

AIR QUALITY REPORT FOR M 275
FROM I 96 AND I 696 TO M 59



MICHIGAN DEPARTMENT OF STATE HIGHWAYS

AIR QUALITY REPORT FOR M 275
FROM I 96 AND I 696 TO M 59

Research Laboratory Section
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Michigan State Highway Commission
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This report presents air quality information for a proposed section of M 275 in southwestern Oakland County as shown in Figure 1. Meteorological data, and estimates of pollution levels that might occur adjacent to the roadway should it be constructed, are included.

Terrain and Demography

The terrain surrounding this project is flat to gently rolling, so that dispersion of air pollutants is facilitated. The population of Oakland County is 90 percent urban with a population density of 1,009 per square mile. Most of the urban area of the county is located in the southeastern corner adjacent to the City of Detroit.

Meteorology

Michigan lies in the normal track of migrating high and low pressure centers at all times of the year. This results in great variation in day to day weather. Frequent changes in wind speed and direction are experienced. Even on occasions when an atmospheric inversion restricts vertical dispersion of pollutants, horizontal dispersion continues freely. Figure 2 shows a 36-point bargraph of wind speed and direction occurrences at Pontiac City Airport. Hourly weather data (6 a.m. to 11 p.m. only data recorded) were obtained from the National Climatic Center at 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 3 is a 12-point wind rose obtained by condensing the 36-point wind data.

Figure 4 shows the distribution of wind speeds observed. Wind speeds are greater than 5 mph more than 95 percent of the time at Pontiac City Airport between 6 a.m. and 11 p.m. The most probable daytime wind speeds are in the 8 to 12 mph range. Atmospheric mixing depths generally range between 500 and 1,200 meters (547 to 1,300 yd), which is very favorable for vertical dispersion of pollutants.

Existing Ambient Air Quality

No data are available to establish presently existing air quality in the area of this project.

