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**AIR QUALITY SECTION FOR THE FINAL ENVIRONMENTAL
IMPACT STATEMENT FOR PROPOSED
NORTHWESTERN HIGHWAY**



MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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IMPACT STATEMENT FOR PROPOSED
NORTHWESTERN HIGHWAY**

**Research Laboratory Section
Testing and Research Division
Research Project 73 TI-146
Research Report No. R-882**

**Michigan State Highway Commission
E. V. Erickson, Chairman; Charles H. Hewitt,
Vice-Chairman, Carl V. Pellonpaa, Peter B. Fletcher
Lansing, August 1973**

This report presents air quality information for the environmental impact statement concerning proposed Northwestern Highway. Included are meteorological data and estimates of pollution levels that might occur adjacent to the roadway, should it be constructed.

General Description of the Project

The proposed 9.6 mile section of Northwestern Highway between Telegraph Rd and the proposed I 275 extension is located in a semi-urban area of southcentral and central Oakland County as shown in the maps in Figure 1. The terrain surrounding the proposed project is partly wooded rolling hills, with many lakes and swamps.

Summary

Examination of meteorological data shows that the potential for air pollution episodes in the area of this project is very low. Wind direction is variable and the probable daytime wind speed is 8 to 12 mph. Atmospheric mixing depth generally ranges between 500 and 1,200 meters. This means that pollutants will be quickly diluted and dispersed.

Pollution estimates made by a mathematical model indicate that pollutant levels adjacent to this part of Northwestern Highway will be low. The project does not conflict with the State of Michigan Implementation Plan for meeting Federal air quality standards.

Meteorology

Michigan lies in the normal track of migrating high and low pressure centers at all times of the year. This results in great variations in day to day weather. While prevailing winds are from westerly directions, frequent changes in wind speed and direction are experienced. Even on occasions when an atmospheric inversion restricts vertical dispersion of pollutants, horizontal ventilation continues freely. Figure 2 shows a 36-point bar graph of wind speed and direction occurrences recorded at Pontiac City Airport, the weather station nearest the project. Figure 3 is a 12-point wind rose obtained by condensing the 36-point wind data. Hourly weather data (6 a. m. to 11 p. m. only data recorded) were obtained from the National Climatic Center in Asheville, N. C. for the years 1967 through 1971 and a one-day in nine-day sampling of the hourly data with a random start each year was used to prepare meteorological data.

