

AIR QUALITY REPORT FOR M 3
(US 25 BR), MACOMB COUNTY



MICHIGAN DEPARTMENT OF
STATE HIGHWAYS AND TRANSPORTATION

AIR QUALITY REPORT FOR M 3
(US 25 BR), MACOMB COUNTY

Research Laboratory Section
Testing and Research Division
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Research Report No. R-921R

Michigan State Highway Commission
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This report presents air quality information for a proposed section of M 3 (US 25 BR) in the city of Mount Clemens, Macomb 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 the city of Mount Clemens is flat to gently rolling so dispersion of air pollutants is facilitated. Mount Clemens has a population of 20,476 according to the 1970 census. Mount Clemens together with the many other cities and towns in the rapidly urbanizing section of southeastern Michigan is classified as part of the Detroit Metropolitan Area.

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. Figure 2 shows a 36-point bar graph of wind speed and direction occurrences at the Mount Clemens City Airport. Hourly weather data were obtained from the National Climatic Center at Asheville, N. C. for the years 1968 through 1972 and a one day in three 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 80 percent of the time. The most probable daytime wind speed was found to be 10 mph.

According to air pollution publication AP 101, U. S. Environmental Protection Agency, 1972, atmospheric mixing depths in lower Michigan 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 existing air quality in the area of this project; however, estimates of carbon monoxide concentrations in the project area based on air quality information from similar locations in Michigan are:

1. Above Gratiot Ave, the present route of M 3. These values are for information only; they are not related to carbon monoxide levels on the proposed route.