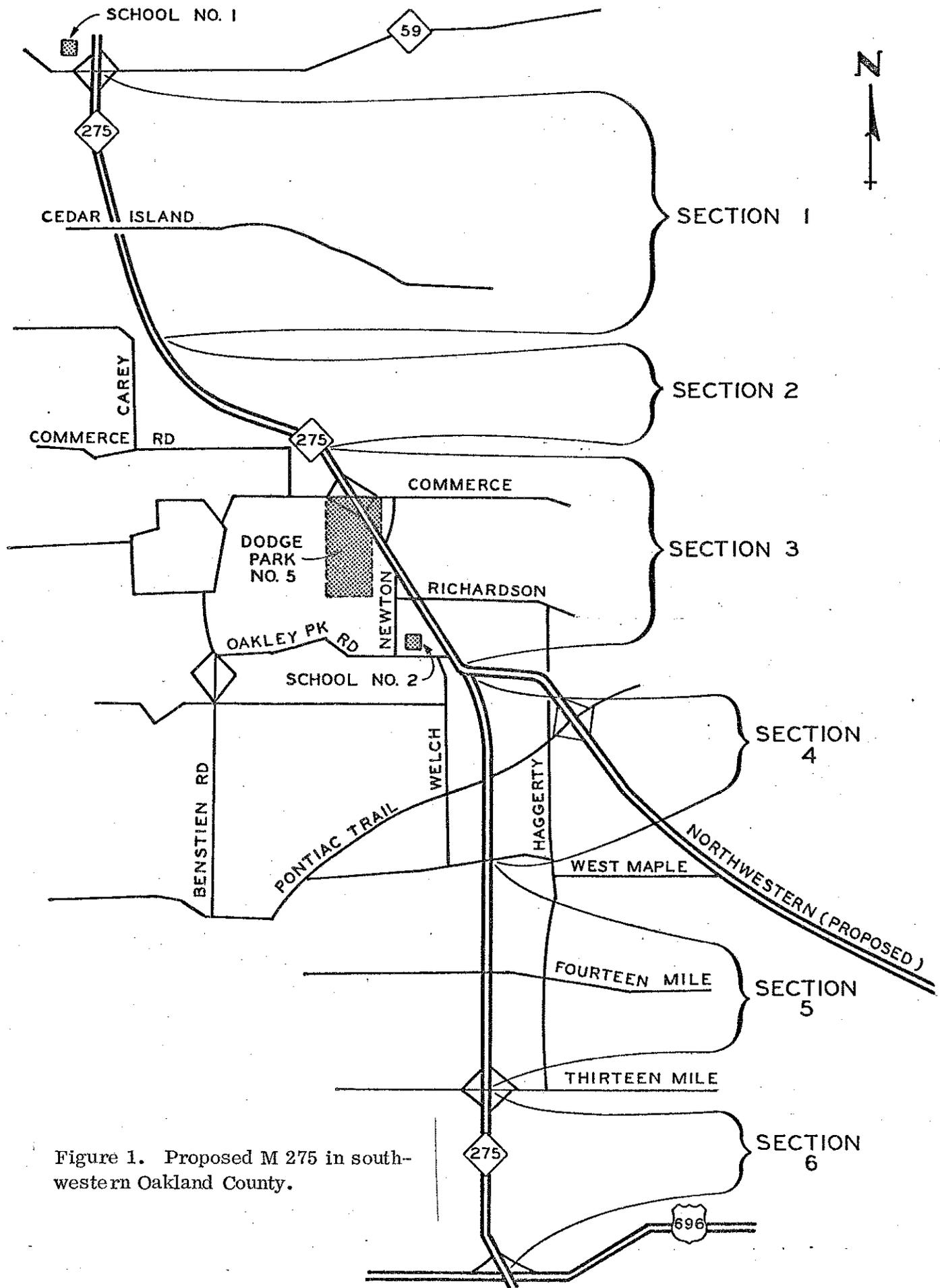


Figure 1. Proposed M 275 in southwestern Oakland County.

