APTD-1446

# TRANSPORTATION CONTROLS TO REDUCE MOTOR VEHICLE EMISSIONS IN PITTSBURGH, PENNSYLVANIA

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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Prepared by

GCA Corporation
GCA Technology Division
Bedford, Massachusetts



Contract No. 68-02-0041

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Prepared for
ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

December 1972

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Publication No. APTD-1446

Acknowledgements

Many individuals and several organizations have been helpful in carrying out this study; for these contributions the GCA Technology Division extends its sincere gratitude.

Continued project direction and guidance were given by Mr. Fred Winkler (Project Officer) and Mr. Dave Tamny of the Land Use Planning Branch, EPA, Durham, North Carolina, and Mr. Israel Milner (Co-Project Officer) and Mr. Chuck Miesse of EPA Region III.

Many members of local and state agencies supplied data and critical analysis to the study.

Alan M. Voorhees, Inc., acted as subcontractors to GCA Technology Division and supplied major input to the study, especially in the areas of traffic data, control strategies, and implementation obstacles.

## COMMENT REGARDING THE RETROFIT PROGRAM (STRATEGY No. 4)

It has been called to our attention that a retrofit program using the catalytic converter implies the use of unleaded fuel. There is some doubt that cars of model years 1968-1970, perhaps 1968-1971, even, can operate satisfactorily on 91 octane gasoline. The data shown below* indicate that the exclusion of the 1968-1971 model years from the vehicle age group to be retrofitted under the recommended program would cause a loss of 4.6% of CO emission reduction, leaving a net reduction due to the retrofit program of 3.6%. In other words, this is the amount of reduction from retrofit applied to model years 1972-1974 only, based on the derived VAD for Allegheny County (see Table II-15), as of 31 December 1977. Since only about 2.4% reduction from retrofit is needed to meet the federal standard for CO by 31 December 1977, there would remain a "pad" of some 1.2% which would result in a maximum 8-hour average CO concentration of about 8.9 ppm, still 0.1 ppm to the good. The obstacles to the retrofit program are analogous to those for the I&M program, i.e., regressive burden on those least able to pay, etc.

| *Allegheny County VAD: | Pre-1968 | 1968-1970 | 1968-1971 | 1968-1974 | 1975-1978 |
|---|---|---|---|---|---|
| (as of 12/31/77) | 4.1% | 13.6% | 22.5% | 55.3% | 40.6% |

From Table 6 of the paper by Kircher and Armstrong, the average emission factor for the 1968-1971 cars is 37 gm/mi, while the factor for the 1972-1974 cars is 19 gm/mi. Thus, the weighted reduction realized from the retrofit program is 44% of the 8.2%, or 3.6%. This equates to the expected ambient concentration (maximum 8-hour average) of 8.88 ppm.

<u>NOTE</u>: In the discussion of total net reduction to be realized from the recommended transportation control program (Sections I and IV), there is a source of possible confusion in the method of numbering the various strategies, due to the fact that two different lists are shown in two different sequences. In order to avoid this needless complication, it is suggested that the strategies tagged as "#1" and "#2" in the computation in pages I-12 and IV-6&7 and in Table I-4 be renumbered #2 and #3 to agree with the priority sequence shown in Table I-7. Thus, Strategy #1 will always be Inspection and Maintenance (I&M), Strategy #2 will always be the street improvement program, Strategy #3 will always be the parking and mass transit improvements program, and Strategy #4 will be the retrofit program (as modified above).

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# I. INTRODUCTION AND SUMMARY

## A. BACKGROUND

States were required to submit implementation plans by January 30, 1972, that contained control strategies demonstrating how the national ambient air quality standards would be achieved by 1975. Many urban areas could not achieve the carbon monoxide and oxidant air quality standards by 1975 or even 1977 through the expected emission reductions from the 1975 exhaust systems control. Major difficulty was encountered by many states in the formulation of implementation plans that included transportation control strategies (including, for example, retrofit and inspection, gaseous fuel conversions, traffic flow improvements, increased mass transit usage, car pools, motor vehicle restraints, and work schedule changes.) Because of the complex implementation problems associated with transportation controls, states were granted until February 15, 1973, to study and to select a combination of transportation controls that demonstrated how the national air quality standards would be achieved and maintained by 1977.

## B. PURPOSE, SCOPE AND LIMITATIONS OF STUDY

The purpose of the study reported on herein was to identify and develop transportation control strategies that will achieve the carbon monoxide and oxidant air quality standards required to be met by Pennsylvania in the Pittsburgh urban area by the year 1977. The results of the study were to help determine the initial direction that the Commonwealth of Pennsylvania should take in selecting feasible and effective transportation controls. It was anticipated that the control strategies outlined in this study would be periodically revised in the coming years. State implementation plans were analyzed to verify and assess the severity of the carbon monoxide and oxidant pollutant problems, and the most promising transportation controls and their likely air quality impact were determined. Major implementation obstacles were noted after discussions with those agencies responsible for implementing the controls and, finally, a surveillance review process (January 1973 - December, 1976, inclusive) was developed for EPA to use in monitoring implementation progress and air quality impact of transportation control strategies.

It should be noted that the study was carried out relying on the best data and techniques available during the period of the study and further, that a large number of assumptions were made as to the nature of future events. The 1977 air quality predictions were based on extant air quality data and on predicted stationary source emissions and predicted traffic patterns, and these predicted parameters themselves were based on anticipated emission control techniques, anticipated growth patterns, and the assumed outcome of unresolved legal and political decisions. (The opening of key major traffic facilities before 1977 was particularly sensitive to the outcome of legal and political decisions.) Further, the development, ranking and selection of transportation controls were based on extant and predicted economic, sociological, institutional and legal considerations. Finally, the surveillance process presented in this report, although showing key checkpoints towards implementation of the recommended controls, is in itself dependent upon the same assumed pattern of future events.

It should be emphasized therefore, that to the extent that the time-scale of the recommended program permits, the conclusions and recommendations of this report should not be construed as a program which must be rigidly followed until 1977, but rather it should be regarded first, as a delineation as to what appears at the present time to be a feasible course of action to attain air quality goals, and secondly, as a framework upon which an optimum on-going program can be built as new data and techniques become available, as legal and political decisions are made, and as the assumptions as to future events are, or are not, validated.

C. CONTENT OF REPORT

Section II of this report describes how the pollutant concentration levels which could be expected to occur in 1977 in the Pittsburgh area were predicted. These levels were determined by an adaptation of the proportional model using motor vehicle emissions from traffic patterns predicted for 1977 together with predicted non-vehicular emissions for 1977 obtained from state agencies. Comparison of these predicted 1977 air pollutant concentrations with the national air quality standards enabled the computation of the motor vehicle emissions which would result in the air quality standards being met, and therefore, to what extent, if any, reductions in the predicted 1977 motor vehicle emissions would be required. In order to determine the pollutant concentration(s) which was to serve as the basis for the proportional model, an intensive evaluation of all existing meteorological and air quality data was performed.

The final determination as to the concentration value used was made in close cooperation with representatives of local and state agencies and of EPA.

Section III describes how candidate control strategies were developed, evaluated and ranked having regard to technical, legal, institutional, sociological and economic criteria. An important feature of this task was the continuing interaction between, on one hand, the GCA study team, and on the other hand, representatives of local and state environmental planning and transportation agencies, concerned citizen's groups, and EPA representatives.

Section IV presents the rationale for selecting the optimum package of controls necessary to achieve the required reduction in motor vehicle emissions and also presents the confirmed effect on air quality.

Section V deals in detail with the obstacles to the implementation of the selected strategies. Since the obstacles to implementation were important criteria in the evaluation of the feasibility of candidate transportation controls, there is considerable discussion on such obstacles in earlier sections.

Section VI presents the surveillance review process which will enable EPA to monitor the implementation progress and air quality impact of the recommended strategies. A curve showing predicted air quality levels for the years 1973 to 1977 and beyond is presented, based on the implementation of the recommended transportation controls. This will provide a basic indication of the way in which air quality should improve as time passes and as controls are implemented. In addition, important checkpoints are provided delineating the salient actions which must be taken in order to implement the strategies such as the obtaining of the necessary financing and legislation. Further, important background assumptions, such as growth rate are identified, and methodologies supplied, to provide verification that these assumptions are in fact, validated during the course of the program.

It should be noted, however, that the surveillance process thus provided is of necessity based on the problem, and the concomitant transportation controls, as they are presently perceived. An equally important part of any surveillance process is the continuing reassessment of both the problem itself and the appropriateness of the required controls. As was discussed earlier in this Introduction, the present study employed a whole range of extant data and techniques, and also of assumptions about the course of future events. This data base should be continuously reviewed as new information becomes available. Thus, although the key background parameters are called out in the Surveillance Process, a thorough and continuing review of all the data, techniques, and assumptions contained in this report will be required to properly update the problem definition and appropriate control measures.

## D. SUMMARY OF PROBLEM AND REQUIRED TRANSPORTATION CONTROLS

### 1. Summary and Review

As a result of our investigation of the Pittsburgh region, it was found that while the federal standards for both carbon monoxide (CO) and oxidants ($O_x$) are being exceeded at the present time, only the CO emissions will constitute a problem by 1977. This is because, although the FMVECP together with the planned controls on stationary sources will not, of themselves, quite achieve the reduction necessary to meet the oxidant standards by 1977 (Table I-2), the transportation control strategies which will be required to achieve the standard for CO by that time will also satisfy the requirement for reduction of hydrocarbon (HC) emissions sufficient to assure a "safe" level of $O_x$ concentrations.

The specific expected emissions and concentrations are shown in Tables I-1 and I-2. The small differences noted between the data in the body of this report (see Tables II-18 and II-19) and the data shown here are due solely to the use of the vehicle age distribution for Allegheny County in lieu of the distribution for the entire SPRPC Region. Tables II-13, II-15 and II-21 show the differences and the resulting emissions due to these differences. The model years shown are as of 1971. The computer program VEHEMI2 automatically shifts the derived age distribution forward or backward in time, to be compatible with the particular calendar year being investigated.

Figure I-1 shows the expected air quality levels for CO, first with no strategies applied and using the SPRPC vehicle age distribution and that for Allegheny County, then showing the effects of the various strategies.

TABLE I-1

TOTAL VEHICULAR EMISSIONS IN KG/DAY AND EXPECTED MAXIMUM 8-HOUR AVERAGE CO CONCENTRATIONS IN PPM FOR PITTSBURGH, ZONE 1

| YEAR | NO STRATEGIES | | CO CONC.* | WITH STRATEGIES 1 AND 2 | | WITH I & M | | WITH RETROFIT | | NON-VEH. | TOTAL EMISS. | NET CO CONC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CO | HC | | CO | HC | CO | HC | CO | HC | CO | CO | |
| 1970 | 29,530 | 4,775 | ---- | | | | | | | | | |
| 1971 | 28,541 | 4,325 | ---- | | | | | | | | | |
| 1972 | 27,111 | 3,820 | 21.3 | | | | | | | 2,200 | 29,311 | 21.3 |
| 1973 | 24,654 | 3,399 | 19.3 | | | | | | | 1,940 | 26,594 | 19.3 |
| 1974 | 22,343 | 3,012 | 17.5 | 22,119 | 2,988 | | | | | 1,680 | 23,799 | 17.3 |
| 1975 | 19,538 | 2,558 | 15.2 | 18,910 | 2,488 | | | | | 1,419 | 20,329 | 14.8 |
| 1976 | 15,992 | 2,059 | 12.7 | 15,028 | 1,947 | 14,352 | 1,842 | 13,764 | 1,766 | 1,419 | 15,183 | 11.0 |
| 1977 | 13,120 | 1,704 | 10.6 | 12,207 | 1,596 | 11,108 | 1,424 | 10,197 | 1,307 | 1,419 | 11,616 | 8.4 |
| 1978 | 10,698 | 1,443 | 8.8 | 9,965 | 1,352 | 9,068 | 1,206 | 8,324 | 1,107 | 1,469 | 9,793 | 7.1 |
| 1979 | 8,897 | 1,221 | 7.6 | 8,300 | 1,145 | 7,553 | 1,021 | 6,934 | 937 | 1,520 | 8,454 | 6.1 |
| 1980 | 7,199 | 1,034 | 6.4 | 6,730 | 971 | 6,124 | 866 | 5,622 | 795 | 1,573 | 7,195 | 5.2 |
| 1981 | 5,974 | 928 | 5.5 | 5,598 | 873 | 5,094 | 779 | 4,676 | 715 | 1,628 | 6,304 | 4.6 |
| 1982 | 5,278 | 856 | 5.1 | 4,957 | 806 | 4,511 | 719 | 4,141 | 660 | 1,685 | 5,826 | 4.2 |
| 1983 | 4,825 | 791 | 4.8 | 4,540 | 746 | 4,131 | 665 | 3,792 | 610 | 1,744 | 5,536 | 4.0 |
| 1984 | 4,447 | 774 | 4.5 | 4,192 | 730 | 3,815 | 651 | 3,502 | 598 | 1,805 | 5,307 | 3.9 |
| 1985 | 4,404 | 770 | 4.6 | 4,154 | 726 | 3,780 | 648 | 3,470 | 595 | 1,868 | 5,338 | 3.9 |
| 1986 | 4,309 | 759 | 4.5 | 4,067 | 717 | 3,701 | 640 | 3,398 | 588 | 1,933 | 5,331 | 3.9 |

* Includes non-vehicular emissions - see Column 11

NOTE: It was assumed that the reductions in HC emissions from strategies 1 and 2 shown for Zone 1 were just offset by corresponding increases spread over the rest of the County; i.e., the County-wide total HC emissions were not changed as a result of the application of these strategies. See Table I-2

TABLE I-2

TOTAL VEHICULAR HC EMISSIONS IN KG/DAY AND EXPECTED MAXIMUM 1-HOUR AVERAGE OXIDANT CONCENTRATIONS IN PPM FOR ALLEGHENY COUNTY

| YEAR | WITHOUT STRATEGIES | TOTAL EMISSIONS | OX CONC.* | WITH I & M | WITH RETROFIT | NON-VEHICULAR EMISSIONS | TOTAL EMISSIONS | % RED. REQD** | NET OX CONC |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | 124,141 | | | | | | | | |
| 1971 | 112,553 | | | | | | | | |
| 1972 | 99,500 | 128,320 | .165 | | | 28,820 | 128,320 | 55.0 | .165 |
| 1973 | 88,603 | 114,454 | .153 | | | 25,851 | 114,454 | 49.5 | .153 |
| 1974 | 78,588 | 101,471 | .140 | | | 22,883 | 101,471 | 43.1 | .140 |
| 1975 | 66,803 | 86,718 | .122 | | | 19,915 | 86,718 | 33.4 | .122 |
| 1976 | 53,822 | 71,247 | .101 | 50,915 | 48,828 | 17,425 | 66,253 | 12.8 | .095 |
| 1977 | 44,593 | 59,529 | .084 | 39,777 | 36,516 | 14,936 | 51,452 | 0.0 | <.080 |
| 1978 | 37,793 | 53,252 | <.080 | 33,712 | 30,947 | 15,459 | 46,406 | | |
| 1979 | 31,995 | 47,995 | | 28,539 | 26,199 | 16,000 | 42,199 | | |
| 1980 | 27,124 | 43,684 | | 24,195 | 22,211 | 16,560 | 38,771 | | |
| 1981 | 24,381 | 41,521 | | 21,748 | 19,964 | 17,140 | 37,104 | | |
| 1982 | 22,505 | 40,245 | | 20,075 | 18,429 | 17,740 | 36,169 | | |
| 1983 | 20,817 | 39,178 | | 18,569 | 17,046 | 18,361 | 35,407 | | |
| 1984 | 20,374 | 39,378 | | 18,173 | 16,683 | 19,004 | 35,687 | | |
| 1985 | 20,282 | 39,951 | | 18,092 | 16,608 | 19,669 | 36,277 | | |
| 1986 | 20,020 | 40,387 | <.080 | 17,867 | 16,402 | 20,357 | 36,759 | 0.0 | <.080 |

* Maximum observed 1-hour average $O_3$ concentration; includes non-vehicular emissions - see Column 7.
** % reduction in HC emissions required to reach "safe" rate of 57,744 kg/day (based on 55% red. from .165 $O_x$ conc.)

NOTE 1: Strategies 1 and 2 were not applied, since it was assumed that the Zone 1 reductions in hydrocarbons due to those strategies would not be realized in the rest of the County; i.e., the total emissions would remain unchanged. (See Note, Table I-1).

NOTE 2: Oxidant concentrations were derived from the data in Table II-20, page , and by reading the curve in Appendix J, 40 CFR 51, "backwards," assuming a "safe" HC emissions rate of 57,744 kg/day from all sources.