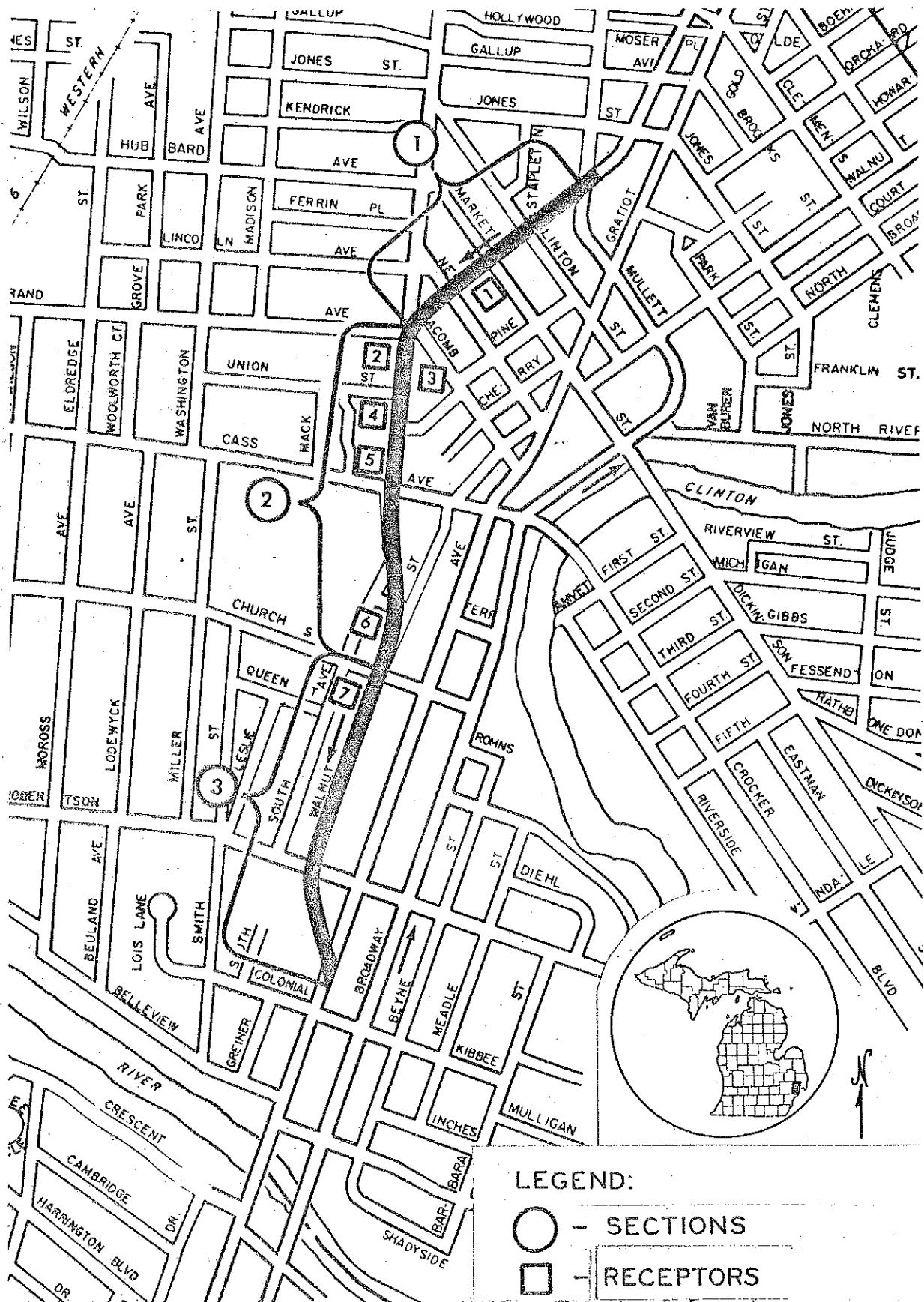


Figure 1. Proposed M 3 (US 25 BR) in the city of Mount Clemens.

14 to 23 mg/cu m for a maximum one hour concentration including background

7 to 9 mg/cu m for a maximum eight hour concentration including background

2. Background concentrations in the area - 1 to 3 mg/cu m

These estimates were supplied by the Michigan Department of Natural Resources, Air Pollution Control Division.

Pollution Estimates

Estimates of carbon monoxide concentrations were made at a height of 1.5 meters (5 ft) above the roadway. A mathematical model based on the Gaussian diffusion equation, modified for a line source, was used¹. Inputs to the model include meteorological conditions, traffic volumes, vehicle emission factors and design of the highway.

Estimates of nitrogen dioxide concentrations are not included in this report because, while the National air quality standard is for nitrogen dioxide (NO₂), the mixture of nitrogen oxides (NO_x) emitted by vehicles consists largely of nitric oxide (NO) with less than five percent of the nitrogen oxides emitted as NO₂, according to Federal EPA data. Subsequent to being emitted from the tailpipe, NO may be converted to NO₂ at varying rates, depending on atmospheric conditions. There is no air quality standard for NO, which is much less toxic than NO₂. Thus, there is no meaningful way of comparing vehicle exhaust emissions with the air quality standard for NO₂.

Vehicle emission factors shown in the following table were calculated using procedures from "Compilation of Air Pollutant Emission Factors," AP 42, Supplement No. 5, December 1975 edition, U. S. Environmental Protection Agency. Emission factors were calculated at a temperature of 60 F with 20 percent of vehicles in a cold start condition, 27 percent of vehicles in a hot start condition, and the remainder of vehicles in a hot operation mode. Vehicle age mix data used were for Michigan registrations obtained from the Secretary of State. National estimates from AP 42 for average annual miles driven for various age vehicles were used.

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.