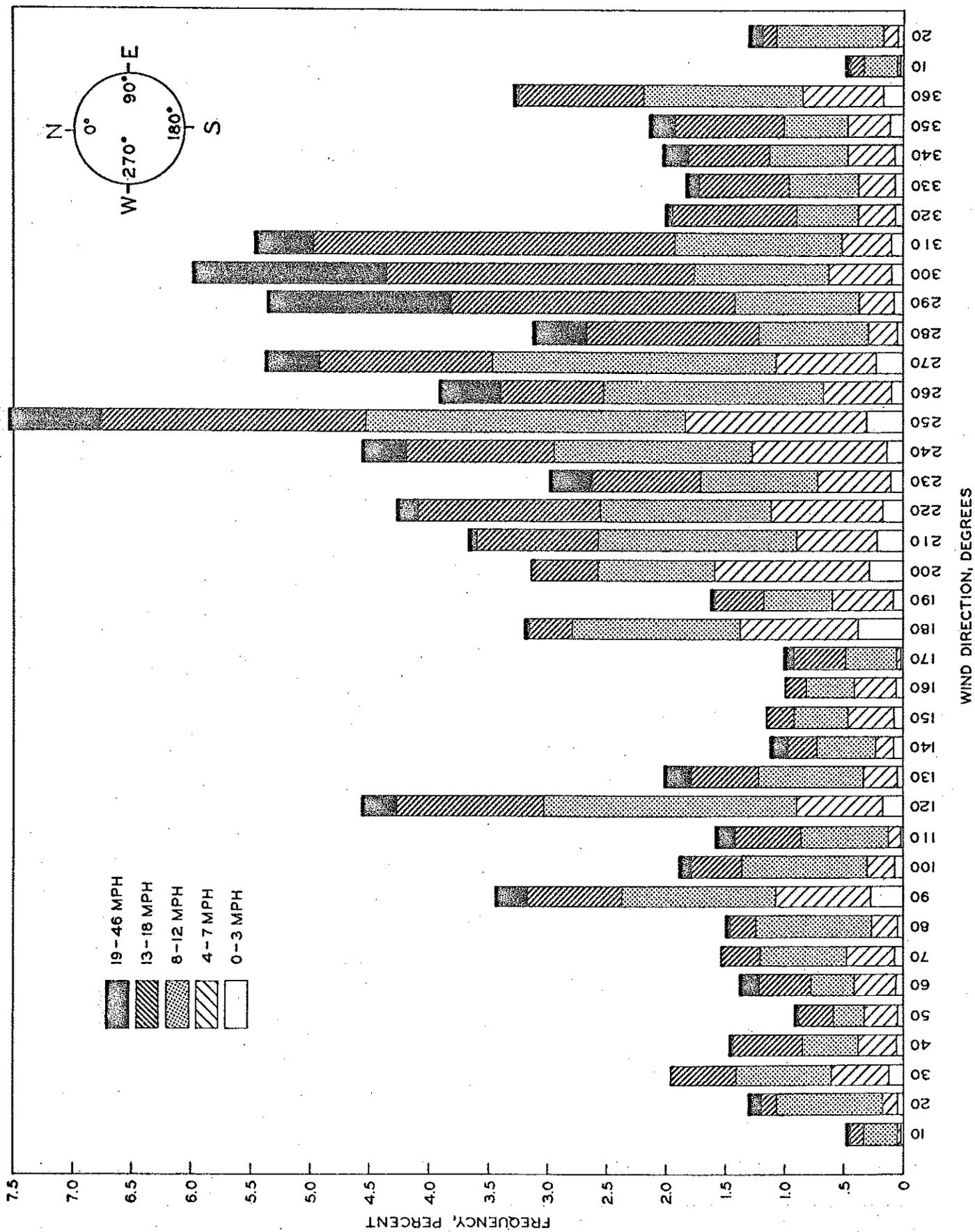


Figure 2. Wind speed and direction occurrences at Pontiac Airport (6 a.m. to 11 p.m.).

