ASSESSMENT OF AIR QUALITY IMPACT OF A PROPOSED SECTION OF INTERSTATE 66

by

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Virginia Highway Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways and the University of Virginia)

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INTRODUCTION

This report presents an assessment of the impact of a proposed section of Interstate 66 on the quality of the air in the immediate area of the project and in adjacent areas. The proposed project begins with an extension of existing I-66 at the interchange on I-495 in Fairfax County, passes through Arlington County, and terminates near the Key Bridge.

Because of the limited time available for the assessment, consideration was given to only the most abundant gaseous pollutant emitted by motor vehicles, namely, carbon monoxide (CO).

The assessment includes: (1) a mesoscale analysis of the effect of the proposed highway on the total CO emissions for the area, and (2) a microscale or corridor analysis to estimate the CO concentrations to be expected in some immediate areas of the project after its completion.

TRAFFIC DATA

The traffic data used in the analyses were furnished by the Metropolitan Transportation Planning Division of the Virginia Department of Highways. The data were for three years, namely: (1) 1975, the estimated date of completion (EDC); (2) 1985, ten years after the EDC; and (3) 1995, twenty years after the EDC. The data for 1975 were taken as 96% of those for 1985.

The types of traffic data used were: (1) peak hour and off-peak hour conditions in terms of vehicles per hour (vph), average route speed and traffic mix; and (2) daily vehicle miles traveled (DVMT) and traffic mix. Data were furnished for both the proposed I-66 and the existing major roads in the area. For the latter, two possibilities were presented: (1) an estimate assuming I-66 is not built, and (2) an estimate assuming it is.

No data were available for urban mass transit or land use regulations in the area.

The traffic data are summarized in Tables I and II. (All tables and figures are appended.)

EMISSION FACTORS (EF)

The vehicular emission factors for carbon monoxide used in the analyses were developed by the California Division of Highways,[1] based on the California Air Resources Board (ARB) and the Environmental Protection Agency (EPA) emission control standards.

The emission factors take into account several criteria that affect vehicular emissions: (1) emission control standards for light and heavy duty vehicles for each model year, (2) deterioration of emission control devices as a function of miles traveled, (3) the vehicle model-year mix at any given time, (4) the percentage of heavy duty vehicles (HDV, traffix mix) and (5) emissions as a function of average route speed. It is the consensus of the California ARB and the EPA that emission factors based on the ARB test procedure are realistic for the freeway operating mode, while emission factors based on the 1972 EPA procedures are realistic for the city-street operating mode.

The emission factors have been reviewed and approved by the California ARB and the EPA for use by the California Division of Highways in its air quality impact study. These factors are shown in Figures 1, 2, and 3. It must be emphasized, however, that they probably give slightly lower pollutant concentrations than would be expected in Virginia. This situation arises because California is about three years ahead of the federal standards for automobile pollution control devices. Therefore, in these analyses 1972 emission factors were used for the 1975 study, 1984 factors for the 1985 study, and 1995 factors for the 1995 study.

In the corridor analysis, the projected traffic mix for the proposed I-66 extension was approximately 8% HDV. The emission factors for the next higher percentage HDV, namely 10% HDV, were used. This usage would result in approximately 6% higher pollutant concentrations.

METEOROLOGICAL DATA

The proposed I-66 extension begins at the interchange on I-495 in Fairfax County, passes through Arlington County, and terminates near the Key Bridge. Since this general area is bounded on the west by the Dulles International Airport and on the east by the National Airport, the meteorological data observed for these airports would be ideal for use in the area. However, because of the inadequacy of the data for Dulles, only the National Airport data were used. Besides, it is felt that the National Airport data are representative of the area under construction.

The hourly surface meteorological data for National Airport used in this analysis included the hour of the day, the day of the month, the year, the cloud cover, ceiling height, and wind direction and speed for the period from January 1952 to December 1961. Ten years' data were used in order to provide valid estimations of the air flow patterns in the study area.

The meteorological data were processed by a computer program whose output is a set of stability wind rose data which gives the relative frequency distributions of 16 wind directions, 9 wind speed classes, and 6 stability classes for different times and seasons.(2) The stability wind rose data (Tables III — VII) were then used in a highway line source dispersion model (Appendix I) to estimate the pollutant concentration within the highway corridor for 1975 and 1990.

The National Airport meteorological data were obtained from the National Climatic Center of the National Oceanic and Atmospheric Administration, Asheville, North Carolina.

MATHEMATICAL ANALYSIS

In order to assess the impact of the Interstate 66 on the air quality of the affected area, the meso- and microscale analyses were made as described below.

Mesoscale Analysis

The mesoscale analysis involved estimations of the total carbon monoxide emission (Appendix II) of the existing and anticipated major roads in the area, with the assumptions that I-66 is not built and that I-66 is built. A comparison of such total emission would yield the effect of the proposed I-66 on the overall air quality of the area. By performing the analysis for the years 1975, 1985, and 1995, one can also estimate the general trend of these pollutant emissions.

The inputs for this analysis were DVMT estimates for each major road and the emission factors discussed earlier in the report.

The results of the analysis with and without the proposed I-66 are presented in Table VIII. The table shows that as the traffic on major roads decreases due to the operation of the proposed I-66 the emissions from these roads decrease correspondingly. The operation of I-66 will result in a reduction in the total CO emissions of 17% for 1975, 7.0% for 1985, and 7.5% for 1995. Figure 4 illustrates this reduction in CO emissions and shows the general trend of pollutant emissions from 1975 to 1995. The relatively large reductions in emissions (77% without I-66 and 74% with I-66) from 1975 to 1985 will be due to more effective emission controls in motor vehicles.

Table IX shows that from 1975 to 1985 there will be a 59% increase in the daily vehicle miles of travel in the area, even without the proposed I-66. However, instead of a corresponding increase in CO emissions, there will be a 73% decrease because of improved emission control devices. If I-66 is built as planned, the CO emissions will be reduced further to 75%. This reduction will result from the combined effects of better emission control devices and the operation of the proposed I-66. Since emission controls account for 73% of the reduction, the remaining 2% emission reduction must be credited to I-66.

Microscale Analysis

The microscale analysis produces an estimate of the CO pollutant levels (in ppm.) adjacent to the proposed roadway (at 50 ft., 100 ft., and 200 ft. from the edge of the pavement). The analysis was performed for the years 1975 to 1995. As time was very limited for this study, the analysis was carried out only for the winter months (December, January, and February); however, since the worst meteorological conditions and therefore the highest pollutant levels occur during the winter (see Tables III and IV), this limited analysis provides a valid estimate of the impact of the proposed facility.

Nine sites were chosen as representative of the corridor area. Figures 5 and 6 show the prevailing and worst CO concentrations, respectively, along site No. 1. The prevailing and worst conditions for all sites are shown in Tables X — XV. Note that in some instances the predicted worst case is a lower level than the prevailing case. This implies that because of local conditions (see Appendix I) the theoretically worst case was not as dangerous as others. As explained in Appendix I, all such occurrences are easily understood and it can be shown that in such instances it is wise to select the prevailing case as also being the worst case.

The extremes for the corridor analyses are summarized in Table XVI. As can be seen from this table, the low values are well within the federal standards of 35 ppm. averaged over an hour period. Note that the highest values, although at first alarming, have a very low probability of occurrence (around 1-2%) and will last no longer than one hour, thus they will still fall within the federal standards.[3] (California allows the occurrence of a one-hour peak up to 40 ppm. — and I-66 would be well within this standard.)

In summary, the results of this analysis are very encouraging. The values are generally low (recall that the winter months are the most adverse) and the highest values have a very minimal chance of occurrence. Finally, the 1995 predictions show that the highway will have a minimal effect on the environment.