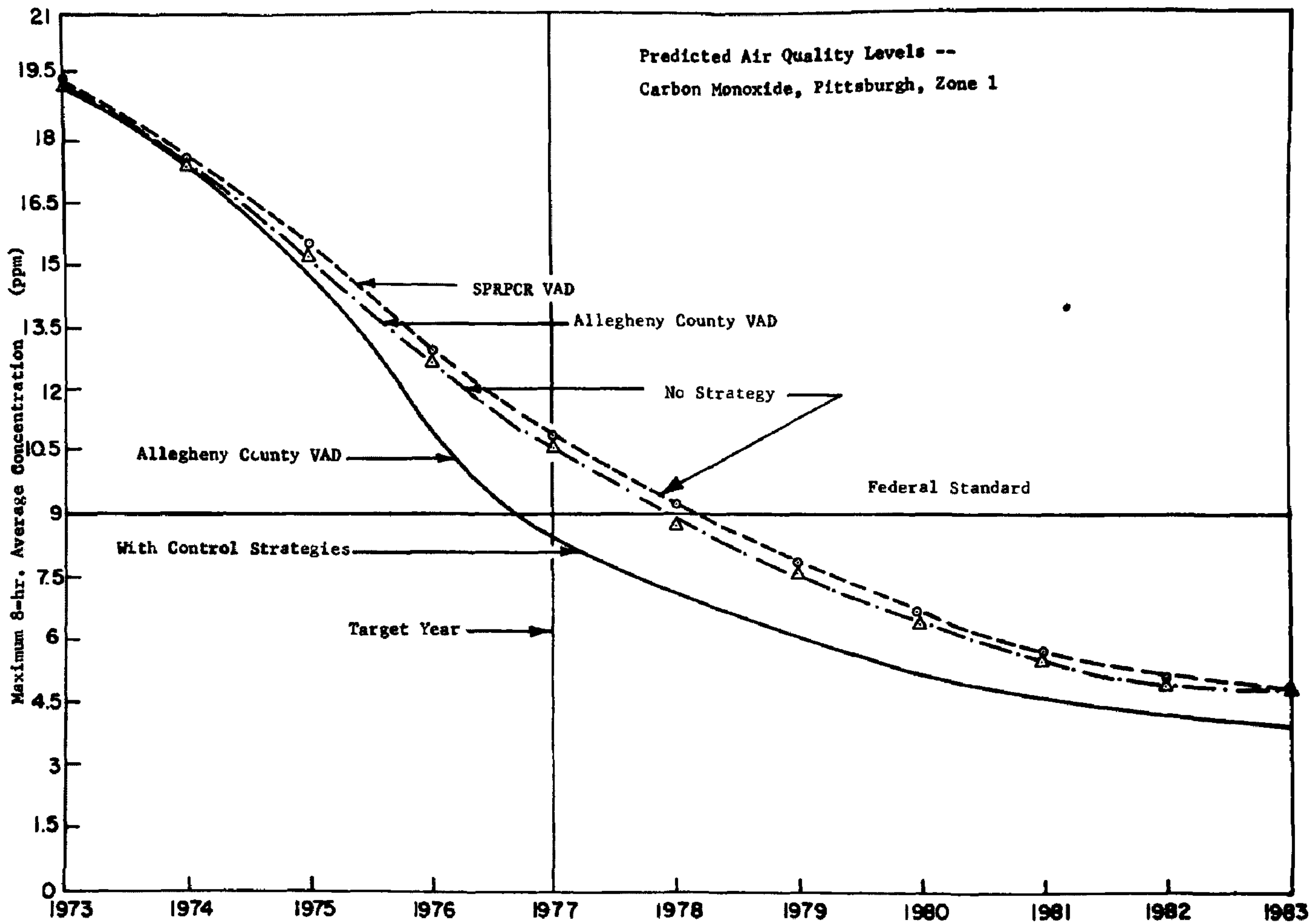
Predicted Air Quality Levels --
Carbon Monoxide, Pittsburgh, Zone 1
Maximum 8-hr. Average Concentration (ppm)
21
19.5
18
16.5
15
13.5
12
10.5
9
7.5
6
4.5
3
1.5
0
SPRPCR VAD
Allegheny County VAD
No Strategy
Allegheny County VAD
Federal Standard
With Control Strategies
Target Year
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983

Figure I-1.

TABLE I-3

TOTAL VEHICULAR EMISSIONS, PITTSBURGH, ZONE 1 (Kg/day)

| CALENDAR YEAR | WITHOUT STRATEGIES REGIONAL VEHICLE AGE DISTRIBUTION* | | WITH STRATEGIES 1 & 2 ALLEGHENY COUNTY VEHICLE AGE DIST.* | |
|---|---|---|---|---|
| | CO | HC | CO | HC |
| 1970 | 29,845 | 4,852 | 29,530 | 4,775 |
| 1971 | 28,903 | 4,416 | 28,541 | 4,325 |
| 1972 | 27,543 | 3,923 | 27,111 | 3,820 |
| 1973 | 25,179 | 3,505 | 24,654 | 3,399 |
| 1974 | 22,916 | 3,113 | 22,119** | 2,988** |
| 1975 | 20,186 | 2,656 | 18,910** | 2,488** |
| 1976 | 16,705 | 2,154 | 15,208** | 1,947** |
| 1977 | 13,829 | 1,794 | 12,207** | 1,596** |
| 1978 | 11,340 | 1,523 | 9,965 | 1,352 |
| 1979 | 9,474 | 1,288 | 8,300 | 1,145 |
| 1980 | 7,658 | 1,084 | 6,730 | 971 |
| 1981 | 6,326 | 971 | 5,598 | 873 |
| 1982 | 5,551 | 890 | 4,957 | 806 |
| 1983 | 5,049 | 815 | 4,540 | 746 |
| 1984 | 4,593 | 793 | 4,192 | 730 |
| 1985 | 4,535 | 787 | 4,154 | 726 |
| 1986 | 4,401 | 771 | 4,067 | 717 |

* See Table II-13, p. II-58; and Table II-15, p. II-60.

** Transportation Control Program phased in over the 1974-1977 time period.

Because of the greater relative number of "new" cars in Allegheny County as compared with the rest of the Region (see Tables II-13 and II-15), the completed CO and HC emissions are somewhat lower if the local vehicle age distribution (VAD) is used. Because of the increasing influence on the total vehicle population of late-model "controlled" cars, this differential in computed emissions increases with time until about 1978, when the population begins to become more homogeneous (see Figure I-1). After that time, as the effect of uncontrolled vehicles becomes less important, the differences due to different VAD's become smaller again, ranging from 1% for 1970 up to around 5% for 1978 and 1979, then back down to 1% again by 1986.

While the effects of the individual strategies are broken out, year by year, in Tables I-1 and I-2, only the cumulative effect of the entire strategy package is shown in the bottom curve in Figure I-1.

2. Recommended Strategies

In order of preference, the recommended strategies are:

| STRATEGY | AMOUNT OF ROLLBACK EXPECTED |
|---|---|
| Inspection and maintenance (affects entire Region) | 9% (CO); 10.8% (HC) |
| Traffic flow improvements through the upgrading of existing streets (affects Zone 1 only) | 1.4% (CO & HC) |
| Increase daily parking rate by $1.45, use existing parking space in fringe areas, and improve short-term mass transit (affects Zone 1 only) | 5.5% (CO & HC) |
| Retrofit program (use of oxidizing catalytic converters) (affects entire Region) | 8.2% (CO & HC) |

The amounts of rollback shown are taken for each strategy as though it were the only one to be adopted. The actual amounts expected as a result of the total program package are shown below. The total net rollback is expected to be 22.2%*. The total rollback of vehicular emissions

---

* Computations of rollback percentages from various baseline values:

| | REQUIRED | EXPECTED |
|---|---|---|
| From 1972 vehicular CO emission rate: | $\frac{27111-10965}{27111} = 59.6\%$ | $\frac{27111-10213}{27111} = 62.3\%$ |
| From 1972 total CO emission rate: | $\frac{29311-12384}{29311} = 57.7\%$ | $\frac{29311-11632}{29311} = 60.3\%$ |
| From 1977 vehicular CO emission rate: | $\frac{13120-10965}{13120} = 16.4\%$ | $\frac{13120-10213}{13120} = 22.2\%$ |
| From 1977 total CO emission rate: | $\frac{14539-12384}{14539} = 14.8\%$ | $\frac{14539-11632}{14539} = 20.0\%$ |

required to meet the federal standard for CO by 1977 is 16.4% of the 1977 vehicular emission rate expected as a result of the FMVECP alone. The apparent "pad" of 5.8% in the recommended package of strategies is related to an air quality level of 8.4 ppm, only 0.6 ppm below the federal standard for CO (see Figure I-1 and Table I-1).

| | Successive Reductions And Resultant Emissions Rates |
|---|---|
| 1972 CO emissions from motor vehicles, Zone 1 (the "Baseline" value) | 27,111 kg/day |
| Less expected reduction from FMVECP (51.6% of baseline) | 13,991 |
| 1977 vehicular CO emission rate, no strategies | 13,120 |
| Less 1.4% emission reduction expected from traffic flow improvements (2% increase in average speed) | 184 due to strategy 1<br>12,936 |
| Less 5.5% emission reduction expected from parking strategies and improvements in short-term mass transit (5.5% decrease in VMT within Zone 1) | 711 due to strategy 2<br>12,225* |
| Less 9.0% emission reduction expected from regional or state-wide inspection and maintenance program | 1,100 due to I & M program<br>11,125* |
| Less 8.2% emission reduction expected from regional or state-wide retrofit program (oxidizing catalytic converters attached to 1968-1974 model year vehicles) | 912 due to retrofit |
| Net expected CO emission rate for Zone 1 | 10,213* kg/day |
| Net expected rollback from 1977 "no-strategy" rate | 22.2% (62.3% of 1972) |

* The slight differences between these values and those shown in Table I-1 are due to the fact that the "with strategies 1 & 2" column in the Table uses the values generated by the computer programs VEHEMI2 and VEHEMI3, whereas the listing above only approximates the reduction in emissions from the 2% increase in average speed in Zone 1. In any event, the difference is very small: on the order of 0.15%.

From Table I-1 the e/c ratio is 29,311/21.3 = 1376.1; hence, the "safe" emission rate from all sources is 9 x 1376 = 12,384 kg/day. This is the rate to be attained by 1977;* assuming that the e/c ratio holds, it will just meet the federal standard of 9 ppm CO for the maximum 8-hour average concentration. Since the highest maximum value observed occurred in the CBD, and since the other zones are expected to have much lower emission rates (see Appendix C), the standards should be met by the recommended program everywhere within the Region. The expected CO emission rate from non-vehicular sources in 1977 is 1,419 kg/day. Adding this to the figure derived above for vehicular emissions gives an expected total emission rate of 11,632 kg/day. This is 6% below the so-called "safe" value of 12,384 kg/day, which requires a vehicular emission rate of 10,965 kg/day, and 20% below the no-strategy rate of 14,539 kg/day from all sources. The net vehicular CO emission rate derived above is 6.86% below this "safe" rate for vehicular emissions of CO; combined with the other emissions it would result in an ambient CO concentration of 11,632/1376 = 8.4 ppm, as shown in Table I-1.

---

*In the absence of any prior direction on the effective date in 1977 by which these reductions were to be attained, and to maintain compatibility with the other data used in the computations (VMT, derived VAD, etc.), the computer program relates everything to 31 December of the calendar year. If it is desired to shift the effective date to some other day - say, 1 July - then the VAD may be used as given in Table II-13 but the VMT's will have to be altered by interpolation to account for the desired amount of temporal shift. Under these conditions, of course, since the FMVECP would be operating for a shorter time, the required emissions reduction from controls would be correspondingly higher.

TABLE I-4

PHASE-IN OF REDUCTIONS DUE TO EACH TRANSPORTATION CONTROL STRATEGY IN THE RECOMMENDED PROGRAM

| | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|
| Strategy 1, Street Improvements | (27%)(2.0%)=0.54% | (70%)(2.0%)=1.40% | (93%)(2.0%)=1.86% | 100%=2.0% incr. avg. speed |
| Values of SPD: | 39.21, 19.10, 17.09<br>(27%)(1.4%)=0.38% | 39.55, 19.27, 17.24<br>(70%)(1.4%)=0.98% | 39.73, 19.35, 17.32<br>(93%)(1.4%)=1.30% | 39.78, 19.38, 17.34<br>100%=1.4% decr. in emissions |
| Strategy 2, Parking & Transit Improvements | (10%)(5.5%)=0.55%<br>(99.45%)$VMT_{74}$ | (37%)(5.5%)=2.04%<br>(97.96%)$VMT_{75}$ | (83%)(5.5%)=4.57%<br>(95.43%)$VMT_{76}$ | 100%=5.5% decr. in VMT<br>(94.5%)$VMT_{77}$ |

See Table I-5 for values of VMT and SPD used in the "with strategies" runs.

---

After the computer run using the "strategy 1 & 2" values was made, the reductions for the other two strategies were computed by hand, assuming that 50% of the reductions due to the I & M and retrofit programs were effective in 1976 and 100% of these reductions were effective in 1977 and following years, as shown below:

| | | |
|---|---|---|
| Inspection and Maintenance | (50%)(9.0%)=4.5%<br>(50%)(10.8%)=5.4% | 100%=9.0% for CO<br>100% = 10.8% for HC |
| Retrofit, controlled vehicles only (1968 - 1974 model years) | (50%)(8.2%)=4.1% | 100% = 8.2% for both CO & HC |

The expected emissions resulting from the application of the above reductions in the manner shown are displayed in Tables I-1 and I-2.

## TABLE I-5

### VMT'S AND SPD'S FOR PITTSBURGH, ZONE 1, WITH STRATEGIES

| YEAR | CODE | VEHICULAR MILES TRAVELED | | | | OFF-PEAK SPEEDS, AVERAGE | | |
|---|---|---|---|---|---|---|---|---|
| | | LDV | HDV | OV | TOTAL | FREEWAY | ARTERIAL | LOCAL STREETS |
| 1970 | 13 | 399,772 | 20,545 | 7,704 | 428,021 | 39.00 | 19.00 | 17.00 |
| 1971 | 14 | 407,054 | 20,919 | 7,845 | 435,818 | 39.00 | 19.00 | 17.00 |
| 1972 | 15 | 414,336 | 21,294 | 7,985 | 443,615 | 39.00 | 19.00 | 17.00 |
| 1973 | 16 | 421,619 | 21,668 | 8,125 | 451,412 | 39.00 | 19.00 | 17.00 |
| 1974 | 17 | 426,542 | 21,921 | 8,220 | 456,683 | 39.21 | 19.10 | 17.09 |
| 1975 | 18 | 427,287 | 21,959 | 8,234 | 457,480 | 39.55 | 19.27 | 17.24 |
| 1976 | 19 | 423,201 | 21,749 | 8,155 | 453,105 | 39.73 | 19.35 | 17.32 |
| 1977 | 20 | 425,958 | 21,891 | 8,209 | 456,058 | 39.78 | 19.38 | 17.34 |
| 1978 | 21 | 432,840 | 22,244 | 8,342 | 463,426 | 39.78 | 19.38 | 17.34 |
| 1979 | 22 | 439,721 | 22,598 | 8,475 | 470,794 | 39.78 | 19.38 | 17.34 |
| 1980 | 23 | 446,604 | 22,952 | 8,607 | 478,163 | 39.78 | 19.38 | 17.34 |
| 1981 | 24 | 453,487 | 23,306 | 8,739 | 485,532 | 39.78 | 19.38 | 17.34 |
| 1982 | 25 | 460,368 | 23,659 | 8,873 | 492,900 | 39.78 | 19.38 | 17.34 |
| 1983 | 26 | 467,251 | 24,012 | 9,005 | 500,268 | 39.78 | 19.38 | 17.34 |
| 1984 | 27 | 474,132 | 24,367 | 9,137 | 507,636 | 39.78 | 19.38 | 17.34 |
| 1985 | 28 | 481,014 | 24,720 | 9,271 | 515,005 | 39.78 | 19.38 | 17.34 |
| 1986 | 29 | 487,897 | 25,073 | 9,403 | 522,373 | 39.78 | 19.38 | 17.34 |
| (1987) | 30 | (494,778) | (25,428) | (9,535) | (529,741) | FSPD = fraction of VMT's traveled at each speed class, Zone 1: | | |
| (last line not used in computations) | | | | | | 0.17 | 0.13 | 0.70 |

The above values were the inputs to the programs VEHEMI2 and VEHEMI3 for the "with strategies" computer runs. They may be compared with the VMT's in the Appendices (see 1977 24-hour VMT for Zone 1), and with those listed in Table II-14, page II-80. The latter formed the basis for the "no-strategy" computer runs.