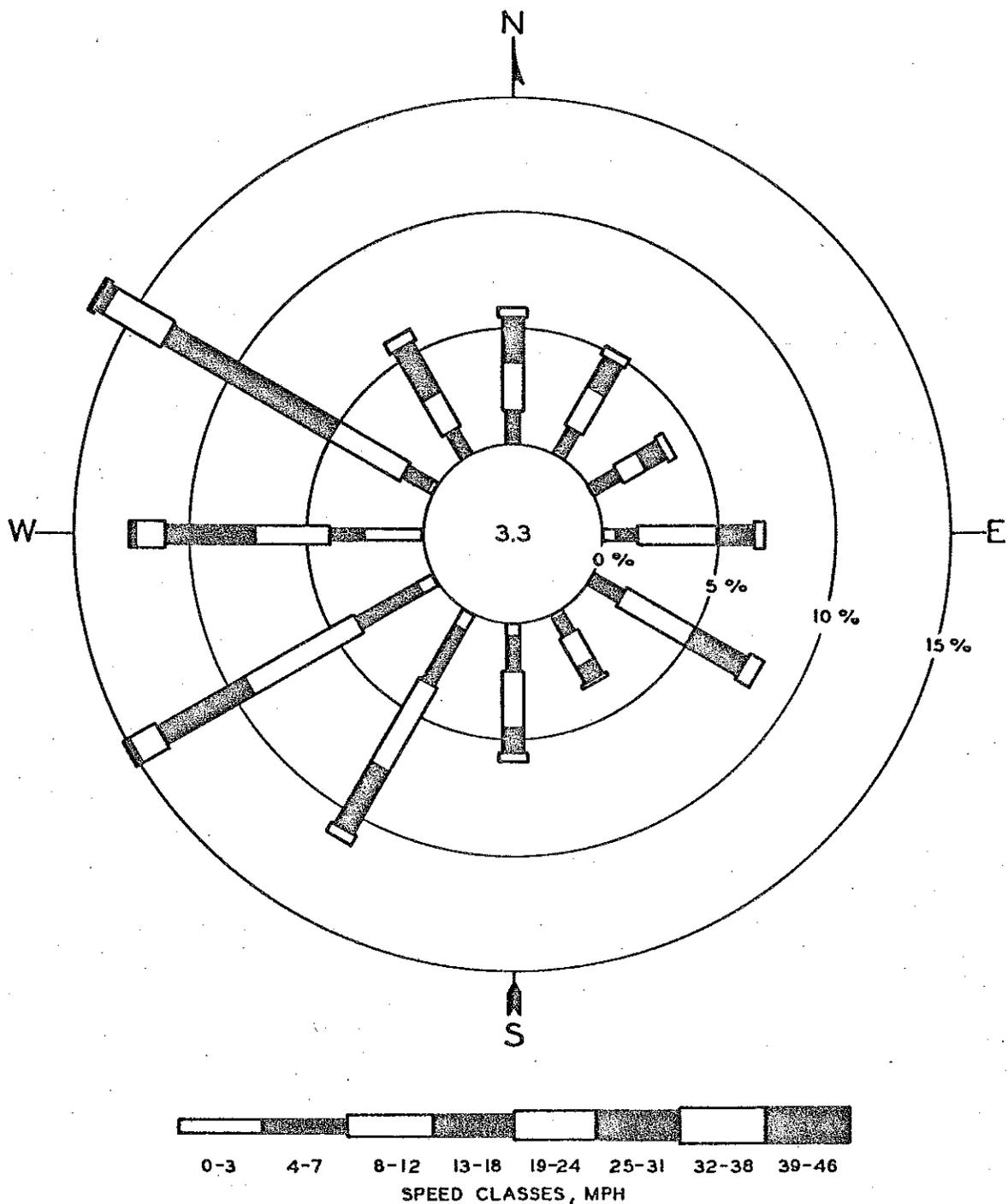


Figure 3. Wind speed and direction occurrences at Pontiac Airport (6 a.m. to 11 p.m.).

