	0.1139	0.1134	0.1137	0.2084	0.2109	0.2094
Running (g/mi)	34	0.1115	0.1113	0.1114	0.2076	0.2106	0.2088
Running (g/mi)	35	0.1096	0.1096	0.1096	0.2067	0.2103	0.2081
Running (g/mi)	36	0.1077	0.1077	0.1077	0.2079	0.2114	0.2093
Running (g/mi)	37	0.1060	0.1060	0.1060	0.2089	0.2124	0.2103
Running (g/mi)	38	0.1045	0.1045	0.1045	0.2097	0.2134	0.2112
Running (g/mi)	39	0.1033	0.1033	0.1033	0.2105	0.2143	0.2120
Running (g/mi)	40	0.1020	0.1020	0.1020	0.2115	0.2151	0.2130
Running (g/mi)	41	0.1005	0.1005	0.1005	0.2133	0.2169	0.2147
Running (g/mi)	42	0.0992	0.0992	0.0992	0.2151	0.2189	0.2166
Running (g/mi)	43	0.0980	0.0980	0.0980	0.2167	0.2202	0.2181
Running (g/mi)	44	0.0968	0.0968	0.0968	0.2185	0.2219	0.2198
Running (g/mi)	45	0.0957	0.0957	0.0957	0.2199	0.2235	0.2214
Running (g/mi)	46	0.0948	0.0948	0.0948	0.2224	0.2261	0.2239
Running (g/mi)	47	0.0938	0.0938	0.0938	0.2251	0.2285	0.2265
Running (g/mi)	48	0.0929	0.0929	0.0929	0.2273	0.2307	0.2287
Running (g/mi)	49	0.0919	0.0919	0.0919	0.2295	0.2330	0.2309
Running (g/mi)	50	0.0911	0.0911	0.0911	0.2315	0.2351	0.2330
Running (g/mi)	51	0.0905	0.0905	0.0905	0.2351	0.2385	0.2365
Running (g/mi)	52	0.0898	0.0898	0.0898	0.2383	0.2420	0.2398
Running (g/mi)	53	0.0894	0.0894	0.0894	0.2414	0.2451	0.2429
Running (g/mi)	54	0.0889	0.0889	0.0889	0.2446	0.2480	0.2460
Running (g/mi)	55	0.0882	0.0882	0.0882	0.2477	0.2513	0.2491
Running (g/mi)	56	0.0883	0.0883	0.0883	0.2522	0.2558	0.2536
Running (g/mi)	57	0.0882	0.0882	0.0882	0.2566	0.2603	0.2581
Running (g/mi)	58	0.0882	0.0882	0.0882	0.2610	0.2647	0.2625
Running (g/mi)	59	0.0882	0.0882	0.0882	0.2653	0.2688	0.2667
Running (g/mi)	60	0.0881	0.0881	0.0881	0.2692	0.2728	0.2706
Running (g/mi)	61	0.0881	0.0881	0.0881	0.2754	0.2788	0.2767
Running (g/mi)	62	0.0883	0.0883	0.0883	0.2815	0.2848	0.2828
Running (g/mi)	63	0.0883	0.0883	0.0883	0.2874	0.2908	0.2887
Running (g/mi)	64	0.0885	0.0885	0.0885	0.2931	0.2966	0.2945
Running (g/mi)	65	0.0886	0.0886	0.0886	0.2985	0.3020	0.2999

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	0.5272	0.2176
Hot Soak Loss (g/trip end)	0.2826	-
Hot Start (g/trip start, Light Duty Only)	0.0956	0.0509

Table 6: 2030 Running, Cold Start, and Hot Soak Average Emissions Factors for "Traffic Stream" TERMs (Mobile6.2)

Emission Type	Speed (mph)	Average 2030 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway- 40%	NOx		Arterial - 60%, Freeway- 40%
Running (g/mi)	1	1.4783	1.4783	1.4783	0.3478	0.3477	0.3477
Running (g/mi)	2	1.4783	1.4783	1.4783	0.3478	0.3477	0.3477
Running (g/mi)	3	1.1696	1.1696	1.1696	0.3312	0.3312	0.3312
Running (g/mi)	4	0.7837	0.7837	0.7837	0.3102	0.3102	0.3102
Running (g/mi)	5	0.5520	0.5520	0.5520	0.2978	0.2978	0.2978
Running (g/mi)	6	0.4623	0.4575	0.4604	0.2760	0.2651	0.2716
Running (g/mi)	7	0.3980	0.3901	0.3949	0.2606	0.2418	0.2530
Running (g/mi)	8	0.3499	0.3392	0.3456	0.2490	0.2242	0.2391
Running (g/mi)	9	0.3122	0.2997	0.3072	0.2398	0.2106	0.2281
Running (g/mi)	10	0.2824	0.2683	0.2768	0.2325	0.1997	0.2194
Running (g/mi)	11	0.2607	0.2459	0.2548	0.2215	0.1865	0.2075
Running (g/mi)	12	0.2427	0.2271	0.2365	0.2122	0.1758	0.1976
Running (g/mi)	13	0.2275	0.2111	0.2209	0.2046	0.1666	0.1894
Running (g/mi)	14	0.2146	0.1976	0.2078	0.1979	0.1587	0.1822
Running (g/mi)	15	0.2031	0.1858	0.1962	0.1922	0.1519	0.1761
Running (g/mi)	16	0.1910	0.1760	0.1850	0.1865	0.1513	0.1724
Running (g/mi)	17	0.1807	0.1673	0.1753	0.1820	0.1506	0.1694
Running (g/mi)	18	0.1712	0.1597	0.1666	0.1778	0.1502	0.1667
Running (g/mi)	19	0.1626	0.1526	0.1586	0.1741	0.1498	0.1644
Running (g/mi)	20	0.1552	0.1465	0.1517	0.1708	0.1493	0.1622
Running (g/mi)	21	0.1495	0.1420	0.1465	0.1676	0.1489	0.1601
Running (g/mi)	22	0.1441	0.1379	0.1416	0.1648	0.1484	0.1582
Running (g/mi)	23	0.1395	0.1341	0.1373	0.1620	0.1483	0.1565
Running (g/mi)	24	0.1351	0.1308	0.1334	0.1598	0.1478	0.1550
Running (g/mi)	25	0.1311	0.1276	0.1297	0.1576	0.1475	0.1535
Running (g/mi)	26	0.1273	0.1243	0.1261	0.1556	0.1473	0.1522
Running (g/mi)	27	0.1239	0.1214	0.1229	0.1538	0.1470	0.1511
Running (g/mi)	28	0.1204	0.1185	0.1196	0.1523	0.1467	0.1501
Running (g/mi)	29	0.1175	0.1159	0.1169	0.1505	0.1465	0.1489
Running (g/mi)	30	0.1146	0.1136	0.1142	0.1493	0.1464	0.1481
Running (g/mi)	31	0.1118	0.1111	0.1115	0.1483	0.1461	0.1474
Running (g/mi)	32	0.1093	0.1090	0.1092	0.1475	0.1458	0.1468
Running (g/mi)	33	0.1070	0.1067	0.1069	0.1467	0.1456	0.1462
Running (g/mi)	34	0.1048	0.1046	0.1047	0.1458	0.1454	0.1457
Running (g/mi)	35	0.1030	0.1030	0.1030	0.1452	0.1452	0.1452
Running (g/mi)	36	0.1011	0.1011	0.1011	0.1458	0.1458	0.1458
Running (g/mi)	37	0.0996	0.0996	0.0996	0.1466	0.1466	0.1466
Running (g/mi)	38	0.0983	0.0983	0.0983	0.1472	0.1472	0.1472
Running (g/mi)	39	0.0970	0.0970	0.0970	0.1478	0.1478	0.1478
Running (g/mi)	40	0.0957	0.0957	0.0957	0.1484	0.1484	0.1484
Running (g/mi)	41	0.0944	0.0944	0.0944	0.1496	0.1496	0.1496
Running (g/mi)	42	0.0933	0.0933	0.0933	0.1507	0.1507	0.1507
Running (g/mi)	43	0.0919	0.0919	0.0919	0.1517	0.1517	0.1517
Running (g/mi)	44	0.0909	0.0909	0.0909	0.1527	0.1527	0.1527
Running (g/mi)	45	0.0899	0.0899	0.0899	0.1537	0.1537	0.1537
Running (g/mi)	46	0.0889	0.0889	0.0889	0.1553	0.1553	0.1553
Running (g/mi)	47	0.0880	0.0880	0.0880	0.1565	0.1565	0.1565
Running (g/mi)	48	0.0870	0.0870	0.0870	0.1579	0.1579	0.1579
Running (g/mi)	49	0.0863	0.0863	0.0863	0.1593	0.1593	0.1593
Running (g/mi)	50	0.0857	0.0857	0.0857	0.1603	0.1603	0.1603
Running (g/mi)	51	0.0850	0.0850	0.0850	0.1623	0.1623	0.1623
Running (g/mi)	52	0.0844	0.0844	0.0844	0.1643	0.1643	0.1643
Running (g/mi)	53	0.0839	0.0839	0.0839	0.1661	0.1661	0.1661
Running (g/mi)	54	0.0831	0.0831	0.0831	0.1677	0.1677	0.1677
Running (g/mi)	55	0.0827	0.0827	0.0827	0.1695	0.1695	0.1695
Running (g/mi)	56	0.0829	0.0829	0.0829	0.1719	0.1719	0.1719
Running (g/mi)	57	0.0827	0.0827	0.0827	0.1742	0.1742	0.1742
Running (g/mi)	58	0.0830	0.0830	0.0830	0.1765	0.1765	0.1765
Running (g/mi)	59	0.0827	0.0827	0.0827	0.1787	0.1787	0.1787
Running (g/mi)	60	0.0827	0.0827	0.0827	0.1811	0.1811	0.1811
Running (g/mi)	61	0.0828	0.0828	0.0828	0.1843	0.1843	0.1843
Running (g/mi)	62	0.0831	0.0831	0.0831	0.1873	0.1873	0.1873
Running (g/mi)	63	0.0831	0.0831	0.0831	0.1903	0.1903	0.1903
Running (g/mi)	64	0.0832	0.0832	0.0832	0.1932	0.1932	0.1932
Running (g/mi)	65	0.0832	0.0832	0.0832	0.1960	0.1960	0.1960

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	0.4639	0.1565
Hot Soak Loss (g/trip end)	0.2078	-
Hot Start (g/trip start, Light Duty Only)	0.0854	0.0382

Exhibit - 1
VOC MOBILE6.2 RUNNING EMISSION RATES
TRAFFIC STREAM
FOR 2008, 2009, 2010, 2020 AND 2030
WEIGHTED AVERAGE of ARTERIAL & FREEWAY