REFERENCES

1. Ranzieri, A. J., et al., "Motor Vehicle Emission Factors for Estimates of Highway Impact on Air Quality," California Division of Highways, Research Report No. M & R 657082S-2, February 1972.

2. Environmental Protection Agency, Air Pollution Meteorology, January 1971.

3. Environmental Protection Agency, Federal Register, Vol. 36, No. 84, April 30, 1971.

4. Ranzieri, A. J., et al., "Meteorology and Its Influence on the Dispersion of Pollutants from Highway Line Source," California Division of Highways, Research Report No. M & R 657082S-3, March 1972.

APPENDIX I

MICROSCALE ANALYSIS

The microscale analysis is divided into two categories by meteorological type; i.e., the prevailing and worst cases. The worst case, is taken as the light wind condition (4-7 mph) where the winds are parallel to the highway alignment, in which case an accumulation or build-up effect is observed.

The method used to predict the prevailing nonparallel effect of the roadway is developed in full detail in Reference 4. For the parallel analysis, the Virgina Highway Research Council has developed its own mathematical approach based on the generally accepted Gaussian dispersion model for gaseous pollutants. The California model was not used for the parallel analysis since preliminary data from California indicated that their parallel model may overestimate by a factor of as much as 1,000%. There is also evidence that the California nonparallel model occasionally overestimates by as much as 400%; however, since it generally gives accurate results (an occasional overestimation is perhaps more in the public interest than an underestimation) it was used.

Since the report is not intended as a forum for scientific or mathematical analyses, the Virginia Highway Research Council's parallel model will not be further pursued. However, a complete mathematical presentation is available.

As mentioned in the body of this report, there are some instances where the parallel case does not yield the higher pollutant concentrations. In these instances, it can be seen that one of several factors has an effect:

1. Pollutants are "trapped" in a cut in the parallel case thus increasing concentrations within the cut, but simultaneously decreasing concentrations outside the cut.

2. Winds parallel to a cut or fill prevent the occurrence of aerodynamic eddies near the edges of the protruding level masses and therefore, actually cause a reduction in local pollutant concentrations.

3. The roadway may be located near one edge of a large valley (with the observer located at the top of that edge), in which case winds blowing across the valley will pile the pollutants up near the observer while winds parallel to the valley would "sweep" the pollutants from the hillside.

Again, the theoretical aspects of the gaseous dispersion model have not been detailed; however, detailed descriptions of the analyses can be made available upon request.

APPENDIX II

MESOSCALE ANALYSIS

The mesoscale analysis evaluates the overall effect of a proposed highway on the air quality of its environment. A comparison is made of the total emissions with and without the new highway. This comparison indicates the increase or decrease in pollutant emissions that the new facility precipitates by changes in local traffic patterns.

In the analysis the following information is needed:

1. Daily vehicle miles traveled for freeways and local streets both with and without the proposed facility.

2. Average daily route speeds for freeways and local streets.

3. Emission factors for CO as a function of average route speed.

The pollutant emission (tons per day) from each road is estimated from the equation:

$$\text{Tons per day} = \text{E. F.} \times \text{DVMT} \times 1.10 \times 10^{-6}$$

where E. F. = emission factor in grams/mile
DVMT = daily vehicle miles traveled

The summation of the emissions from the individual roads yields the total pollutant emission for the affected area.

TABLE I

TRAFFIC DATA

Route	From	To	Length	DVMT with I-66		DVMT without I-66		% Trucks for	Average Operating Speeds (MPH)	
				1985	1995	1985	1995	1985 & 1995 ADT	1985 (off peak)	1995 (off peak)
Route 50	Rte. 650	Glebe Road	7.13 mi.	468,720	693,690	730,690	1,081,430	3%	30	Same as 1985
	Glebe Road	S. Lynn St.	2.68	192,810	285,360	254,460	376,600	3%	45	
	S. Lynn St.	Roosevelt Br.	0.53	49,790	73,700	56,150	83,110	3%	40	
Route 7	Dulles Access	Rte. 123	1.33	36,140	53,480	77,680	114,980	4%	45	
	Rte. 123	Rte. 66	2.37	72,040	106,620	142,310	210,610	4%	30	
	Rte. 66	Rte. 50	2.96	43,450	64,300	150,480	222,710	3%	25	
Route 123	Rte. 7	Rte. 495	0.93	23,810	35,240	29,610	43,820	3%	35	
	Rte. 495	Dulles Access	0.83	15,980	23,650	22,650	33,520	3%	40	
	Dulles Access	Rte. 193	3.50	95,800	141,790	176,430	261,130	2%	35	
	Rte. 193	Glebe Road	1.77	32,150	47,570	65,958	77,860	2%	30	
	Glebe Road	D.C. Line	0.07	2,090	3,090	2,880	4,260	2%	20	
Route 29 & 211	Rte. 650	Rte. 338	2.90	85,410	126,410	120,200	177,910	4%	35	
	Rte. 338	Rte. 120	3.23	86,270	127,690	160,700	237,850	3-4%	25	
	Rte. 120	Lynn St.	3.03	126,640	187,420	152,660	226,360	2%	30	
	Lynn St.	Key Bridge	0.13	14,840	21,960	15,360	22,740	2%	20	
G. W. Mem. Pkwy.	Rte. 123	Rte. 29 & 211	4.77	190,300	281,650	323,140	478,240	0%	40	
	Rte. 29 & 211	Rte. 66	0.67	27,990	41,426	38,160	56,480	0%	35	
Wilson Blvd.	Rte. 50	Four Mile Run	1.27	25,030	37,050	44,780	66,270	3%	30	
	Four Mile Run	10th Street	2.06	40,600	60,080	68,070	100,730	3%	25	
	10th Street	Rte. 50	2.17	78,550	116,260	114,000	168,630	3%	20	

Traffic Data Table I (Continued)

Route	From	To	Length	DVMT with I-66		DVMT without I-66		% Trucks for 1985 & 1995 ADT	Average Operating Speeds (MPH)	
				1985	1995	1985	1995		1985 (off peak)	1995 (off peak)
Route 120	6th St.	Wash. Blvd.	1.90 mi.	31,050	45,970	61,940	91,690	3%	30	Same as 1985
	Wash. Blvd.	Rte. 29 & 211	1.00	17,490	25,880	27,560	40,800	3%	35	
	Rte. 29 & 211	Rte. 123	3.07	84,580	125,160	87,650	129,710	3%	25	
Route 338	Rte. 29 & 211	Rte. 7 & 50	1.20	18,920	28,010	22,700	33,600	3%	30	
Ft. Myer Dr. & N. Lynn St.	Rte. 50	Rte. 29 & 211	1.00	76,300	112,920	80,310	118,860	3%	25	
Four Mile Run	Rte. 66	Rte. 50	1.27	79,620	117,840	13,260	19,630	3%	35	
Fairfax Drive	Rte. 66	Arlington Blvd.	1.92	59,610	88,600	57,300	84,800	3%	30	
Wash. Blvd.	Lee Hwy.	Wilson Blvd.	3.37	95,060	140,690	125,660	185,970	5%	25	
Dulles Access Rd.	Leesburg Pk.	Rte. 123	2.34	201,630	298,420	109,310	161,790	2%	60	
	Rte. 123	Rte. 66	2.03	133,110	196,990	13,840	49,950	2%	55	
Route 124	Rte. 29 & 211	G. W. Pkwy.	0.87	30,020	44,440	33,080	48,950	0%	40	
Route 495	Gallows Rd.	Rte. 193	7.15	409,110	684,900	607,010	898,320	6-9%	65	
Route 66	Rte. 243	Rte. 495	2.40	251,420	372,120	157,680	233,380	5%	65	
	Rte. 495	Lee Hwy.	7.68	801,990	1,186,960			4%	60	
	Lee Hwy.	Ft. Myer Dr.	1.47	85,360	126,340			4%	50	
	Ft. Myer Dr.	D. C. Line	0.77	77,750	93,600	43,348	64,160	4%	50	