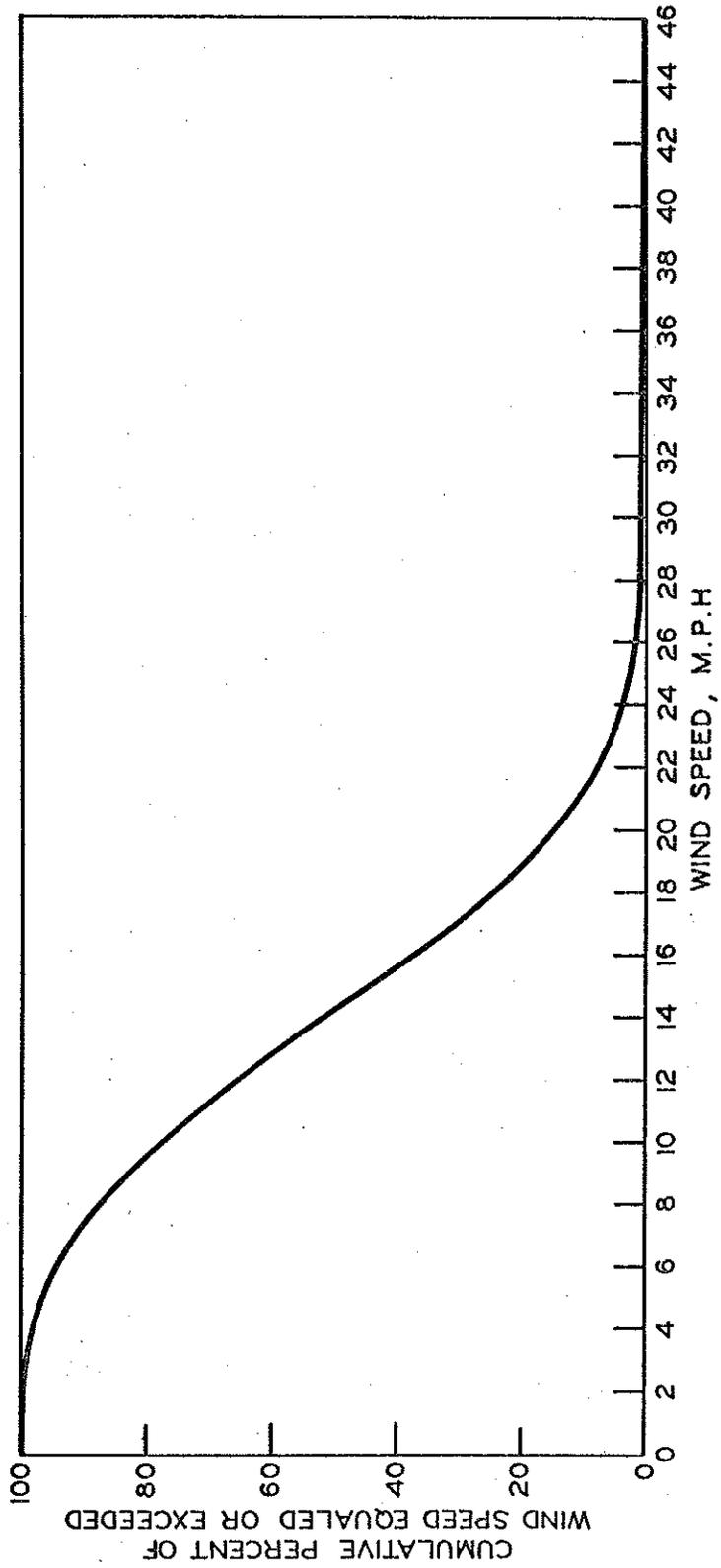


Figure 4. Distribution of wind speeds at Pontiac Airport (6 a.m. to 11 p.m.).

Pollution Estimates

Estimates of pollutant concentrations at a height of 1.5 meters (5 ft) above the ground were made for carbon monoxide and nitrogen oxides as nitrogen dioxide under various wind conditions. A mathematical model based on the Gaussian diffusion equation, modified for a line source, was used¹. This model has been accepted by the Federal Highway Administration and the Federal Environmental Protection Agency. Inputs to the model include meteorological conditions, traffic volumes, vehicle emission factors, and design of the highway.

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 and interim light duty vehicle standards promulgated by the EPA administrator in September 1973.

EMISSION FACTORS
(g/mile at 55 mph)
7 Percent Commercial Vehicles

Year	Carbon Monoxide	Oxides of Nitrogen
1980	10.0	3.5
1985	5.8	1.9
1990	5.2	1.7

¹ Beaton, J. L., Ranzieri, A. J., Shirley, E. C., and Skog, J. B., "Mathematical Approach to Estimating Highway Impact on Air Quality," Prepared by California Division of Highways, National Technical Information Service, Report No. FHWA-RD-72-36.

Pollution concentrations were estimated for:

1) Six representative sections which covered the length of the project. See Figure 1 for the location of the sections which are identified as follows:

Section	Location
1	M 59 to Carey Rd (near)
2	Carey Rd (near) to Commerce Rd (proposed)
3	Commerce Rd (near) to Northwestern (proposed)
4	Northwestern (proposed) to West Maple Rd
5	West Maple Rd to 13 Mile Rd
6	13 Mile Rd to I 96

2) The years 1980, 1985, and 1990.

3) The area above the pavement (mixing cell).

Information used as input to the model consisted of:

1) Estimated peak p.m. (5:00 to 6:00) and off-peak traffic volumes. Traffic estimates are shown in Table 1. Off-peak traffic was taken as 4 percent of ADT for the years 1980 and 1985 and 3.5 percent for 1990.