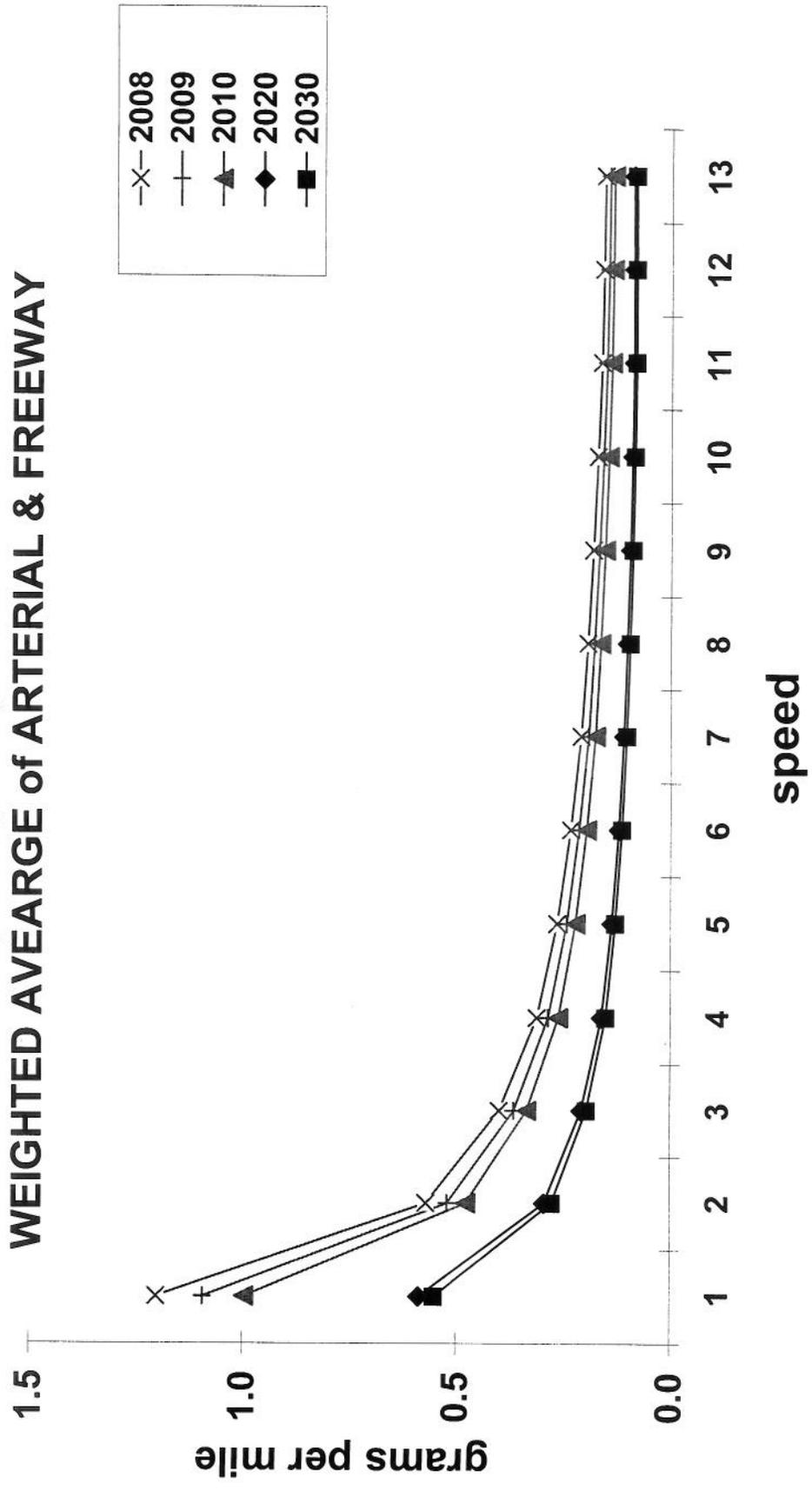
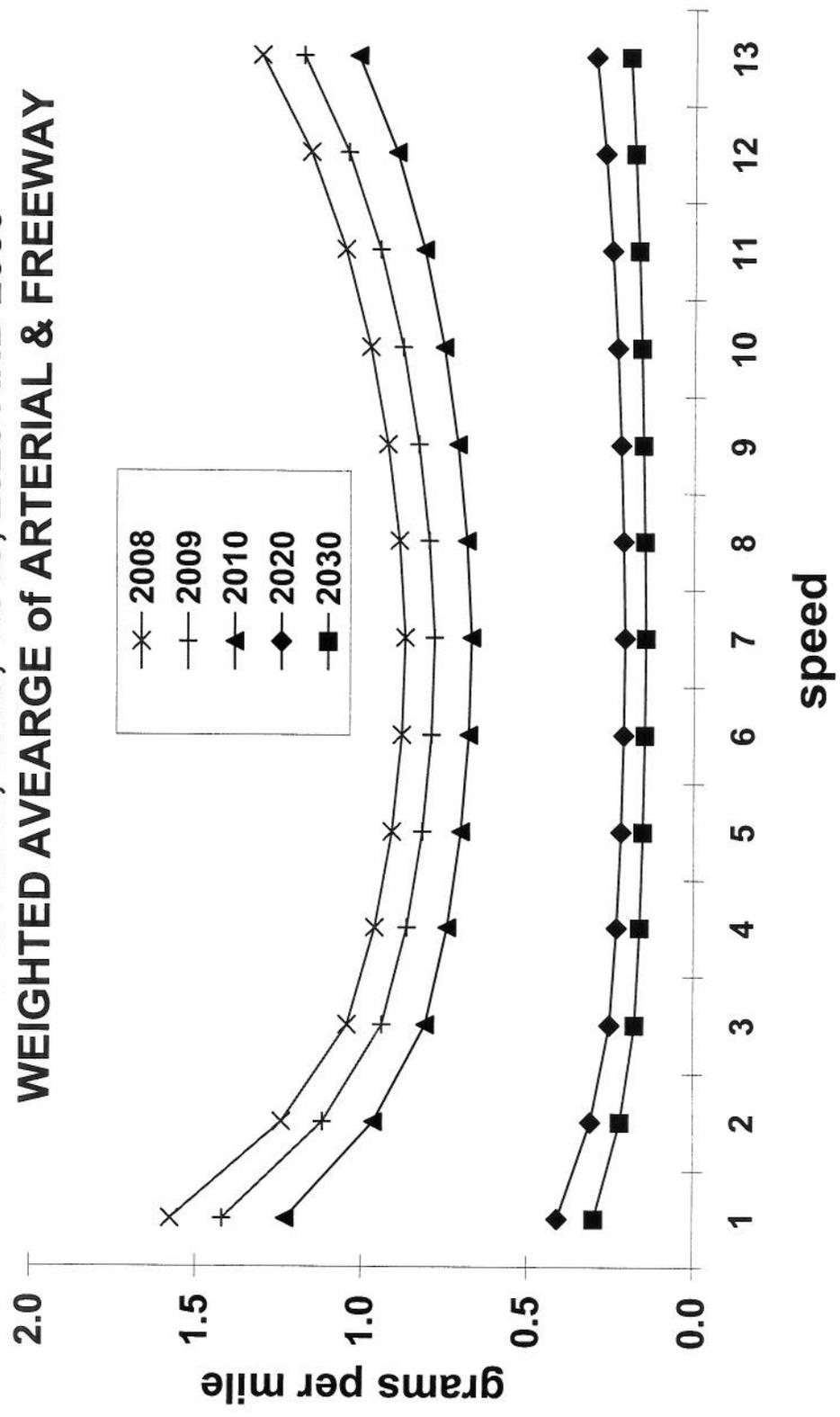


Exhibit - 2
NOx MOBILE6.2 RUNNING EMISSION RATES
TRAFFIC STREAM
FOR 2008, 2009, 2010, 2020 AND 2030
WEIGHTED AVERAGE of ARTERIAL & FREEWAY



**Table 7: 2008 Running, Cold Start, and Hot Soak Average Emissions Factors for "Commute" TERMS
(Mobile 6.2)**

Emission Type	Speed (mph)	Average 2008 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway- 40%	NOx		Arterial - 60%, Freeway- 40%
Running (g/mi)	1	3.5511	3.5511	3.5511	1.0401	1.0400	1.0400
Running (g/mi)	2	3.5511	3.5511	3.5511	1.0401	1.0400	1.0400
Running (g/mi)	3	2.7595	2.7594	2.7595	0.9877	0.9877	0.9877
Running (g/mi)	4	1.7697	1.7697	1.7697	0.9218	0.9218	0.9218
Running (g/mi)	5	1.1760	1.1759	1.1760	0.8824	0.8823	0.8824
Running (g/mi)	6	0.9648	0.9546	0.9607	0.8161	0.7779	0.8008
Running (g/mi)	7	0.8140	0.7963	0.8069	0.7688	0.7031	0.7425
Running (g/mi)	8	0.7010	0.6778	0.6917	0.7333	0.6470	0.6988
Running (g/mi)	9	0.6129	0.5856	0.6020	0.7057	0.6035	0.6648
Running (g/mi)	10	0.5427	0.5118	0.5303	0.6836	0.5688	0.6377
Running (g/mi)	11	0.4988	0.4661	0.4857	0.6504	0.5283	0.6016
Running (g/mi)	12	0.4619	0.4280	0.4483	0.6226	0.4945	0.5713
Running (g/mi)	13	0.4308	0.3955	0.4167	0.5993	0.4659	0.5459
Running (g/mi)	14	0.4044	0.3679	0.3898	0.5791	0.4414	0.5240
Running (g/mi)	15	0.3813	0.3439	0.3664	0.5618	0.4202	0.5051
Running (g/mi)	16	0.3593	0.3267	0.3462	0.5460	0.4213	0.4961
Running (g/mi)	17	0.3397	0.3115	0.3284	0.5323	0.4224	0.4884
Running (g/mi)	18	0.3224	0.2981	0.3127	0.5201	0.4233	0.4814
Running (g/mi)	19	0.3069	0.2862	0.2986	0.5093	0.4240	0.4752
Running (g/mi)	20	0.2927	0.2751	0.2857	0.4994	0.4248	0.4696
Running (g/mi)	21	0.2819	0.2671	0.2760	0.4903	0.4249	0.4641
Running (g/mi)	22	0.2718	0.2593	0.2668	0.4820	0.4253	0.4593
Running (g/mi)	23	0.2628	0.2526	0.2587	0.4743	0.4256	0.4548
Running (g/mi)	24	0.2546	0.2464	0.2513	0.4676	0.4257	0.4508
Running (g/mi)	25	0.2466	0.2406	0.2442	0.4612	0.4259	0.4471
Running (g/mi)	26	0.2401	0.2351	0.2381	0.4551	0.4258	0.4434
Running (g/mi)	27	0.2339	0.2299	0.2323	0.4495	0.4258	0.4400
Running (g/mi)	28	0.2281	0.2251	0.2269	0.4444	0.4258	0.4370
Running (g/mi)	29	0.2226	0.2204	0.2217	0.4397	0.4258	0.4341
Running (g/mi)	30	0.2179	0.2165	0.2173	0.4351	0.4258	0.4313
Running (g/mi)	31	0.2128	0.2118	0.2124	0.4321	0.4248	0.4292
Running (g/mi)	32	0.2082	0.2074	0.2079	0.4292	0.4239	0.4271
Running (g/mi)	33	0.2039	0.2035	0.2038	0.4268	0.4233	0.4254
Running (g/mi)	34	0.2001	0.1999	0.2000	0.4241	0.4224	0.4234
Running (g/mi)	35	0.1960	0.1960	0.1960	0.4218	0.4218	0.4218
Running (g/mi)	36	0.1934	0.1934	0.1934	0.4233	0.4233	0.4233
Running (g/mi)	37	0.1906	0.1906	0.1906	0.4248	0.4248	0.4248
Running (g/mi)	38	0.1882	0.1882	0.1882	0.4262	0.4262	0.4262
Running (g/mi)	39	0.1858	0.1858	0.1858	0.4275	0.4275	0.4275
Running (g/mi)	40	0.1836	0.1836	0.1836	0.4288	0.4288	0.4288
Running (g/mi)	41	0.1812	0.1812	0.1812	0.4308	0.4308	0.4308
Running (g/mi)	42	0.1791	0.1791	0.1791	0.4329	0.4329	0.4329
Running (g/mi)	43	0.1769	0.1769	0.1769	0.4351	0.4351	0.4351
Running (g/mi)	44	0.1748	0.1748	0.1748	0.4370	0.4370	0.4370
Running (g/mi)	45	0.1728	0.1728	0.1728	0.4388	0.4388	0.4388
Running (g/mi)	46	0.1708	0.1708	0.1708	0.4413	0.4413	0.4413
Running (g/mi)	47	0.1687	0.1687	0.1687	0.4433	0.4433	0.4433
Running (g/mi)	48	0.1667	0.1667	0.1667	0.4454	0.4454	0.4454
Running (g/mi)	49	0.1653	0.1653	0.1653	0.4475	0.4475	0.4475
Running (g/mi)	50	0.1635	0.1635	0.1635	0.4494	0.4494	0.4494
Running (g/mi)	51	0.1617	0.1617	0.1617	0.4519	0.4519	0.4519
Running (g/mi)	52	0.1600	0.1600	0.1600	0.4543	0.4543	0.4543
Running (g/mi)	53	0.1585	0.1585	0.1585	0.4564	0.4564	0.4564
Running (g/mi)	54	0.1569	0.1569	0.1569	0.4587	0.4587	0.4587
Running (g/mi)	55	0.1555	0.1555	0.1555	0.4608	0.4608	0.4608
Running (g/mi)	56	0.1544	0.1544	0.1544	0.4633	0.4633	0.4633
Running (g/mi)	57	0.1540	0.1540	0.1540	0.4658	0.4658	0.4658
Running (g/mi)	58	0.1528	0.1528	0.1528	0.4681	0.4681	0.4681
Running (g/mi)	59	0.1520	0.1520	0.1520	0.4704	0.4704	0.4704
Running (g/mi)	60	0.1514	0.1514	0.1514	0.4728	0.4728	0.4728
Running (g/mi)	61	0.1506	0.1506	0.1506	0.4752	0.4752	0.4752
Running (g/mi)	62	0.1501	0.1501	0.1501	0.4778	0.4778	0.4778
Running (g/mi)	63	0.1496	0.1496	0.1496	0.4801	0.4801	0.4801
Running (g/mi)	64	0.1490	0.1490	0.1490	0.4825	0.4825	0.4825
Running (g/mi)	65	0.1486	0.1486	0.1486	0.4847	0.4847	0.4847