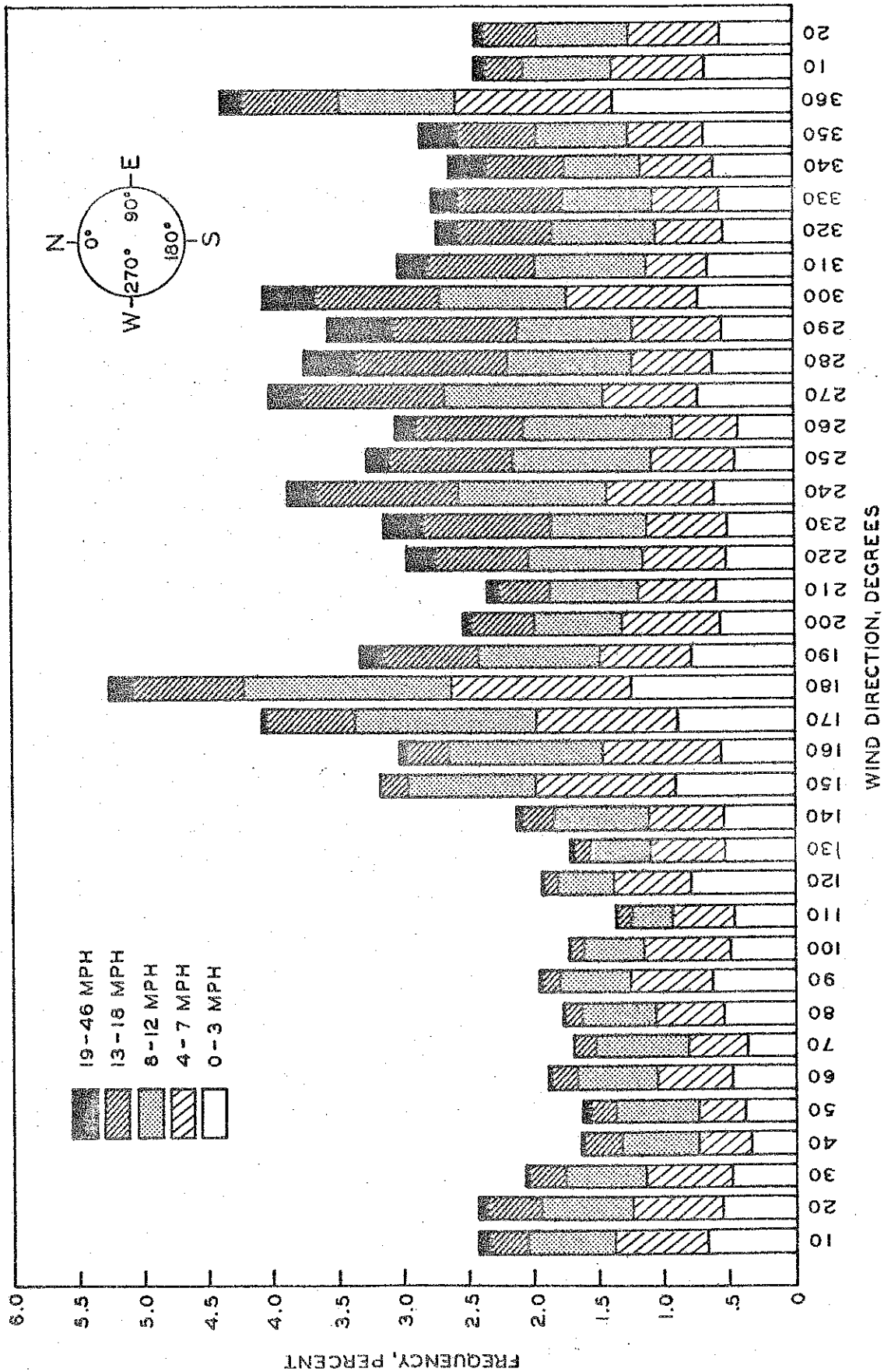


Figure 2. Wind speed and direction occurrences at Mount Clemens City Airport.

EMISSION FACTORS FOR
CARBON MONOXIDE, g/mi
(3 Percent Commercial Vehicles)

Year	Average Vehicle Speed, mph		
	26	28	30
1978	---	28.2	26.0
1985	---	7.8	7.2
2000	5.9	---	5.0

Pollution concentrations were estimated for:

1) Three 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	Welts St to Grand Ave
2	Grand Ave to Church St
3	Church St to Gratiot Ave

2) The years 1978, 1985, and 2000.

3) The area above the pavement and at seven receptors near the proposed roadway.

Information used as input to the model consisted of:

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

2) Meteorological Conditions

a) Worst meteorological conditions were taken as a 3 mph wind parallel to the roadway, under atmospheric stability class F.

b) Most probable meteorological conditions for the afternoon - a 10 mph wind at 180 degrees under atmospheric stability class D.

3) Road Profile. All sections are at grade.