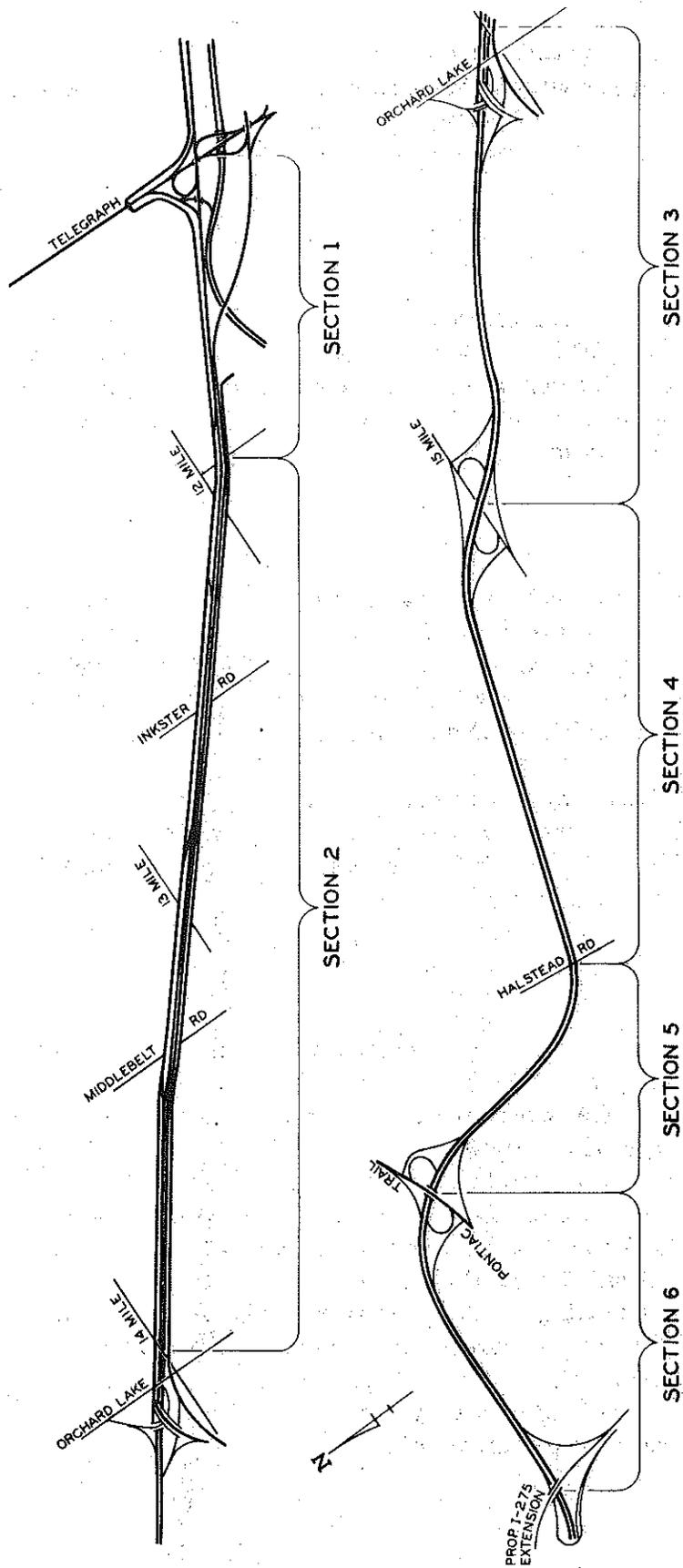


Figure 1. Location of sections used for pollution estimates.