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty	1.1236	0.6292
Hot Soak Loss (g/trip end)	0.6107	0.0000
Hot Start (g/trip start, Light Duty	0.1933	0.1386

Table 8: 2009 Running, Cold Start, and Hot Soak Average Emissions Factors for "Commute" TERMS (Mobile 6.2)

Emission Type	Speed (mph)	Average 2009 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway - 40%	NOx		Arterial - 60%, Freeway - 40%
Running (g/mi)	1	3.2177	3.2177	3.2177	0.9303	0.9303	0.9303
Running (g/mi)	2	3.2177	3.2177	3.2177	0.9303	0.9303	0.9303
Running (g/mi)	3	2.5028	2.5028	2.5028	0.8834	0.8833	0.8834
Running (g/mi)	4	1.6094	1.6094	1.6094	0.8248	0.8248	0.8248
Running (g/mi)	5	1.0735	1.0734	1.0734	0.7895	0.7895	0.7895
Running (g/mi)	6	0.8815	0.8719	0.8776	0.7303	0.6959	0.7165
Running (g/mi)	7	0.7447	0.7281	0.7381	0.6879	0.6290	0.6644
Running (g/mi)	8	0.6420	0.6201	0.6332	0.6561	0.5789	0.6252
Running (g/mi)	9	0.5618	0.5362	0.5515	0.6314	0.5401	0.5949
Running (g/mi)	10	0.4982	0.4693	0.4866	0.6116	0.5088	0.5705
Running (g/mi)	11	0.4576	0.4273	0.4455	0.5820	0.4726	0.5382
Running (g/mi)	12	0.4242	0.3922	0.4114	0.5572	0.4423	0.5112
Running (g/mi)	13	0.3956	0.3626	0.3824	0.5363	0.4169	0.4885
Running (g/mi)	14	0.3713	0.3370	0.3576	0.5182	0.3949	0.4689
Running (g/mi)	15	0.3501	0.3150	0.3361	0.5028	0.3758	0.4520
Running (g/mi)	16	0.3298	0.2995	0.3177	0.4887	0.3768	0.4439
Running (g/mi)	17	0.3119	0.2854	0.3013	0.4765	0.3778	0.4370
Running (g/mi)	18	0.2962	0.2733	0.2870	0.4655	0.3788	0.4308
Running (g/mi)	19	0.2817	0.2622	0.2739	0.4558	0.3795	0.4253
Running (g/mi)	20	0.2690	0.2523	0.2623	0.4470	0.3802	0.4203
Running (g/mi)	21	0.2590	0.2447	0.2533	0.4390	0.3806	0.4156
Running (g/mi)	22	0.2499	0.2379	0.2451	0.4315	0.3807	0.4112
Running (g/mi)	23	0.2414	0.2317	0.2375	0.4247	0.3808	0.4071
Running (g/mi)	24	0.2336	0.2260	0.2306	0.4188	0.3812	0.4037
Running (g/mi)	25	0.2267	0.2209	0.2243	0.4129	0.3815	0.4004
Running (g/mi)	26	0.2207	0.2159	0.2188	0.4077	0.3813	0.3971
Running (g/mi)	27	0.2150	0.2111	0.2134	0.4028	0.3813	0.3942
Running (g/mi)	28	0.2096	0.2066	0.2084	0.3982	0.3813	0.3914
Running (g/mi)	29	0.2047	0.2027	0.2039	0.3938	0.3813	0.3888
Running (g/mi)	30	0.2000	0.1988	0.1995	0.3898	0.3813	0.3864
Running (g/mi)	31	0.1957	0.1947	0.1953	0.3871	0.3804	0.3844
Running (g/mi)	32	0.1915	0.1906	0.1911	0.3845	0.3797	0.3826
Running (g/mi)	33	0.1875	0.1870	0.1873	0.3822	0.3790	0.3809
Running (g/mi)	34	0.1839	0.1837	0.1838	0.3798	0.3785	0.3793
Running (g/mi)	35	0.1804	0.1804	0.1804	0.3778	0.3778	0.3778
Running (g/mi)	36	0.1779	0.1779	0.1779	0.3792	0.3792	0.3792
Running (g/mi)	37	0.1755	0.1755	0.1755	0.3805	0.3805	0.3805
Running (g/mi)	38	0.1732	0.1732	0.1732	0.3817	0.3817	0.3817
Running (g/mi)	39	0.1711	0.1711	0.1711	0.3830	0.3830	0.3830
Running (g/mi)	40	0.1691	0.1691	0.1691	0.3842	0.3842	0.3842
Running (g/mi)	41	0.1669	0.1669	0.1669	0.3861	0.3861	0.3861
Running (g/mi)	42	0.1650	0.1650	0.1650	0.3881	0.3881	0.3881
Running (g/mi)	43	0.1631	0.1631	0.1631	0.3899	0.3899	0.3899
Running (g/mi)	44	0.1614	0.1614	0.1614	0.3917	0.3917	0.3917
Running (g/mi)	45	0.1594	0.1594	0.1594	0.3932	0.3932	0.3932
Running (g/mi)	46	0.1577	0.1577	0.1577	0.3954	0.3954	0.3954
Running (g/mi)	47	0.1557	0.1557	0.1557	0.3974	0.3974	0.3974
Running (g/mi)	48	0.1541	0.1541	0.1541	0.3993	0.3993	0.3993
Running (g/mi)	49	0.1528	0.1528	0.1528	0.4010	0.4010	0.4010
Running (g/mi)	50	0.1512	0.1512	0.1512	0.4028	0.4028	0.4028
Running (g/mi)	51	0.1498	0.1498	0.1498	0.4048	0.4048	0.4048
Running (g/mi)	52	0.1483	0.1483	0.1483	0.4071	0.4071	0.4071
Running (g/mi)	53	0.1468	0.1468	0.1468	0.4093	0.4093	0.4093
Running (g/mi)	54	0.1455	0.1455	0.1455	0.4113	0.4113	0.4113
Running (g/mi)	55	0.1440	0.1440	0.1440	0.4131	0.4131	0.4131
Running (g/mi)	56	0.1433	0.1433	0.1433	0.4154	0.4154	0.4154
Running (g/mi)	57	0.1426	0.1426	0.1426	0.4177	0.4177	0.4177
Running (g/mi)	58	0.1419	0.1419	0.1419	0.4197	0.4197	0.4197
Running (g/mi)	59	0.1413	0.1413	0.1413	0.4217	0.4217	0.4217
Running (g/mi)	60	0.1407	0.1407	0.1407	0.4237	0.4237	0.4237
Running (g/mi)	61	0.1402	0.1402	0.1402	0.4260	0.4260	0.4260
Running (g/mi)	62	0.1397	0.1397	0.1397	0.4283	0.4283	0.4283
Running (g/mi)	63	0.1393	0.1393	0.1393	0.4304	0.4304	0.4304
Running (g/mi)	64	0.1390	0.1390	0.1390	0.4324	0.4324	0.4324
Running (g/mi)	65	0.1384	0.1384	0.1384	0.4343	0.4343	0.4343

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty)	1.0372	0.5761
Hot Soak Loss (g/trip end)	0.5837	-
Hot Start (g/trip start, Light Duty)	0.1788	0.1266

**Table 9: 2010 Running, Cold Start, and Hot Soak Average Emissions Factors for "Commute" TERMS
(Mobile 6.2)**

Emission Type	Speed (mph)	Average 2010 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway - 40%	NOx		Arterial - 60%, Freeway - 40%
Running (g/mi)	1	2.9073	2.9073	2.9073	0.8218	0.8218	0.8218
Running (g/mi)	2	2.9073	2.9073	2.9073	0.8218	0.8218	0.8218
Running (g/mi)	3	2.2637	2.2637	2.2637	0.7804	0.7803	0.7804
Running (g/mi)	4	1.4592	1.4592	1.4592	0.7285	0.7285	0.7285
Running (g/mi)	5	0.9764	0.9764	0.9764	0.6974	0.6974	0.6974
Running (g/mi)	6	0.8027	0.7939	0.7992	0.6451	0.6147	0.6329
Running (g/mi)	7	0.6786	0.6635	0.6726	0.6077	0.5553	0.5867
Running (g/mi)	8	0.5857	0.5654	0.5776	0.5794	0.5109	0.5520
Running (g/mi)	9	0.5134	0.4895	0.5038	0.5577	0.4763	0.5251
Running (g/mi)	10	0.4556	0.4287	0.4448	0.5403	0.4488	0.5037
Running (g/mi)	11	0.4186	0.3904	0.4073	0.5140	0.4168	0.4751
Running (g/mi)	12	0.3880	0.3584	0.3762	0.4919	0.3899	0.4511
Running (g/mi)	13	0.3619	0.3313	0.3497	0.4734	0.3673	0.4310
Running (g/mi)	14	0.3396	0.3082	0.3270	0.4574	0.3478	0.4136
Running (g/mi)	15	0.3207	0.2882	0.3077	0.4438	0.3311	0.3987
Running (g/mi)	16	0.3021	0.2736	0.2907	0.4316	0.3321	0.3918
Running (g/mi)	17	0.2855	0.2607	0.2756	0.4206	0.3331	0.3856
Running (g/mi)	18	0.2709	0.2496	0.2623	0.4110	0.3338	0.3801
Running (g/mi)	19	0.2579	0.2395	0.2505	0.4023	0.3343	0.3751
Running (g/mi)	20	0.2460	0.2302	0.2397	0.3944	0.3351	0.3707
Running (g/mi)	21	0.2368	0.2236	0.2315	0.3873	0.3353	0.3665
Running (g/mi)	22	0.2286	0.2174	0.2241	0.3808	0.3357	0.3628
Running (g/mi)	23	0.2210	0.2119	0.2174	0.3749	0.3359	0.3593
Running (g/mi)	24	0.2140	0.2067	0.2111	0.3697	0.3361	0.3562
Running (g/mi)	25	0.2074	0.2018	0.2051	0.3643	0.3363	0.3531
Running (g/mi)	26	0.2018	0.1972	0.2000	0.3597	0.3364	0.3504
Running (g/mi)	27	0.1968	0.1929	0.1953	0.3554	0.3363	0.3478
Running (g/mi)	28	0.1919	0.1890	0.1907	0.3514	0.3363	0.3454
Running (g/mi)	29	0.1871	0.1851	0.1863	0.3476	0.3363	0.3431
Running (g/mi)	30	0.1832	0.1816	0.1826	0.3439	0.3363	0.3409
Running (g/mi)	31	0.1789	0.1779	0.1785	0.3417	0.3357	0.3393
Running (g/mi)	32	0.1752	0.1744	0.1749	0.3393	0.3350	0.3376
Running (g/mi)	33	0.1717	0.1711	0.1714	0.3373	0.3345	0.3362
Running (g/mi)	34	0.1683	0.1681	0.1682	0.3353	0.3338	0.3347
Running (g/mi)	35	0.1649	0.1649	0.1649	0.3334	0.3334	0.3334
Running (g/mi)	36	0.1629	0.1629	0.1629	0.3347	0.3347	0.3347
Running (g/mi)	37	0.1609	0.1609	0.1609	0.3358	0.3358	0.3358
Running (g/mi)	38	0.1586	0.1586	0.1586	0.3370	0.3370	0.3370
Running (g/mi)	39	0.1569	0.1569	0.1569	0.3382	0.3382	0.3382
Running (g/mi)	40	0.1550	0.1550	0.1550	0.3392	0.3392	0.3392
Running (g/mi)	41	0.1533	0.1533	0.1533	0.3409	0.3409	0.3409
Running (g/mi)	42	0.1513	0.1513	0.1513	0.3428	0.3428	0.3428
Running (g/mi)	43	0.1496	0.1496	0.1496	0.3442	0.3442	0.3442
Running (g/mi)	44	0.1482	0.1482	0.1482	0.3458	0.3458	0.3458
Running (g/mi)	45	0.1465	0.1465	0.1465	0.3474	0.3474	0.3474
Running (g/mi)	46	0.1448	0.1448	0.1448	0.3493	0.3493	0.3493
Running (g/mi)	47	0.1432	0.1432	0.1432	0.3510	0.3510	0.3510
Running (g/mi)	48	0.1418	0.1418	0.1418	0.3528	0.3528	0.3528
Running (g/mi)	49	0.1405	0.1405	0.1405	0.3543	0.3543	0.3543
Running (g/mi)	50	0.1392	0.1392	0.1392	0.3559	0.3559	0.3559
Running (g/mi)	51	0.1378	0.1378	0.1378	0.3579	0.3579	0.3579
Running (g/mi)	52	0.1365	0.1365	0.1365	0.3597	0.3597	0.3597
Running (g/mi)	53	0.1353	0.1353	0.1353	0.3615	0.3615	0.3615
Running (g/mi)	54	0.1342	0.1342	0.1342	0.3634	0.3634	0.3634
Running (g/mi)	55	0.1331	0.1331	0.1331	0.3650	0.3650	0.3650
Running (g/mi)	56	0.1323	0.1323	0.1323	0.3670	0.3670	0.3670
Running (g/mi)	57	0.1321	0.1321	0.1321	0.3690	0.3690	0.3690
Running (g/mi)	58	0.1314	0.1314	0.1314	0.3711	0.3711	0.3711
Running (g/mi)	59	0.1310	0.1310	0.1310	0.3728	0.3728	0.3728
Running (g/mi)	60	0.1306	0.1306	0.1306	0.3747	0.3747	0.3747
Running (g/mi)	61	0.1303	0.1303	0.1303	0.3767	0.3767	0.3767
Running (g/mi)	62	0.1298	0.1298	0.1298	0.3786	0.3786	0.3786
Running (g/mi)	63	0.1295	0.1295	0.1295	0.3805	0.3805	0.3805
Running (g/mi)	64	0.1292	0.1292	0.1292	0.3824	0.3824	0.3824
Running (g/mi)	65	0.1289	0.1289	0.1289	0.3843	0.3843	0.3843