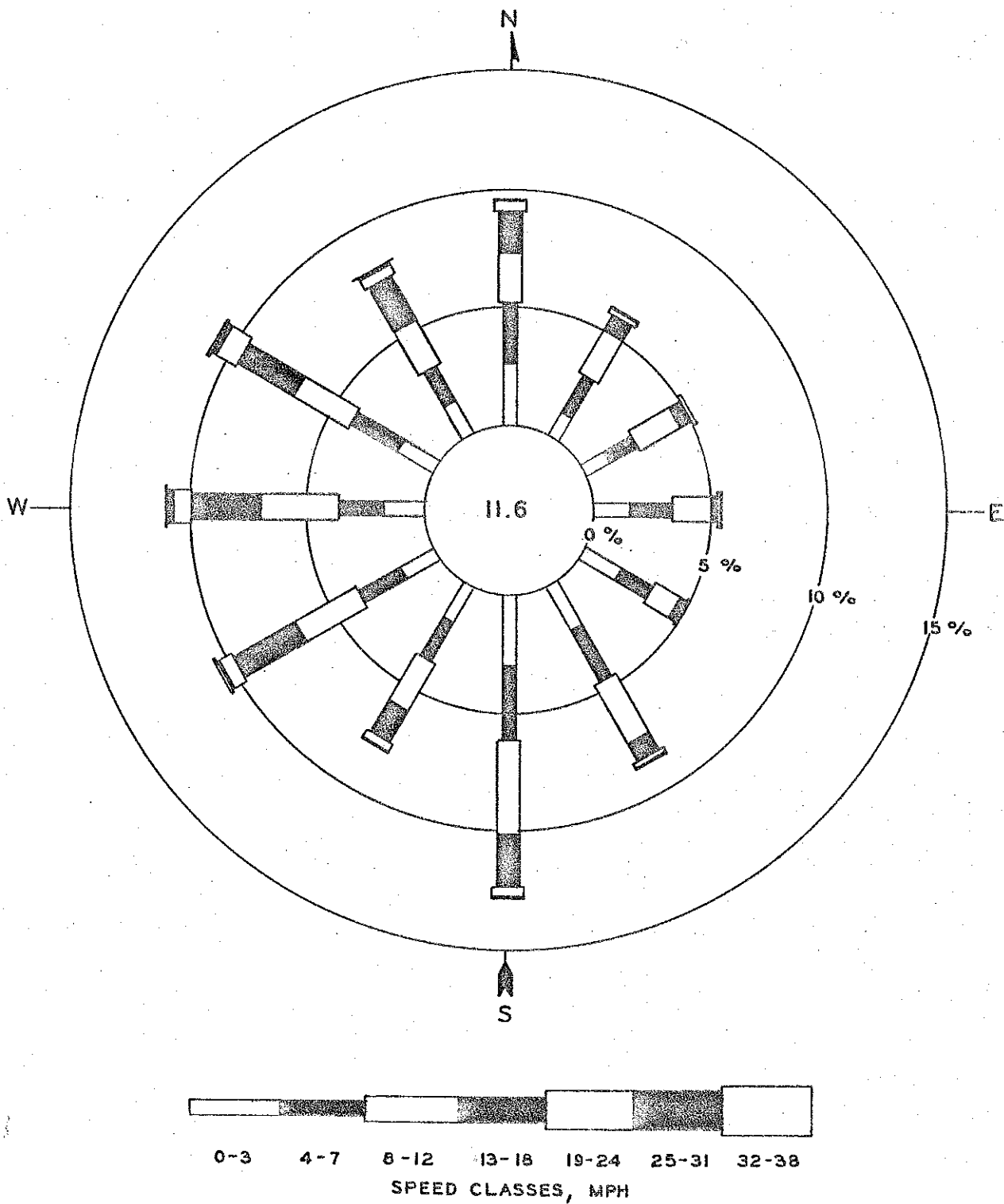


Figure 3. Frequency of wind direction and speed, percent (calms distributed).

4) Roadway widths:

Section 1	36 ft roadway Welts St to Market St 48 ft roadway Market St to Grand Ave
Section 2	48 ft roadway Grand Ave to Pine St 60 ft roadway Pine St to Cass Ave 48 ft roadway Cass Ave to Church St
Section 3	36 ft roadway Church St to Gratiot Ave

All estimates of carbon monoxide levels represent maximum one hour concentrations and are in addition to existing background levels. Table 2 presents estimates of carbon monoxide in the area over the pavement.