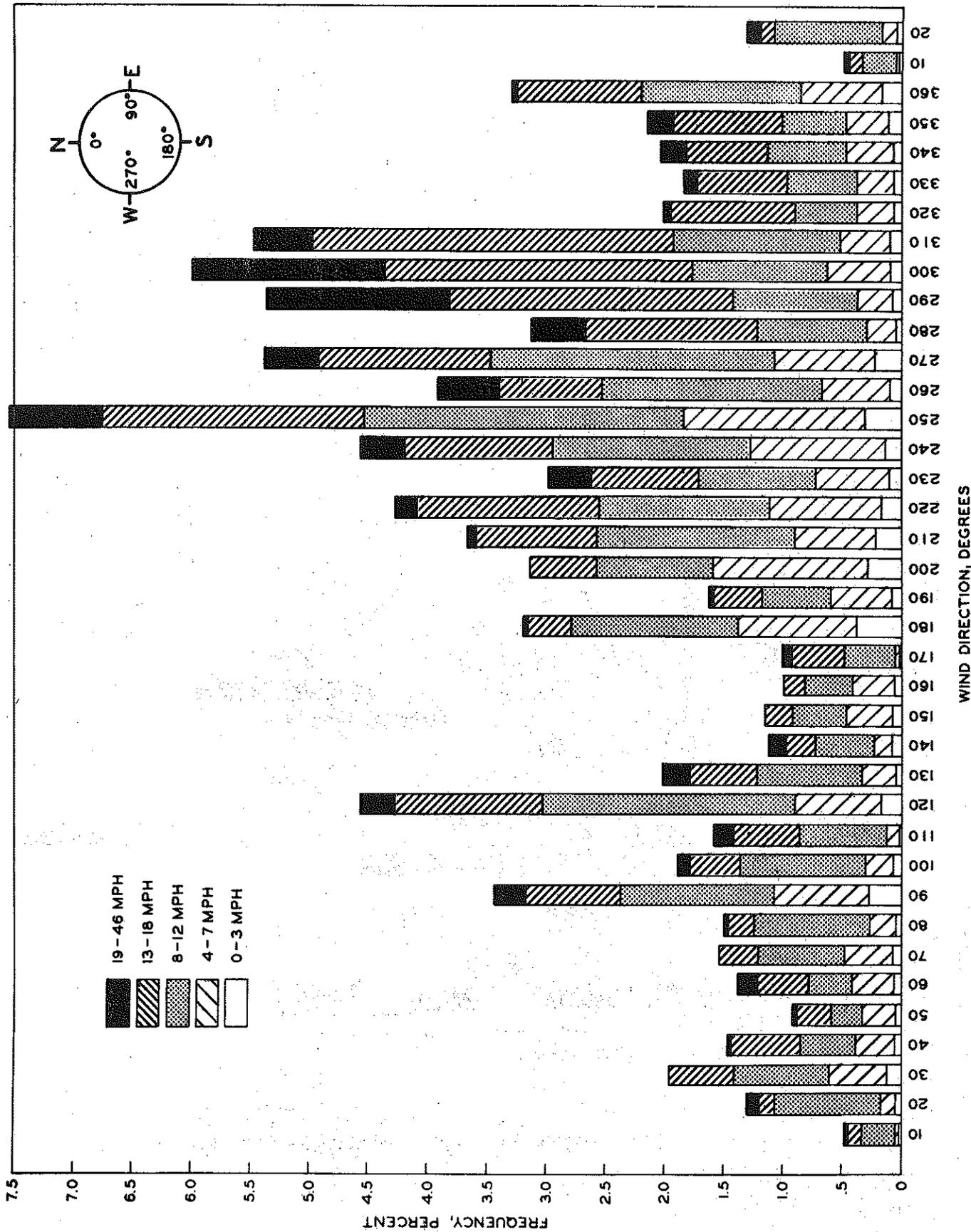


Figure 2. Wind speed and direction occurrences at Pontiac Airport (6 a. m. to 11 p. m.).