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty)	0.9436	0.5180
Hot Soak Loss (g/trip end)	0.5579	-
Hot Start (g/trip start, Light Duty)	0.1632	0.1151

Table 10: 2020 Running, Cold Start, and Hot Soak Average Emissions Factors for "Commute" TERMS (Mobile 6.2)

Emission Type	Speed (mph)	Average 2020 Running Emission Factor (g/mi)					
		Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60%, Freeway- 40%	NOx		Arterial - 60%, Freeway- 40%
Running (g/mi)	1	1.6161	1.6161	1.6161	0.3613	0.3613	0.3613
Running (g/mi)	2	1.6161	1.6161	1.6161	0.3613	0.3613	0.3613
Running (g/mi)	3	1.2686	1.2686	1.2686	0.3429	0.3429	0.3429
Running (g/mi)	4	0.8345	0.8345	0.8345	0.3199	0.3199	0.3199
Running (g/mi)	5	0.5737	0.5737	0.5737	0.3059	0.3059	0.3059
Running (g/mi)	6	0.4757	0.4699	0.4734	0.2824	0.2687	0.2769
Running (g/mi)	7	0.4053	0.3959	0.4016	0.2657	0.2421	0.2563
Running (g/mi)	8	0.3532	0.3406	0.3482	0.2530	0.2219	0.2406
Running (g/mi)	9	0.3121	0.2972	0.3061	0.2431	0.2065	0.2284
Running (g/mi)	10	0.2794	0.2625	0.2726	0.2354	0.1939	0.2188
Running (g/mi)	11	0.2571	0.2392	0.2499	0.2235	0.1795	0.2059
Running (g/mi)	12	0.2385	0.2197	0.2310	0.2138	0.1675	0.1953
Running (g/mi)	13	0.2228	0.2032	0.2150	0.2055	0.1574	0.1862
Running (g/mi)	14	0.2093	0.1892	0.2013	0.1985	0.1488	0.1786
Running (g/mi)	15	0.1975	0.1768	0.1892	0.1921	0.1413	0.1718
Running (g/mi)	16	0.1855	0.1673	0.1782	0.1867	0.1418	0.1688
Running (g/mi)	17	0.1750	0.1591	0.1686	0.1820	0.1423	0.1661
Running (g/mi)	18	0.1657	0.1519	0.1601	0.1775	0.1427	0.1636
Running (g/mi)	19	0.1573	0.1452	0.1525	0.1736	0.1431	0.1614
Running (g/mi)	20	0.1499	0.1393	0.1457	0.1703	0.1434	0.1595
Running (g/mi)	21	0.1442	0.1354	0.1407	0.1671	0.1435	0.1577
Running (g/mi)	22	0.1394	0.1318	0.1364	0.1642	0.1439	0.1561
Running (g/mi)	23	0.1349	0.1287	0.1324	0.1615	0.1440	0.1545
Running (g/mi)	24	0.1307	0.1255	0.1286	0.1592	0.1441	0.1531
Running (g/mi)	25	0.1271	0.1229	0.1255	0.1570	0.1442	0.1519
Running (g/mi)	26	0.1233	0.1200	0.1220	0.1549	0.1442	0.1506
Running (g/mi)	27	0.1202	0.1174	0.1191	0.1531	0.1442	0.1495
Running (g/mi)	28	0.1172	0.1150	0.1163	0.1513	0.1443	0.1485
Running (g/mi)	29	0.1145	0.1127	0.1138	0.1495	0.1443	0.1474
Running (g/mi)	30	0.1117	0.1104	0.1112	0.1479	0.1443	0.1465
Running (g/mi)	31	0.1092	0.1083	0.1089	0.1469	0.1442	0.1458
Running (g/mi)	32	0.1070	0.1065	0.1068	0.1458	0.1439	0.1451
Running (g/mi)	33	0.1050	0.1045	0.1048	0.1449	0.1435	0.1443
Running (g/mi)	34	0.1027	0.1024	0.1026	0.1439	0.1433	0.1437
Running (g/mi)	35	0.1010	0.1010	0.1010	0.1431	0.1431	0.1431
Running (g/mi)	36	0.0995	0.0995	0.0995	0.1438	0.1438	0.1438
Running (g/mi)	37	0.0982	0.0982	0.0982	0.1443	0.1443	0.1443
Running (g/mi)	38	0.0971	0.0971	0.0971	0.1449	0.1449	0.1449
Running (g/mi)	39	0.0959	0.0959	0.0959	0.1455	0.1455	0.1455
Running (g/mi)	40	0.0950	0.0950	0.0950	0.1460	0.1460	0.1460
Running (g/mi)	41	0.0937	0.0937	0.0937	0.1468	0.1468	0.1468
Running (g/mi)	42	0.0925	0.0925	0.0925	0.1475	0.1475	0.1475
Running (g/mi)	43	0.0915	0.0915	0.0915	0.1484	0.1484	0.1484
Running (g/mi)	44	0.0905	0.0905	0.0905	0.1489	0.1489	0.1489
Running (g/mi)	45	0.0896	0.0896	0.0896	0.1498	0.1498	0.1498
Running (g/mi)	46	0.0889	0.0889	0.0889	0.1507	0.1507	0.1507
Running (g/mi)	47	0.0880	0.0880	0.0880	0.1516	0.1516	0.1516
Running (g/mi)	48	0.0872	0.0872	0.0872	0.1524	0.1524	0.1524
Running (g/mi)	49	0.0864	0.0864	0.0864	0.1532	0.1532	0.1532
Running (g/mi)	50	0.0857	0.0857	0.0857	0.1537	0.1537	0.1537
Running (g/mi)	51	0.0851	0.0851	0.0851	0.1547	0.1547	0.1547
Running (g/mi)	52	0.0846	0.0846	0.0846	0.1556	0.1556	0.1556
Running (g/mi)	53	0.0841	0.0841	0.0841	0.1566	0.1566	0.1566
Running (g/mi)	54	0.0838	0.0838	0.0838	0.1575	0.1575	0.1575
Running (g/mi)	55	0.0833	0.0833	0.0833	0.1585	0.1585	0.1585
Running (g/mi)	56	0.0833	0.0833	0.0833	0.1595	0.1595	0.1595
Running (g/mi)	57	0.0832	0.0832	0.0832	0.1602	0.1602	0.1602
Running (g/mi)	58	0.0834	0.0834	0.0834	0.1612	0.1612	0.1612
Running (g/mi)	59	0.0832	0.0832	0.0832	0.1620	0.1620	0.1620
Running (g/mi)	60	0.0835	0.0835	0.0835	0.1630	0.1630	0.1630
Running (g/mi)	61	0.0834	0.0834	0.0834	0.1639	0.1639	0.1639
Running (g/mi)	62	0.0837	0.0837	0.0837	0.1649	0.1649	0.1649
Running (g/mi)	63	0.0837	0.0837	0.0837	0.1657	0.1657	0.1657
Running (g/mi)	64	0.0839	0.0839	0.0839	0.1665	0.1665	0.1665
Running (g/mi)	65	0.0840	0.0840	0.0840	0.1675	0.1675	0.1675

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	0.5273	0.2177
Hot Soak Loss (g/trip end)	0.2776	-
Hot Start (g/trip start, Light Duty Only)	0.0957	0.0509

Table 11: 2030 Running, Cold Start, and Hot Soak Average Emissions Factors for "Commute" TERMS (Mobile 6.2)