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TABLE II

TRAFFIC DATA FOR INTERSTATE 66

Route	From	To	1985 & 1995 Peak Hour VPH, W/and W/O I-66					1985 & 1995 Off Peak VPH, W/and W/O I-66					Ave. Oper. Speed	
			1985	1985	1995	1995	% of	1985	1985	1995	1995	% of	1985 & 1995	
			W/ I-66	W/O I-66	W/ I-66	W/O I-66	Trucks	W/ I-66	W/O I-66	W/I-66	W/O I-66	Trucks	Peak	Off Peak
Route 66	Rte. 243	Rte. 495	10,480	6,570	15,500	9,720	2.3	5,240	3,280	7,750	4,860	5.8	40 MPH	65 MPH
	Rte. 495	Leesburg Pk.	8,040		11,900		2.0	4,020		5,950		5.0	40	60
	Leesburg Pk.	Dulles Access	9,170		13,570		2.0	4,580		6,780		5.0	40	60
	Dulles Access	Westmoreland Rd.	12,660		18,740		2.0	6,330		9,370		5.0	40	60
	Westmoreland Rd.	Wash. St.	11,570		17,120		2.0	5,780		8,560		5.0	40	60
	Wash. St.	Sycamore	12,860		19,040		2.0	6,430		9,520		5.0	40	60
	Sycamore	Patrick Henry	14,100		20,870		2.0	7,050		10,430		5.0	40	60
	Patrick Henry	Fairfax Dr.	11,230		16,610		2.0	5,610		8,300		5.0	40	60
	Fairfax Dr.	N. Glebe	7,190		10,650		2.0	3,590		5,320		5.0	40	60
	N. Glebe	Lee Hwy.	8,510		12,590		2.0	4,250		6,290		5.0	40	60
	Lee Hwy.	Spout Run Pkwy.	8,330		12,330		2.0	4,160		6,260		5.0	40	50
	Spout Run Pkwy.	Lee Hwy.	5,760		8,520		2.0	2,880		4,260		5.0	40	50
	Lee Hwy.	Ft. Myer	4,200		6,220		2.0	2,100		3,110		4.0	40	50
	Ft. Myer	Roosevelt Br.	9,440	4,860	13,970	7,190	2.0	4,720	2,430	6,980	3,590	4.0	35	50
	Roosevelt Br.	D. C. Line	14,510	10,780		15,960	2.0	7,250	5,390		7,980	4.0	35	50

TABLE III

RELATIVE FREQUENCY DISTRIBUTION OF STABILITY CLASSES IN WINTER MONTHS

Winter: (December, January, February)

	Stability Class	% Relative Frequency
Hours (7, 8, 9)	A	0.4062
	B	3.9513
	C	7.2378
	D	60.9675
	E	13.3678
	F	14.0694
Hours (11, 12, 13)	A	0.4799
	B	7.5305
	C	19.3060
	D	72.6836
	E	0
	F	0
Hours (16, 17, 18)	A	0.2216
	B	2.0679
	C	4.9852
	D	62.2230
	E	17.3929
	F	13.1093

TABLE IV

RELATIVE FREQUENCY DISTRIBUTION OF STABILITY CLASSES IN SUMMER MONTHS

Summer: (June, July, August)

	Stability Class	% Relative Frequency
Hours (6, 7, *)	A	19.0217
	B	23.5145
	C	18.1884
	D	25.0000
	E	6.1232
	F	8.1522
Hours (10, 11, 12)	A	12.7536
	B	29.6014
	C	35.4710
	D	22.1739
	E	0
	F	0
Hours (15, 16, 17)	A	8.8768
	B	30.6159
	C	41.9927
	D	18.5145
	E	0
	F	0

TABLE V

PREVAILING STABILITY WIND ROSE DATA FOR MORNING PEAK HOURS IN WINTER MONTHS

WEATHER STATION NO.13743 NAME: VIRGINIA
MAGNETIC TAPE NO. 040000 PERIOD OF RECORD: 1/52 TO 12/61
PROJECT DESCRIPTION: I-66 NORTHERN VIRGINIA AIR STUDIES
SOURCE: 19701 CHARGE: 19701 EA: 762561 LCC: E40SL
IN THE FOLLOWING TABLE THE CALMS ARE DISTRIBUTED

THE FOLLOWING TABLE IS FOR :
MONTHS OF JAN FEB DEC COMBINED
HOURS 7 8 9 COMBINED
STABILITY CLASS D

********** FREQUENCY DISTRIBUTION **********

DIRECTION	SPEED,MPH 0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47	TOT	AVE	%
N	7	10	30	34	10	2	0	0	0	92	12.6	5.6
NNE	5	17	25	38	7	0	0	0	0	92	11.8	5.6
NE	5	15	57	34	4	0	0	0	0	115	11.1	7.0
ENE	6	35	53	15	1	0	0	0	0	111	8.9	6.7
E	7	14	6	2	0	0	0	0	0	30	6.3	1.8
ESE	1	17	6	3	0	0	0	0	0	27	7.4	1.6
SE	6	8	9	0	0	0	0	0	0	23	6.3	1.4
SSE	1	21	18	2	1	1	0	0	0	44	8.5	2.7
S	9	43	59	29	3	0	0	0	0	143	9.5	8.6
SSW	3	(43)	(71)	(50)	8	0	0	0	0	174	10.9	(10.5)
SW	10	14	24	13	2	1	0	0	0	64	9.5	3.9
WSW	1	19	17	6	1	0	0	0	0	45	8.8	2.7
W	8	8	15	19	5	1	0	0	0	55	11.4	3.4
WNW	1	16	31	(108)	32	10	3	0	0	201	15.7	(12.1)
NW	4	16	56	(99)	43	16	1	0	0	235	15.3	(14.2)
NNW	8	16	46	(102)	25	6	0	0	0	202	14.1	(12.2)
CALM	38	0	0	0	0	0	0	0	0	38	0.0	0.0
TOT	81	312	524	554	142	37	4	0	0	1655	0.0	0.0

TABLE VI

PREVAILING STABILITY WIND ROSE DATA FOR NOON OFF-PEAK HOURS IN WINTER MONTHS

WEATHER STATION NO.13743 NAME: VIRGINIA
MAGNETIC TAPE NO. 040000 PERIOD OF RECORD: 1/52 TO 12/61
PROJECT DESCRIPTION: I-66 NORTHERN VIRGINIA AIR STUDIES
SOURCE: 19701 CHARGE: 19701 EA: 762561 LCC: E40SL
IN THE FOLLOWING TABLE THE CALMS ARE DISTRIBUTED

