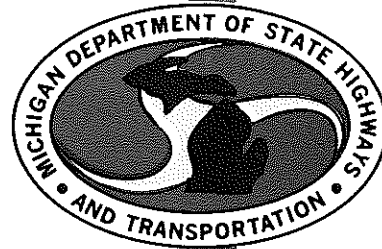


AIR QUALITY REPORT FOR M 99 IN
INGHAM AND CLINTON COUNTIES



**TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION**

AIR QUALITY REPORT FOR M 99 IN
INGHAM AND CLINTON COUNTIES

Research Laboratory Section
Testing and Research Division
Research Project 76 AP-12A
Research Report No. R-1026R

Michigan State Highway Commission
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John P. Woodford, Director
Lansing, December 1978

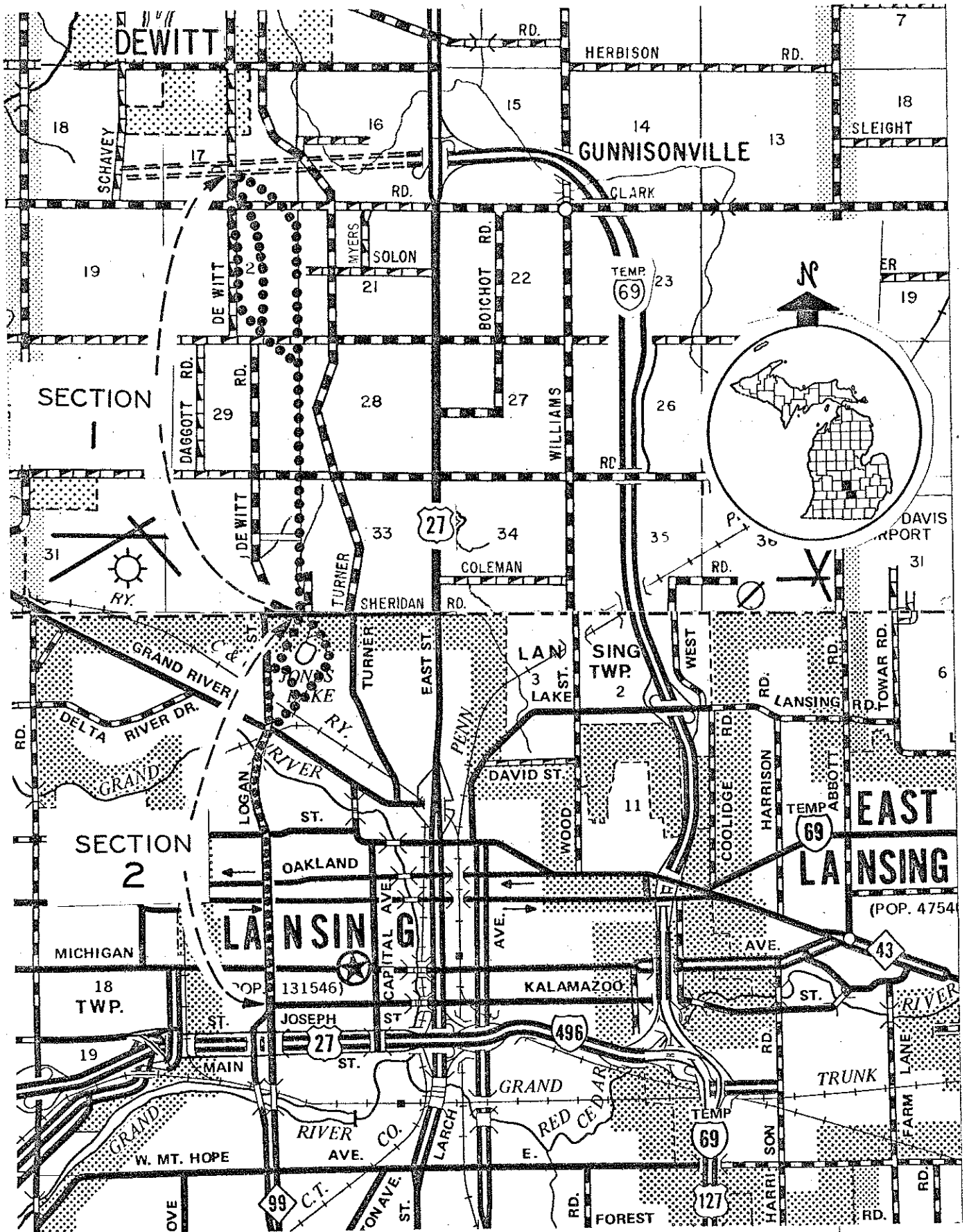


Figure 1. Proposed M 99, Ingham and Clinton Counties.