Average 2030 Emission Factors (gm/mi)							
Emission Type	Speed (mph)	Arterial	Freeway	Weighted Factor VOC	Arterial	Freeway	Weighted Factor NOx
		VOC		Arterial - 60% Freeway 40%	NOx		Arterial - 60% Freeway 40%
Running (g/mi)	1	1.529	1.529	1.5287	0.313	0.313	0.3133
Running (g/mi)	2	1.529	1.529	1.5287	0.313	0.313	0.3133
Running (g/mi)	3	1.199	1.199	1.1995	0.297	0.297	0.2972
Running (g/mi)	4	0.788	0.788	0.7884	0.277	0.277	0.2771
Running (g/mi)	5	0.541	0.541	0.5413	0.265	0.265	0.2653
Running (g/mi)	6	0.449	0.443	0.4466	0.244	0.232	0.2395
Running (g/mi)	7	0.383	0.374	0.3791	0.230	0.209	0.2212
Running (g/mi)	8	0.333	0.321	0.3282	0.219	0.191	0.2076
Running (g/mi)	9	0.294	0.281	0.2888	0.210	0.178	0.1971
Running (g/mi)	10	0.263	0.248	0.2572	0.203	0.167	0.1885
Running (g/mi)	11	0.243	0.226	0.2359	0.193	0.154	0.1774
Running (g/mi)	12	0.225	0.208	0.2181	0.184	0.144	0.1680
Running (g/mi)	13	0.210	0.192	0.2030	0.177	0.135	0.1600
Running (g/mi)	14	0.197	0.179	0.1900	0.171	0.127	0.1534
Running (g/mi)	15	0.187	0.167	0.1788	0.165	0.121	0.1475
Running (g/mi)	16	0.175	0.158	0.1683	0.161	0.121	0.1448
Running (g/mi)	17	0.165	0.150	0.1593	0.156	0.122	0.1424
Running (g/mi)	18	0.156	0.143	0.1512	0.153	0.122	0.1402
Running (g/mi)	19	0.148	0.137	0.1436	0.149	0.122	0.1385
Running (g/mi)	20	0.141	0.131	0.1372	0.146	0.123	0.1368
Running (g/mi)	21	0.136	0.128	0.1326	0.144	0.123	0.1352
Running (g/mi)	22	0.131	0.124	0.1285	0.141	0.123	0.1336
Running (g/mi)	23	0.127	0.121	0.1247	0.139	0.123	0.1323
Running (g/mi)	24	0.123	0.118	0.1211	0.136	0.123	0.1312
Running (g/mi)	25	0.120	0.116	0.1181	0.135	0.124	0.1301
Running (g/mi)	26	0.116	0.113	0.1150	0.133	0.124	0.1289
Running (g/mi)	27	0.113	0.111	0.1121	0.131	0.124	0.1280
Running (g/mi)	28	0.110	0.108	0.1093	0.129	0.124	0.1271
Running (g/mi)	29	0.107	0.106	0.1070	0.128	0.124	0.1262
Running (g/mi)	30	0.105	0.104	0.1047	0.127	0.124	0.1254
Running (g/mi)	31	0.103	0.102	0.1025	0.126	0.123	0.1247
Running (g/mi)	32	0.101	0.100	0.1005	0.125	0.123	0.1239
Running (g/mi)	33	0.099	0.098	0.0984	0.124	0.123	0.1234
Running (g/mi)	34	0.097	0.096	0.0965	0.123	0.123	0.1228
Running (g/mi)	35	0.095	0.095	0.0950	0.123	0.123	0.1225
Running (g/mi)	36	0.094	0.094	0.0935	0.123	0.123	0.1227
Running (g/mi)	37	0.092	0.092	0.0923	0.124	0.124	0.1236
Running (g/mi)	38	0.091	0.091	0.0912	0.124	0.124	0.1238
Running (g/mi)	39	0.090	0.090	0.0899	0.125	0.125	0.1246
Running (g/mi)	40	0.089	0.089	0.0889	0.125	0.125	0.1247
Running (g/mi)	41	0.088	0.088	0.0882	0.126	0.126	0.1257
Running (g/mi)	42	0.087	0.087	0.0870	0.126	0.126	0.1264
Running (g/mi)	43	0.086	0.086	0.0860	0.127	0.127	0.1268
Running (g/mi)	44	0.085	0.085	0.0851	0.128	0.128	0.1277
Running (g/mi)	45	0.084	0.084	0.0841	0.128	0.128	0.1283
Running (g/mi)	46	0.083	0.083	0.0833	0.129	0.129	0.1289
Running (g/mi)	47	0.082	0.082	0.0825	0.130	0.130	0.1297
Running (g/mi)	48	0.082	0.082	0.0819	0.130	0.130	0.1304
Running (g/mi)	49	0.081	0.081	0.0810	0.131	0.131	0.1313
Running (g/mi)	50	0.080	0.080	0.0803	0.132	0.132	0.1318
Running (g/mi)	51	0.080	0.080	0.0798	0.133	0.133	0.1325
Running (g/mi)	52	0.079	0.079	0.0794	0.133	0.133	0.1334
Running (g/mi)	53	0.079	0.079	0.0791	0.134	0.134	0.1343
Running (g/mi)	54	0.078	0.078	0.0784	0.135	0.135	0.1352
Running (g/mi)	55	0.078	0.078	0.0781	0.136	0.136	0.1358
Running (g/mi)	56	0.078	0.078	0.0782	0.137	0.137	0.1367
Running (g/mi)	57	0.078	0.078	0.0782	0.138	0.138	0.1375
Running (g/mi)	58	0.078	0.078	0.0782	0.138	0.138	0.1383
Running (g/mi)	59	0.078	0.078	0.0784	0.139	0.139	0.1392
Running (g/mi)	60	0.078	0.078	0.0782	0.140	0.140	0.1398
Running (g/mi)	61	0.079	0.079	0.0787	0.141	0.141	0.1408
Running (g/mi)	62	0.079	0.079	0.0788	0.142	0.142	0.1416
Running (g/mi)	63	0.079	0.079	0.0789	0.142	0.142	0.1423
Running (g/mi)	64	0.079	0.079	0.0790	0.143	0.143	0.1433
Running (g/mi)	65	0.079	0.079	0.0791	0.144	0.144	0.1439

Emission Type	VOC	NOx
Cold Start (g/trip start, Light Duty Only)	0.4640	0.1565
Hot Soak Loss (g/trip end)	0.2055	-
Hot Start (g/trip start, Light Duty Only)	0.0855	0.0383

Exhibit - 3
VOC MOBILE6.2 RUNNING EMISSION RATES
COMMUTE STREAM
FOR 2008, 2009, 2010, 2020 AND 2030
WEIGHTED AVERAGE of ARTERIAL & FREEWAY

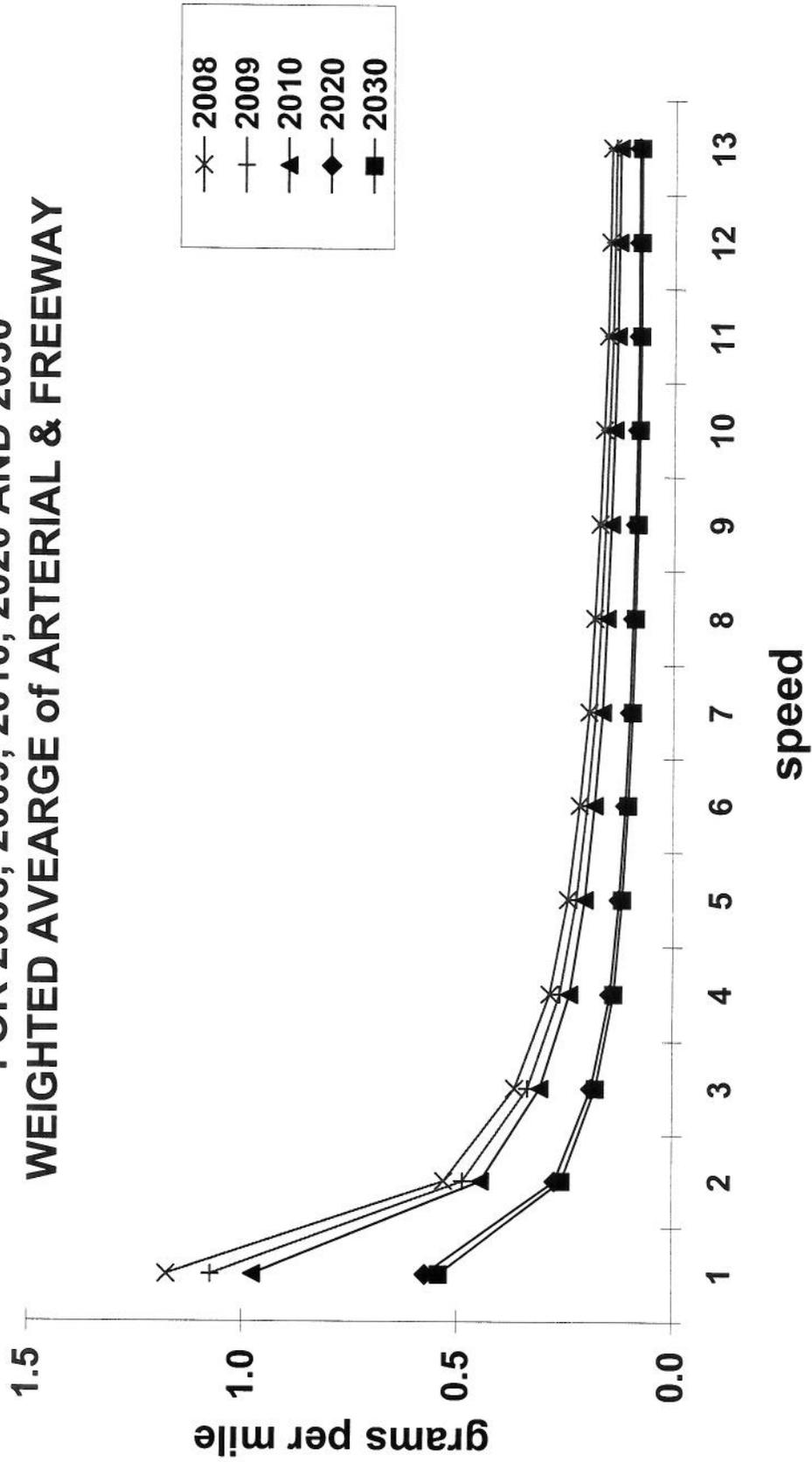


Exhibit - 4
NOx MOBILE6.2 RUNNING EMISSION RATES
COMMUTE STREAM
FOR 2008, 2009, 2010, 2020 AND 2030
WEIGHTED AVERAGE OF ARTERIAL & FREEWAY

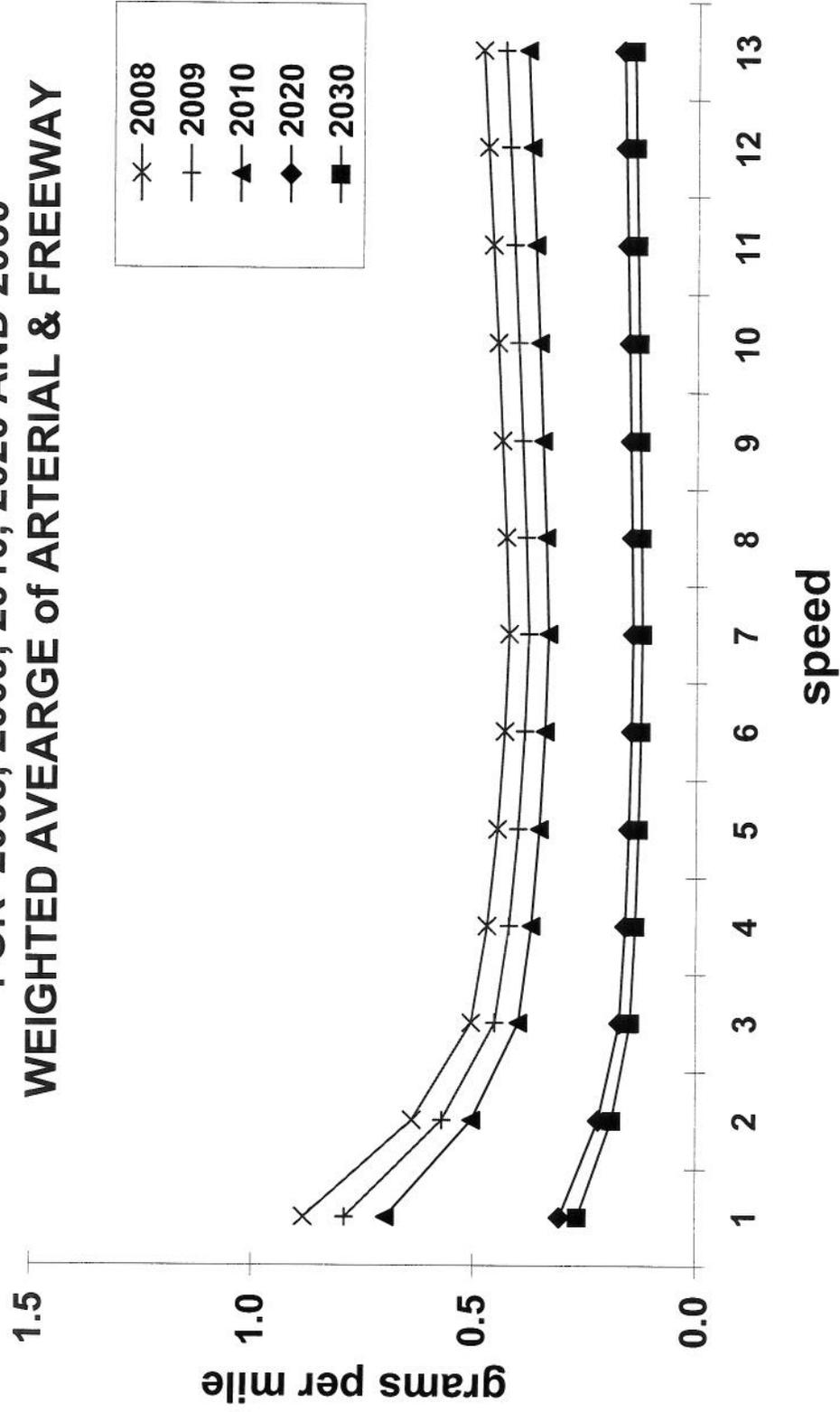


Table - 12 Idling Emissions Factors
(Mobile 6.2)