THE FOLLOWING TABLE IS FOR :
MONTHS OF JAN FEB DEC COMBINED
HOURS 11 12 13 COMBINED
STABILITY CLASS D

********** FREQUENCY DISTRIBUTION **********

DIRECTION	SPEED,MPH 0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47	TOT	AVE	%
N	2	9	14	35	9	2	0	0	0	71	13.9	3.6
NNE	1	21	28	31	2	0	0	0	0	84	11.0	4.2
NE	3	25	36	26	5	0	0	0	0	95	10.7	4.8
ENE	1	26	24	25	4	0	0	0	0	80	10.7	4.1
E	4	13	8	1	0	0	0	0	0	26	6.6	1.3
ESE	3	15	8	6	0	0	0	0	0	32	8.1	1.6
SE	1	17	9	5	0	0	0	0	0	32	8.2	1.6
SSE	2	34	20	7	2	0	0	0	0	66	8.3	3.3
S	5	(52)	(88)	(73)	6	1	0	0	0	225	10.9	(11.4)
SSW	6	23	(58)	(92)	24	4	0	0	0	207	13.4	(10.5)
SW	1	15	20	18	9	2	0	0	0	65	12.5	3.3
WSW	1	4	7	26	5	1	0	0	0	44	14.3	2.3
W	1	2	15	31	20	5	1	0	0	75	16.6	3.8
WNW	1	12	31	(143)	(83)	43	4	0	0	317	18.1	(16.1)
NW	2	14	27	(169)	(100)	18	1	0	0	331	17.1	(16.8)
NNW	2	14	30	107	52	14	0	0	0	219	16.2	11.1
CALM	23	0	0	0	0	0	0	0	0	23	0.0	0.0
TOT	39	295	423	795	321	90	6	0	0	1969	0.0	0.0

TABLE VII

PREVAILING STABILITY WIND ROSE DATA FOR EVENING PEAK HOURS IN WINTER MONTHS

WEATHER STATION NO.13743 NAME: VIRGINIA
MAGNETIC TAPE NO. 040000 PERIOD OF RECORD: 1/52 TO 12/61
PROJECT DESCRIPTION: I-66 NORTHERN VIRGINIA AIR STUDIES
SOURCE: 19701 CHARGE: 19701 EA: 762561 LCC: E40SL
IN THE FOLLOWING TABLE THE CALMS ARE DISTRIBUTED

THE FOLLOWING TABLE IS FOR :
MONTHS OF JAN FEB DEC COMBINED
HOURS 16 17 18 COMBINED
STABILITY CLASS D

********** FREQUENCY DISTRIBUTION **********

DIRECTION	SPEED, MPH 0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47	TOT	AVE	%
N	5	8	23	45	10	1	0	0	0	92	13.3	5.5
NNE	4	8	31	22	5	0	0	0	0	70	11.5	4.1
NE	3	10	24	32	5	1	0	0	0	75	12.4	4.5
ENE	4	18	35	28	4	5	1	0	1	97	11.9	5.7
E	0	8	15	3	0	0	0	0	0	26	9.3	1.5
ESE	3	9	26	6	0	0	0	0	0	44	9.2	2.6
SE	2	5	18	12	2	0	0	0	0	40	11.2	2.3
SSE	6	15	41	11	2	2	0	0	0	78	9.9	4.6
S	5	(39)	(80)	(50)	5	2	0	0	0	181	10.8	(10.8)
SSW	4	12	61	55	11	2	0	0	0	145	12.6	8.6
SW	6	12	11	9	4	3	0	0	0	45	10.9	2.7
WSW	1	5	7	7	1	0	0	0	0	21	10.8	1.3
W	1	5	4	20	9	1	1	0	0	41	15.4	2.5
WNW	0	3	37	(162)	(75)	18	1	1	0	297	17.1	(17.6)
NW	3	6	46	(138)	54	15	2	0	0	265	16.2	(15.7)
NNW	0	8	21	107	28	4	0	0	0	168	15.7	9.9
CALM	17	0	0	0	0	0	0	0	0	17	0.0	0.0
TOT	51	171	480	707	215	54	5	1	1	1685	0.0	0.0

TABLE VIII

Estimated Carbon Monoxide Emissions for Major Roads in the Affected Area

Route	DMVT W/O I-66			DMVT W/ I-66			CO (tons/day) W/O I-66			CO (tons/day W-I-66		
	1975	1985	1995	1975	1985	1995	1975	1985	1995	1975	1985	1995
50	999,648	1,041,300	1,541,140	682,865	711,320	1,052,750	47.60	9.57	11.87	32.13	6.52	8.11
7	226,049	235,470	548,300	145,563	151,630	224,400	10.75	3.43	4.22	7.38	1.40	1.73
123	285,624	297,528	420,590	163,034	169,830	251,340	13.49	2.73	3.24	7.68	1.55	1.94
29 & 211	430,962	448,920	664,860	300,633	313,160	403,480	23.31	4.20	5.12	16.12	2.93	3.57
G. Wash. Mem. Pkwy.	346,847	361,300	534,720	209,550	218,290	323,076	14.32	3.23	4.12	8.68	1.96	2.49
Wilson Blvd.	217,775	226,850	335,630	138,320	144,180	213,390	14.12	2.18	2.58	9.07	1.38	1.64
120	170,063	177,150	262,200	127,905	133,120	197,010	9.38	1.66	2.02	7.24	1.24	1.52
338	21,792	22,700	33,600	18,170	18,920	28,010	1.13	0.21	0.26	0.94	0.18	0.22
Ft. Myer Drive	77,097	80,310	118,860	73,200	76,300	112,920	4.66	0.76	0.92	4.43	0.72	0.87
Four Mile Drive	12,729	13,260	19,630	76,500	79,620	117,840	0.59	0.12	0.15	3.53	0.73	0.91
Fairfax Drive	55,008	57,300	84,800	57,200	59,610	88,600	2.84	0.54	0.65	2.96	0.56	0.68
Washington Blvd.	120,633	125,660	185,970	91,200	95,060	140,690	7.30	1.19	1.43	5.52	0.99	1.08
I-495	582,729	607,010	898,320	392,746	409,110	684,900	14.74	5.81	6.92	9.94	3.92	5.27
124	31,756	33,080	48,950	28,819	30,020	44,440	1.29	0.29	0.38	1.17	0.27	0.34
I-66	286,108	298,030		1,167,864	1,216,520	1,779,020	7.24	2.29	1.70	25.24	9.36	10.18
Dulles Access		123,150	182,270		334,741	495,410		0.95	1.04		2.82	2.83
Total CO Emissions							171.76	39.16	46.90	142.04	36.44	43.38
% Reduction in Total CO Emissions due to I-66										17%	7.0%	7.5%

TABLE IX

EFFECTS OF EMISSION CONTROL STANDARDS AND I-66 ON CARBON MONOXIDE EMISSIONS

Total DVMT W/O I-66, 1975		3,578,712 miles
1995		5,697,570 miles
% Total DVMT increase from 1975 to 1995		59%
% CO emission reduction from 1975 - 1995	W/O I-66	73%
	W/ I-66	75%

TABLE X

ESTIMATED CO CONCENTRATION RANGES AT SOME SITES ON I-66 CORRIDOR

Year: 1975
Month: Dec., Jan., Feb.

Hours: 7, 8, 9
Predominant Stability : Class D

Site No.	Description	ppm. for Most Probable Conditions				ppm. for Worst Conditions			
		% Probability	at 50 ft	at 100 ft	at 200 ft	% Probability	at 50 ft	at 100 ft	at 200 ft
1	Barbour Street	14	6-8	3-4	2-3	1	9-20	8-15	5-7
2	Virginia Lane	14	6-8	3-4	2-3	2	6-11	5-8	3-5
3	Greenwich St. & Haycock Rd.	14	19-26	9-13	8-11	1	13-23	11-19	6-13
4	Wyoming St. (by 29th St.)	14	2-3	2-3	2-3	1	4-6	3-6	2-4
5	McKinley Road	14	9-13	8-11	7-9	1	6-11	5-9	3-6
6	George Mason Dr. & Edison Street	14	3-4	3	2-3	1	4-6	3-5	1-3
7	Taylor Road	14	3-4	2-3	2-3	2	13-22	9-15	4-6
10	Near Potomac Tower Apt.	14	6-8	3-4	3	1	5-8	2-4	0-1
11	N. Quinn Street	14	2-3	1-2	1	2	3-6	2-3	0-1