TABLE I-6

FRACTION OF TOTAL VEHICLES IN USE - LDV ONLY
(As of 31 December)

| AGE (YEARS) | NATION-WIDE | REGION-WIDE | COUNTY-WIDE |
|---|---|---|---|
| 0 | 0.038 | 0.030 | 0.033 |
| 1 | .068 | .104 | .114 |
| 2 | .117 | .124 | .133 |
| 3 | .111 | .120 | .126 |
| 4 | .098 | .111 | .113 |
| 5 | .106 | .108 | .108 |
| 6 | .105 | .110 | .107 |
| 7 | .087 | .094 | .089 |
| 8 | .076 | .071 | .066 |
| 9 | .059 | .050 | .045 |
| 10 | .036 | .028 | .025 |
| 11 | .029 | .015 | .013 |
| 12 | .016 | .009 | .007 |
| 13+ | .054 | .026 | .021 |

The above tabulation compares the nation-wide data as given in Table 14 of the paper by Kircher and Armstrong with those derived from the AMV data for the SPRPC Region and Allegheny County, respectively. The base year was 1971. The "zero years" age group refers to next year's models introduced in the fall; in this case, these would be the 1972 models. As explained in the text, the computer program shifts the selected VAD forward or backward in time from the year 1971, assuming that the same VAD holds for the calendar year being studied. The successively "younger" vehicle populations are evident as we go from the national average to the Regional distribution, then to that for Allegheny County by itself. The importance of this is that the greater the mix of "new" cars, the lower the overall rate of emissions from the given population. This is the reason for the apparent discrepancy between the numbers generated earlier in this study using the Regional figures, and those given here which are based on the County averages. Since it is good practice to use local distributions whenever possible, the lower emission figures are believed to be more nearly correct than those published in the Draft Report.

# TABLE I-7

## RECOMMENDED TRANSPORTATION CONTROL PROGRAM

| Transportation Control Strategy | Emission Reduction | SOURCE OF EMISSION REDUCTION | | Capital Costs | Non-Economic Impact |
|---|---|---|---|---|---|
| | | Emission Rate Reduction | VMT Reduction | | |
| #1 Inspection & Maintenance | CO, HC<br>0% 16.4%<br>Decrease daily CO emissions by 9% and daily HC emissions by 10.8% | Expected to reduce HC emission rate by 10.8% and daily CO emission rate by 9.0% | No reduction expected | Approximately $38 Million | Program is adaptable to existing program.<br>State legislation required.*<br>Technology has been developed. |
| #2 Upgrading existing streets Traffic Flow Improvements | CO, HC<br>0% 16.4%<br>Decrease daily CO and HC emissions by 1.4% | Due to 2 percent average daily speed increase, a 1.4% emission rate reduction | No reduction expected | Minimal capital cost | Similar program implemented.<br>No legislative enactment needed.<br>No technical innovation required. |
| #3 Increase daily parking rate $1.45, utilize existing parking spaces in fringe areas, and institute express bus service, extend coverage, decrease headways & increase running speed | CO,HC<br>0% 16.4%<br>Decrease CO & HC emissions by 5.5 percent | No significant reduction expected | Expected to reduce VMT by 5.5% | Approximately $12 Million | Similar program implemented elsewhere.<br>No legislative enactment needed.<br>No significant technical innovation required. |
| #4 Retrofit | CO, HC<br>0% 16.4%<br>Decrease CO & HC emissions by 8.2% | Expected to reduce daily CO & HC emission rates by 8.2% | No reduction expected | Approximately $34 Million** | Program is adaptable to existing program.<br>State legislation required.*<br>Technology has been developed. |
| Total Control Program | CO<br>0% 24%<br>Decrease daily CO emissions by 22.2%, HC emissions by 24 %.<br>Desired reduction for CO is 16.4%. | An 18.5% HC emission rate reduction and a 16.7% CO emission rate reduction | A 5.5% VMT reduction | Approximately $84 Million | Program is implementable with State legislation.* No significant technical innovation required. |

*Already in PL 154 (1972), Sections 834(a) and 850.
**Total capital cost of retrofit plus I&M is approximately $72 million for the SPRPC Region.

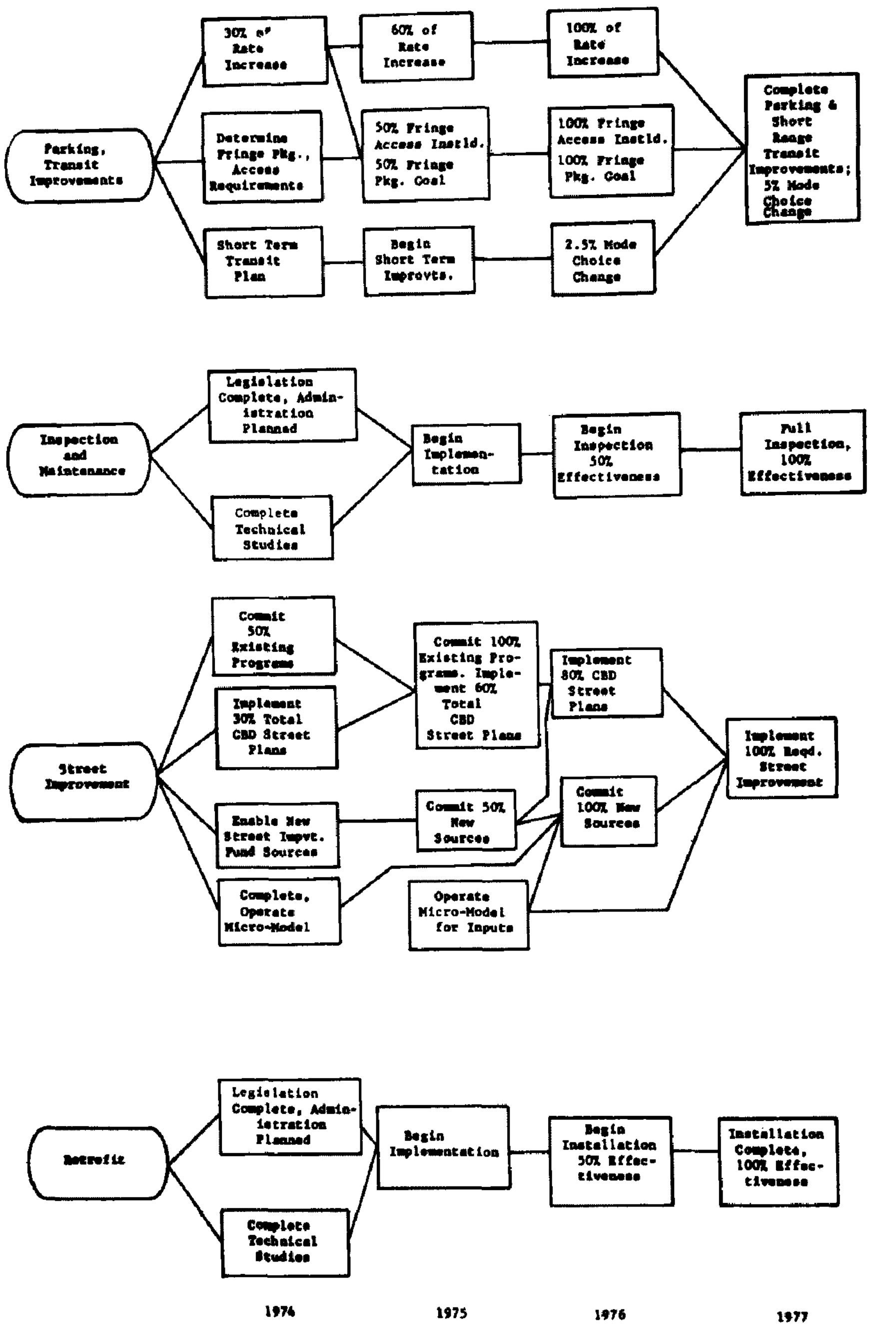


Figure I-2. Implementation schedule for the recommended transportation control program.

## II. VERIFICATION AND ASSESSMENT OF AIR POLLUTION PROBLEM

### A. OUTLINE OF METHODOLOGY

The basic procedure employed was to develop, for each city,* pollutant concentration levels which could be expected in 1977 without the application of transportation controls (the potential 1977 levels). Pollutant levels were determined by the proportional model using non-vehicular emissions supplied by state agencies and using vehicular emissions based on traffic data developed during the course of this study. More sophisticated techniques could not be employed due to the lack of suitable extant calibrated diffusion models, and the short time period of the contract which precluded the development of a suitable model and the required inputs. Comparison of potential 1977 air quality levels with the appropriate standard gave the allowable motor vehicle emissions in 1977, which in turn formed the basis for the development of transportation control strategies.

Emissions from non-vehicular sources were obtained from state implementation plans updated as required from information supplied by state agencies. Emissions from vehicular sources were computed following the recommendations given in EPA draft publication An Interim Report on Motor Vehicle Emission Estimation by David S. Kircher and Donald P. Armstrong, dated October 1972. Air quality data for each sensor within

*In this discussion, the word city is used to denote the urban area covered by the study and is not restricted to the area within the political limits of the city.

the city area was reviewed and evaluated in close cooperation with state and local agencies. The instrumental method and sensor location were studied and records of instrument maintenance and calibration examined so as to identify questionable readings. Meteorological records were then examined and compared with seasonal and diurnal variations in air quality levels. Finally the pollutant concentration which would form the basis for the proportional rollback calculations was decided upon in concert with state and local agencies and EPA representatives. The year in which this concentration level occurred defined the base year for the proportional rollback calculations.*

Because of the major differences involved, the detailed methodologies for carbon monoxide and oxidants are presented separately below.

1. Methodology for Carbon Monoxide

Because ambient concentrations of carbon monoxide at any given location appear to be highly dependent on carbon monoxide emissions in the near vicinity, it was felt that some justification existed for a modification of the proportional model. It was felt that in order to reduce ambient CO levels in, for example, a central business district (CBD), it would be more appropriate to roll back CO emissions in the CBD itself, rather than the entire air quality region. The assumption was therefore made that pollutant concentration in any given zone was directly propor-

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*Because the air quality data for Pittsburgh were available for the period June 1971, to July 1972, and because the "as of" date of the VMT is December 1971, the fact that the highest 8-hourly maximum occurred in November 1971 makes all data closely compatible in time.

tional to the emission rate of that pollutant emission within that zone. Accordingly, each city area was divided into traffic zones - about the size of the central business district (CBD) in the center of the city with increasingly larger zones towards the suburban areas. Where traffic data was already available for existing "traffic districts" the traffic zones were either the traffic districts themselves or suitable aggregations thereof. Otherwise the traffic zones were based on rectangular grids.

An emission concentration ratio (e/c ratio) was assigned to each sensor, the e/c ratio being based on the daily CO emissions (expressed in kg/24 hrs.) for the base year within the zone in which the sensor was located, and the CO concentration value which formed the basis of the proportional rollback computations. Based on the e/c ratios so obtained, the maximum allowable emission rate was derived which corresponded to the national air quality level to be achieved (i.e., 9 ppm for an 8-hour average). The emission rates for the critical zone were then prepared for years 1977, etc., based on the predicted vehicular and non-vehicular emissions for those years. Vehicular emissions were based on traffic patterns predicted for those years in the absence of any transportation controls imposed in order to meet national air quality standards for CO (the "no strategy case"). Non-vehicular emissions for the years of interest were obtained from state implementation plans and state agencies, and take into account predicted growth and the predicted control strategies to be applied to those sources. The predicted control strategies were generally those which state agencies considered to be the maximum feasible, and therefore the predicted non-vehicular emissions were assumed to be irreducible for the purposes of this study.

On the assumption that the predicted emission densities from non-vehicular sources were to be taken as irreducible, the allowable emissions from motor vehicles in each zone for the year of interest were then determined. For the purposes of evaluating the effects of candidate transportation controls, the maximum allowable emission rate for the year 1977 was expressed as a percentage reduction from the 1977 "no strategy" emission rate. However, as will be seen in following sections of this report, as each traffic control was developed, emissions were recomputed, using the revised VMT's and speeds resulting from the application of the control measures.

A typical summary sheet of the output of this methodology is shown in Table II-A. It should be noted that the term "without strategy" refers to a transportation strategy, i.e, one which affects only vehicle emissions. The non-vehicular emissions used reflected both the growth expected in such emissions and also the effect of various control strategies for non-vehicular sources as predicted by state agencies. It should also be noted that total emissions rather than emission densities are presented in Table II-A, since the summary refers to the rollback in one zone only.

TABLE II-A

SUMMARY SHEET FOR: PITTSBURGH

DATE: 5 January 1973

II. CARBON MONOXIDE

A. Zone for which emissions computed

Zone 1 - the Golden Triangle (downtown Pittsburgh)

B. Area: 1.26 sq. miles

C. Carbon Monoxide Emissions (kg/24 hr.) and CO levels (ppm)

| | Present 1972 | 1975 Without Strategy | 1977 Without Strategy | 1977 with Oxidant Strategy Only | 1977 with CO Strategy Only |
|---|---|---|---|---|---|
| Vehicular Emissions | 27,111 | 19,538 | 13,120 | 13,120* | 10,197 |
| Non-Vehicular Emissions | 2,200 | 1,419 | 1,419 | 1,419 | 1,419 |
| Total Emissions | 29,311 | 20,957 | 14,539 | 14,539 | 11,616 |
| CO level (8-hr average) | 21.3 | 15.2 | 10.6 | 10.6 | 8.4** |

*No special oxidant strategy planned

**Federal standard is 9.0 ppm

WITHOUT STRATEGIES

| | 1978 | 1979 | 1980 | 1982 |
|---|---|---|---|---|
| Vehicular Emissions | 10,698 | 8,897 | 7,199 | 5,278 |
| Non-Vehicular Emissions | 1,469 | 1,520 | 1,573 | 1,685 |
| Total Emissions | 12,167 | 10,417 | 8,772 | 6,963 |
| CO level (8-hr average) | 8.8 | 7.6 | 6.4 | 5.1 |

2. Discussion of Methodology for Carbon Monoxide

a. Modified Proportional Model Applications

Modified proportional model applications and the limitations of the conventional proportional rollback method have been well documented and reviewed[1] and need not be discussed further here. The technique used in the present study was an extension of the conventional rollback technique to the extent that it was assumed first, that the constant of proportionality between emissions and concentration may be derived from emissions emanating from the relatively small area around the sensor (the traffic zone), and second, that this constant of proportionality (the emission/concentration ratio) could be applied to determine pollutant concentrations in other zones of comparable area on the basis of the pollutant emissions in those zones.

Some justification of the first assumption can be found, for example, in recent work of Hanna[2] and Gifford[3] who demonstrate the dominance of urban pollution patterns by the distribution of the local area sources. The success of their urban diffusion model, in which concentration is simply directly proportional to the area source strength and inversely proportional to wind speed, is attributed largely to the relatively uniform distribution of emission within an urban area and the rate at which

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[1] Noel de Nevers. Rollback Modeling, Basic and Modified. Draft Document, EPA, Durham, N.C. (August 1972).

[2] Hanna, S.R., "A Simple Method of Calculating Dispersion from Urban Area Sources," J. APCA 21, 774-777 (December 1971)

[3] Gifford, F.A., "Applications of a Simple Urban Pollution Model," (paper presented at the Conference on Urban Environment and Second Conference on Biometeorology of the Amer. Meteor. Soc., October 31 - November 2, 1972, Philadelphia, Pa.).

the effect of an area source upon a given receptor decreases with distance. In the proportional model, meteorological effects, such as wind speed, are assumed to be duplicated over one-year periods. The validity of the second assumption depends, in large part, upon the extent to which diffusion and transport parameters are uniform from zone to zone - a factor which could not be investigated because of the constraints of the program. Thus, it was felt that, in the absence of a more sophisticated technique, the use of this extension to the proportional model was justified first, to obtain some assessment as to whether the existing sensors were located in the hot-spots, and second, to obtain some assurance that transportation strategies intended to reduce emission densities in one zone (to the level required to meet ambient standards) did not increase emission densities to unacceptable levels in adjacent zones. In Pittsburgh it was found that the sensors were, in fact, in the "hot spot" zone and also that the recommended transportation controls did not increase emissions in adjacent areas to unacceptable levels. Thus the final rollbacks were confined to the zone with a sensor within its boundaries and the extensions of the techniques to other non-sensor zones did not, therefore, play a primary role in the final computations.