Vehicle Type	2010			2020			2030		
	VOC (g/hr)	NOx (g/hr)	PM (g/hr)	VOC (g/hr)	NOx (g/hr)	PM (g/hr)	VOC (g/hr)	NOx (g/hr)	PM (g/hr)
LDGV	1.1688	2.3925	-	0.5313	0.9000	-	0.4563	0.7300	-
LDGT12	1.2500	2.1900	-	0.7175	0.8813	-	0.6850	0.7863	-
LDGT34	1.9950	3.0913	-	0.9838	1.3038	-	0.8650	1.1038	-
HDGV	14.3938	4.5063	-	6.1063	1.1400	-	5.1125	0.3263	-
LDDV	0.6225	0.8638	-	0.2925	0.1625	-	0.2575	0.1113	-
LDDT	1.7250	2.0675	-	0.4288	0.3100	-	0.3775	0.2413	-
HDDV	3.1125	32.1350	0.9841	1.8663	6.5875	0.9237	1.6975	1.9863	0.9237
MC	20.2563	1.5825	-	20.2288	1.5825	-	20.2288	1.5825	-
Avg. for all vehicles	1.8401	4.2763	-	1.0011	1.3492	-	0.9213	0.9040	-

Notes:

- 1- NOx & VOC Average rates for all vehicle is weighted by the VMT percentages
- 2- EPA Mobile 6 guidance provides instructions for estimating PM idling rates only for heavy duty vehicles
- 3- PM average shown in the above table are based on the average of three jurisdictions. (District of Columbia, Fairfax County, Montgomery County)

Also for use in the emissions reduction calculations average weighted speed by time period are shown in Table 13 below. The 24 hour regional average weighted speed is 41 miles per hour and should be used for TERMS affecting the entire traffic stream, where site-specific speed data are not available. Please express reductions of VOC and NOx for all years in both kilograms per day and tons per day using a conversion factor of .0011 (# of kg reduced x .0011 = # of tons reduced).

Table 13: Average Weighted Speeds by Hour

Time	Speed (mph)
12-1	48
1-2	49
2-3	49
3-4	49
4-5	48
5-6	45
6-7	41
7-8	38
8-9	39
9-10	41
10-11	43
11-12	42
12-1 PM	40
1-2 PM	42
2-3 PM	42
3-4 PM	41
4-5 PM	40
5-6 PM	39
6-7 PM	40
7-8 PM	42
8-9 PM	43
9-10 PM	44
10-11 PM	45
11-12 MID	45
24 Hour Avg	41

Table 14: Mobile 6 Vehicle Classifications		
Number	Abbreviation	Description
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
6	HDGV2b	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8a	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8b	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)
15	LDDT12	Light-Duty Diesel Trucks 1 and 2 (0-6,000 lbs. GVWR)
16	HDDV2b	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
22	HDDV8a	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8b	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

General Assumptions

The detailed assumptions for the each TERMS varies as per the nature of the TERM. However, some of the assumptions are common to the all the TERMS. Such assumptions included 2010 travel conditions, regional average emissions factors, regional average one way trip length of 15.5 miles etc.

Following tables shows regional data (VT & VMT by purpose, year) obtained from the travel demand model and some of the generic assumptions are the being used for the TERM analysis.

Table 15- Daily Regional Home Based Work Purpose Mode Analysis by Year

YEAR	HBW MOTORIZED PERSON	TOTAL HBW AUTO PSN	TOTAL HBW AUTO DRV	HBW CAROCC	HBW TRANSIT	HBW TRANSIT (%)
2002	4,324,141	3,786,913	3,383,290	1.119	537,228	12.42%
2010	4,996,374	4,402,627	3,917,671	1.124	593,747	11.88%
2020	5,735,274	5,050,711	4,493,080	1.124	684,563	11.94%
2030	6,457,144	5,715,775	5,083,862	1.124	741,369	11.48%

Table 16- Daily Regional Analysis by Year for all Trip Purposes

YEAR	TOTAL MOTORIZED PERSON	TOTAL AUTO PSN	TOTAL AUTO DRV	TOTAL CAROCC	TOTAL TRANSIT	TRANSIT (%)
2002	24,716,371	23,795,845	18,220,519	1.303	920,526	3.72%
2010	28,346,002	27,339,680	20,901,519	1.304	1,006,322	3.55%
2020	32,098,012	30,908,000	23,571,119	1.300	1,190,012	3.71%
2030	35,535,918	34,245,929	26,215,916	1.296	1,289,989	3.63%

Table 17- Daily Regional Vehicle Trips by Purpose by Year

YEAR	WORK & NON-WORK AUTO DRV	TRUCKS (MED + HVY)	MISC + THRU TRIPS	TOTAL VEH. TRIPS	TOTAL VMT
2002	18,257,637	479,016	708,631	19,445,284	149,205,834
2010	20,972,066	558,629	824,585	22,355,280	171,415,586
2020	23,773,735	652,136	952,699	25,378,570	195,681,991
2030	26,421,717	746,394	1,082,348	28,250,459	216,988,518

Source: 2005 CLRP / FY2006-2011 TIP CLRP air quality conformity document

Cost Effectiveness Estimation Procedure

The staff has gathered cost information from the various agencies and cost figures are in today's dollars. The TERMS project cost is expressed in terms of TIP cost and cost per year. The total

cost of project thus includes capital cost, operating cost and maintenance cost. The TIP cost consists of capital cost, and three year of operating cost and maintenance cost. For the cost effectiveness annualized cost has been used. The annualized cost is total cost per year. The following formula shows the procedure.

Consistency between programming agencies in assumptions and methodology for effectiveness estimations is critical for meaningful comparison of different projects around the region.

Therefore, please use the following guidelines when calculating the cost effectiveness of your TERM projects. When determining the cost effectiveness, capital costs, operating costs, and revenues should be considered. Projects should be expressed in dollars per ton of reduction for both VOC and NOx. Please use the following series of formulas to compute cost effectiveness:

$$A. \text{ Total Project Cost} = \text{Capital Costs} + \text{Operating Costs} - (\text{Revenues} + \text{Resale Value, if relevant/significant})$$

$$B. \text{ Cost Per Day} = \frac{\text{Total Project Cost}}{\text{Benefit Days per Year} \times \text{Lifespan}}$$

$$C. \text{ Cost Per Ton} = \text{Cost Per Day} / \text{Tons VOC or NOx Reduced Per Day}$$

Where:

$$\text{Benefit Days per Year} = \begin{array}{l} 250 \text{ for projects mostly related to work travel (i.e.,} \\ \text{commuter lots, ridesharing)} \end{array}$$

$$365 \text{ for projects relating to all travel (e.g. roadway signal systems)}$$

$$\text{Lifespan}^1 = \begin{array}{l} 30 \text{ years for park and ride lot (construction)} \\ 100 \text{ years for park and ride lot land (right-of-way)} \\ 20 \text{ years for roadways} \\ 30 \text{ years for bridges} \\ 12 \text{ years for roadway signal systems} \\ 20 \text{ years for rail signalization} \\ 35 \text{ years for structures (i.e., garages)} \\ 12 \text{ years for buses} \\ 35 \text{ years for railcars} \\ 30 \text{ years for locomotives} \\ 10 \text{ years for sidewalks} \end{array}$$

Travel demand model assumptions:

Average one-way trip length for commute trips = 15.5 miles

Average vehicle occupancy = 1.12

¹ These lifespan values were provided by various transit and highway agencies and consultants. If lifespan values necessary for the cost/benefit calculation of any TERM projects are not provided, please contact Daivamani Sivasailam at (202) 962-3226.

Section II

The EPA guidance on fine particulate matter (PM 2.5) emissions requires the region to estimate direct PM 2.5 and NOx emissions as a PM2.5 precursor. In addition these emissions estimations are required on an annual basis and not on a daily basis as in the case of ozone precursors. Direct PM2.5 emission rates are constant for all speeds and are expressed in grams/mile. Direct PM 2.5 has no start-up, soak or other evaporative emissions associated with them. However, NOx as a precursor to PM 2.5 is similar to NOx as a precursor to ozone, and has start-up emissions in addition to running emissions.

The recommended methodology to estimate annual direct PM2.5 and NOx emissions as a PM2.5 precursor is to use an average of the three seasonal emission rates (Jan–April, May–September, & October–December) and apply these average rates to annual VT and VMT to estimate the annual direct PM2.5 and precursor NOx emissions. Direct PM2.5 emissions rates and average seasonal precursor NOx emissions rates for the analysis years 2010, 2020, & 2030 are shown in Tables 18, 19, 20, & 21

An example of a commuter TERM analysis with PM2.5 and NOx emissions as a PM2.5 precursor is shown on the following pages.

Table-18

Direct PM2.5 Emissions Factors

Scenario	Season	Speed	Facility	Total PM
2010 PM25 - Auto Access	Jan-Apr	35.0	Arterial	0.0115
	May-Sep	35.0	Arterial	0.0115
	Oct-Dec	35.0	Arterial	0.0114
	Average			0.0115
2020 PM25 - Auto Access	Jan-Apr	35.0	Arterial	0.0113
	May-Sep	35.0	Arterial	0.0113
	Oct-Dec	35.0	Arterial	0.0113
	Average			0.0113
2030 PM25 - Auto Access	Jan-Apr	35.0	Arterial	0.0113
	May-Sep	35.0	Arterial	0.0113
	Oct-Dec	35.0	Arterial	0.0113
	Average			0.0113

**Table 19: PM2.5 Precursor NOx - 2010 Running, Cold Start
Average Emissions Factors for Commute TERMS (Mobile 6.2)
(Seasonal Average)**

Speed	Weighted Factor Jan-Apr NOx (grams/mile)	Weighted Factor May-Sep NOx (grams/mile)	Weighted Factor Oct-Dec NOx (grams/mile)	Average of Seasonal Factors (grams/mile)
1	0.9968	0.7555	0.8367	0.8630
2	0.9968	0.7555	0.8367	0.8630
3	0.9532	0.7201	0.8006	0.8246
4	0.8988	0.6757	0.7548	0.7764
5	0.8659	0.6492	0.7274	0.7475
6	0.7931	0.5914	0.6660	0.6835
7	0.7410	0.5501	0.6219	0.6377
8	0.7018	0.5189	0.5891	0.6033
9	0.6714	0.4949	0.5632	0.5765
10	0.6472	0.4755	0.5429	0.5552
11	0.6143	0.4495	0.5151	0.5263
12	0.5868	0.4280	0.4920	0.5023
13	0.5637	0.4097	0.4725	0.4820
14	0.5439	0.3940	0.4557	0.4645
15	0.5266	0.3805	0.4412	0.4494
16	0.5197	0.3746	0.4353	0.4432
17	0.5135	0.3694	0.4302	0.4377
18	0.5080	0.3648	0.4257	0.4328
19	0.5033	0.3606	0.4215	0.4285
20	0.4988	0.3568	0.4178	0.4245
21	0.4948	0.3535	0.4145	0.4209
22	0.4914	0.3504	0.4115	0.4178
23	0.4880	0.3475	0.4089	0.4148
24	0.4851	0.3448	0.4063	0.4121
25	0.4824	0.3426	0.4040	0.4097
26	0.4798	0.3402	0.4019	0.4073
27	0.4776	0.3382	0.4001	0.4053
28	0.4754	0.3361	0.3982	0.4032
29	0.4734	0.3343	0.3966	0.4014
30	0.4716	0.3327	0.3950	0.3998
31	0.4704	0.3314	0.3940	0.3986
32	0.4693	0.3302	0.3931	0.3975
33	0.4684	0.3291	0.3923	0.3966
34	0.4674	0.3280	0.3915	0.3956
35	0.4666	0.3272	0.3907	0.3948
36	0.4660	0.3266	0.3929	0.3968
37	0.4711	0.3302	0.3948	0.3987
38	0.4732	0.3313	0.3965	0.4003
39	0.4752	0.3330	0.3983	0.4022
40	0.4772	0.3342	0.4000	0.4038
41	0.4800	0.3362	0.4026	0.4063
42	0.4829	0.3382	0.4048	0.4086
43	0.4858	0.3401	0.4072	0.4110
44	0.4881	0.3415	0.4096	0.4131
45	0.4906	0.3434	0.4116	0.4152
46	0.4936	0.3455	0.4143	0.4178
47	0.4966	0.3474	0.4167	0.4202
48	0.4994	0.3494	0.4191	0.4226
49	0.5022	0.3512	0.4213	0.4249
50	0.5045	0.3530	0.4235	0.4270
51	0.5077	0.3551	0.4263	0.4297
52	0.5108	0.3573	0.4292	0.4324
53	0.5138	0.3594	0.4315	0.4349
54	0.5168	0.3614	0.4340	0.4374
55	0.5195	0.3634	0.4364	0.4398
56	0.5227	0.3656	0.4392	0.4425
57	0.5259	0.3677	0.4421	0.4452
58	0.5292	0.3698	0.4446	0.4479
59	0.5320	0.3718	0.4471	0.4503
60	0.5347	0.3738	0.4496	0.4527
61	0.5382	0.3761	0.4525	0.4556
62	0.5411	0.3784	0.4552	0.4582
63	0.5440	0.3804	0.4577	0.4607
64	0.5472	0.3821	0.4603	0.4632
65	0.5501	0.3842	0.4627	0.4657