TABLE XI

ESTIMATED CO CONCENTRATION RANGES AT SOME SITES ON I-66 CORRIDOR

Year: 1995 Hours: 7, 8, 9
Month: Dec., Jan., Feb. Predominant Stability: Class D

Site No.	Description	ppm. for Most Probable Conditons				ppm. for Worst Conditions			
		% Probability	at 50 ft	at 100 ft	at 200 ft	% Probability	at 50 ft	at 100 ft	at 200 ft
1	Barbour Street	14	2-3	1-2	1	1	4-8	3-6	2-3
2	Virginia Lane	14	2	1	1	2	2-4	2-3	1-2
3	Greenwich St. & Haycock Rd.	14	7-10	3-5	3-4	1	5-9	4-7	2-4
4	Wyoming St. (by 29th St.)	14	1	1	1	1	1-2	1-2	1-1
5	McKinley Road	14	3-5	3-4	3	1	2-4	2-4	1-2
6	George Mason Dr. & Edison Street	14	1-2	1-1	1	1	1-3	1-2	1
7	Taylor Road	14	1-2	1	1	2	5-9	3-6	1-2
10	Near Potomac Tower Apt.	14	2-3	1-2	1	1	2-3	1-2	0
11	N. Quinn Street	14	1	0-1	0	2	1-2	1	0

TABLE XII

ESTIMATED CO CONCENTRATION RANGES AT SOME SITES ON I-66 CORRIDOR

Year: 1975 Hours: 11,12,13
Month: Dec., Jan., Feb. Predominant Stability: Class D

Site No.	Description	ppm. for Most Probable Conditions				ppm. for Worst Conditions			
		% Probability	at 50 ft	at 100 ft	at 200 ft	% Probability	at 50 ft	at 100 ft	at 200 ft
1	Barbour Street	17	2-3	1	1	1	5-9	4-6	2-3
2	Virginia Lane	17	2-3	1	1	1	2-4	2-3	1-2
3	Greenwich St. & Haycock Rd.	17	7-10	3-5	3-4	1	5-8	4-7	2-4
4	Wyoming St. (by 29th St.)	17	1	1	1	1	1-2	1-2	1
5	McKinley Road	17	3-5	3-4	2-3	1	2-4	2-3	1-2
6	George Mason Dr. & Edison Street	17	1-2	1	1	1	1-2	1-2	1
7	Taylor Road	17	1	1	1	1	5-8	3-5	1-2
10	Near Potomac Tower Apt	17	2-3	1-2	1	1	2-3	1-2	0
11	N. Quinn Street	17	1	1	0-1	1	1-2	1	0

TABLE XIII

ESTIMATED CO CONCENTRATION RANGES AT SOME SITES ON I-66 CORRIDOR

Year: 1995
Month: Dec., Jan., Feb.

Hours: 11, 12, 13
Predominant Stability: Class D

Site No.	Description	ppm. for Most Probable Conditions				ppm. for Worst Conditions			
		% Probability	at 50 ft	at 100 ft	at 200 ft	% Probability	at 50 ft	at 100 ft	at 200 ft
1	Barbour Street	17	1	0	0	1	3-5	2-3	1-2
2	Virginia Lane	17	1	0	0	1	1-2	1-2	1
3	Greenwich St. & Haycock Rd.	17	4-5	2-3	2	1	3-5	2-4	1-2
4	Wyoming St. (by 29th St.)	17	0-1	0-1	0-1	1	1	1	0-1
5	McKinley Road	17	2-3	2	1-2	1	1-2	1-2	1
6	George Mason Dr. & Edison Street	17	1	1	1	1	1	1	0-1
7	Taylor Road	17	1	1	1	1	2-4	2-3	1
10	Near Potomac Tower Apt.	17	1	0-1	0	1	1-2	0-2	0
11	N. Quinn St.	17	0	0	0	1	1	0-1	0

TABLE XIV

ESTIMATED CO CONCENTRATION RANGES AT SOME SITES ON I-66 CORRIDOR

Year: 1975 Hours: 16, 17, 18
Month: Dec., Jan., Feb. Predominant Stability: Class D

Site No.	Description	ppm. for Most Probable Conditons				ppm. for Worst Conditons			
		% Probability	at 50 ft	at 100 ft	at 200 ft	% Probability	at 50 ft	at 100 ft	at 200 ft
1	Barbour Street	18	6-8	3-4	2-3	1	14-24	10-18	5-9
2	Virginia Lane	18	6-8	3-4	2-3	1	6-11	5-8	3-5
3	Greenwich St. & Haycock Road	18	5-7	4-5	2-3	1	13-23	11-19	6-11
4	Wyoming St. (by 29th St.)	18	2	1-2	1	1	4-6	3-6	2-4
5	McKinley Road	18	2-3	2-3	1-2	1	6-11	5-9	3-6
6	George Mason Dr. & Edison Street	18	4-5	3-5	3-4	1	4-6	3-5	1-3
7	Taylor Road	18	4-5	3-4	3	1	13-22	9-15	4-6
10	Near Potomac Tower Apt.	18	11-15	507	4-6	1	5-8	2-4	0-1
11	N. Quinn Street	18	3-4	2-2	1-2	2	3-6	2-3	0-1

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TABLE XV

ESTIMATED CO CONCENTRATION RANGES AT SOME SITES ON I-66 CORRIDOR

Year: 1995 Hours: 16, 17, 18
Month: Dec., Jan., Feb. Predominant Stability: Class D

Site No.	Description	ppm. for Most Probable Conditions				ppm. for Worst Conditions			
		% Probability	at 50 ft	at 100 ft	at 200 ft	% Probability	at 50 ft	at 100 ft	at 200 ft
1	Barbour Street	18	2-3	1-2	1	1	5-9	4-7	2-3
2	Virginia Lane	18	2-3	1	1	1	2-4	2-3	1-2
3	Greenwich St. & Haycock Rd.	18	2-3	2	1	1	5-9	4-7	2-4
4	Wyoming St. (by 29th St.)	18	0-1	0-1	0	1	1-2	1-2	1
5	McKinley Road	18	1	1	0-1	1	2-4	2-4	1-3
6	George Mason Drive & Edison Street	18	2	1-2	1-2	1	1-3	1-2	1
7	Taylor Road	18	2	1-2	1	1	5-9	3-6	1-2
10	Near Potomac Tower Apt.	18	4-6	2-3	2	1	2-3	1-2	0
11	N. Quinn Street	18	1-2	1	0-1	1	1-2	1	0

TABLE XVI

CORRIDOR ANALYSIS EXTREMES

Distance (ft)	1975 Morning Peak(ppm)	1975 Noon off Peak(ppm)	1975 Evening Peak(ppm)	1995 Morning Peak(ppm)	1995 Noon off Peak(ppm)	1995 Evening Peak(ppm)
	Lowest-Highest	Lowest-Highest	Lowest-Highest	Lowest-Highest	Lowest-Highest	Lowest-Highest
50	3 - 26	1 - 10	2 - 24	1 - 10	0 - 5	1 - 9
100	2 - 19	1 - 7	2 - 19	1 - 7	0 - 4	1 - 7
200	1 - 11	1 - 4	1 - 11	0 - 4	0 - 2	0 - 4