This report presents air quality information for a proposed section of M 99 in Ingham and Clinton Counties 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 southern section of the proposed project is located in the city of Lansing, Ingham County and is largely residential-commercial. The northern section is in Clinton County and is primarily a residential-farming area. The terrain surrounding this project is flat to gently rolling with no tall buildings or structures in the immediate vicinity which might hinder dispersion of pollutants.

Meteorology

Meteorological conditions in Michigan are generally good for dispersion and dilution of air pollutants. According to air pollution publication AP 101, U. S. Environmental Protection Agency, 1972 (p 96) there are few days with a high meteorological potential for air pollution.

Daily weather data recorded every third hour at Capital City Airport (Lansing) were obtained from the National Climatic Center in Asheville, N. C. for the years 1967 through 1973. Figure 2 shows a 36-point bar graph of wind speed and direction occurrences. 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 90 percent of the time. The most probable daytime wind speed was found to be 11 mph.

Existing Ambient Air Quality

No data are available to establish existing air quality in the area of this project; however, estimates of background air quality that may exist in the project area are:

carbon monoxide - 1 to 3 mg/cu m for a maximum 8-hour concentration, and 5 to 9 mg/cu m for a maximum 1-hour concentration.

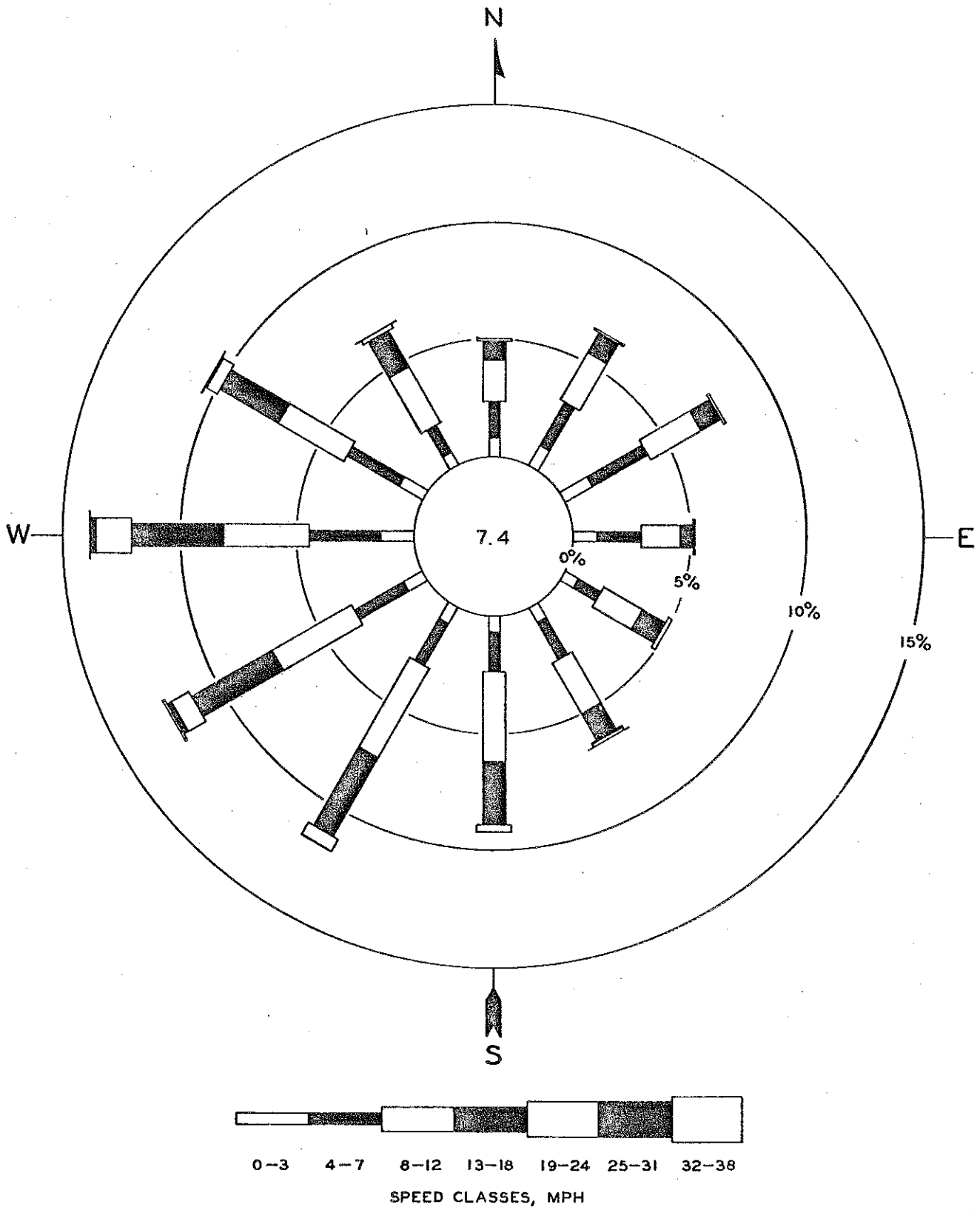


Figure 3. Wind speed and direction occurrences at Capital City Airport (Lansing).