As might be expected, where an urban area had several sensors, the emission concentration ratios were widely different and this served to underline the fundamental limitations of the technique employed. An implicit assumption in the technique employed was that the air quality in a traffic zone could be fairly represented by one con -

centration level and that this level depended only upon the average emission density within that zone. The two major factors mitigating against this assumption are

(a) Emission densities are not uniform across even a small traffic zone.

(b) Concentration levels are not uniform across the traffic zone partly because of the lack of uniformity of emission density and partly because the point surface concentrations are affected by micrometeorology and microtopography as well as emission density.

Considerable judgment had to be used, therefore, both in the derivation of e/c ratios and in their subsequent use. In heavily trafficked downtown areas the variation was judged not to be too great, so that the single recorded concentration might reasonably be expected to be representative of the zone's air quality and emission density. However, in suburban zones having overall low traffic densities, sensors were often found to be placed at very localized hot spots, such as a traffic circle, so that the recorded concentration levels were neither representative of the overall air quality nor of the overall emission density in the zone.

Accordingly, e/c ratios were generally derived from sensors in the central areas of the cities and applied to suburban areas for the prediction of 1977 concentration levels. This procedure gave air levels which were generally representative of the suburban zone. However, it must be realized that control strategies based on this procedure, while they may ensure that the overall air quality in a suburban zone will not exceed ambient standards, do not preclude the occurrence of higher concentrations in very localized hot spots such as might occur in the immediate vicinity of a major traffic intersection.

b. Seasonal and Diurnal Variations

The carbon monoxide concentration level chosen as the basis for the base year e/c ratio in the CBD was the highest valid 8-hour average observed during the base year 1971-1972. The one-hour averages were very much closer to the standard than the 8-hour average, so that controls required to meet the 8-hour standard would also result in the 1-hour standard being met. Although seasonal variations in readings were noted, traffic data were not available on a seasonal basis, so that vehicle emissions were based on annual average work day traffic data.

c. Background Concentrations

Background concentration levels of CO were not taken into account. Where a zone was located near a large point source, simple "worst case" diffusion calculations were performed to assess the effect of the point source on the zone. In all cases, it was found that this contribution was negligible.

3. <u>Methodology and Discussion for Oxidants</u>

The technique employed for oxidants was basically the same as has just been described for CO with the major difference that only one, very much larger area, was used as the basis for the proportional rollback. Because of the length of time required for the formation of oxidants from hydrocarbon emissions, the relatively small areas used as the basis for CO could not be justified. The actual area used in each city was largely a matter of judgment and the decision was made in concert with state and local officials and EPA. In general, it was about the size of the metropolitan area. For Pittsburgh, Allegheny County was used.

The reductions in hydrocarbon emissions necessary to achieve oxidant ambient standards were obtained from Appendix J, Federal Register of August 14, 1971.

## B. DISCUSSION OF 1971-1972 AIR QUALITY LEVELS

### 1. Natural Features

#### a. Topography

The Southwest Pennsylvania Intrastate Air Quality Control Region is designated in paragraph 81.23 of 40 CFR 81, Federal Register, Vol. 36, No. 228, 25 November 1971 in accordance with the provisions of the Federal Clean Air Act, as amended (42 USC 1857 as amended by PL 91-604) to consist of Allegheny County (Pittsburgh) and surrounding Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Washington, and Westmoreland Counties (see Figure II-1). Most of the population and activity is concentrated in the City of Pittsburgh and suburban Allegheny County. The region lies to the west of the Allegheny Mountains of central Pennslyvania and occupies the central portion of the Allegheny Plateau, which extends from southwestern West Virginia through western and northern Pennsylvania into central New York. Several large rivers have cut deep valleys into the plateau, so that the terrain is characterized by quite rugged relief. The larger valleys, such as those of the Ohio, Allegheny, Monongahela and Youghiogheny Rivers, have steep sides and narrow, winding channels lying some 300 to 500 feet below the level of the plateau. Historically, commerce and industry developed along the river valleys, and the consequences in terms of air pollution have been apparent for generations. The City of Pittsburgh was founded at the point where the Allegheny and Monongahela Rivers join to form the Ohio River; today, the "Point" of the "Golden Triangle" is at the center of a large metropolitan region containing a major portion of the steel industry of the United States as well as much other industrial and commer-

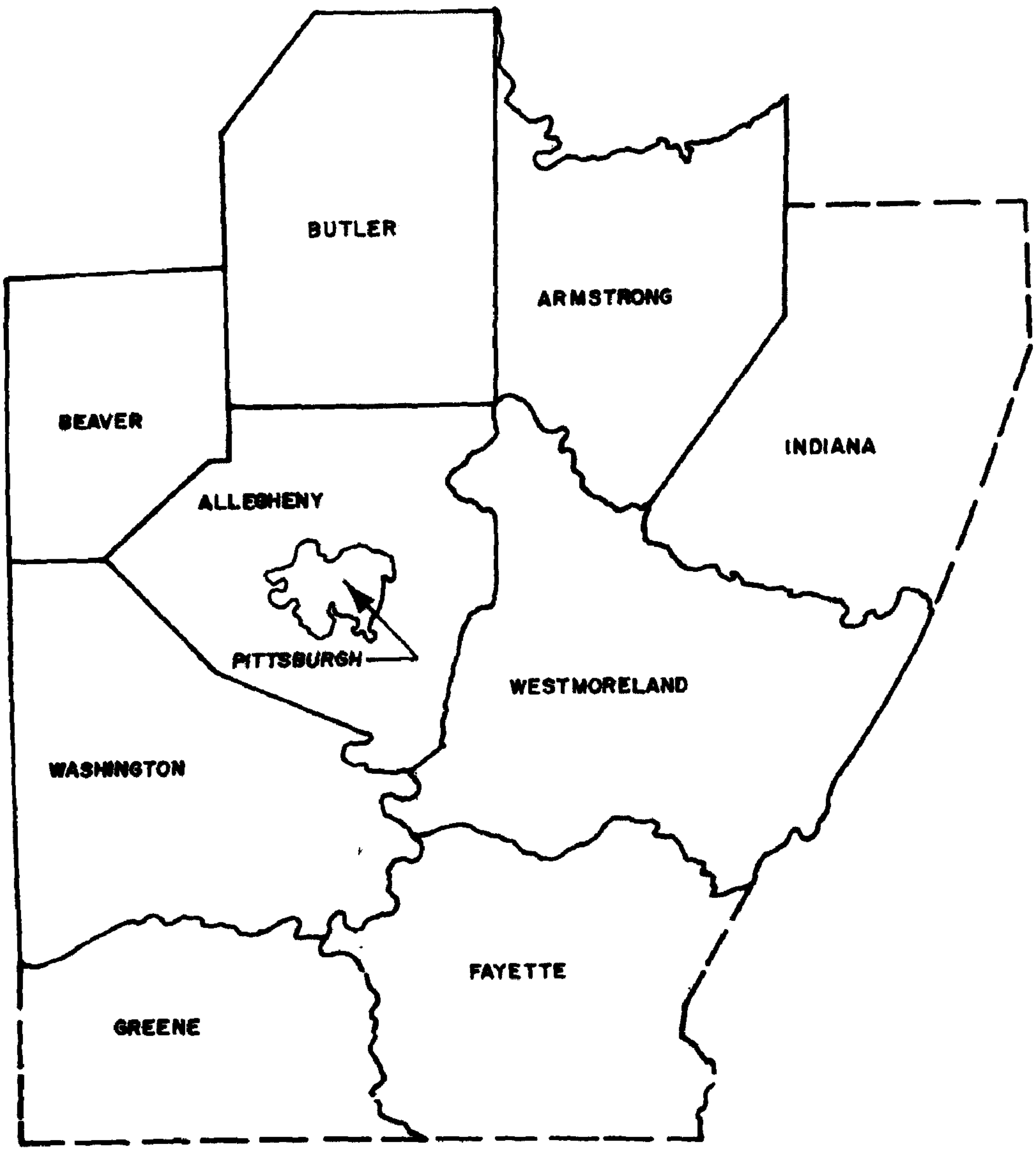



Figure II-1. SPRPC and SPAQC regions.

cial activity. The emanations from the many mills and factories are to a considerable extent trapped by the walls of the valleys and thus are not dispersed as they would be in more open terrain. This condition is exacerbated under conditions of atmospheric stability and especially when temperature inversions are experienced,as discussed in the following section.

b. Meteorology and Climatology

The Allegheny Plateau, shielded to a large extent from the moderating influence of the Atlantic Ocean by the Appalachian Mountains, is for the most part under the influence of continental polar air masses traveling from Canada by way of the Great Lakes or the Great Plains, although during the summer months the area is frequently overrun by maritime tropical air from the Gulf of Mexico. The Pittsburgh area, lying near the mean storm track for much of the year, is subject to moderately high annual amounts of precipitation and cloudiness, although episodes of slowly moving anticyclonic circulations, the so-called "stagnant highs", are fairly common, especially in the fall and winter months. Under these conditions the air becomes very stable, especially at night under clear skies when radiational cooling gives rise to pronounced temperature inversions near the ground. The pollutants from the numerous steel mills and other stationary sources, as well as those from motor vehicles, tend to become trapped in the lower layers of the atmospheric during the late night and early morning hours, until the increasing input of solar energy after sunrise can burn off the ground fog and clear the air generally by wiping out the inversion and restoring a more normal temperature distribution aloft. While this condition is certainly not unique to the Pittsburgh area, it is made worse there by the presence of concentrated emissions of pollutants in the narrow, deep, and winding valleys which act both as physical deterrents to the dispersal of pollutants and as delaying agents to the onset of the solar heating effect referred to above. There is an additional effect as well, that of the well-known "mountain and valley breeze", which tends to concentrate the colder air near the bottoms of the valleys during the hours of darkness, thus increasing still further the strength of the temperature inversions which are present on a regional basis anyway, and causing a further delay in their break-up during the day. All of this gives rise to frequent river fogs and, where concentrations of pollutants are present, to potentially severe air pollution episodes. One of the best-known of such occurrences, that at Donora, Pennsylvania, took place in 1948 not more than 20 miles from downtown Pittsburgh under precisely the conditions outlined above: stable atmosphere with little or no wind, cold weather, night-time hours, concentrated industrial emissions in a narrow, winding, steep-walled valley (that of the Monongahela River).

Next to terrain and atmospheric stability effects, the most important meteorological parameters for air pollution considerations are the wind speed and direction. These three factors, topography, stability, and wind velocity, are closely interrelated in many ways, but for our purposes it suffices to emphasize that, while the Pittsburgh area lies in the heart of the prevailing westerlies of the Temperate Zone (see Table II-1), the rough terrain creates wide variations from the mean wind velocity. In

TABLE II-1

PERCENTAGE FREQUENCY OF SURFACE WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

Greater Pittsburgh Airport, 1945-1965

| Speed (knots) / Direction | 1-3 | 4-6 | 7-10 | 11-16 | 17-21 | 22-27 | 28-33 | 34-40 | 41-47 | 48-55 | 56 | % | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.3 | 1.3 | 1.6 | 0.5 | 0.0 | 0.0 | | | | | | 3.7 | 7.3 |
| NNE | 0.4 | 1.4 | 1.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | | | | 3.5 | 6.8 |
| NE | 0.5 | 1.5 | 1.1 | 0.2 | 0.0 | 0.0 | | | | | | 3.4 | 5.2 |
| ENE | 0.5 | 1.4 | 1.6 | 0.4 | 0.0 | 0.0 | | | | | | 3.9 | 7.0 |
| East | 0.6 | 1.8 | 1.6 | 0.5 | 0.0 | 0.0 | | | | | | 4.7 | 6.8 |
| ESE | 0.5 | 1.4 | 1.6 | 0.7 | 0.1 | 0.0 | 0.0 | 0.0 | | | | 4.3 | 7.6 |
| SE | 0.6 | 1.8 | 1.7 | 0.6 | 0.1 | 0.0 | 0.0 | | | | | 4.7 | 7.1 |
| SSE | 0.5 | 1.5 | 1.4 | 0.4 | 0.0 | 0.0 | 0.0 | | | | | 3.8 | 7.8 |
| South | 0.6 | 1.7 | 1.6 | 0.5 | 0.1 | 0.0 | 0.0 | 0.0 | | | | 4.4 | 7.0 |
| SSW | 0.4 | 1.4 | 2.0 | 1.3 | 0.3 | 0.1 | 0.0 | 0.0 | | | | 5.4 | 8.9 |
| SW | 0.8 | 1.8 | 3.4 | 2.7 | 0.7 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | | 9.5 | 10.0 |
| WSW | 0.5 | 1.9 | 4.5 | 4.6 | 1.5 | 0.5 | 0.1 | 0.0 | 0.0 | 0.0 | | 13.5 | 11.4 |
| West | 0.5 | 1.8 | 2.9 | 2.7 | 0.8 | 0.3 | 0.0 | 0.0 | 0.0 | | | 9.0 | 10.5 |
| WNW | 0.4 | 1.5 | 2.6 | 2.6 | 0.8 | 0.2 | 0.0 | 0.0 | 0.0 | | | 8.0 | 10.7 |
| NW | 0.3 | 1.4 | 2.3 | 1.7 | 0.4 | 0.1 | 0.0 | 0.0 | | | | 6.0 | 9.4 |
| NNW | 0.3 | 1.2 | 1.9 | 1.1 | 0.1 | 0.0 | 0.0 | | | | | 4.8 | 8.7 |
| CALM | | | | | | | | | | | | 7.4 | |
| | 7.8 | 24.7 | 32.9 | 20.6 | 4.8 | 1.3 | 0.2 | 0.1 | 0.0 | 0.0 | | 100.0 | 8.3 |

Total number of observations was 176,927.

general, the "roughness effect" acts to decrease the mean wind speed due to frictional forces; at the same time, the local wind direction tends to become channeled along the orientation of the valleys. The overall result is to create a tendency for further concentration of pollutants in the valley areas occupied by industrial and highway sources.
With this combination of unfavorable influences at work in the Greater Pittsburgh area since the middle of the 19th Century, there is little wonder that a serious air pollution problem has existed for a long time. Forbes Magazine for 15 November 1972 contains a photograph (p. 36) of Pittsburgh as it looked thirty years ago, before the clean air campaign took hold.

One favorable aspect of the distribution of industry and motor vehicle traffic in the Pittsburgh area is that, from the standpoint of one who is studying the air pollution problem there, the fact that population and pollution sources tend to be concentrated in the valleys at least allows him to focus his attention on these relatively small geographical areas. The 20 zones with the highest emission densities are listed in Table II-2. As can be seen by referring to Figures II-2 and II-3, they are clustered around the CBD. Zone 1 is the downtown Pittsburgh area, the "Golden Triangle." The zones contiguous to Zone 1 are 2, 9, 14, 16, and 17. Zones 1-20 are in the City of Pittsburgh. Zones 21-51 compose the rest of Allegheny County. In general, the higher the zone number, the farther it is from the "Point", but there are exceptions to this. (It is of some interest to note that the sequence of highest emission densities is not the same for HC as it is for CO; the reasons for this are not yet fully understood, although non-vehicular sources do play a larger part in HC emissions than they do in CO emissions.) The "zone"

TABLE II-2

EMISSION DENSITIES IN THE SPRPC REGION, 1972 and 1977 (kg/sq. mi.)

Showing the 20 highest zones in descending order of CO emission density.

| 1972 | | | 1977 | | |
|---|---|---|---|---|---|
| Zone # | CO | HC | Zone # | CO | HC |
| 1 | 21,859.16 | 3113.65 | 1 | 10,975.53 | 1423.70 |
| 2 | 7,929.38 | 1159.65 | 16 | 4,419.27 | 579.63 |
| 16 | 7,373.80 | 1063.84 | 2 | 3,950.94 | 523.46 |
| 3 | 6,437.18 | 925.84 | 3 | 3,165.03 | 413.77 |
| 14 | 6,230.87 | 976.34 | 14 | 3,155.99 | 441.85 |
| 6 | 6,016.03 | 864.62 | 6 | 2,996.99 | 391.55 |
| 9 | 5,957.84 | 836.96 | 9 | 2,959.80 | 379.86 |
| 17 | 5,207.37 | 745.04 | 17 | 2,648.50 | 345.02 |
| 18 | 4,071.58 | 592.94 | 18 | 1,981.63 | 261.90 |
| 11 | 3,214.32 | 463.03 | 11 | 1,515.73 | 198.56 |
| 7 | 2,803.93 | 390.82 | 7 | 1,378.30 | 175.76 |
| 23 | 2,498.99 | 449.39 | 23 | 1,286.98 | 197.91 |
| 50 | 2,104.05 | 387.23 | 20 | 1,114.95 | 143.94 |
| 13 | 2,103.67 | 297.25 | 50 | 1,111.17 | 173.90 |
| 20 | 1,972.03 | 278.33 | 21 | 1,031.89 | 156.67 |
| 21 | 1,904.18 | 336.67 | 13 | 949.95 | 122.50 |
| 12 | 1,761.90 | 255.58 | 44 | 804.22 | 126.62 |
| 5 | 1,586.24 | 220.24 | 12 | 804.08 | 105.93 |
| 8 | 1,450.34 | 198.93 | 5 | 725.99 | 92.28 |
| 19 | 1,345.57 | 194.73 | 8 | 721.98 | 90.86 |

Source: computer program VEHEMI2, "no-strategy" case.