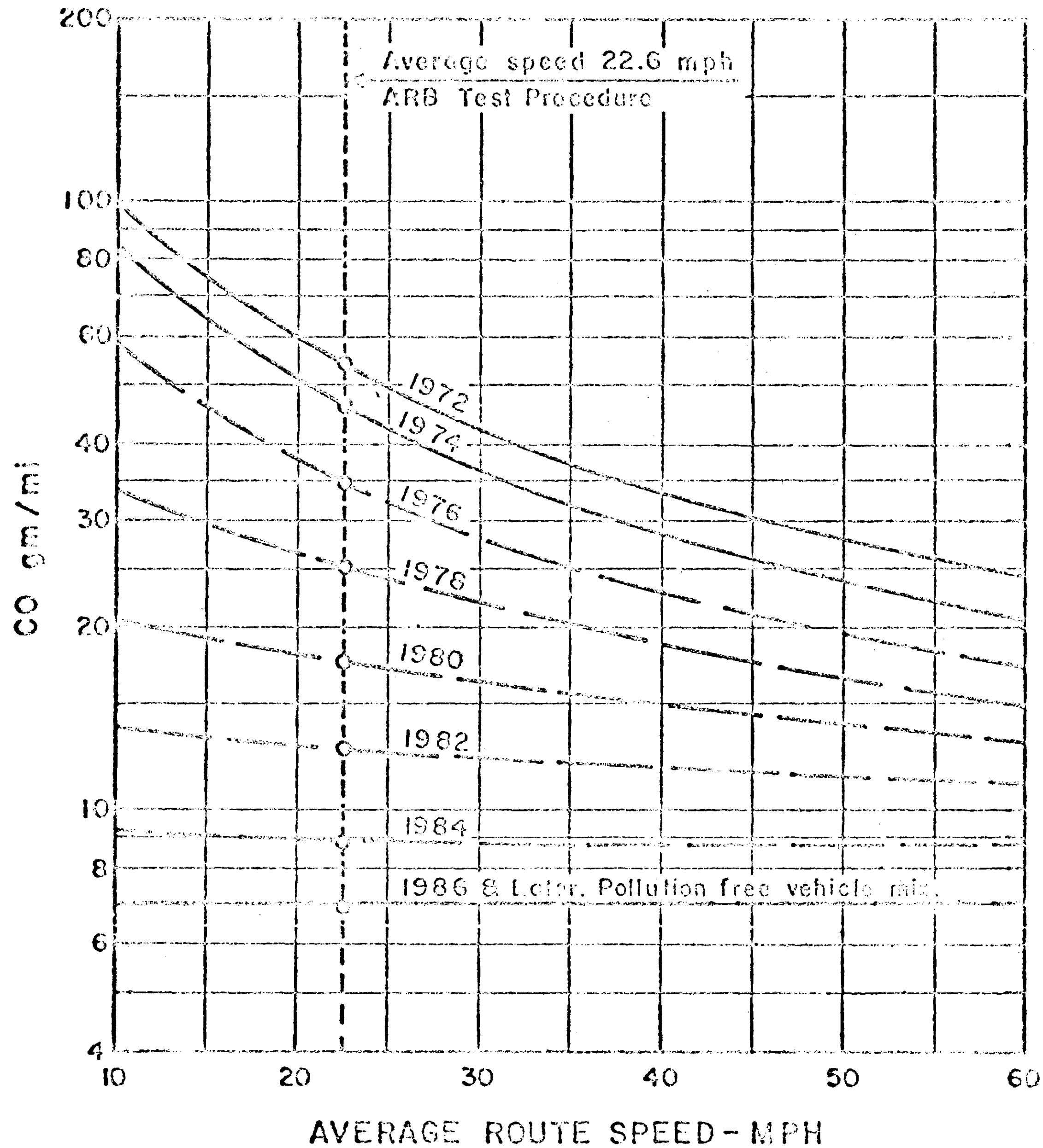

Figure 1: Emission factors for carbon monoxide vs. average route speed on freeways 10% HDV

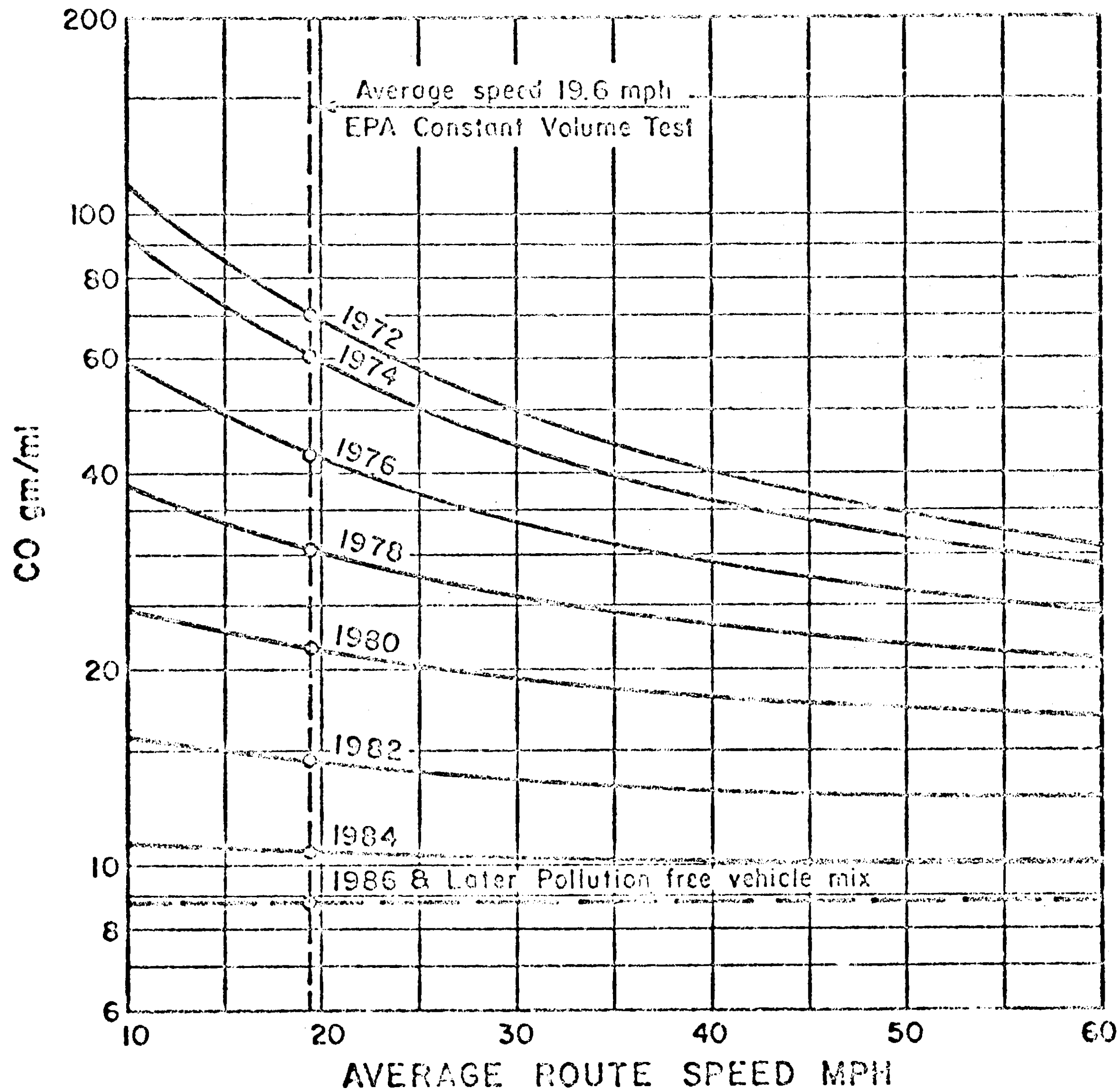

Figure 2: Emission factors for carbon monoxide vs. average route speed on city streets-10% HDV.