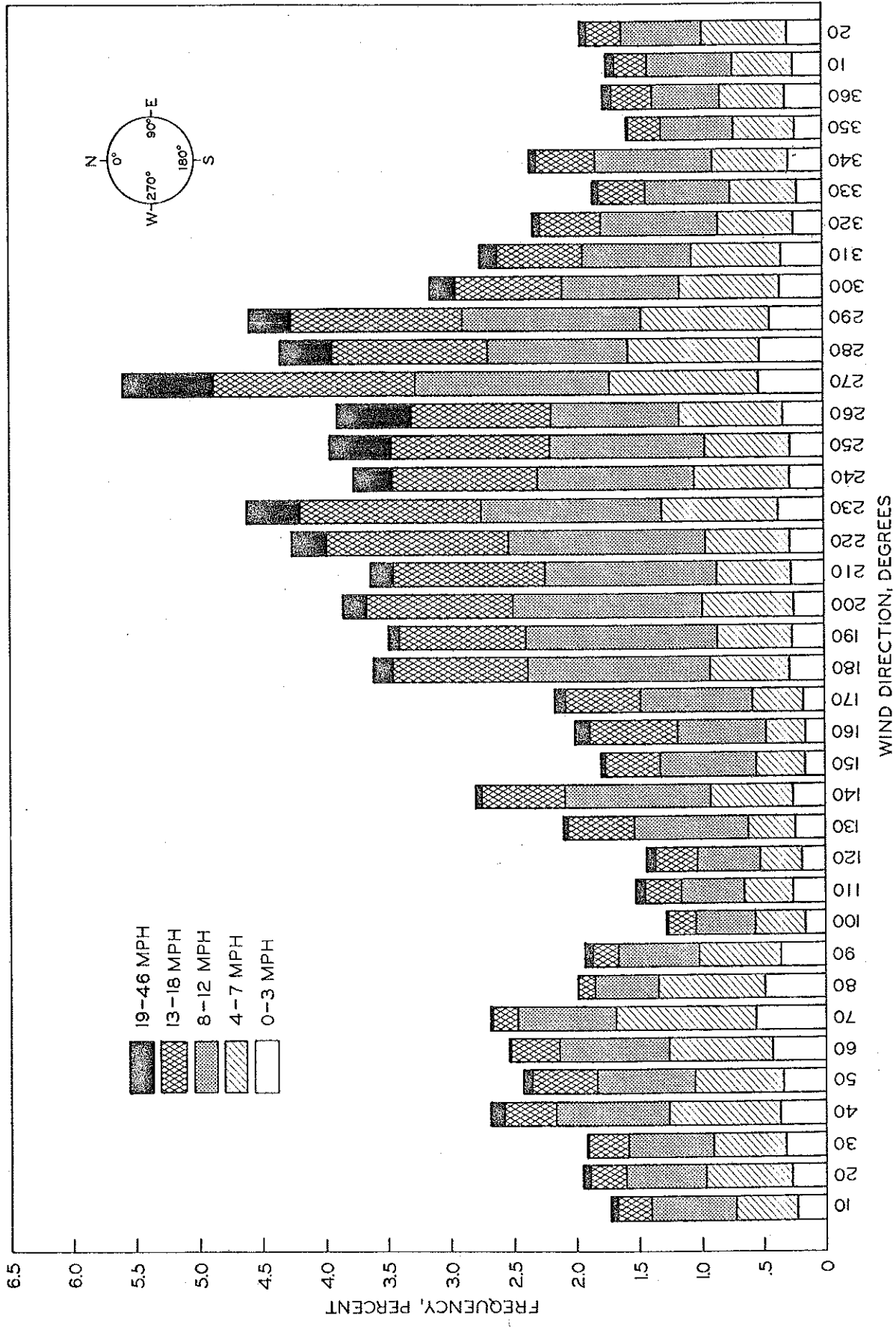


Figure 2. Wind speed and direction occurrences at Capital City Airport (Lansing).

Pollution Estimates

Estimates of carbon monoxide concentrations were made at a height of 1.5 meters (5 ft) above ground level. A mathematical model based on the Gaussian diffusion equation, modified for a line source, was used.¹ Inputs to the model include wind speed and direction, atmospheric stability class, traffic volumes, vehicle emission factors and design of the roadway.

Carbon monoxide concentrations were estimated for:

1) Two 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	Kalamazoo St to Sheridan Rd (urban section)
2	Sheridan Rd to Proposed I 69 (rural section)

2) Two alternate cross-sections within each section.

3) Two major crossroads - Saginaw St and Oakland Ave.

4) The year 2010.

5) At a 4 m distance from the edge of the proposed roadway (estimated distance to the nearest receptor).

Information used as input to the model consisted of:

1) Vehicle emission factors shown in the following table, were calculated using "Mobile Source Emission Factors," March 1978, U. S. Environmental Protection Agency. Emission factors were calculated at temperatures of 30 and 60 F with 20 percent of the vehicles in a cold start condition, 27 percent of the vehicles in a hot start condition, and the remainder of the vehicles in a hot operation mode. Vehicle age mix data used were for Michigan registrations, and average annual miles driven for various age vehicles were national estimates from "Mobile Source Emission Factors."

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, Report No. FHWA-RD-72-36. CALINE 2 modification, programmed March 1975, was used.