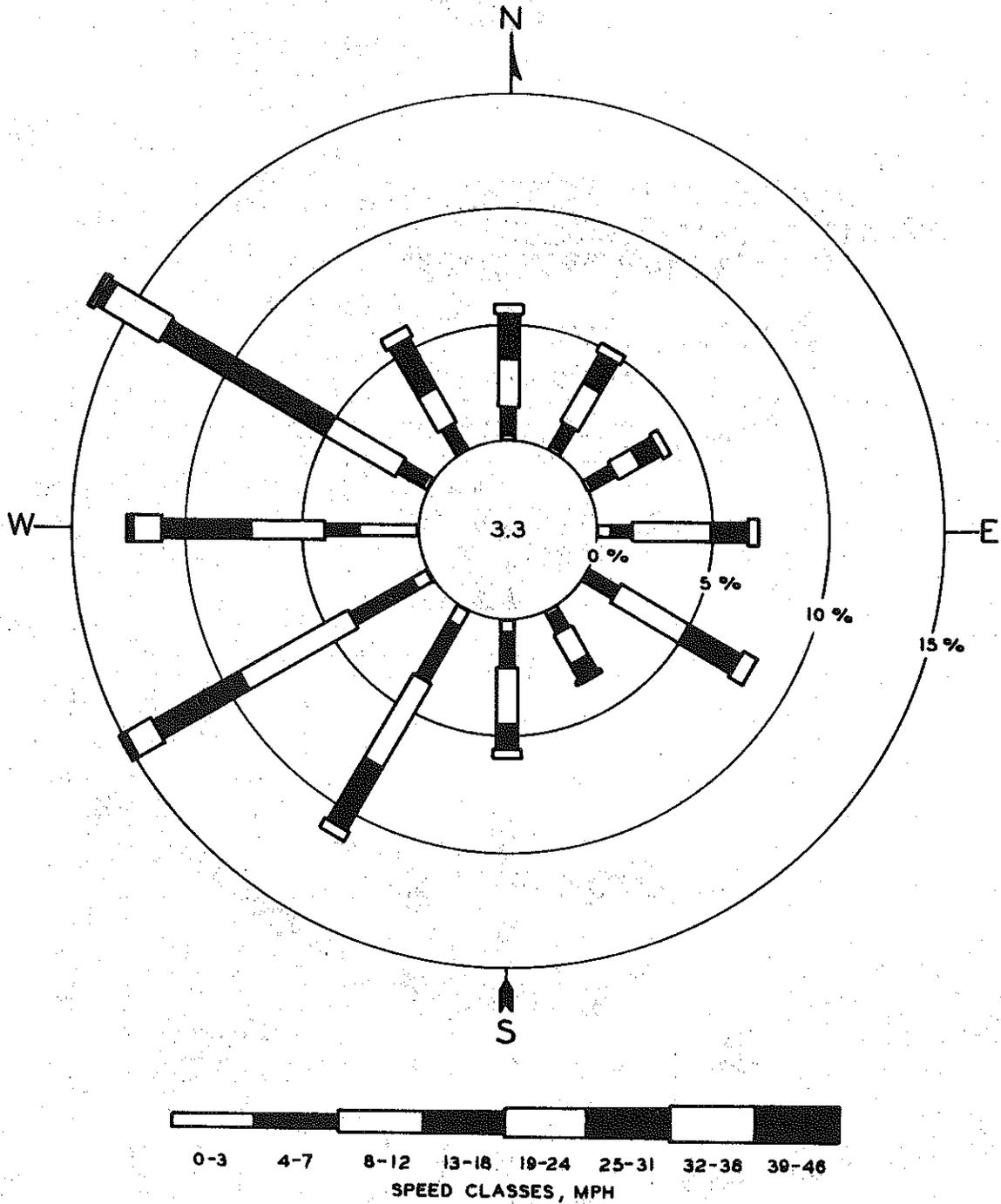


Figure 3. Wind speed and direction occurrences at Pontiac Airport (6 a. m. to 11 p. m.).

Figure 4 shows the distribution of wind speeds during the 6 a.m. to 11 p.m. period of the day for which records were available. Wind speeds are greater than 5 mph more than 95 percent of the time. The most probable daytime wind speed was found to be 8 to 12 mph. Atmospheric mixing depths generally range between 500 and 1,200 meters, which is very favorable for vertical dispersion of pollutants.

There is insufficient time for photochemical reactions between air pollutants to take place before dilution and dispersion occur. As a result, photochemical smog of the Los Angeles type is not thought to occur in Michigan¹.

Existing Ambient Air Quality

No ambient air quality data are available for the area of this project.

Pollution Estimates

Estimates of pollutant concentrations at a height of 1.8 meters (5 ft) above the ground (approximate face height) were made for carbon monoxide and nitrogen oxides, under various wind conditions at distances up to 100 meters from the shoulder of the roadway. A mathematical model based on the Gaussian diffusion equation, modified for a line source, was used². Inputs to the model include meteorological conditions, traffic volumes, vehicle emission factors, and design of the highway.

¹"Implementation Plan for the Control of Suspended Particulates, Sulfur Oxides, Carbon Monoxide, Hydrocarbons, Nitrogen Oxides, and Photochemical Oxidants in the State of Michigan," January 1972, pp. 5-9 to 5-11.

²J. L. Beaton, A. J. Ranzieri, E. C. Shirley and J. B. Skog, "Mathematical Approach to Estimating Highway Impact on Air Quality." Prepared by California Division of Highways. National Technical Information Service, Springfield Va., Report No. FHWA-RD-72-36.