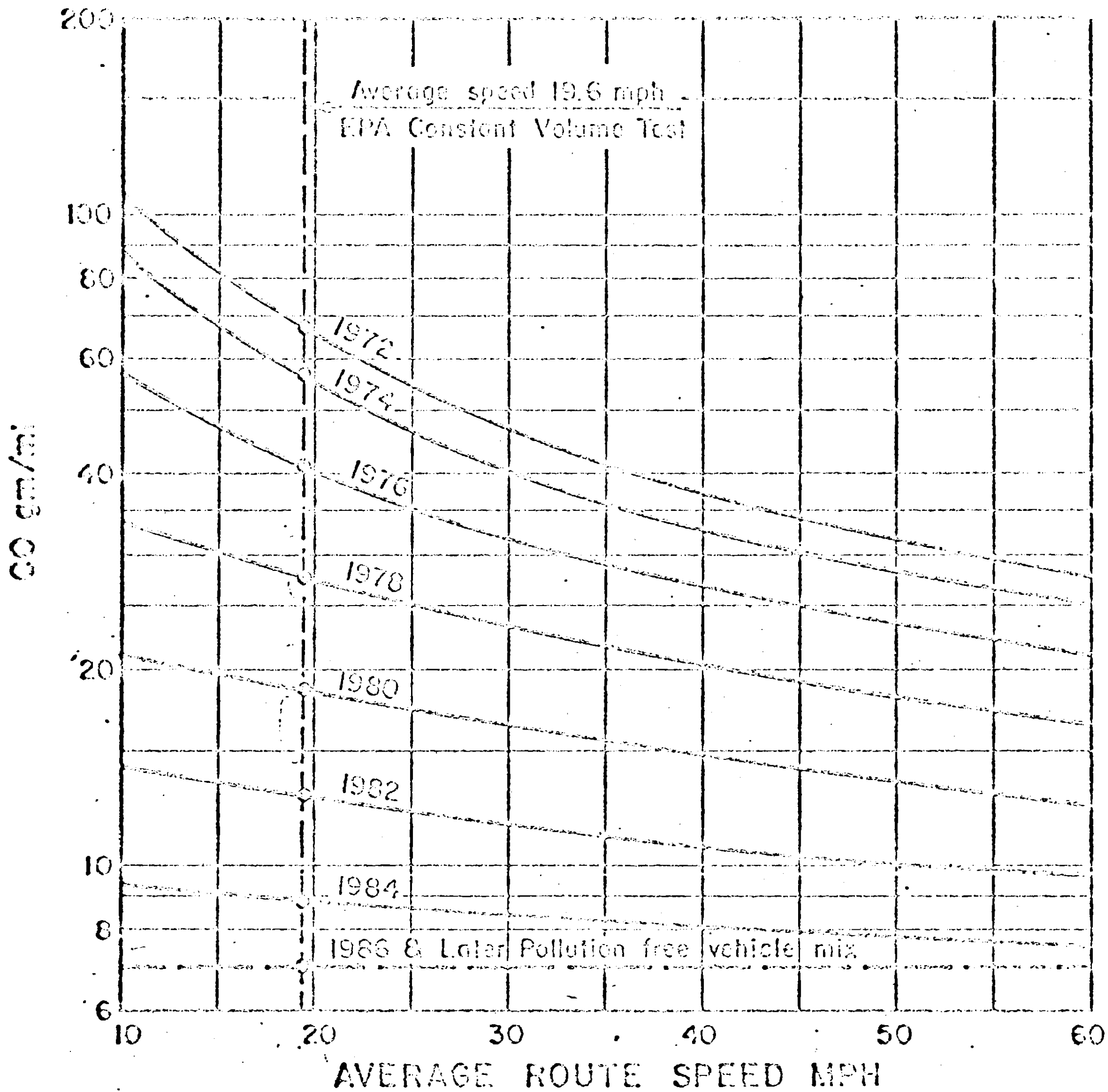

Figure 3: Emission factors for carbon monoxide vs. average route speed on city streets 5% HDV.

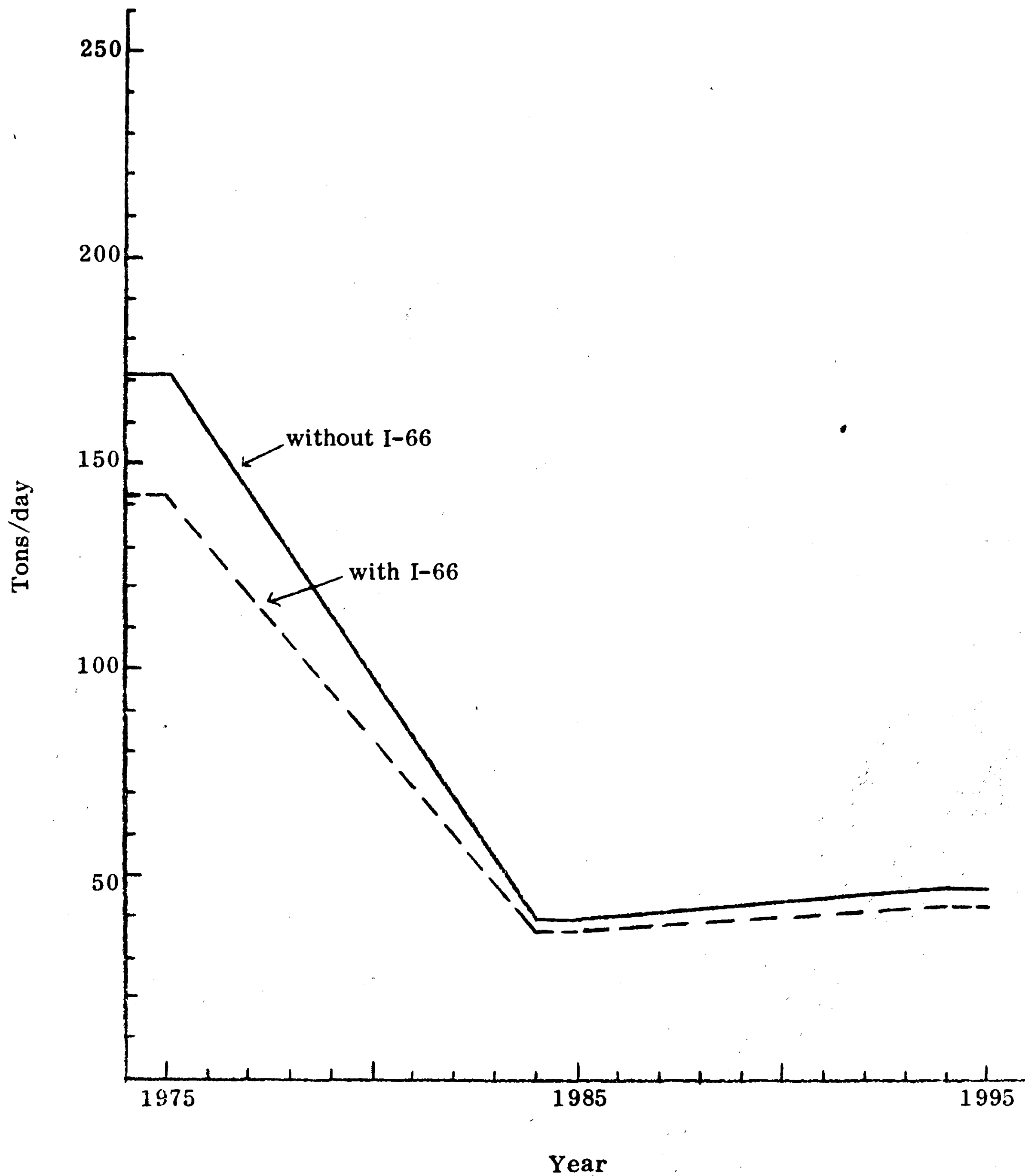

Figure 4. Estimated total carbon monoxide emissions in the area to be affected by the proposed I-66.