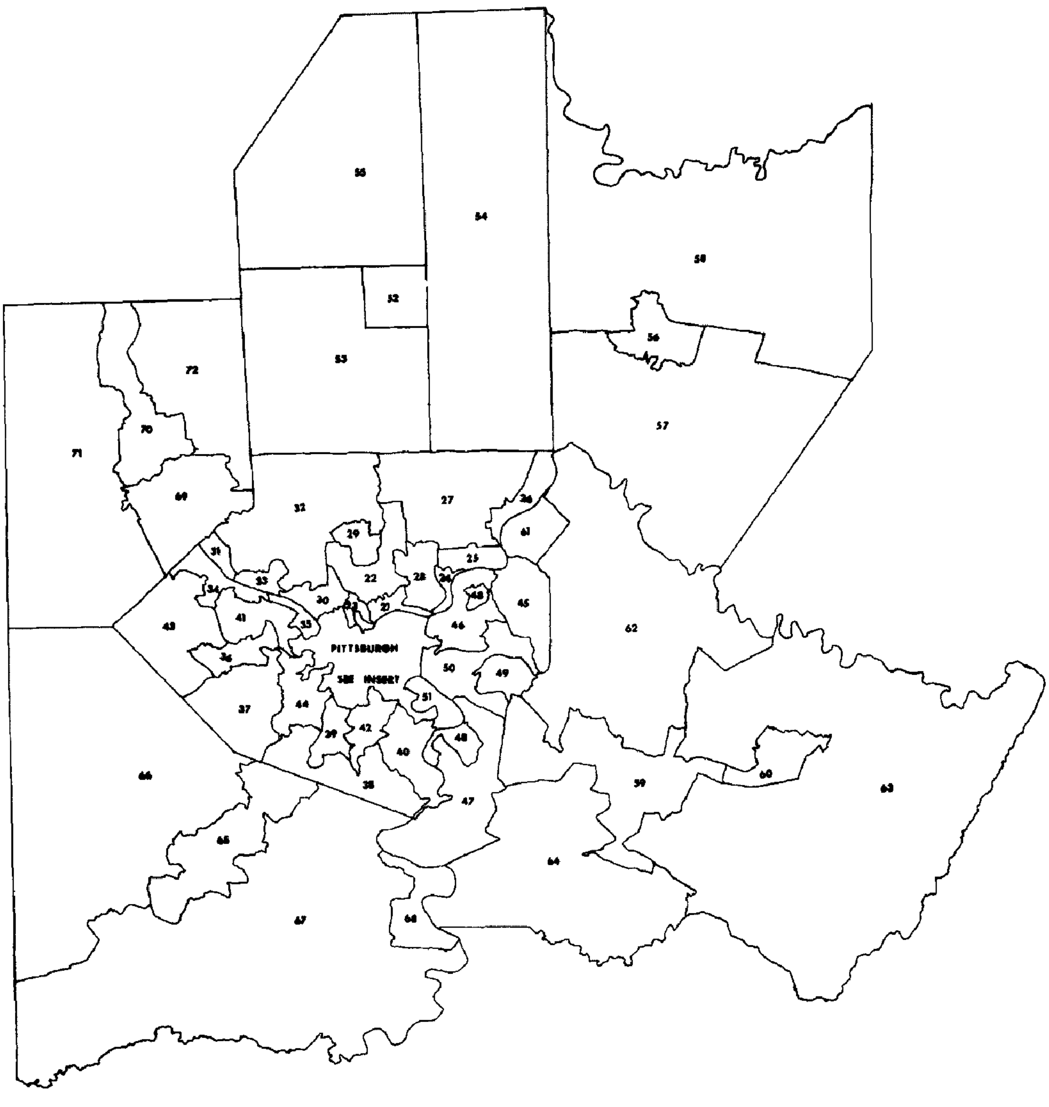



Figure II-2. Zone map, SPRPC region.

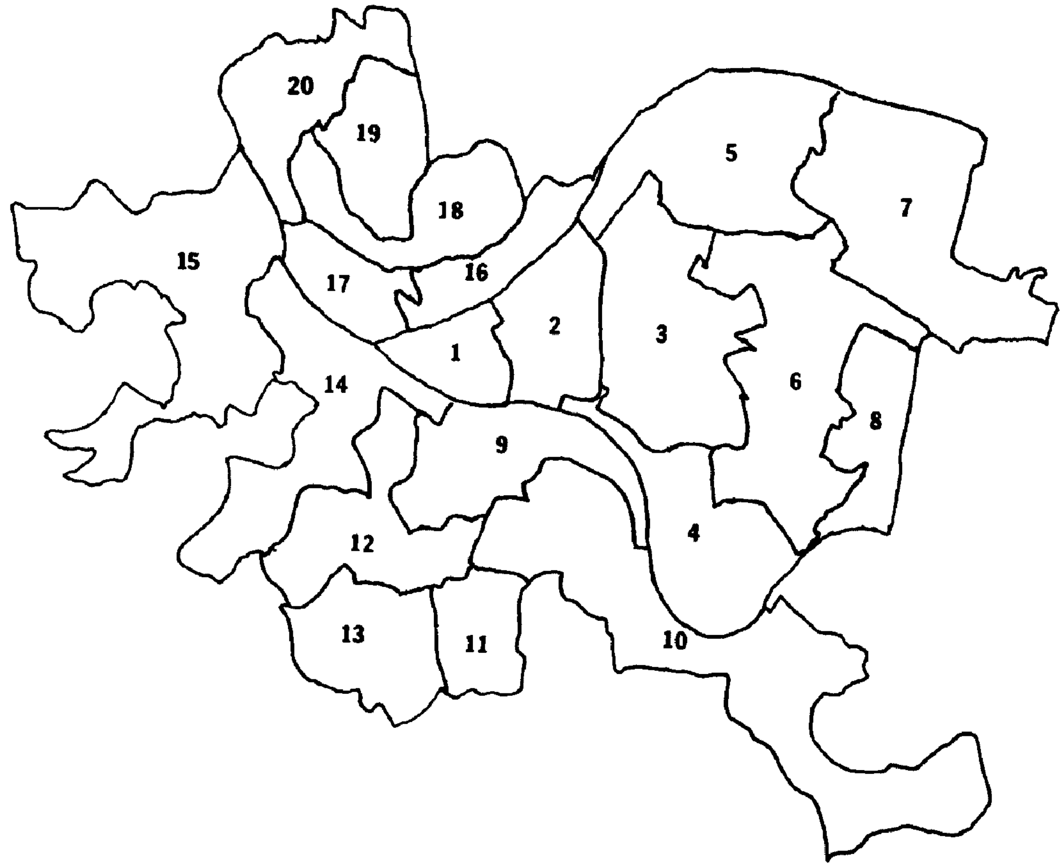



Figure II-3. Zone map, city of Pittsburgh.

terminology refers to the AMV Districts, which are aggregates of the Southwestern Pennsylvania Regional Planning Commission (SPRPC) Traffic Analysis Zones (see Figures II-2 and II-3).

2. Instrumentation

a. Sampling Locations

(1) General

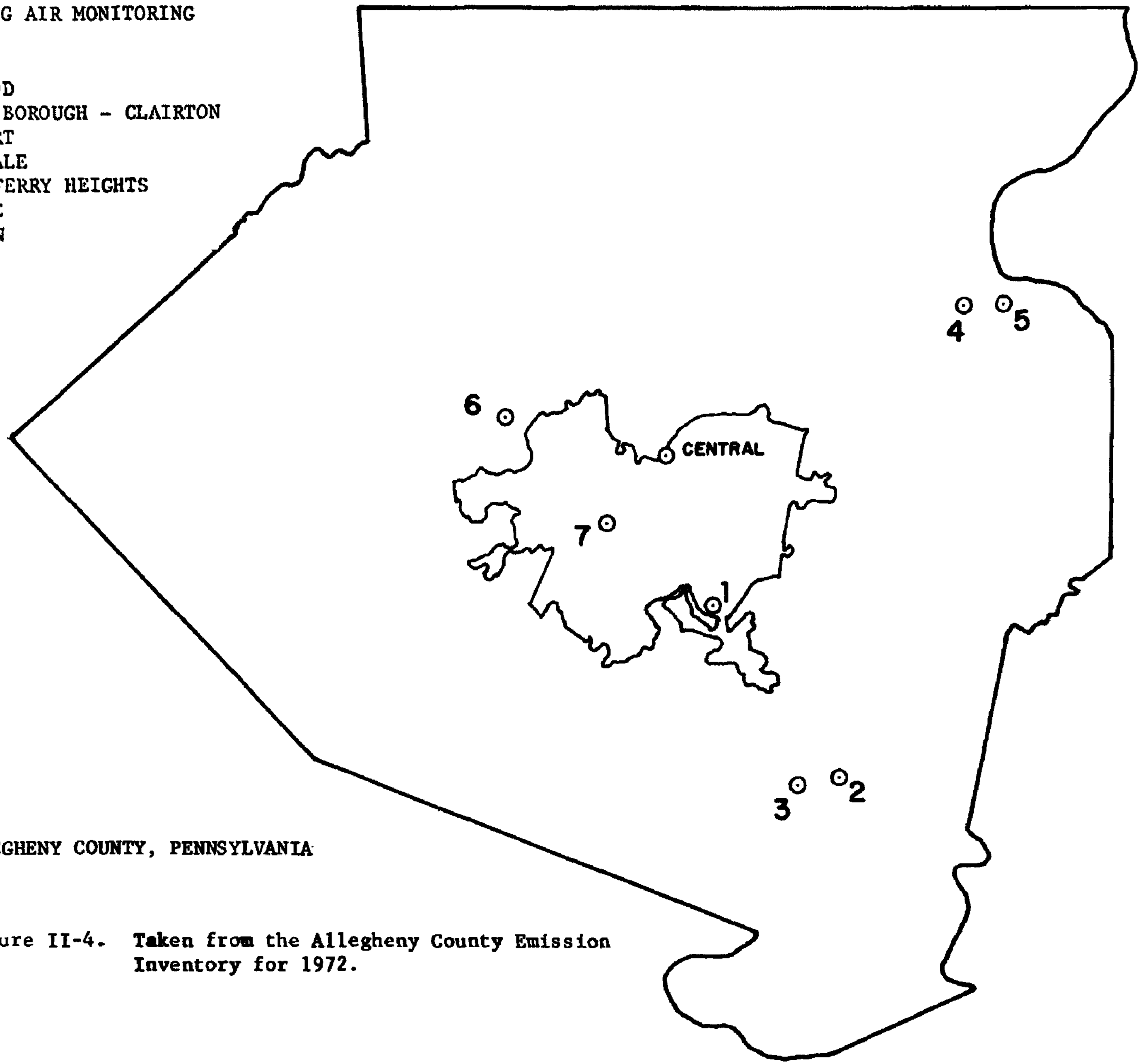
While we have some data on CO, total oxidants, and total hydrocarbons (HC) from five different sites in the Greater Pittsburgh area (See Map, Figure II-4), close inspection of these data and consultation with personnel of the Allegheny County Bureau of Air Pollution Control (BAPC) have revealed that only the observations from the three sites discussed in detail below were both consistently accurate and of sufficient frequency over a significant period of time to form the basis for conclusions regarding the ambient air quality in the region. No data were abstracted from the other three stations of the BAPC telemetering network (nos. 2, 4, and 5 in Figure II-4).

(2) Downtown Pittsburgh (Zone 1)

The sensor is located on the Forbes St. (southwest) side of the Allegheny County Court House, about 15 feet above the street level and 20 feet in from the curb. Its position below a window of the Court House is about 50 feet from Grant Street. The recorder and other instrumentation are in a room of the Court House adjacent to the sensor location. Situated on the southeast side of the Golden Triangle, in the

BUREAU OF AIR POLLUTION CONTROL
TELEMETERING AIR MONITORING
STATION MAP

1 HAZELWOOD
2 LIBERTY BOROUGH - CLAIRTON
3 GLASSPORT
4 SPRINGDALE
5 LOGANS FERRY HEIGHTS
6 BELLEVUE
7 DOWNTOWN




ALLEGHENY COUNTY, PENNSYLVANIA

Figure II-4. **Taken from the Allegheny County Emission Inventory for 1972.**

very heart of downtown Pittsburgh, this location is well suited to give a true representation of the concentrations of CO and HC pollutants to be expected from the heavy vehicular traffic to which it is exposed. Given the general experience in most urban areas that practically all of the CO emissions (on the order of 90 - 95%) come from the internal combustion engine and that the vast preponderance (75 - 80%) of HC emissions also come from gasoline-fueled engines, this site is almost ideally located for purposes of a study of transportation-related air pollution. This is all the more true since, as will be discussed later, there is only one major point source located within Zone 1, the downtown area, and it contributes only about 0.2 ppm to the ambient concentration of CO. Since the sensing device is located on the wall of a high building there is a physical restriction of the sampling process: it is exposed to air from only one-half of the possible directions. On the other hand, the "roughness" concept as discussed in the preceding section with respect to the effects of terrain and underlying surface is equally applicable to urban areas with their many tall buildings and narrow, canyon-like streets. Indeed, the study of the eddy motions of all scales related to turbulence induced by urban built-up areas is a highly complex area of specialization in its own right and can only be acknowledged in passing here, important as it is in air pollution meteorology.

(3) Bellevue (Zone 30)

The sensor for this site (No. 6 in Figure II-4) is positioned on top of a camper-type trailer semipermanently parked on the north bank of the Ohio River on a high bluff about 200 feet above the water level and 30 feet in from the river bank below. The site is off of Ohio River Blvd. in the Borough of Bellevue, about 4 miles downstream (northwest) of the Golden Triangle. The height of the sensor above the ground is 20 feet; it is about 100 feet from the roadside, behind a steel fence which separates it from a gasoline service station. There is a possibility of some interference from the HC fumes emanating from the adjacent gas station, which is only some 40 feet away. Because of its high elevation and nearness to a major highway artery, the readings from this site should prove to be representative of the surrounding area as far as motor vehicular pollutants are concerned.

(4) Arsenal Health Center (Zone 2)

This is under the jurisdiction of the Allegheny County Health Department, the parent organization of the BAPC. The complex of buildings is located at the corner of 39th Street and Penn Avenue, in the Lawrenceville section of Pittsburgh near the Allegheny River. While this site is some three miles from the downtown area, it is still well within the built-up and highly industrialized area characterizing the city proper. As a matter of fact, it is situated not far from several large point sources (tank farms and the like) which are located along the south bank of the Allegheny within a mile of the Center. It is also located near a major arterial highway, but not close enough to be exposed to high concentrations of exhaust emissions from motor vehicles. This site was used only for measurements of ozone concentrations in this study, and its precise location with respect to the various sources is therefore not a critical matter as long as it lies generally downwind from them, since in the case of oxidants we are concerned more with the area-wide picture than with particular zones within the area. The sensing instrument was located 20 feet above the ground.

b. Type of Instrumentation

(1) Downtown Pittsburgh

The instrument used for the detection and measurement of CO concentrations is an MSA Lira non-dispersive infrared analyzer. It has a 25 cu ft/hr flow rate and a refrigerator to remove moisture. Sampling is continuous and is recorded at three minute intervals and telemetered to the Arsenal Health Center (see above). The room where the instruments are located is presently undergoing remodeling and they are covered with plastic sheets to prevent excessive dust from interfering with their operation. The effectiveness of these measures could not be assessed. It is expected that the instruments will be moved to a new location within the Court House, possibly on the Grant Street side. If this does occur, a new exposure will create some minor discontinuity in the records, but the effect, if any, on the overall efficiency of the BAPC operation should prove to be only slight.

A Mast instrument for measuring total oxidants was also installed in the equipment room; however, it had been shut down because of the danger to the historical site (the Old County Court House itself) represented by the hydrogen tank associated with the Mast instrument. In any event, the data from this and other oxidant-measuring instruments at other sites in the Pittsburgh area were not usable because they lay outside the range of possible values as oxidants are usually measured and reported for purposes of air pollution control.