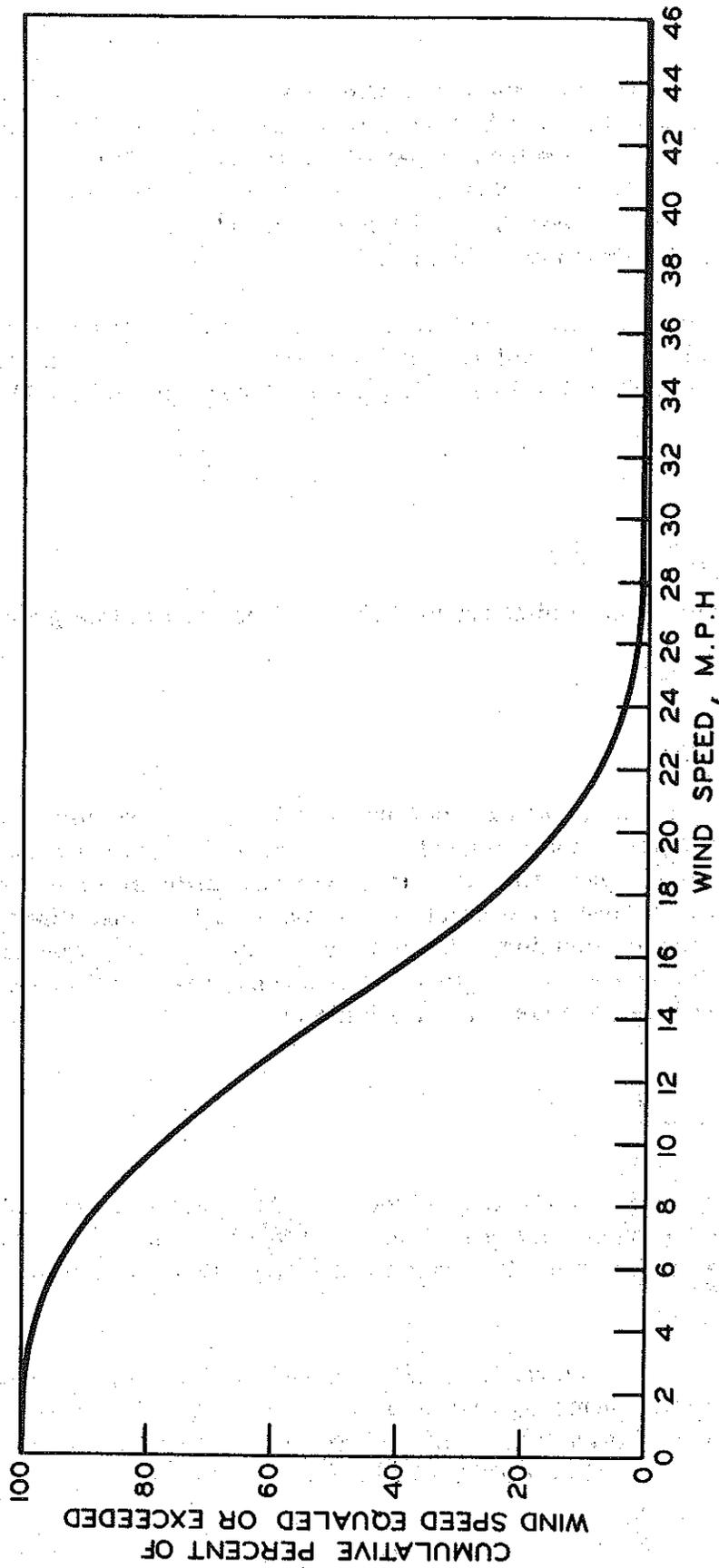


Figure 4. Distribution of wind speeds at Pontiac Airport (6 a.m. to 11 p.m.).

Vehicle emission factors shown in the following table were calculated using procedures from "Compilation of Air Pollutant Emission Factors," AP 42, 2nd edition, U. S. Environmental Protection Agency, April 1973.

EMISSION FACTORS g/mi
(10% Heavy Duty Vehicles)

Carbon Monoxide					Nitrogen Dioxide				
Year	Speed, Miles Per Hour				Year	Speed, Miles Per Hour			
	20	30	35	60		20	30	35	60
1976	*	*	22.4	14.3	1976	*	*	8.8	11.1
1981	*	*	7.5	4.8	1981	*	*	4.3	5.4
2000	5.0	3.5	3.1	2.0	2000	1.7	1.9	2.0	2.5

*These data not required for this study.

Pollutant concentrations were estimated for:

1. Six representative sections, covering the entire length of the project. See Figure 1 for the location of the sections which are identified as follows:

Section	Location
1	Telegraph Rd to Franklin Rd
2	Franklin Rd to 14 Mile Rd
3	14 Mile Rd to 15 Mile Rd
4	15 Mile Rd to Halstead Rd
5	Halstead Rd to Pontiac Trail
6	Pontiac Trail to proposed I 275

2. The years 1976, 1981, and 2000.

3. Distances of 40, 60, and 100 meters from the edge of the roadway shoulder.

TABLE 1
TRAFFIC ESTIMATES FOR PROPOSED
NORTHWESTERN HIGHWAY¹
(Total Traffic in Both Directions)