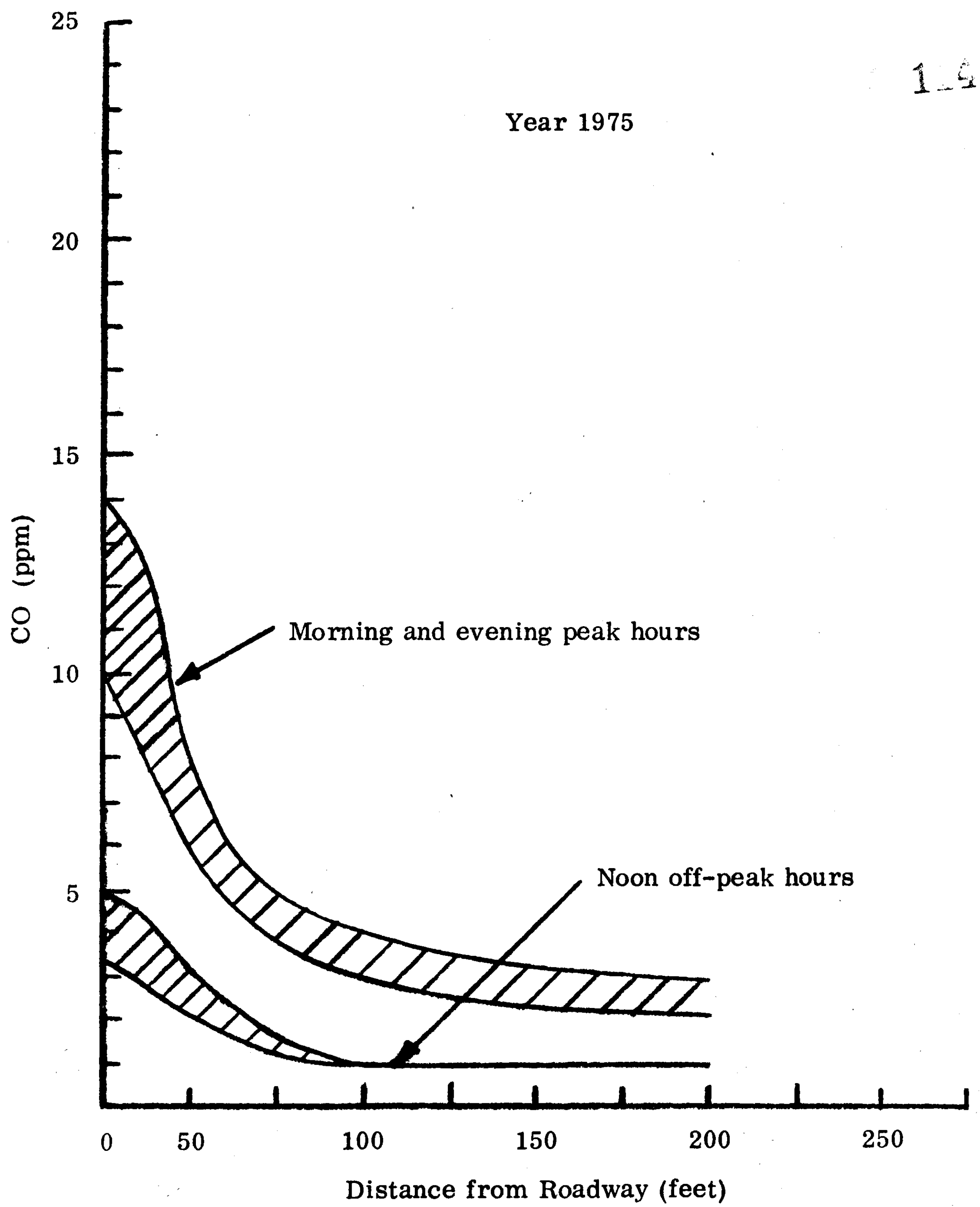

Figure 5. Most probable CO distribution at Site #1.

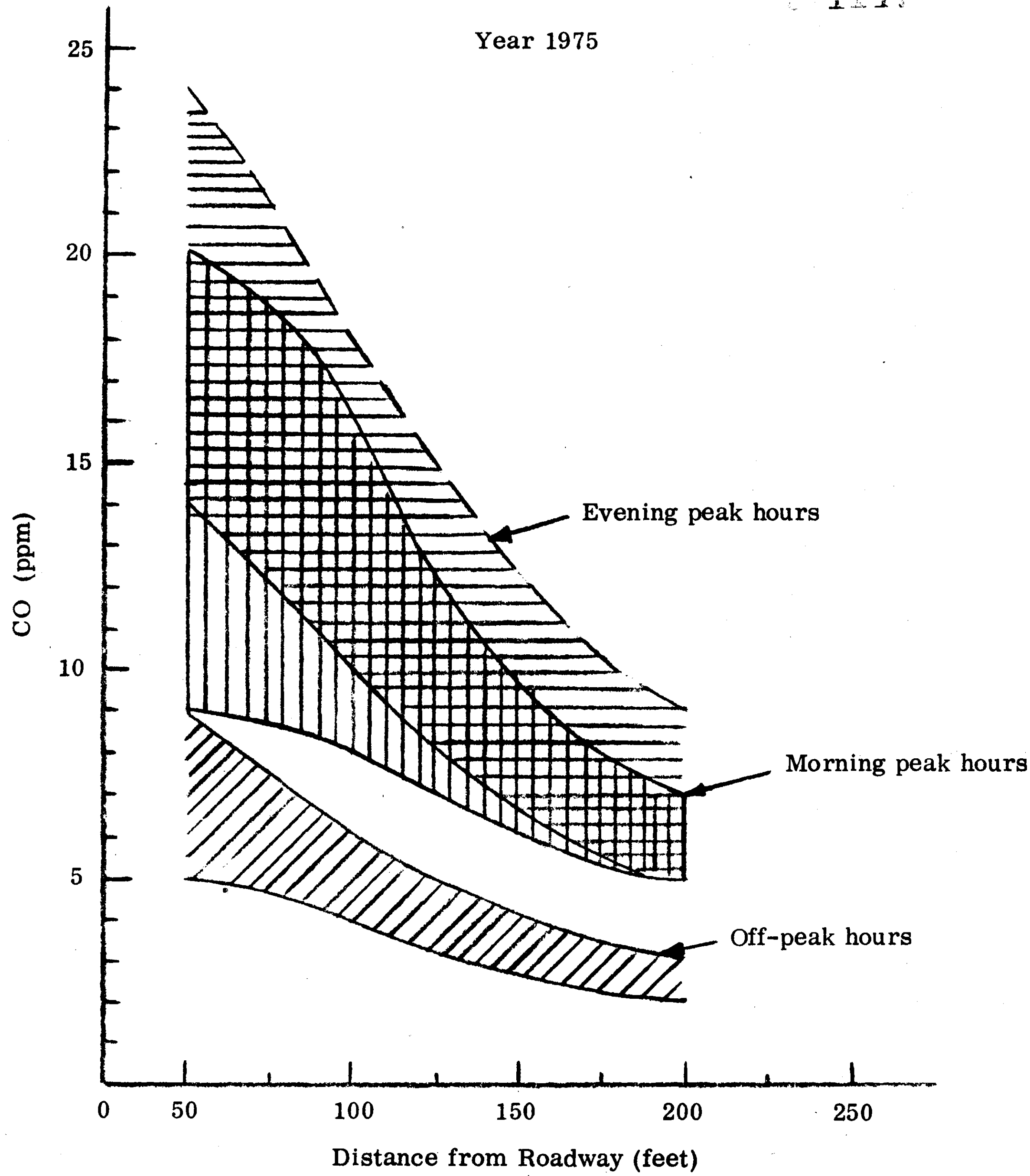

Figure 6. Worst possible CO distributions at Site #1.