Comparison of Estimates with Air Quality Standards

a) 8 hr carbon monoxide air quality standard - 10 mg/cu m (9 ppm)

If for 1978 the highest carbon monoxide levels from the roadway are used (Section 2), and an 8-hr period is taken as two peak hours of 11.9 mg/cu m and six off-peak hours of 3.6 mg/cu m, the 8-hr average carbon monoxide concentration from the roadway is 5.7 mg/cu m. Adding this concentration to the 1 to 3 mg/cu m estimated background results in a total carbon monoxide concentration of 6.7 to 8.7 mg/cu m, which is below the air quality standard. For 1985 and 2000 the carbon monoxide concentrations are estimated to be much lower than the 1978 concentrations due to a larger percentage of exhaust controlled vehicles required by Federal law.

b) One-hour carbon monoxide air quality standard - 40 mg/cu m (36 ppm)

The maximum estimated one-hour concentration of carbon monoxide (roadway plus background) is 11.9 plus 1 to 3 mg/cu m, a range of 12.9 to 14.9 mg/cu m. This is far below the 40 mg/cu m standard.

The estimated concentrations of carbon monoxide, including existing background, above and near the proposed roadway are within National air quality standards. No adverse environmental effects are expected. The project is consistent with the State implementation plan for meeting National air quality standards.

Additional Information for Receptor Sites

Concentrations of carbon monoxide were estimated at two schools, three churches, a public library, and a rest home near the proposed route

(Fig. 1). The locations are as follows:

1. St. Marys School located on Market St approximately 200 ft east of the proposed route.
2. Macomb School located on North Ave approximately 25 ft west of the proposed route.
3. The public library located on North Ave approximately 20 ft east of the proposed route.
4. The church located on North Ave approximately 25 ft east of the proposed route.
5. The church located on the northwest corner of North Ave and Cass Ave approximately 40 ft from the proposed roadway.
6. The rest home located on the southeast corner of South Ave and Maple St approximately 60 ft from the proposed roadway.
7. The church located on Walnut St approximately 40 ft from the proposed roadway.

The following table shows estimated worst meteorological condition levels of carbon monoxide (including 3 mg/cu m background) at the above receptors. The meteorological conditions are a 3 mph wind blowing parallel to the proposed route under atmospheric stability class F. Such atmospheric conditions are seldom expected to occur.

Location	Distance From Roadway		Year		
	Meters	Feet	1978	1985	2000
			mg/cu m	mg/cu m	mg/cu m
1 - St. Marys School	61	200	3.9	3.3	3.3
2 - Macomb School	8	25	12.3	6.2	5.6
3 - Public Library	6	20	13.3	6.5	5.9
4 - Church	8	25	12.3	6.1	5.6
5 - Church	12	40	11.2	5.8	5.3
6 - Rest Home	18	60	10.4	5.5	5.1
7 - Church	12	40	9.4	5.1	4.9

The mathematical model used to estimate carbon monoxide levels is believed to yield values higher than those which will actually occur at any time. Even so, the highest estimated value including background is 13.3 mg/cu m, far below the peak Federal air quality standard of 40 mg/cu m. When carbon monoxide levels were estimated for the most probable conditions, off-peak traffic, a 10 mph wind and atmospheric stability class D - the highest value, including 3 mg/cu m background, at any of the receptors was only 3.3 mg/cu m. It should also be noted that after 1978 the carbon monoxide levels decrease markedly as new clean running cars replace older cars.