Year	Section 1	Section 2	Sections 3, 4, 5, 6
1976	49,000 <4,100(60)> [1,960(60)]	28,000 <3,270(60)> [1,120(60)]	21,600 <2,600(60)> [864(60)]
1981	59,400 <6,200(60)> [2,376(60)]	35,600 <3,890(60)> [1,424(60)]	27,400 <3,240(60)> [1,096(60)]
2000	120,600 <12,000(30)> [4,824(60)]	75,000 <8,050(60)> [3,000(60)]	51,400 <5,660(60)> [2,056(60)]

¹ 10 percent heavy duty vehicles
000 = Average daily traffic
<000> = p.m. peak traffic
[000] = Off peak traffic
(00) = Average speed

TABLE 2
TRAFFIC ESTIMATES FOR SECTIONS 1 AND 2
SERVICE ROADS

Year	Section 1		Section 2	
	Northwest Bound	Southeast Bound	Northwest Bound	Southeast Bound
1976	2,700 <550(35)> [108(35)]	200 <20(35)> [8(35)]	500 <90(35)> [20(35)]	500 <90(35)> [20(35)]
1981	3,430 <700(35)> [137(35)]	250 <20(35)> [10(35)]	630 <100(35)> [25(35)]	630 <100(35)> [25(35)]
2000	6,710 <1,200(20)> [268(35)]	500 <20(35)> [20(35)]	1,220 <150(35)> [49(35)]	1,220 <150(35)> [49(35)]

000 = Average daily traffic
<000> = p.m. peak traffic
[000] = Off peak traffic
(00) = Average speed

Information used as input to the model consisted of:

1) Peak p. m. (5:00 to 6:00) and off-peak traffic volumes. Traffic estimates are shown in Tables 1 and 2. Off-peak traffic was taken as 4 percent of ADT.

2) Meteorological conditions

a) Worst meteorological conditions, which will seldom occur, were taken as a 3 mph wind parallel to the roadway, under atmospheric stability class D. Parallel wind buildup distances used were: Section 1, 2,000 ft; Section 2, 18,000 ft; Section 3, 9,500 ft; Section 4, 9,500 ft; Section 5, 5,500 ft; Section 6, 5,500 ft.

Calculated pollutant levels under parallel wind conditions were found to be higher for atmospheric stability class D than for class F.

b) Most probable meteorological conditions (shown with estimate tables) were chosen for the time of day involved, and the overall most likely stability class D, was used. Table 3 shows the frequency distribution of atmospheric stability classes for the meteorological data used.

3) Roadway profile

Section 1	below grade an average of 5 ft
Section 2, 3	below grade an average of 13 ft
Section 4	at grade
Section 5	above grade an average of 8 ft
Section 6	above grade an average of 11 ft.

4) Representative widths of the highway sections were taken as follows:

Section 1

Two 46-ft roadways, including shoulders, separated by an 18-ft median. Service roads are 40-ft roadways, including shoulders, located 50 ft from the freeway shoulder.

Section 2

6 12-ft lanes	72
2 11-ft outside shoulders	22
1 26-ft median	<u>26</u>
	120 ft total

TABLE 3
STABILITY CLASS FREQUENCY DISTRIBUTION
BY HOUR (Percent)

Hour	Stability Class					
	A	B	C	D	E	F
6	11.6	14.0	7.0	48.8	7.0	11.6
7	11.7	6.2	13.6	54.3	10.5	3.7
8	9.3	9.3	18.5	55.6	3.7	3.7
9	7.4	9.9	21.6	61.1	0.0	0.0
10	6.2	6.8	17.9	69.1	0.0	0.0
11	4.3	6.8	16.7	72.2	0.0	0.0
12	3.7	4.3	17.3	74.7	0.0	0.0
13	3.7	4.9	17.9	73.5	0.0	0.0
14	3.1	6.2	17.3	73.5	0.0	0.0
15	3.7	5.6	15.4	75.3	0.0	0.0
16	3.7	4.9	13.6	76.5	0.6	0.6
17	3.1	4.9	19.1	65.4	4.9	2.5
18	2.5	5.6	11.7	63.0	11.7	5.6
19	0.0	0.0	0.0	67.3	21.6	11.1
20	0.0	0.0	0.0	64.2	23.5	12.3
21	0.0	0.0	0.0	57.4	24.1	18.5
22	0.0	0.0	0.0	57.4	19.1	23.5
23	0.0	0.0	0.0	61.3	16.0	22.7
Overall percent	3.8	4.6	11.9	65.8	7.8	6.0

Service roads are 40-ft roadways, including shoulders, located 60 ft from the freeway shoulder.