(2) Bellevue

The same type of CO analyzer was installed at this site; the MSA Lira with refrigerant dryer to remove moisture from the air stream. As in the downtown location, sampling is continuous and the results are telemetered to the Arsenal Health Center at three minute intervals for data reduction. This instrument was down for parts at the time of our visit and had been so since 1 September 1972; it should be back in operation "shortly". The operating personnel had some difficulties with the air conditioner during the year that the installation was in operation. During the summer months the trailer housing the recorder and other instrumentation gets very hot, and the failure of the air conditioning produced some bad data. This station commenced operation in August, 1971, and the first full month's data are for September of that year. Thus, because of the shortness of the record, the data from the Bellevue site must be used with some caution. The CO data appear to be within reasonable limits, but those for total oxidants and total hydrocarbons, like the corresponding data from the downtown site and elsewhere, were not in useable form. In the case of the Bellevue site the possibility of interference from the nearby gas station has already been mentioned (for HC measurements).

(3) Arsenal Health Center

The reference method for determination of ozone concentrations, instrumental chemiluminescence, was used in the special study made by EPA and other agencies during the summer of 1971 to assist those cities which did not possess an adequate capability for monitoring oxidant levels. No information is available to us on the details of the equipment used or the level of the staff expertise. However, some additional information is included in the following section on the air quality data itself (see Section IIB 3c).

3. Review and Evaluation of Air Quality Data

a. General

Some general comments on the regularity, validity, and reliability of the available data have already been made in the preceding sections. As stated previously, the CO data were uniformly good, with only one or two "far-out" observations recorded. On the other hand, the $O_x$ and HC data from the stations listed below were not available in useful form because the results tabulated were "out of range" for the expected values of "HC corrected for methane" and "oxidants as ozone," respectively. The several tables of these data are not reproduced in this report, since they do not add anything of value and are quite voluminous. In any event, they are already available to the various interested agencies. Some of the possible reasons for the results appearing in this form have been treated in the section on instrumentation.

| Type of Pollutant | Name of Station | Ref. No., Figure II-4 | Period of Record |
|---|---|---|---|
| Carbon Monoxide (CO) | Downtown | 7 | Mar 71-Aug 72 |
| | Bellevue | 6 | Apr 71-Aug 72* |
| "Oxidants" and "total oxidants" ($O_x$) | Bellevue | 6 | Apr 71-Aug 72* |
| | Glassport | 3 | Apr 71-Aug 72 |
| | Hazelwood | 1 | Apr 71-Mar 72 |
| Ozone | Arsenal | "Central" | Jun 71-Sep 71** |
| "Total hydrocarbons" (HC) | Downtown | 7 | Apr 71-Feb 72 |
| | Bellevue | 6 | Oct 71-Oct 71 |

(No data from the Logan's Ferry, South Allegheny (Liberty), or Springdale stations.)

*The trailer-mounted instruments were originally set up at the Arsenal Health Center (39th St. and Penn Ave.) and were moved out to the present site in Bellevue in August, 1971.

**These data were taken by the EPA-MITRE Summer Study project (see below).

b. CO Data

An analysis of the usable CO data from the two sites described in Section IIB 2a, above, for the periods shown in Section 3A yielded the results summarized in Table II-3. The curves in Figures II-5 and II-6 show the seasonal and diurnal variations in maximum intensities. Complete tables of maximum 1-hour CO concentrations are included as Appendix A.

As can be seen, both the 1- and 8-hour average concentrations of CO in downtown Pittsburgh have exceeded the approved national standards. The highest recorded 1-hour average concentration of CO as measured at the sensing device for Zone 1 (AMV District 1) is 44.2 ppm and the second highest is 38.6 ppm for the period of record. The required reduction of 20.8 percent from the highest reading can easily be attained

## TABLE II-3

| Station | Zone | Averaging Period | Highest ppm | Highest Date | 2nd Highest ppm | 2nd Highest Date | Federal Standard ppm | Reduction Required* (%) | |
|---|---|---|---|---|---|---|---|---|---|
| Downtown | 1 | 1-hour | 44.2 | 1 Oct 71 | 38.6 | 3 Nov 71 | 35.0 | 20.8 | 9.3 |
| | | 8-hour | 21.3 | 18 Nov 71 | 21.2 | 2 Oct 71 | 9.0 | 57.8 | 57.6 |
| Bellevue | 30 | 1-hour | 37.3 | 14 Sep 71 | 35.3 | 15 Dec 71 | 35.0 | 6.2 | 1.0 |
| | | 8-hour | 20.6 | 29 Feb 72 | 20.0 | 24 Feb 72 | 9.0 | 56.3 | 55.0 |

*If the Federal standard could be met by neglecting non-vehicular emissions.

Summary of Data for Ozone for the Period 1 June - 30 September 1971:

| Station | Zone | Averaging Period | Highest ppm | Highest Date | 2nd Highest ppm | 2nd Highest Date | Federal Standard ppm | Reduction Required* (%) | |
|---|---|---|---|---|---|---|---|---|---|
| Arsenal | 2 | 1-hour | 0.165 | 28 Jun 71 (1200) | 0.155 | 28 Jun 71 (1300) | 0.08 | 51.5 | 48.4 |

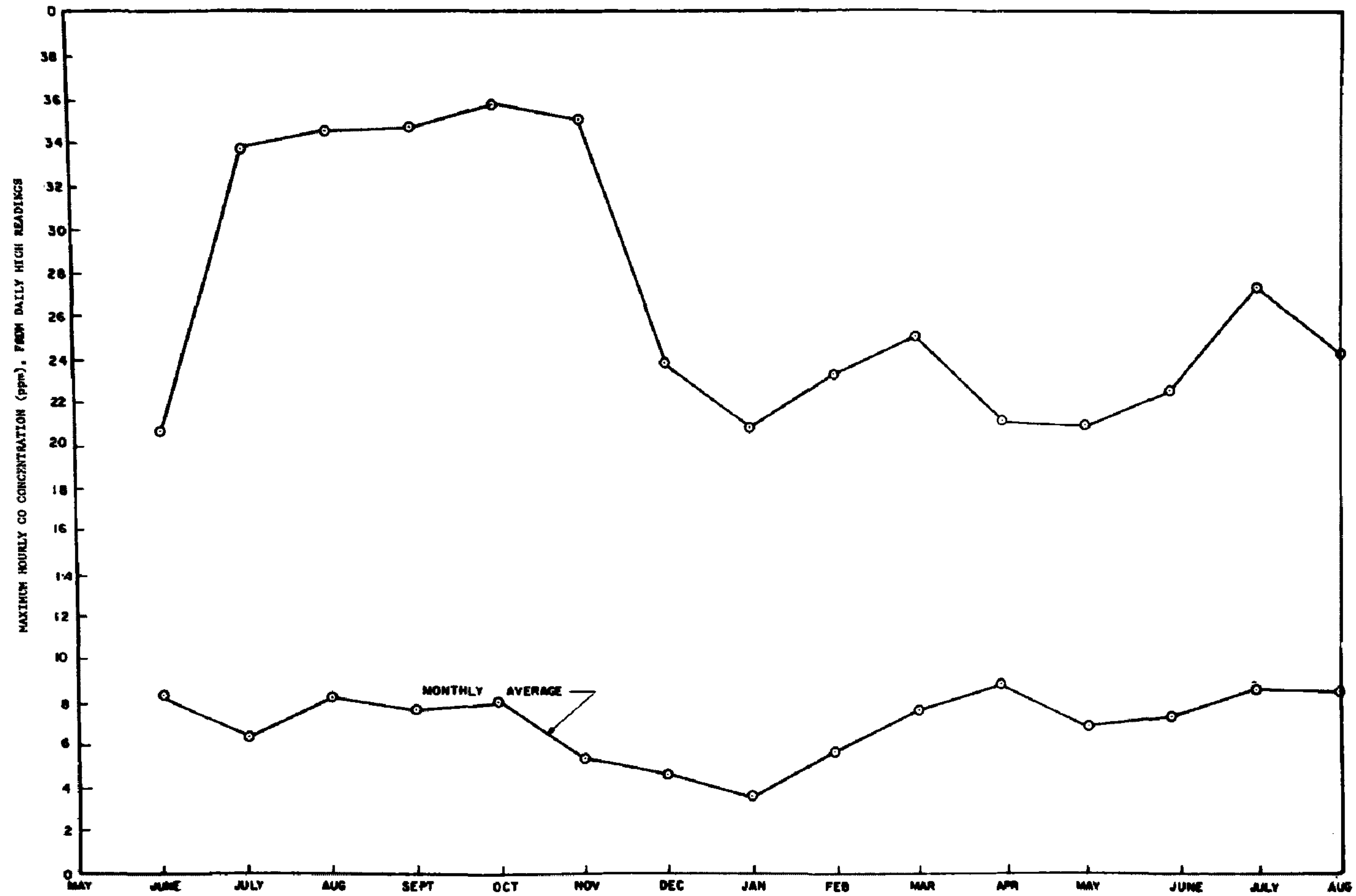



Figure II-5. Monthly variation in maximum hourly CO concentration downtown Pittsburgh. Monthly average also shown. (Value plotted is average of two highest readings for the month.)

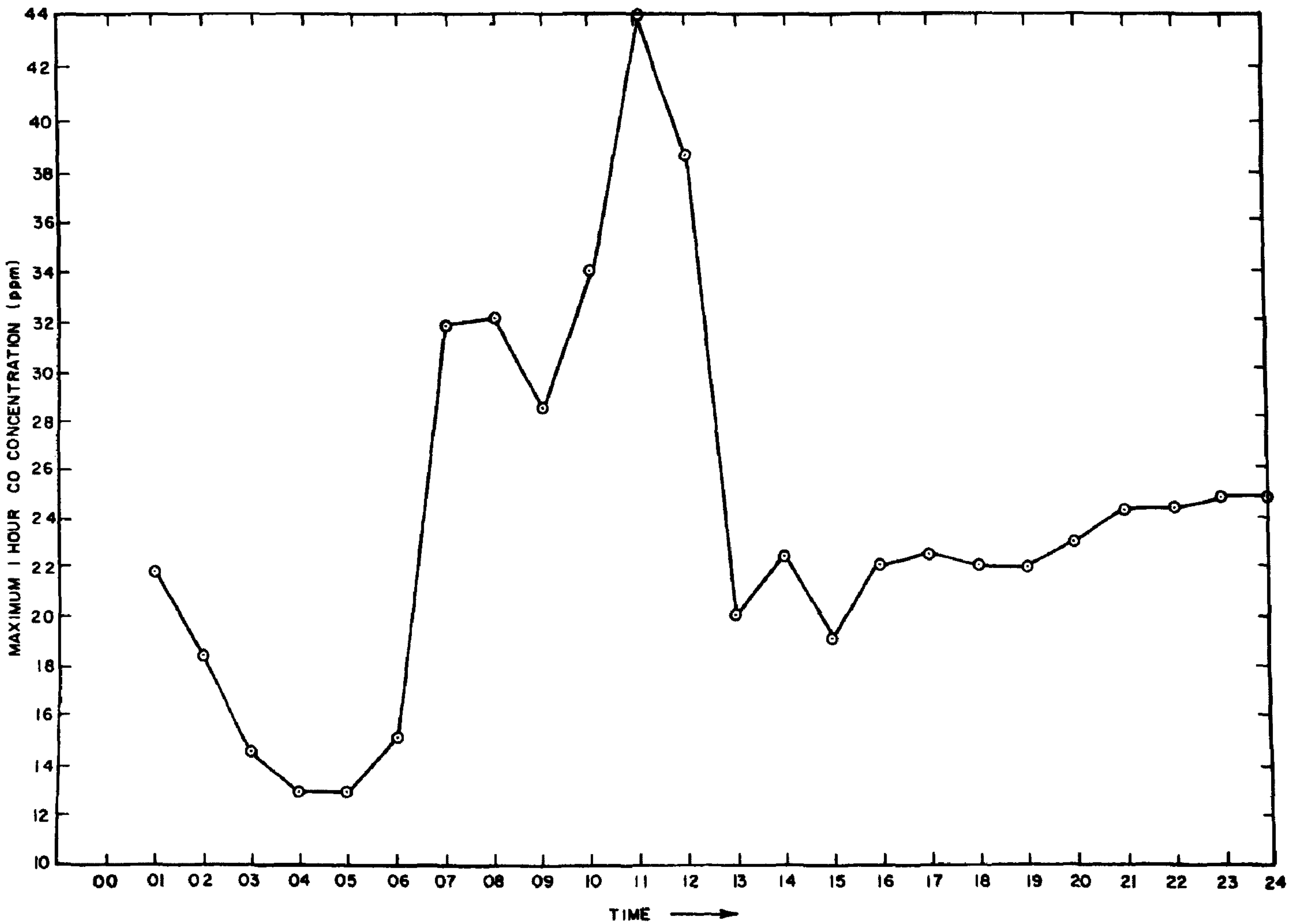



Figure II-6. Diurnal variation in hourly maximum CO readings (downtown Pittsburgh).

as a result of the operation of the presently authorized and required Federal program for control of emissions from motor vehicles. Even though the presence of emissions from non-vehicular sources would act to prevent the desired standard from being achieved if this amount of reduction were just barely reached, there is sufficient leeway in the expected results of the Federal program, as will be shown later, to insure that the 1-hour standard can be met. The problem arises when we look at the 8-hour averages: the highest recorded thus far at the Zone 1 site is 21.3 ppm and the next highest is 21.2 ppm (see Table II-3 above). These are more than twice as large as the Federal standard and require a reduction in vehicular emissions (under the same assumption of negligible non-vehicular emissions) of 57.8 percent and 57.6 percent, respectively. These are not attainable through the present Federal program; thus, a transportation control plan for the downtown area must be instituted in order to bring the level of CO concentration down to the standard by 1977. It must be emphasized here that the above reduction percentages are <u>not</u> the actual figures required to attain the standards. As will be shown in a later section, the non-vehicular emissions cannot be neglected and the reduction percentages must be figured based on <u>total</u> emissions, not just vehicular ones.

Since the control strategy required to reduce high 8-hour CO concentrations may depend on the time of day or the season of the year when they occur most often, the data were analyzed to determine, if possible, the patterns of interest. The 1-hour averages were directly available from the raw data (see Appendix A), but the 8-hour values had to be computed from the 1-hour data. The method used was to scan the raw data for "runs" of high hourly values, then add successive overlapping 8-hour series to obtain the candidates for highest 8-hour average concentrations. As can be seen from the table below (Table II-4), this technique produced several values which were nearly the same. Thus, conclusions as to time of maximum 8-hour concentration are apt to be based on somewhat shaky ground if it turns out that the high values are more or less randomly distributed through the day and through the year. Moreover, with only one year's record available for analysis, it is not really valid to assume that it is typical of the long-term period in which we are interested (out to at least 1977). With these caveats in mind, we can state, at least tentatively, that the diurnal cycle of CO concentration seems to be displaced in Pittsburgh from the early morning or nighttime maximum usually found elsewhere (see Figure II-6). Based on these limited data, the maxima at both sites appear in the late morning hours; similarly, whereas the common experience in most areas has been that the highest concentrations of CO occur generally in the late fall and winter months, it appears from these data that the annual maximum can be found in the early fall in and around Pittsburgh (Figure II-5). The reasons for this apparent departure from the distribution to be expected on the basis of previous experience are not immediately apparent; it may be that additional data from future months and years, especially if the instrumentation and technical staff are maintained at a high level of efficiency, will enable us to ascertain the true patterns of annual and diurnal variation. About all that can be said with any degree of confi-

TABLE II-4

HIGHEST RECORDED 8-HOUR AVERAGE CONCENTRATIONS (CO), PITTSBURGH, ZONE 1

| DATE | HOURS | 8-HOUR AVG. CONCENTRATION (PPM) |
|---|---|---|
| 18 Nov 1971 | 07-14 | 21.27 |
| 2-3 Oct 1971 | 20-03 | 21.2 |
| 29 Feb - 1 Mar 1972 | 18-01 | 20.9 |
| 14-15 Dec. 1971 | 18-01 | 20.4 |
| | 19-02 | 20.4 |
| 1 Oct 1971 | 08-15 | 20.4 |
| 17-18 Nov 1971 | 17-24 | 19.8 |
| 18 Aug 1971 | 07-14 | 18.7 |

HIGHEST RECORDED 8-HOUR AVERAGE CONCENTRATIONS (CO), BELLEVUE, ZONE 30

| DATE | HOURS | 8-HOUR AVG. CONCENTRATION (PPM) |
|---|---|---|
| 29 Feb-1 Mar 1972 | 19-02 | 20.6 |
| 24 Feb 1972 | 11-18 | 20.0 |
| 14-15 Dec 1971 | 17-24 | 19.1 |
| | 18-01 | 19.1 |

dence at this time is that there is a greater frequency of high 8-hour average concentrations of CO in the late afternoon and evening (1800 to 0200 hrs) than at other times, although even this generality is based on extremely limited data.