2) Meteorological Conditions

a) Worst meteorological conditions, which will seldom occur according to meteorological records, were taken as a 3 mph wind parallel to the roadway, under atmospheric stability class F. Parallel wind buildup distances used were: Section 1) 18,080 ft; Section 2) 10,050 ft; Section 3) 11,260 ft; Section 4) 9,380 ft; Section 5) 11,720 ft; Section 6) 10,450 ft.

b) Most probable meteorological conditions (shown in data tables) were chosen for the time of day involved, and the overall most likely stability class (D) was used. Table 2 shows the frequency distribution of atmospheric stability classes for the meteorological data used.

3) Road profile. All sections are at grade.

4) Width of all sections, two 36-ft roadways with 10-ft shoulders, separated by a variable (94-ft minimum) median except Section 3 is two 48-ft roadways.

TABLE 1
 TRAFFIC ESTIMATES FOR PROPOSED M 275
 (Total Traffic in Both Directions)

Year	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
1980	39,800 <4,300> [1,600]	39,800 <4,300> [1,600]	43,800 <4,840> [1,760]	43,800 <4,840> [1,760]	49,400 <5,360> [1,980]	57,180 <6,200> [2,280]
1985	57,800 <6,250> [2,320]	57,800 <6,250> [2,320]	65,000 <7,180> [2,600]	65,000 <7,180> [2,600]	61,600 <6,680> [2,460]	70,400 <7,640> [2,820]
1990	69,400 <7,490> [2,420]	69,400 <7,490> [2,420]	78,400 <8,660> [2,740]	78,400 <8,660> [2,740]	74,000 <8,030> [2,600]	83,400 <8,790> [2,920]

Peak Duration - variable, around 1 hour
 All Speeds - 55 mph

Commercial Vehicles

All sections - 7 percent of Peak, 7 percent of Off-Peak

000 = Average Daily Traffic (24 hr average)

<000> = Peak Traffic (vehicles per hr)

[000] = Off-Peak Traffic (vehicles per hr)

TABLE 2
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	11.8	6.2	13.7	54.0	10.6	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	3.9	4.6	11.9	65.8	7.8	6.0

All estimates of pollution levels represent maximum one hour concentrations and are in addition to existing background levels. Table 3 presents estimates of pollutant levels for carbon monoxide and nitrogen dioxide in the area over the highway (mixing cell). Nitrogen oxide data are included as information only. There is no emission factor for nitrogen dioxide as such, so no comparison of the estimates with an air quality standard is possible.

Pollution estimates are calculated based on the present speed limit (55 mph). Should speed limits be increased to the previous 70 mph limit. Carbon monoxide concentrations could decrease by 9 percent, and nitrogen oxide concentrations could increase by 28 percent.

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

CO: (a) 10 mg/cu m (9 ppm) maximum 8 hr average concentration not to be exceeded more than once per year.

(b) 40 mg/cu m (36 ppm) maximum 1 hr concentration not to be exceeded more than once per year.

NO₂: 100 µg/cu m (0.05 ppm) annual arithmetic mean.

The estimated concentrations of carbon monoxide on and near the proposed roadway are low. No adverse environmental effects are expected. The project is consistent with the state implementation plan for meeting air quality standards.

Effect of Other Proposed Highway Construction

Northwestern Highway from Telegraph Rd to M 275 intersecting near Oakley Park Rd (Fig. 1) is proposed for construction about 1980. Construction of Northwestern Highway will modify traffic volumes on proposed M 275. Traffic estimates indicate the following percentage changes in traffic volumes on M 275 if Northwestern is constructed.