	Jan-Apr	May-Sep	Oct-Dec	Average
Cold Start (g/trip start, Light Duty Only)	0.7816	0.5441	0.6700	0.6652

**Table 20: PM2.5 Precursor NOx - 2020 Running, Cold Start
Average Emissions Factors for Commute TERMS (Mobile 6.2)
(Seasonal Average)**

Speed	Weighted Factor Jan-Apr NOx (grams/mile)	Weighted Factor May-Sep NOx (grams/mile)	Weighted Factor Oct-Dec NOx (grams/mile)	Average of Seasonal Factors (grams/mile)
1	0.2483	0.2042	0.2288	0.2271
2	0.2483	0.2042	0.2288	0.2271
3	0.2377	0.1946	0.2191	0.2171
4	0.2243	0.1826	0.2068	0.2046
5	0.2163	0.1754	0.1996	0.1971
6	0.1979	0.1594	0.1823	0.1799
7	0.1846	0.1480	0.1703	0.1676
8	0.1747	0.1395	0.1611	0.1584
9	0.1671	0.1328	0.1539	0.1513
10	0.1610	0.1275	0.1483	0.1456
11	0.1526	0.1204	0.1405	0.1378
12	0.1456	0.1144	0.1341	0.1314
13	0.1398	0.1094	0.1287	0.1260
14	0.1348	0.1051	0.1240	0.1213
15	0.1305	0.1014	0.1199	0.1173
16	0.1288	0.0998	0.1185	0.1157
17	0.1273	0.0984	0.1170	0.1143
18	0.1260	0.0972	0.1158	0.1130
19	0.1248	0.0961	0.1147	0.1119
20	0.1236	0.0951	0.1137	0.1108
21	0.1227	0.0941	0.1129	0.1099
22	0.1219	0.0934	0.1121	0.1091
23	0.1211	0.0927	0.1113	0.1083
24	0.1203	0.0919	0.1107	0.1077
25	0.1198	0.0913	0.1099	0.1070
26	0.1191	0.0906	0.1095	0.1064
27	0.1186	0.0902	0.1090	0.1059
28	0.1181	0.0896	0.1086	0.1054
29	0.1177	0.0892	0.1081	0.1050
30	0.1172	0.0887	0.1077	0.1045
31	0.1169	0.0883	0.1074	0.1042
32	0.1167	0.0880	0.1073	0.1040
33	0.1164	0.0877	0.1070	0.1037
34	0.1162	0.0874	0.1068	0.1035
35	0.1160	0.0871	0.1066	0.1032
36	0.1167	0.0876	0.1072	0.1038
37	0.1173	0.0881	0.1078	0.1044
38	0.1179	0.0885	0.1084	0.1049
39	0.1185	0.0889	0.1089	0.1054
40	0.1189	0.0892	0.1094	0.1058
41	0.1198	0.0898	0.1102	0.1066
42	0.1206	0.0904	0.1109	0.1073
43	0.1214	0.0909	0.1117	0.1080
44	0.1220	0.0914	0.1124	0.1086
45	0.1227	0.0919	0.1130	0.1092
46	0.1235	0.0926	0.1137	0.1099
47	0.1244	0.0931	0.1145	0.1107
48	0.1252	0.0937	0.1153	0.1114
49	0.1260	0.0942	0.1159	0.1120
50	0.1267	0.0948	0.1166	0.1127
51	0.1276	0.0954	0.1176	0.1135
52	0.1286	0.0961	0.1184	0.1143
53	0.1294	0.0967	0.1192	0.1151
54	0.1302	0.0973	0.1199	0.1158
55	0.1310	0.0979	0.1208	0.1166
56	0.1319	0.0987	0.1216	0.1174
57	0.1329	0.0993	0.1224	0.1182
58	0.1338	0.1000	0.1234	0.1191
59	0.1345	0.1006	0.1241	0.1198
60	0.1354	0.1012	0.1249	0.1205
61	0.1364	0.1019	0.1259	0.1214
62	0.1373	0.1025	0.1268	0.1222
63	0.1382	0.1031	0.1275	0.1229
64	0.1391	0.1037	0.1283	0.1237
65	0.1398	0.1043	0.1291	0.1244

	Jan-Apr	May-Sep	Oct-Dec	Average
Cold Start (g/trip start, Light Duty Only)	0.1968	0.1414	0.1806	0.1729

**Table 21: PM2.5 Precursor NOx - 2030 Running, Cold Start
Average Emissions Factors for Commute TERMS (Mobile 6.2)
(Seasonal Average)**

Speed	Weighted Factor Jan-Apr NOx (grams/mile)	Weighted Factor May-Sep NOx (grams/mile)	Weighted Factor Oct-Dec NOx (grams/mile)	Average of Seasonal Factors (grams/mile)
1	0.2093	0.1773	0.1994	0.1953
2	0.2093	0.1773	0.1994	0.1953
3	0.2003	0.1690	0.1909	0.1867
4	0.1893	0.1586	0.1803	0.1760
5	0.1826	0.1522	0.1740	0.1696
6	0.1668	0.1384	0.1590	0.1547
7	0.1556	0.1283	0.1483	0.1441
8	0.1473	0.1209	0.1403	0.1362
9	0.1408	0.1150	0.1340	0.1299
10	0.1355	0.1103	0.1290	0.1249
11	0.1284	0.1042	0.1223	0.1183
12	0.1225	0.0990	0.1166	0.1127
13	0.1175	0.0945	0.1118	0.1079
14	0.1132	0.0907	0.1077	0.1039
15	0.1096	0.0875	0.1042	0.1004
16	0.1081	0.0861	0.1028	0.0990
17	0.1068	0.0850	0.1015	0.0978
18	0.1057	0.0838	0.1006	0.0967
19	0.1047	0.0829	0.0996	0.0958
20	0.1038	0.0820	0.0987	0.0948
21	0.1032	0.0812	0.0980	0.0941
22	0.1023	0.0805	0.0974	0.0934
23	0.1017	0.0798	0.0967	0.0927
24	0.1011	0.0793	0.0961	0.0921
25	0.1006	0.0787	0.0956	0.0916
26	0.1002	0.0781	0.0952	0.0911
27	0.0997	0.0777	0.0947	0.0907
28	0.0992	0.0772	0.0943	0.0903
29	0.0988	0.0768	0.0939	0.0898
30	0.0985	0.0764	0.0936	0.0895
31	0.0982	0.0761	0.0934	0.0892
32	0.0980	0.0759	0.0932	0.0890
33	0.0978	0.0756	0.0930	0.0888
34	0.0976	0.0752	0.0927	0.0885
35	0.0974	0.0751	0.0925	0.0884
36	0.0981	0.0753	0.0931	0.0888
37	0.0986	0.0759	0.0937	0.0894
38	0.0991	0.0763	0.0942	0.0898
39	0.0996	0.0766	0.0947	0.0903
40	0.1000	0.0771	0.0952	0.0908
41	0.1008	0.0774	0.0959	0.0914
42	0.1015	0.0779	0.0966	0.0920
43	0.1021	0.0784	0.0972	0.0926
44	0.1028	0.0789	0.0978	0.0932
45	0.1034	0.0794	0.0984	0.0937
46	0.1041	0.0798	0.0991	0.0944
47	0.1049	0.0804	0.0998	0.0950
48	0.1056	0.0809	0.1004	0.0956
49	0.1063	0.0814	0.1011	0.0963
50	0.1070	0.0819	0.1018	0.0969
51	0.1078	0.0826	0.1026	0.0976
52	0.1085	0.0831	0.1034	0.0984
53	0.1093	0.0838	0.1041	0.0991
54	0.1101	0.0841	0.1049	0.0997
55	0.1108	0.0847	0.1055	0.1003
56	0.1116	0.0853	0.1063	0.1010
57	0.1124	0.0859	0.1071	0.1018
58	0.1133	0.0865	0.1079	0.1025
59	0.1141	0.0870	0.1086	0.1032
60	0.1148	0.0875	0.1093	0.1039
61	0.1155	0.0881	0.1100	0.1045
62	0.1163	0.0888	0.1108	0.1053
63	0.1173	0.0893	0.1116	0.1061
64	0.1180	0.0899	0.1124	0.1068
65	0.1186	0.0904	0.1131	0.1074

	Jan-Apr	May-Sep	Oct-Dec	Average
Cold Start (g/trip start, Light Duty Only)	0.1410	0.1042	0.1340	0.1264

EXAMPLE OF A COMMUTING VEHICLE TRIP TERM ANALYSIS

Proposal: Construction of 1300 additional Parking Spaces at a Metro Station

Description: 1,300 parking spaces will be constructed at a Metro station. The garages at Metrorail stations are currently experiencing full utilization of all existing parking capacity on a daily basis.

Analysis Tool: Sketch Planning

Assumptions:

- To build 1,300 additional parking spaces at a Metro station to increase capacity at a station. Cost to construct the garage is assumed to be \$2.117 million dollars. Life span: 30 years
- New trips generated due to additional parking spaces will be 2/3 of new spaces.
- Average one-way trip length reduced will be 15.5 miles.
- No cold start benefit, as autos will drive to station.
- NOx & VOC estimation using Mobile 6.2 Emissions factors.

Summary Impacts (2010):

Daily VT Reduction:	0	VT
Daily VMT Reduction:	26,846	VMT
Daily NOx Reductions:	0.0100	tons/day
Daily VOC Reductions:	0.0046	tons/day
Cost Effectiveness (NOx)	28,917	\$/ton
Cost Effectiveness (VOC)	63,282	\$/ton

Emission Impacts for (2010):

1,300 additional spaces

Trip length: 15.5 mile x 2 = 31 mi round trip

2/3 new trips: $2/3 \times 1300 = 866$ trips

866×31 miles = 26,846 VMT

Daily NOx & VOC emission reductions (2010):

NOx Estimation

Cold Start	0	x	$\frac{0.518 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0000	tons
Running	26,846	x	$\frac{0.3392 \text{ grams}}{1 \text{ mile}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0108	tons
							Total	0.0100 tons

VOC Estimation

Cold Start + Hot soak	0	x	$\frac{1.5015 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0000	tons
Running	26,846	x	$\frac{0.155 \text{ grams}}{1 \text{ mile}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0046	tons
							Total	0.0046 tons

Methodology for PM2.5 emissions estimation:

Direct PM2.5

Direct PM2.5 emissions factors are available for three seasons (Jan-April, May-Sept., Oct.-Dec). Estimation of direct PM2.5 emissions can be carried out on a seasonal or an annual basis. As PM2.5 seasonal emission factors do not vary significantly, the average of these four seasonal factors is used to estimate annual PM emissions. Please refer Table -14.

The travel demand model and postprocessor use average annual weekday traffic (AAWDT) for analysis. Hence for the analysis of TERMS which are effective 7-days a week, VT and VMT for such TERMS need to be adjusted to reflect average daily traffic (AADT). A factor of 0.95 is used to convert AAWDT volume to AADT volume. For the TERMS that affect only commuter traffic (effective only on weekdays) no adjustment is needed as the VT and VMT reflect average weekday traffic. The formulae for annual direct PM2.5 estimation for these TERMS are shown as below.