An interesting picture is presented by the histogram in Figure II-7, which displays the number of daily maxima of hourly readings of CO concentration in Zone 1, by hour. The morning and evening rush hour traffic shows up clearly and several secondary features also appear. This is an excellent example of the way in which the driving habits and life styles of a city's residents are faithfully reflected in the diurnal variation in the concentrations of its atmospheric pollutants. Without stretching the point too far, one could deduce something about the times of day when most Pittsburghers go to work (between 0700 and 0900), when the ladies do their shopping or meet friends for lunch (around 1100), when the people who work in the downtown area go home for supper (1600 to 1800), when they go out to eat or to a movie, perhaps (2000 to 2100), and when they return home again (2300 to 2400). Even the relative shape of the frequencies is preserved: one can equate the "early shift" (0700) to the early quitting time (1600), and so on.

c. Oxidant Data

As stated earlier, the oxidant data obtained from the BAPC were found not to be useful for the present study. Fortunately, a special study was carried out during the summer of 1971 by the EPA and several of the State and local agencies with the assistance of the MITRE Corp-

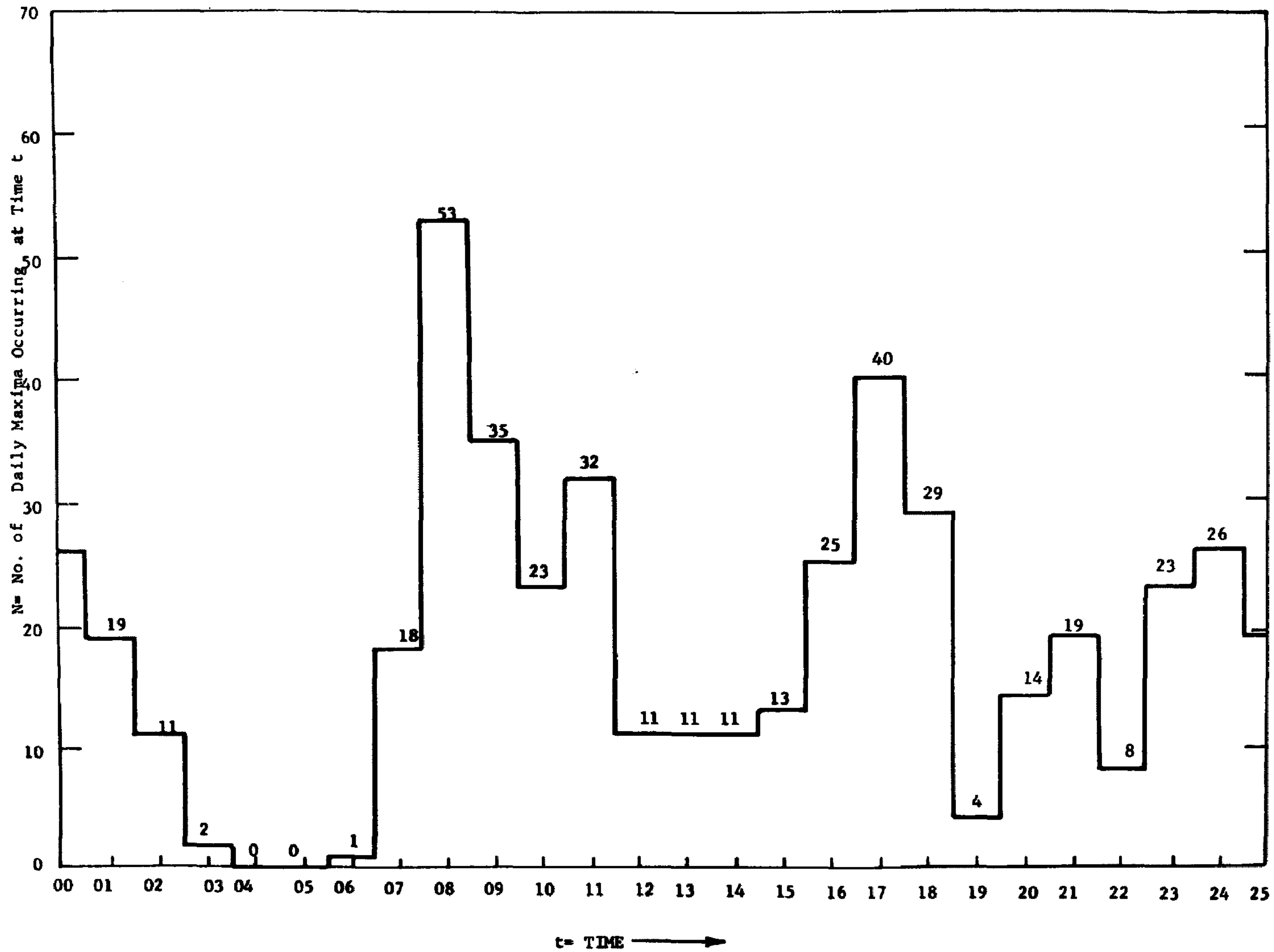



**Figure II-7.** Hourly frequency of daily maximum CO concentration June, 1971 to August, 1972.

oration to determine concentrations of ozone ($O_3$) in cities lacking a capability to monitor ozone adequately but large enough to pose a putative oxidant problem. Fortunately again, Pittsburgh was among the 33 cities included in this study. As stated previously, the site selected in Pittsburgh was well located with respect to the greatest ambient concentrations of hydrocarbons, in that it lies some 3 miles to the northeast of the downtown area. As shown in the computer printout of vehicular emissions of HC for 1972 and 1977 (see Appendix C), the downtown area (Zone 1) has by far the greatest output per unit area of HC (and CO) from motor vehicles. Given the strong prevalence of westerly to southwesterly winds in the Pittsburgh area (Table II-1), it is at once apparent that the Arsenal was an excellent choice.

Ambient ozone concentrations were measured continuously, using the reference method (chemiluminescence) as prescribed by the EPA in 40 CFR 50, Appendix D, Federal Register, Vol. 36, No. 228, 25 November 1971, pp. 22392-22394. Hourly average values of $O_3$ concentration were recorded and collected by the EPA; these data were validated by cross-reference to weekly summary data. In this manner, obvious errors in hourly data were removed and a good set of data was made available to the various agencies for their use in preparing the Implementation Plans for submission to the EPA. Since the original data sheets contain a great deal of information not pertinent to the present study, only the daily maxima and hourly frequency of highest readings are reproduced in Table II-5 and Figure II-8A, below. The last line in Table II-3, above, summarizes the most important

TABLE II-5

MAXIMUM 1-HOUR OZONE READINGS - ARSENAL HEALTH CENTER
Period of Record: 1 June - 30 September 1971. Method: Chemiluminescence
Monthly highs and 2nd highs are underlined.

| | | | | | Time of daily high reading | | | | Frequency | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | June | July | Aug. | Sept. | June | July | Aug | Sept | Hr. | # | Times Ex ** |
| 1 | .070 | (ND) | .055 | .075 | 16,18 | (ND) | 17 | 14-16 | 01 | 0 | 0 |
| 2 | .045 | (ND) | .040 | .060 | 18-19 | (ND) | 13 | 13-14 | 02 | 0 | 0 |
| 3 | .055 | (ND) | .020 | .045 | 18-19 | (ND) | 13-14 | 13-14 | 03 | 0 | 0 |
| 4 | .090 | (ND) | .020 | .050 | 12 | (ND) | 16-17 | 16-17 | 04 | 2 | 0 |
| 5 | .085 | (ND) | .045 | .070 | 14-15 | (ND) | 12-13 | 12-13 | 05 | 1 | 0 |
| 6 | .095 | .085 | .080 | .050 | 15 | 16,19-20 | 16 | 14-15 | 06 | 2 | 0 |
| 7 | .055 | .100 | .110 | .040 | 13 | 15 | 17-18 | 14-15 | 07 | 0 | 0 |
| 8 | .055 | .090 | .100 | .055 | 12-13 | 13 | 14 | 16 | 08 | 0 | 0 |
| 9 | .040 | .100 | .120 | .090 | 15 | 17-18 | 15 | 12-14 | 09 | 0 | 0 |
| 10 | .065 | .070 | .085 | .095 | 17 | 15 | 13-14 | 13 | 10 | 0 | 0 |
| 11 | .085 | .050 | .060 | .030 | 14,16 | 17-18 | 18 | 18 | 11 | 1 | 1 |
| 12 | .045 | .050 | .080 | .020 | 16 | 17-18 | 17-18 | 04,22-23 | 12 | 8 | 7 |
| 13 | .070 | .070 | .135 | .030 | 13-14 | 19 | 17 | 18 | 13 | 20 | 12 |
| 14 | .065 | .070 | .095 | .025 | 18 | 20 | 15 | 17-18 | 14 | 35 | 15 |
| 15 | .030 | .075 | (ND) | .060 | 14-16 | 19 | (ND) | 15,17-18 | 15 | 36 | 15 |
| 16 | .055 | .080 | .055 | .025 | 17-18 | 14 | 15-18 | 00* | 16 | 25 | 16 |
| 17 | .075 | .025 | .080 | .020 | 16 | 19-20 | 15-16 | 13 | 17 | 24 | 13 |
| 18 | .050 | .050 | .105 | .020 | 15 | 14 | 16 | 14-18 | 18 | 22 | 11 |
| 19 | .055 | .065 | .075 | .015 | 14-16 | 14-15 | 15 | 14 | 19 | 0 | 10 |
| 20 | .085 | .050 | .055 | .020 | 16 | 18 | 15 | 11-14 | 20 | 2 | 4 |
| 21 | .060 | .075 | .070 | .030 | 14 | 16 | 15 | 14 | 21 | 0 | 1 |
| 22 | .065 | .105 | .055 | .030 | 16-17 | 15,19 | 14 | 13-15 | 22 | 1 | 0 |
| 23 | .080 | .075 | .045 | .030 | 14-15 | 13,19 | 17 | 18-19 | 23 | 1 | 0 |
| 24 | .075 | .045 | .045 | .030 | 17 | 13 | 15-18 | 14-17 | 24* | 3 | 0 |
| 25 | .095 | .095 | .070 | .040 | 15 | 19 | 14 | 15-16 | | | |
| 26 | .065 | .075 | .035 | .015 | 15 | 00* | 16 | 04-06 | | | |
| 27 | .090 | .055 | .040 | .025 | 16-17 | 17-18 | 15 | 14-15 | | | |
| 28 | .165*** | .065 | .050 | .035 | 12 | 14 | 14 | 13-16 | | | |
| 29 | .105 | .035 | .085 | .040 | 15 | 00,06 | 17 | 14-16 | | | |
| 30 | .070 | (ND) | .080 | .035 | 12 | (ND) | 18 | 14,17 | | | |
| 31 | | (ND) | .145 | | | (ND) | 15 | | | | |
| Avg.: | .071 | .069 | .071 | .040 | | | | | | | |

TOTAL: 105 times

*00 hrs = 24 hrs

**No. of times the std. of 0.08 ppm has been exceeded.

JUN: 36/701=5.14%
JUL: 24/512=4.69%
AUG: 37/696=5.32%
SEP:8/720=1.11%
AVG:105/2629=3.99

***The second highest reading, 0.155, occurred the hour following this one.

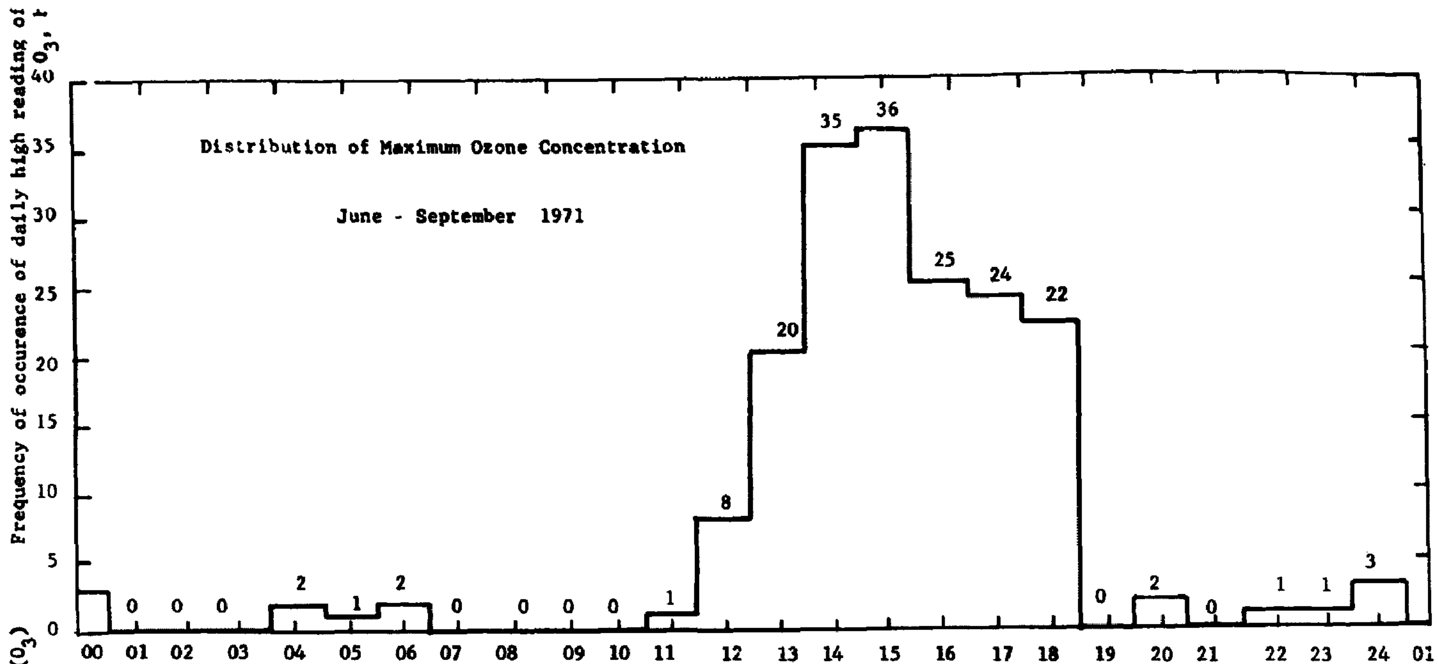



Figure II-8A.

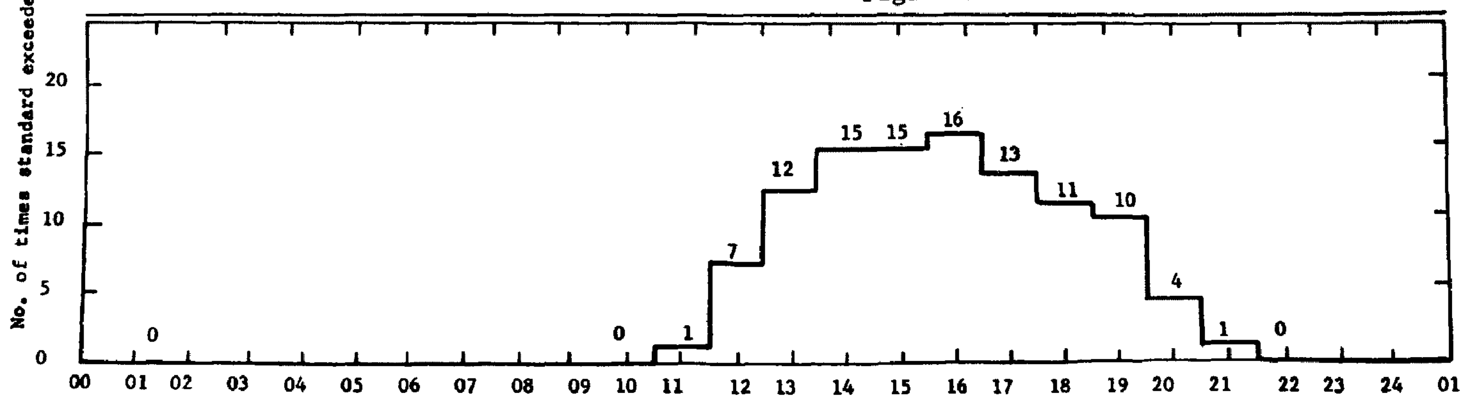



Figure II-8B.

findings needed to form a basis for the determination of the amount of "rollback" required to meet the Federal standard.