Section 3³

Two 58-ft roadways, including shoulders, separated by a median averaging 33 ft in width.

Sections 4, 5, 6

Two 46-ft roadways, including shoulders, separated by a median averaging 72 ft in width.

All estimates of pollutant levels represent maximum one-hour concentrations and are in addition to existing background levels. Table 4 presents estimates of pollutant levels for peak traffic conditions from the freeway only. Table 5 presents estimated pollutant levels for off-peak traffic, from the freeway only. Table 6 presents estimated pollutant levels for sections 1 and 2, including the effect of the service roads adjacent to those sections. Nitrogen oxides, as nitrogen dioxide, are included for information only. There is no emission factor for nitrogen dioxide, so no comparison of the estimates with an air quality standard is possible.

Federal air quality standards for carbon monoxide and nitrogen dioxide are:

- CO: (a) 10 mg/cu m maximum 8 hr average concentration not to be exceeded more than once per year.
- (b) 40 mg/cu m maximum 1 hr concentration not to be exceeded more than once per year.
- NO₂: 100 µg/cu m annual arithmetic mean.

The calculated concentrations of carbon monoxide near the proposed roadway are low. No adverse environmental effects are expected.

³The roadways of sections 3, 4, 5, and 6 are sufficiently separated that calculations were made for each set of lanes and the pollutant concentrations were summed at the appropriate distances.

TABLE 4
 POLLUTION ESTIMATES FOR PEAK TRAFFIC
 (Freeway Only)

Location	Traffic Projection Year	40 Meter Distance From Edge of Freeway Shoulder				60 Meter Distance From Edge of Freeway Shoulder				100 Meter Distance From Edge of Freeway Shoulder			
		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind†		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind†		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind†	
		CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m
Section 1	1976	1.8	1457	0.7	547	0.9	726	0.3	272	0.2	143	*	54
	1981	0.8	862	0.3	323	0.4	430	0.1	161	0.1	85	*	31
	2000	1.1	572	0.4	215	0.6	285	0.2	107	0.1	56	*	21
Section 2	1976	4.0	3107	1.5	1160	2.0	1563	0.8	586	0.4	317	0.2	119
	1981	1.6	1795	0.6	671	0.8	904	0.3	340	0.2	183	0.1	69
	2000	1.4	1706	0.5	637	0.7	858	0.3	323	0.1	174	0.1	65
Section 3	1976	1.4	1126	0.5	419	0.7	543	0.3	205	0.1	107	0.1	40
	1981	0.6	682	0.2	254	0.3	329	0.1	124	0.1	65	*	24
	2000	0.4	547	0.2	205	0.2	264	0.1	100	*	52	*	19
Section 4	1976	0.6	749	0.7	565	0.3	232	0.7	533	0.1	46	0.6	479
	1981	0.3	454	0.3	342	0.1	149	0.3	322	*	28	0.3	290
	2000	0.2	364	0.2	275	0.1	113	0.2	259	*	22	0.2	233
Section 5	1976	0.6	698	0.2	161	0.3	222	0.2	153	0.1	44	0.2	139
	1981	0.2	423	0.1	97	0.1	134	0.1	93	*	27	0.1	54
	2000	0.2	339	0.1	78	0.1	108	0.1	74	*	21	0.1	67
Section 6	1976	0.6	681	0.3	243	0.3	217	0.3	232	0.1	43	0.3	210
	1981	0.2	413	0.1	147	0.1	132	0.1	140	*	26	0.1	127
	2000	0.2	331	0.1	118	0.1	106	0.1	112	*	21	0.1	102

*value less than 0.1
 †angles between wind direction and roadway direction - section 1, 0°; section 2, 10°; section 3, 5°; section 4, 13°; section 5, 50°; section 6, 30°.