For the TERMS effective 365 days:

$$\text{Direct PM2.5 Emissions} = \text{VMT} \times \text{average of seasonal emissions factors} \times \text{weekly VMT adjustment factor} \times \text{days/year.}$$

$$\text{Running } 26,846 \times \frac{0.0115 \text{ grams}}{1 \text{ mi}} \times \frac{1 \text{ ton}}{907,185 \text{ grams}} \times 0.95 \times 365 \text{ days} = 0.1180 \text{ tons}$$

For the TERMS effective only on weekdays:

$$\text{Direct PM2.5 Emissions} = \text{VMT} \times \text{average of seasonal emissions factors} \times \text{days/year.}$$

$$\text{Running } 26,846 \times \frac{0.0115 \text{ grams}}{1 \text{ mi}} \times \frac{1 \text{ ton}}{907,185 \text{ grams}} \times 250 \text{ days} = 0.0851 \text{ Tons}$$

NOx Emissions as a PM 2.5 Precursor:

As conformity assessment criteria for the PM2.5 standards include NOx emissions as a PM 2.5 precursor, we are also required to estimate NOx emissions on seasonal/annual basis. For TERM analysis we follow the annual approach similar to the PM2.5 emission estimation as described above. Emission factors corresponding to 40 mph speed are used to estimate cold start and running NOx precursor emissions. Tables 15-17 show the average of the NOx seasonal emissions factors for years 2010, 2020 and 2030.

For the TERMS effective 365 days:

Cold Start	0	x	$\frac{0.6652 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	x 0.95	x 365	=	0.0000 Tons
Running	26,846	x	$\frac{0.4038 \text{ grams}}{1 \text{ mi}}$	x	$\frac{1 \text{ ton}}{907,185}$	x 0.95	x 365	=	4.1435 Tons
					Total				4.1435 Tons

For the TERMS effective only on weekdays:

Cold Start	0	x	$\frac{0.6652 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	x 250	=	0.0000 Tons
Running	26,846	x	$\frac{0.4038 \text{ grams}}{1 \text{ mi}}$	x	$\frac{1 \text{ ton}}{907,185}$	x 250	=	2.9874 Tons
					Total			2.9874 Tons

Cost Effectiveness (2010):

Garage cost (assumed): \$2.177 million

$$\text{NOx} = \frac{\$2.177 \text{ million}}{250 \text{ days} \times 30 \text{ yr} \times 0.010 \text{ t/d}} = \$28,910 / \text{ton}$$

$$\text{VOC} = \frac{\$2.177 \text{ million}}{250 \text{ days} \times 30 \text{ yr} \times 0.046 \text{ t/d}} = \$63,282 / \text{ton}$$

$$\text{PM2.5} = \frac{\$2.177 \text{ million}}{30 \text{ yr} \times 0.1180 \text{ t/yr}} = \$615,000 / \text{ton}$$

Example-2: Implement 10 Neighborhood Circulator Bus Service to Metrorail

Description:

The circulator bus service would operate over an expanded period from 5:30 am to 10:00 am and from 3:00 pm to 8:00 pm on weekdays.

Analysis Tool: Sketch Planning

Assumptions:

- Sketch planning is used as an analysis tool
- Two buses per neighborhood will be required at a cost of \$150,000 per bus, with a useful life of 12 years.
- Anticipated ridership is 150 riders per day per circulator, for a total of 1500 additional transit riders per day.
- Average trip length = 15.5 miles
- The stations where circulator service could be implemented include:
 - ✓ Cheverly station
 - ✓ Deanwood station
 - ✓ Minnesota Ave. station
 - ✓ Vienna/Fairfax – GMU station
 - ✓ Dunn Loring – Merrifield station
 - ✓ Greenbel station
 - ✓ Van Dorn Street station
 - ✓ Addison Road station
 - ✓ Glenmont station
 - ✓ Rhode Island Ave. station
 - ✓ New Carrollton

Summary of Impacts (2010)

Daily VT Reduction:	3,000	VT
Daily VMT Reduction:	46,500	VMT
Daily NOx Reductions:	0.0191	tons/day
Daily VOC Reductions:	0.0129	tons/day
Cost Effectiveness (NOx)	235,604	\$/ton
Cost Effectiveness (VOC)	348,560	\$/ton

Emission Analysis (2010)

Anticipated ridership = 150 riders/day/circulator

150 * 10 = 1500 additional riders

1 rider = 2 trips

1,500 * 2 = 3000 VT

VMT: 3000 x 15.5 = 46500 VMT

Daily Emissions Reduction

NOx Estimation

Cold Start	3000	x	$\frac{0.5181 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0017	tons
Running	46,500	x	$\frac{0.3392 \text{ grams}}{1 \text{ mile}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0174	tons
					Total		0.0191	tons

VOC Estimation

Cold Start + Hot soak	3000	x	$\frac{1.5015 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0050	tons
Running	46,500	x	$\frac{0.1550 \text{ grams}}{1 \text{ mile}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0079	tons
					Total		0.0129	tons

Cost Analysis:

Annual Operating Costs (\$100,000/bus): \$1,000,000
 Capital Costs: \$150,000/bus x 10 = \$ 1,500,000
 Annualized cost: \$1,000,000 + \$1,500,000/12 = \$1,125,000
 TIP Cost (2006-2011): \$1,000,000 x 5 + \$1,500,000 = \$6,500,000

Cost Effectiveness (2010):

Cost effectiveness NOx	$\frac{\$1,125,000}{250 \times 0.0191}$	=	235,604	\$/ton
Cost effectiveness VOC	$\frac{\$1,125,000}{250 \times 0.0129}$	=	348,560	\$/ton

Direct PM2.5

For the TERMS effective 365 days:

Direct PM2.5 Emissions = VMT x average of seasonal emissions factors x weekly VMT adjustment factor x days/year.

$$\text{Running } 46,500 \times \frac{0.0115 \text{ grams}}{1 \text{ mi}} \times \frac{1 \text{ ton}}{907,185 \text{ grams}} \times 0.95 \times 365 \text{ days} = 0.2044 \text{ tons}$$

For the TERMS effective only on weekdays:

Direct PM2.5 Emissions = VMT x average of seasonal emissions factors x days/year.

$$\text{Running } 46,500 \times \frac{0.0115 \text{ grams}}{1 \text{ mi}} \times \frac{1 \text{ ton}}{907,185 \text{ grams}} \times 250 \text{ days} = 0.1474 \text{ Tons}$$

NOx Emissions as a PM 2.5 Precursor:

For the TERMS effective 365 days:

Cold Start	3000	x	$\frac{0.6652 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	x	365	=	0.7628 Tons
Running	46,500	x	$\frac{0.4038 \text{ grams}}{1 \text{ mi}}$	x	$\frac{1 \text{ ton}}{907,185}$	x	0.95 x 365	=	7.1769 Tons
Total									7.9397 Tons

For the TERMS effective only on weekdays:

Cold Start	3000	x	$\frac{0.6652 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	x	250	=	0.5499 Tons
Running	46,500	x	$\frac{0.4038 \text{ grams}}{1 \text{ mi}}$	x	$\frac{1 \text{ ton}}{907,185}$	x	250	=	5.1477 Tons
Total									5.7224 Tons

Cost Effectiveness (2010):

$$\text{PM2.5} = \frac{\$1.125 \text{ million}}{30 \text{ yr} \times 0.2044 \text{ t/yr}} = \frac{\$5,504,000}{\text{ton}}$$

Example-3: Bus Information Displays with Maps at Bus Stops

Description:

This measure would provide more information at 2,000 Metrobus locations.

Note: WMATA is implementing this TERM

Assumptions

- Sketch planning is used as an analysis tool
- Decrease in waiting time: 2.5 minutes
- Average daily bus ridership: 500,000
- Average daily local bus ridership: 124,000
- Program would be launched in 2008 and continue through 2009
- Average trip length: 15.5 miles

Summary Impact

Daily VT Reduction:	2,210	VT
Daily VMT Reduction:	34,255	VMT
Daily NOx Reductions:	0.0141	tons/day
Daily VOC Reductions:	0.0095	tons/day
Cost Effectiveness (NOx)	28,474	\$/ton
Cost Effectiveness (VOC)	42,126	\$/ton

Emission Analysis

Local bus average daily Ridership	124,000
Average daily WMATA bus ridership	500,000
Average daily regional bus ridership	$500,000 + 124,000 = 624,000$
Total daily person trips	$4,400,000 \text{ (conformity)} \times 0.25 \text{ (HBW)} = 17,600,000$

Regional bus mode share percentage = $624,000 / 17,600,000 = 3.55 \%$

Assumed benefit from the system = 2.5 minute decrease in wait time.

$3.55 \% \rightarrow 4.07\% = 0.52\%$ increase in bus mode share due to decrease in wait time

(Source: William Allen, Mode Choice Model Sensitivity Analysis, April 1993)

WMATA Buses: $500,000 \text{ (0.52\%)} = 2600 \text{ new trips}$
VT reductions: $2600 \times 0.85 \text{ SOV} = 2210$

VMT reductions: 2210 x 15.5 miles = 34255

Daily NOx Emission Reductions (2010)

Nox Estimation

Cold Start	2210	x	$\frac{0.5181 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.00123	tons
Running	34,255	x	$\frac{0.3392 \text{ grams}}{1 \text{ mile}}$	x	$\frac{1 \text{ ton}}{907185 \text{ grams}}$	=	0.0128	tons
							Total	0.0141 tons

VOC Estimation

Cold Start + Hot Soak	2210	x	$\frac{1.5015 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	=	0.0037	tons
Running	34,255	x	$\frac{0.1550 \text{ grams}}{1 \text{ mile}}$	x	$\frac{1 \text{ ton}}{907185 \text{ grams}}$	=	0.0059	tons
							Total	0.0095 tons

Cost Analysis

Cost per box = \$120.00

Number of boxes = 2000

Cost for 2000 display boxes = \$240,000

Capital cost per car – \$30,000

Operating Cost for car to change schedule = \$40,000

Life of car – 6 years

Annualized cost – \$240,000 / 3 years + \$30,000/6 years + \$40,000 = \$125,000

TIP Cost: \$240,000 + \$30,000 + \$40,000 x 2 = \$350,000

Cost Effectiveness (2010)

Cost effectiveness NOx	$\frac{\$125,000}{312 \times 0.0141}$	=	28,470	\$/ton
Cost effectiveness VOC	$\frac{\$125,000}{312 \times 0.0095}$	=	42,126	\$/ton

Direct PM2.5

For the TERMS effective 365 days:

Direct PM2.5 Emissions = VMT x average of seasonal emissions factors x weekly VMT adjustment factor x days/year.

$$\text{Running } 34255 \times \frac{0.0115 \text{ grams}}{1 \text{ mi}} \times \frac{1 \text{ ton}}{907,185 \text{ grams}} \times 0.95 \times 365 \text{ days} = 0.1506 \text{ tons}$$

For the TERMS effective only on weekdays:

Direct PM2.5 Emissions = VMT x average of seasonal emissions factors x days/year.

$$\text{Running } 34255 \times \frac{0.0115 \text{ grams}}{1 \text{ mi}} \times \frac{1 \text{ ton}}{907,185 \text{ grams}} \times 250 \text{ days} = 0.1086 \text{ Tons}$$

NOx Emissions as a PM 2.5 Precursor:

For the TERMS effective 365 days:

Cold Start	2210	x	$\frac{0.6652 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	x	365	=	0.5619 Tons
Running	34255	x	$\frac{0.4038 \text{ grams}}{1 \text{ mi}}$	x	$\frac{1 \text{ ton}}{907,185}$	x	0.95 x 365	=	5.2870 Tons
Total									5.8489 Tons

For the TERMS effective only on weekdays:

Cold Start	2210	x	$\frac{0.6652 \text{ grams}}{1 \text{ trip}}$	x	$\frac{1 \text{ ton}}{907,185 \text{ grams}}$	x	250	=	0.4051 Tons
Running	34255	x	$\frac{0.4038 \text{ grams}}{1 \text{ mi}}$	x	$\frac{1 \text{ ton}}{907,185}$	x	250	=	3.8118 Tons
Total									4.2170 Tons

Cost Effectiveness (2010):

$$\text{PM2.5} = \frac{\$125,000}{0.1506 \text{ t/yr}} = \$830,010/\text{ton}$$