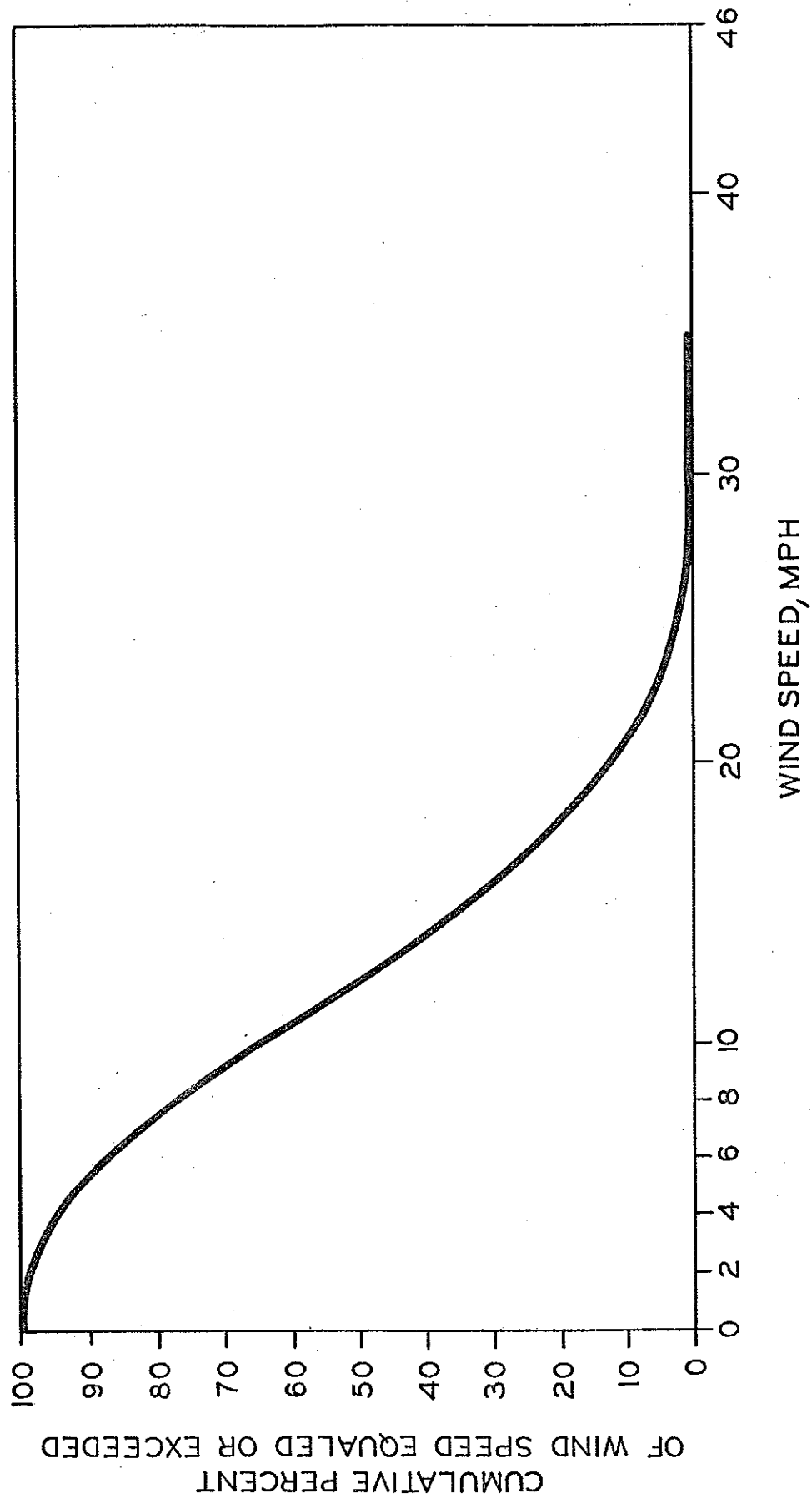


Figure 4. Distribution of wind speeds at Capital City Airport (Lansing).

Comparison of Estimates with Air Quality Standards

- a) One-hour carbon monoxide standard - 40 mg/cu m (36 ppm), not to be exceeded more than once a year.

The maximum estimated 1-hr concentrations of carbon monoxide adjacent to the roadway in 2010 are 6.8 and 9.1 mg/cu m for Section 1, Alternates A and B; 2.9 and 3.9 mg/cu m for Section 2, Alternates A and B; 8.8 and 11.1 mg/cu m adjacent to the Saginaw St and Oakland Ave intersections for Section 1, Alternates A and B, respectively. Section 2 does not intersect Saginaw St or Oakland Ave. Adding these concentrations to the 5 to 9 mg/cu m estimated background results in total 1-hr concentrations of 11.8 to 15.8 and 14.1 to 18.1 mg/cu m for Section 1, Alternates A and B; 7.9 to 11.9 and 8.9 to 12.9 mg/cu m for Section 2, Alternates A and B; and 13.8 to 17.8 and 16.1 to 20.1 mg/cu m adjacent to the Saginaw St and Oakland Ave intersections for Section 1, Alternates A and B, respectively. All are below the 40 mg/cu m standard.

- b) Eight-hour carbon monoxide air quality standard - 10 mg/cu m (9 ppm)

The Federal Highway Administration's report "Project Level Consideration to Assure Adequate Air Quality Analyses" suggests a technique for determining the 8-hr carbon monoxide concentration from the 1-hr concentrations.

$$\frac{V_8}{V_1} \times (1\text{-hr CO concentration}) \times P = 8\text{-hr CO concentration}$$

where: V_8 = average hourly traffic volumes in both directions during the 8-hr period of interest.

V_1 = peak hour traffic volume in both directions.

P = 1 to 8-hr meteorological persistence factor for the 8-hr period.

A value of $P = 0.6$ is suggested unless data are available to calculate a persistence factor for the proposed highway projects.

If this technique is used to calculate the 8-hr carbon monoxide levels in 2010 for the two alternates in each section and also adjacent to the Sagi-

Carbon Monoxide Emission Factors
(g/mile at 25 mph - 6 percent commercial)

Year	30 Degree	60 Degree
2010	20.6	17.9

2) Estimated peak traffic (4:30 to 5:30 p.m.) for both the proposed roadway and major crossroads in vehicles per hour as follows: Section 1 - 4,300, Section 2 - 1,800, Saginaw St - 2,800, and Oakland Ave - 2,800. The percentage used for commercial vehicles was six and the vehicle speed used was 25 mph.