Section	1980		1985		1990	
	ADT	Peak	ADT	Peak	ADT	Peak
1	+24	+23	+8	+8	+8	+8
2	+24	+23	+8	+8	+8	+8
3	+26	+26	+7	+7	+7	+7
4	-21	-22	-23	-24	-23	-26
5	-9	-9	-10	-10	-11	-11
6	-7	-7	-9	-9	-10	-9

TABLE 3
ESTIMATES OF MIXING CELL CONCENTRATIONS¹

Location	Traffic Projection Year	CO (mg/cu m)						NO _x (µg/cu m)					
		Worst Condition Stability F, Parallel 3 mph Wind		Most Probable Condition ² Stability D		Worst Condition Stability F, Parallel 3 mph Wind		Most Probable Condition ² Stability D		Worst Condition Stability F, Parallel 3 mph Wind		Most Probable Condition ² Stability D	
		Peak Traffic	Off Peak Traffic										
1	1980	4.0	1.4	0.3	0.1	1,382	497	120	44				
	1985	3.4	1.2	0.3	0.1	1,118	401	97	35				
	1990	3.6	1.1	0.3	0.1	1,182	369	103	33				
2	1980	3.9	1.4	0.6	0.2	1,367	492	225	82				
	1985	3.3	1.2	0.5	0.2	1,106	397	182	66				
	1990	3.6	1.1	0.6	0.2	1,169	365	192	61				
3	1980	5.0	1.8	0.6	0.2	1,740	622	200	72				
	1985	4.3	1.5	0.5	0.2	1,438	511	165	59				
	1990	4.7	1.5	0.5	0.2	1,531	475	175	55				
4	1980	4.3	1.5	0.3	0.1	1,500	537	116	42				
	1985	3.7	1.3	0.3	0.1	1,240	442	96	34				
	1990	4.1	1.3	0.3	0.1	1,319	411	102	32				
5	1980	5.0	1.8	0.4	0.1	1,715	610	123	44				
	1985	3.6	1.3	0.3	0.1	1,188	422	85	31				
	1990	3.9	1.2	0.3	0.1	1,260	393	90	29				
6	1980	5.7	2.0	0.4	0.1	1,979	701	142	51				
	1985	4.1	1.5	0.3	0.1	1,356	483	97	35				
	1990	4.3	1.4	0.3	0.1	1,406	441	100	32				

¹ All vehicle speeds are 55 mph.

² Angle between roadway direction and wind direction, peak and off-peak (speed 12 mph) Section 1, 45°; Section 2, 0°; Section 3, 28°; Section 4, 55°; Sections 5 and 6, 60°.

The construction of Northwestern would add traffic to Sections 1, 2, and 3 and reduce traffic volumes on Sections 4, 5, and 6. Traffic estimates indicate changes varying from a plus 26 percent during the peak period on Section 3 in 1980 to a minus 26 percent during the peak period on Section 4 in 1990. Since the concentration of roadway generated pollutants would change in direct proportion to traffic increases or decreases, air quality standards would not be exceeded even with maximum increases in traffic volumes resulting from the construction of Northwestern Highway. The traffic decreases would improve on air quality already predicted to be good.

Additional Information for Two Schools

Concentrations of carbon monoxide were estimated at two schools near the proposed route.

The locations are as follows:

1. The school located approximately 300 ft north of M 59 and 400 ft west of the proposed route (Fig. 1).
2. The school located approximately 200 ft north of Oakley Park Rd and 500 ft west of the proposed route (Fig. 1).

Estimated carbon monoxide concentrations at the school buildings under worst meteorological conditions (3 mph wind angling across roadway toward the school) are presented in Table 4. These estimated concentrations of carbon monoxide are low enough to indicate that there will be no adverse environmental effects.

TABLE 4
CARBON MONOXIDE, mg/cu m

Location	Traffic Projection Year	Worst Case, ^{1,2} Peak Traffic Wind Speed 3 mph
School on M 59	1980	0.6
	1985	0.5
	1990	0.5
School on Oakley Park Rd	1980	1.3
	1985	1.1
	1990	1.2

1 Wind angle for school on M 59 is 22°, wind angle for school on Oakley Park Rd is 14°.

2 Carbon monoxide values when the wind is 3 mph and parallel to roadway are less than 0.1 mg/cu m.