TABLE 5
 POLLUTION ESTIMATES FOR OFF-PEAK TRAFFIC
 (Freeway Only)

Location	Traffic Projection Year	40 Meter Distance From Edge of Freeway Shoulder			60 Meter Distance From Edge of Freeway Shoulder			100 Meter Distance From Edge of Freeway Shoulder					
		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind ¹		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind ¹		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind ¹	
		CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m
Section 1	1976	0.8	621	0.2	132	0.4	309	0.2	124	0.1	61	0.2	111
	1981	0.3	366	*	78	0.2	182	*	74	*	35	*	66
	2000	0.3	341	*	73	0.1	169	*	68	*	34	*	61
Section 2	1976	1.4	1060	0.1	74	0.7	536	0.1	68	0.1	109	0.1	60
	1981	0.6	655	*	45	0.3	332	*	42	0.1	67	*	37
	2000	0.5	633	*	44	0.3	321	*	41	0.1	65	*	36
Section 3	1976	0.5	389	0.1	57	0.2	191	0.1	54	*	37	0.1	47
	1981	0.2	241	*	35	0.1	118	*	33	*	23	*	29
	2000	0.2	206	*	30	0.1	101	*	28	*	20	*	25
Section 4	1976	0.2	165	0.1	71	0.1	82	0.1	67	*	16	0.1	60
	1981	0.1	102	*	44	*	51	*	41	*	10	*	37
	2000	0.1	88	*	37	*	44	*	35	*	9	*	32
Section 5	1976	0.2	158	0.1	44	0.1	79	0.1	42	*	16	*	38
	1981	0.1	97	*	27	*	48	*	26	*	10	*	23
	2000	0.1	84	*	23	*	42	*	22	*	8	*	20
Section 6	1976	0.2	154	0.2	118	0.1	77	0.1	113	*	15	0.1	103
	1981	0.1	95	0.1	73	*	47	0.1	70	*	9	0.1	63
	2000	0.1	82	0.1	63	*	41	*	60	*	8	*	54

*value less than 0.1
¹ angles between wind direction and roadway direction - section 1, 50°; section 2, 60°; section 3, 55°; section 4, 37°; section 5, 70°; section 6, 20°.

TABLE 6
 POLLUTION ESTIMATES FOR OFF-PEAK AND PEAK P.M. TRAFFIC
 (Service Roads Included)

Location	Traffic Projection Year	40 Meter Distance From Edge of Freeway Shoulder			60 Meter Distance From Edge of Freeway Shoulder			100 Meter Distance From Edge of Freeway Shoulder					
		Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind ¹	Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind ¹	Worst Condition Parallel Wind, 3 mph		Most Probable Condition, 8 mph wind ¹			
		CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m	CO, mg/cu m	NO ₂ , µg/cu m		
Section 1 Off Peak	1976	0.9	664	0.2	144	0.5	330	0.2	132	0.1	67	0.2	117
	1981	0.4	392	0.1	85	0.2	195	0.1	78	*	41	0.1	69
	2000	0.3	365	0.1	79	0.2	184	0.1	72	*	38	0.1	64
Section 2 Off Peak	1976	1.4	1070	0.1	76	0.7	540	0.1	70	0.1	111	0.1	62
	1981	0.6	661	*	47	0.3	333	*	43	0.1	69	*	38
	2000	0.5	639	*	45	0.3	322	*	42	0.1	66	*	37
Section 1 PM Peak	1976	2.4	1676	0.9	629	1.2	831	0.5	312	0.3	124	0.1	65
	1981	1.0	997	0.4	374	0.5	494	0.2	185	0.1	104	*	39
	2000	1.4	661	0.5	248	0.7	328	0.3	123	0.1	69	0.1	26
Section 2 PM Peak	1976	4.1	3141	1.5	1178	2.1	1583	0.8	594	0.4	323	0.2	121
	1981	1.6	1814	0.6	680	0.8	914	0.3	343	0.2	186	0.1	71
	2000	1.4	1716	0.5	644	0.7	866	0.3	325	0.1	176	0.1	67

*value less than 0.1.

¹ angles between wind direction and roadway direction, section 1, 50°; section 2, 60°.

² angles between wind direction and roadway direction, section 1, 0°; section 2, 10°.