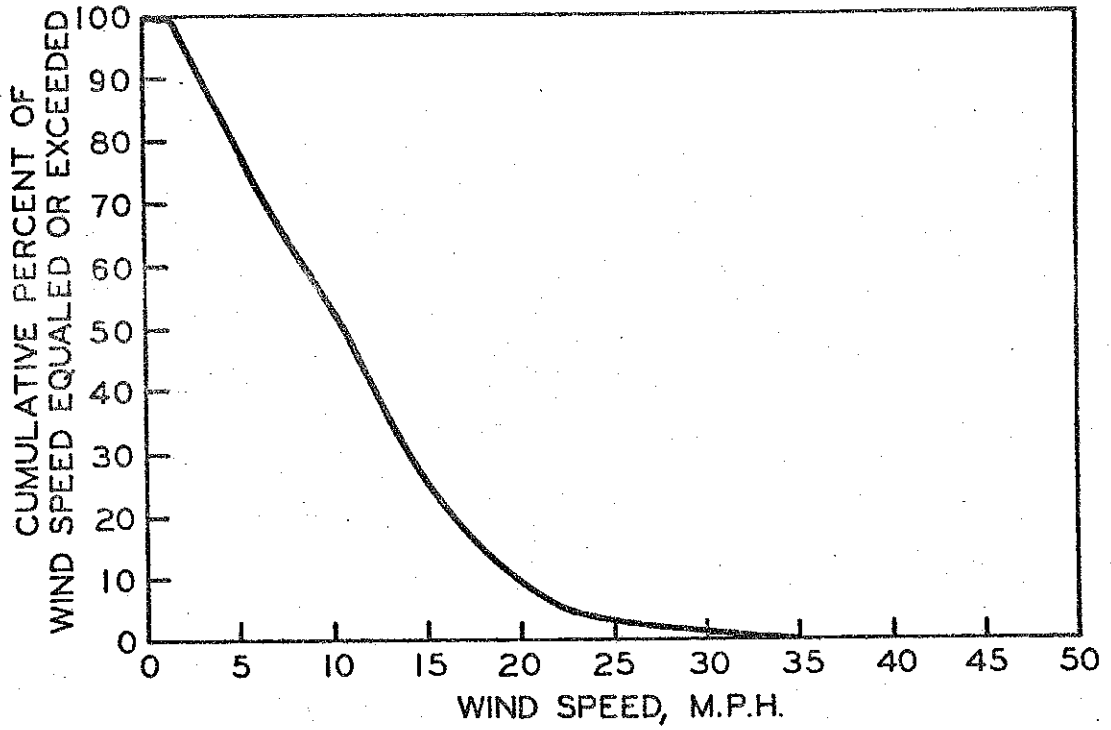


Figure 4. Wind speed distribution at Mount Clemens City Airport.

TABLE 1
TRAFFIC ESTIMATES FOR PROPOSED
M 3 (US 25 BR), MT. CLEMENS

Year	Section 1	Section 2	Section 3
1978	11,200 <1,340(28)> [450(30)]	14,800 <1,780(28)> [590(30)]	11,000 <1,330(28)> [440(30)]
1985	13,600 <1,640(28)> [540(30)]	18,000 <2,160(28)> [720(30)]	12,900 <1,550(28)> [520(30)]
2000	18,000 <1,980(26)> [720(30)]	22,100 <2,400(26)> [884(30)]	17,200 <1,890(26)> [688(30)]

Commercial Vehicles

All sections - 3 percent of Peak, 5 percent of Off-Peak
for 1978 and 1985, 2 percent of Peak and
4 percent of Off-Peak for 2000.

- 000 = Avg. Daily Traffic, vehicles in 24 hr
- <000> = p.m. Peak Traffic, vehicles per hr
- [000] = Off-Peak Traffic, vehicles per hr
- (00) = Avg. Speed

TABLE 2
 ESTIMATES OF CARBON MONOXIDE CONCENTRATIONS
 FROM THE ROADWAY
 (Not Including Background)

Location	Traffic Projection Year	CO (mg/cu m)			
		Worst Condition Parallel Wind, 3 mph		Most Probable Condition ²	
		Peak Traffic	Off-Peak Traffic	Peak Traffic	Off-Peak Traffic
Section 1	1978	9.1	2.8	0.6	0.2
	1985	3.1	0.9	0.2	0.1
	2000	2.8	0.9	0.2	0.1
Section 2	1978	11.9	3.6	1.3	0.4
	1985	4.0	1.2	0.4	0.1
	2000	3.3	1.0	0.4	0.1
Section 3	1978	9.0	2.8	1.0	0.3
	1985	2.9	0.9	0.3	0.1
	2000	2.7	0.8	0.3	0.1

¹ average vehicle speeds are reported in Table 1.

² most probable wind speeds - 10 mph off-peak, 10 mph peak,
 angle between wind direction and roadway direction - Section
 1, 50°; Section 2, 0°; Section 3, 10°.