3) Meteorological Conditions

a) Worst meteorological conditions were taken as a 2.2 mph (1 m/sec) wind parallel to the roadway, under atmospheric stability class D.

4) Road Profile. All sections are at grade.

5) Roadway Width.

Section 1 - Alternate cross-section A, two 36-ft roadways separated by a 60-ft median with curb and gutter. Alternate cross-section B, seven 12-ft lanes, with one a center turn lane and curb and gutter.

Section 2 - Alternate cross-section A, two 24-ft roadways separated by a 60-ft median with curb and gutter. Alternate cross-section B, five 12-ft lanes, with one a center turn lane and curb and gutter.

All estimates of carbon monoxide levels represent 1-hr concentrations and are in addition to existing background levels. Table 1 presents estimates of carbon monoxide, excluding background, at the nearest receptor to the roadway for the highest traffic volume section within each alternate. Also included in Table 1 are estimates of carbon monoxide adjacent to the Saginaw St and Oakland Ave intersections.

TABLE 1
ESTIMATES OF CARBON MONOXIDE CONCENTRATIONS FROM THE
ROADWAY AND ADJACENT TO MAJOR INTERSECTIONS (mg/cu m)
(Not Including Background)

Roadway, Worst Condition, 1 m/sec Parallel Wind, Stability D, Peak Traffic				Major Intersections, Worst Condition, 1 m/sec Wind Parallel to Proposed Roadway and 90° to Crossroad, Stability D, Peak Traffic			
Section 1		Section 2		Saginaw St		Oakland Ave	
Alternate A	Alternate B	Alternate A	Alternate B	Alternate A	Alternate B	Alternate A	Alternate B
6.8	9.1	2.9	3.9	8.8	11.1	8.8	11.1

naw St and Oakland Ave intersections for both alternates in Section 1 the highest 8-hr concentrations from the roadway are:

$$\text{Alternate A} = \frac{1,640 \text{ vehicles per hour}}{4,300 \text{ vehicles per hour}} \times 6.8 \text{ mg/cu m} \times 0.6 = 1.6 \text{ mg/cu m}$$

Section 1

$$\text{Alternate B} = \frac{1,640 \text{ vehicles per hour}}{4,300 \text{ vehicles per hour}} \times 9.1 \text{ mg/cu m} \times 0.6 = 2.1 \text{ mg/cu m}$$

$$\text{Alternate A} = \frac{680 \text{ vehicles per hour}}{1,800 \text{ vehicles per hour}} \times 2.9 \text{ mg/cu m} \times 0.6 = 0.7 \text{ mg/cu m}$$

Section 2

$$\text{Alternate B} = \frac{680 \text{ vehicles per hour}}{1,800 \text{ vehicles per hour}} \times 3.9 \text{ mg/cu m} \times 0.6 = 0.9 \text{ mg/cu m}$$

The highest 8-hr concentration adjacent to the Saginaw St and Oakland Ave intersections are:

$$\text{Alternate A} = \frac{1,640 + 940 \text{ vehicles per hour}}{4,300 + 2,800 \text{ vehicles per hour}} \times 8.8 \text{ mg/cu m} \times 0.6 = 1.9 \text{ mg/cu m}$$

Section 1

$$\text{Alternate B} = \frac{1,640 + 940 \text{ vehicles per hour}}{4,300 + 2,800 \text{ vehicles per hour}} \times 11.1 \text{ mg/cu m} \times 0.6 = 2.4 \text{ mg/cu m}$$

Adding these concentrations to the 1 to 3 mg/cu m estimated maximum 8-hr background results in total carbon monoxide concentrations of 2.6 to 4.6 and 3.1 to 5.1 mg/cu m for Section 1, Alternates A and B; 1.7 to 3.7 and 1.9 to 3.9 mg/cu m for Section 2, Alternates A and B; and 2.9 to 4.9 and 3.4 to 5.4 mg/cu m adjacent to the Saginaw St and Oakland Ave intersections. Carbon monoxide levels adjacent to both alternates in each section are below the air quality standard.

The estimated concentrations of carbon monoxide including existing estimated background adjacent to all of the alternates in both sections of the proposed roadway are within national air quality standards. The project is consistent with the State implementation plan for meeting national air quality standards for carbon monoxide.