The data clearly show both the expected summer-time seasonal maximum and the commonly observed diurnal maximum beginning in the late morning to early afternoon. Figure II-8B depicts the number of times that the Federal standard for oxidants has been exceeded during the four-month period. The corresponding data for CO were not available at the time of preparation of this report. Here also the summer-time maximum is clearly visible, both as regards absolute maximum values and frequency of measurements exceeding the standard. It is felt that, given the care with which these data were generated, even though only one season is represented, they form an adequate basis for forming conclusions as to the likelihood of Pittsburgh's experiencing an oxidant problem within the next few years. In particular, since we are concerned in the case of photochemical oxidants with an area-wide average concentration rather than a localized one, the approach used here seems to be the best that could be devised for the present purpose. As will be discussed at greater length in a later section, the situation in Pittsburgh, based on the information in the bottom line of Table II-3, appears to be that no serious oxidant problem can be expected to persist once the Federal program and the strategies for reduction of CO emissions have been instituted.

Of the 33 cities included in the Summer Study, Pittsburgh ranked fourth in highest level of $O_3$ concentration measured and fifth in the number of times that the standard was exceeded. In absolute terms, the highest concentration recorded anywhere during the study was 0.190 ppm (at Corpus Christi, Texas, Dayton, Ohio, and Milwaukee, Wisconsin), not too far above Pittsburgh's 0.165, while the standard was exceeded no less than 168 times in Dayton, 156 times in Toledo, Ohio, 112 times in Columbus, Ohio, 110 times in Rochester, New York, and 105 times in Pittsburgh.

C. DISCUSSION OF 1972 AND 1977 VMT

The following methodology describes resources, assumptions and analysis techniques used to calculate the data needed to estimate vehicle emissions for the Southwestern Pennsylvania Region. This region is defined to include the City of Pittsburgh and the Counties of Allegheny, Armstrong, Beaver, Butler, Washington and Westmoreland. This region covers approximately 4,500 square miles of land and has a present population of approximately 2.6 million people. In order to facilitate the analysis, the region was divided into 72 districts. Figures II-2 and II-3 delineate the district boundaries. The data required to estimate vehicle emissions by district include:

(1) Vehicle miles of travel (VMT*) by time period where the time periods are Peak Hour, Peak Twelve Hour, and Daily.

(2) Age distribution by vehicle type where the vehicle types are classified Light Duty Gas,

*VMT is defined as the number of vehicles travelling on a given segment of roadway multiplied by the length of that roadway.

Heavy Duty Gas, and Heavy Duty Non-Gas. Light duty vehicle is defined as a vehicle weighing less than 6,000 pounds.

(3) Percent of VMT generated on each type of highway facility where the facility types are classified Freeway, Arterial and Local.

(4) Average vehicular speed by facility type by time period.

(5) Percent of VMT generated by type of vehicle.

The base information needed to calculate the required data listed above was collected from different sources which are specified in this report. The methods used to estimate each of the five sets of data needed are described in the ensuing paragraphs in the identical order that they are listed. The major contributor of data is the Southwestern Pennsylvania Regional Planning Commission. The data supplied by the Commission was reviewed by the Consultant and found to be the best available data which would satisfy the study's requirements.

It is assumed that some additions to the existing transportation system will be made by 1977. Highway improvements falling into this category are the completion of I-79. Short range transit improvements contributing to a modal split increase of 5 percent for trips destined to the CBD were also assumed.

The data base used in estimating 1972 and 1977 vehicle miles of travel by district for the Southwestern Pennsylvania region was derived from traffic assignments simulated by the Southwestern Pennsylvania Regional Planning Commission, SPRPC. 1967 was used as the base year, and the trip generation, distribution, modal split and assignment models were calibrated to survey data. The models were then applied to regional input totals for the projection year 2000, and the result was a 2000, Cycle I, traffic assignment. The links in the highway network were then identified with one of the 968 SPRPC zones in the region. The Interzonal VMT was then calculated by zone by summing the VMT for all the links in each zone by the following equation:

$$VMT_i = \sum_{j=1}^{N} D_j \, ADT_j$$

where:

$VMT_i$ = Daily Interzonal VMT for zone i

$D_j$ = Length of link j

$ADT_j$ = Simulated daily traffic for link j

N = Number of links in zone i

The next step was to aggregate the zones into districts. This aggregation of zones into districts was based on:

(1) Topology

(2) Meteorology

(3) Political Jurisdiction

(4) Similar VMT Density

(5) A Minimum District Area of One Square Mile

The aggregation reduced the 968 SPRPC zones to 72 districts with areas ranging from 1.21 to 513.30 square miles with an average district area of approximately 63 square miles. The interzonal VMT for all zones in a district were summed for 1967 and 2000. At this point, reasonable estimates of interzonal VMT by district were known for 1967 and 2000.

In order to arrive at 1972 and 1977 estimates of interzonal VMT by district, methods of interpolating the 1967 and 2000 interzonal VMT data were analyzed. The first method used SPRPC zonal population equivalents for each district to apportion county VMT increases between 1967 and 2000 to district increases. This method underestimated VMT growths for districts containing high volume transportation facilities and for districts with modest population-employment growths and a high percentage of through trips. Similar results occurred when a population plus growth factor was used. Appendix E details the algorithm used and describes its inadequacies.

The method selected to estimate 1972 and 1977 interzonal VMT by district from 1967 and 2000 data was to linearly interpolate the data by district. This method assumes a constant annual growth in VMT for each district and unlike the first method, it does not severely underestimate growths for districts with high volume transportation facilities or a high percentage of through trips. At the same time it does not underestimate VMT increases for districts which experience large population and employment growths from 1967 to 2000. These growths are inherently accounted for in the trip generation model. Overall, the linear interpolation of VMT by district reflects transportation demand and supply changes for each district. The following equations were utilized.

$$(j\ VMT_{2000} - j\ VMT_{1967}) \times \frac{5}{33} = \Delta VMT_j$$

$$j\ VMT_{1972} = j\ VMT_{1967} + \Delta VMT_j$$

$$j\ VMT_{1977} = j\ VMT_{1972} + \Delta VMT_j$$

where:

$j$ = District being analyzed

$j\ VMT_{2000}$ = Interzonal VMT for district j for 2000

$j\ VMT_{1967}$ = Interzonal VMT for district j for 1967

$j\ VMT_{1972}$ = Interzonal VMT for district j for 1972

$j\ VMT_{1977}$ = Interzonal VMT for district j for 1977

$\Delta VMT_j$ = Five year interzonal VMT growth for district j.

Upon completion of the interpolation, interzonal VMT for 1972 and 1977 by district were known.

A factor was then applied to the interzonal VMT for all districts in a county in order to include VMT generated by intrazonal trips. The number of intrazonal trips was derived from SPRPC's base year assignment. Based on the data available, the estimation of intrazonal VMT was calculated on the county level. The number of intrazonal trips multiplied by average trip length resulted in intrazonal VMT. The intrazonal VMT for the county was then added to the base year interzonal VMT previously calculated. The ratio of total VMT to interzonal VMT was then calculated. The appropriate county ratio was then applied to the 1972 and 1977 interzonal district VMT's in order to arrive at total VMT by district for 1972 and 1977. These ratios varied from 1.0056 to 1.0520.

After reviewing traffic counts in different locations throughout the region, it was estimated that 75 percent of the daily VMT occurred during the peak 12-hours of the day and that 10 percent of the daily VMT occurred during the peak hour. These factors were applied to the district VMT totals and the result was the completion of estimating VMT by district for all three time periods for 1972 and 1977. The methodologies for the four remaining sets of required data follow in the next paragraph in the same order as they were listed.

The age distribution of passenger cars and trucks in operation by county as of July 1, 1971, was received from R. L. Polk. The percents of VMT traveled in each district via freeway, arterial, and local facilities were summarized from SPRPC's base year highway assignment. District peak hour and off-peak hour speeds for each of the three facility types were similarly derived from the base year assignment. The VMT estimates for heavy duty gas and heavy duty non-gas vehicles were derived from 1967 base year data. The VMT traveled by heavy duty gas and non-gas vehicles were estimated by county. The VMT generated by these types of vehicles by county were based on the mean truck trip length for the region, and on the heavy duty truck trip ends produced and attracted in each county. The mean truck trip length multiplied by the number of truck trips in the county resulted in Truck VMT. The VMT estimated for heavy duty gas and non-gas vehicles for the base year for each county were then divided by the total base year county VMT estimates, and the resulting percentages were applied to 1972 and 1977 VMT estimates.

Appendix D summarizes the results of the analysis just described. Vehicle miles of travel are listed by district for 1972 and 1977 by facility and vehicle type for each time period analyzed. Also listed are average vehicle speeds by facility type, district and time period.

Figures II-9 and II-10 show the district VMT densities as a function of their distances from the CBD for 1972 and 1977, respectively. Also shown in each figure is a non-linear approximation of the function. Figure II-11 compares the 1972 and 1977 non-linear approximations.

In further elucidation of the VMT question, the following information is reproduced from the Annual Report Issue (September, 1971) of the SPRPC Reports with the kind permission of Mr. Robert Kochanowski of the SPRPC Staff.

TRANSPORTATION PLANNING

Transportation planning activities during the past year have been primarily in technical work preparatory to the development of the transportation plan. This work is a necessary and important part of the transportation planning process. The major work activities follow:

Accuracy Checks

During the past year a series of accuracy checks were completed on data from various SPRPC surveys. The purpose of this job was to establish the validity of the data collected as a basis from which to forecast future activities and travel in the region. Included among these were

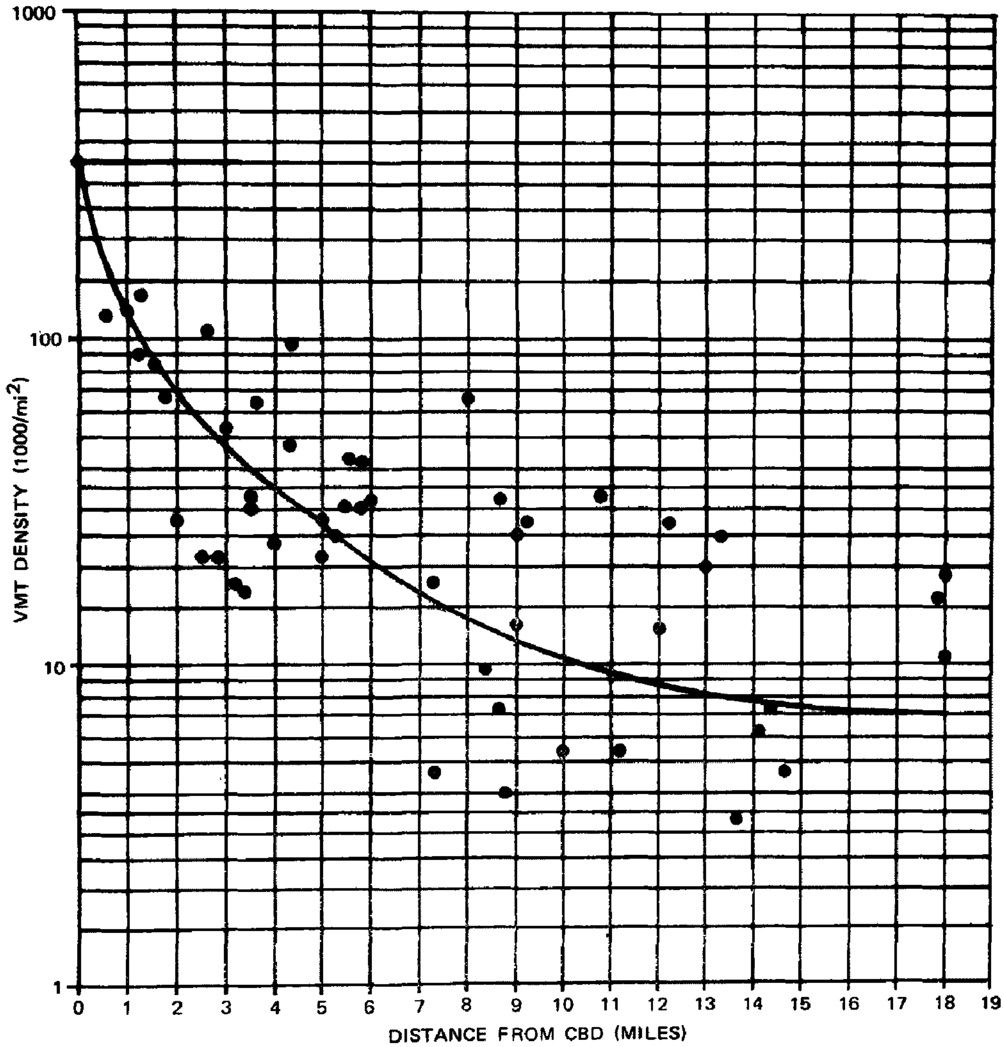



Figure II-9. VMT density (1000/mi$^2$) vs. distance from CBD (miles) Pittsburgh 1972.

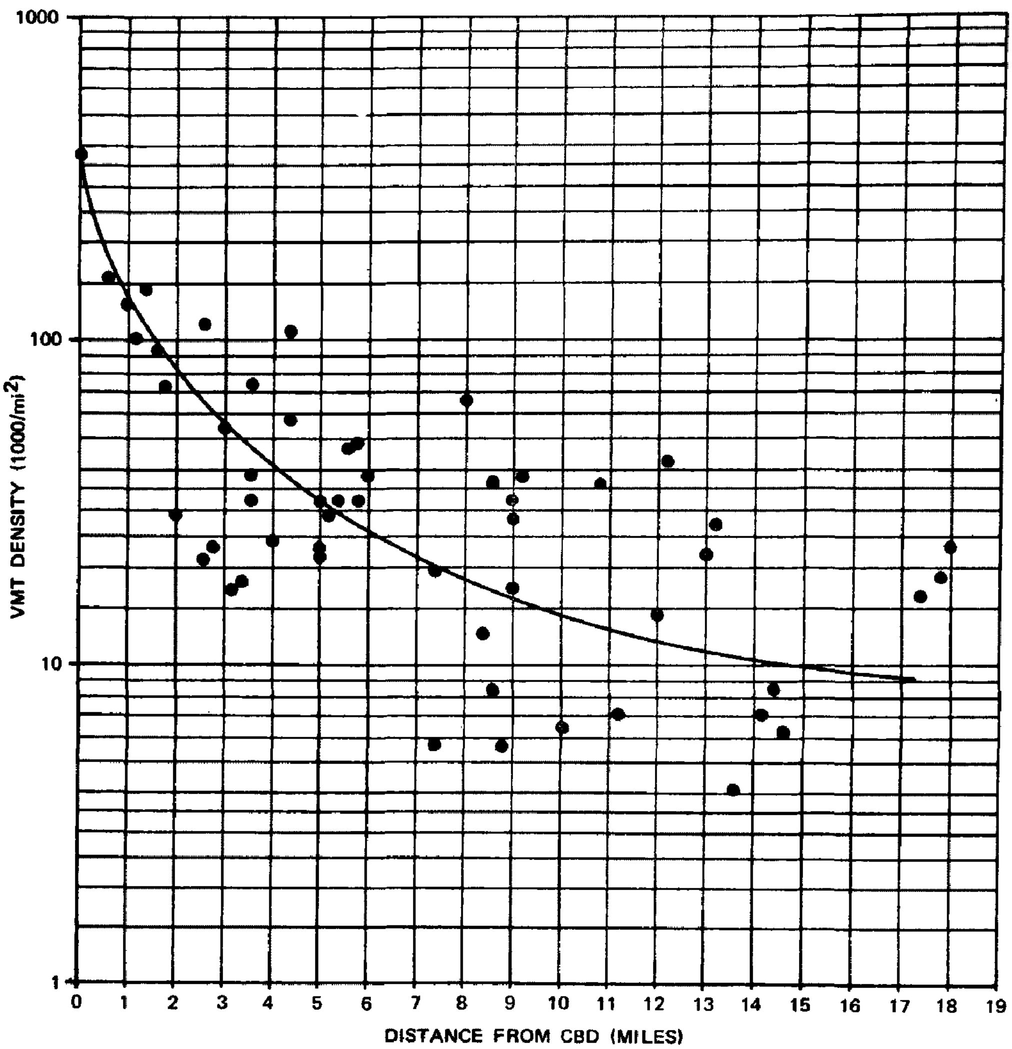



Figure II-10. VMT density (1000/mi$^2$) vs. distance from CBD (miles) Pittsburgh 1977.

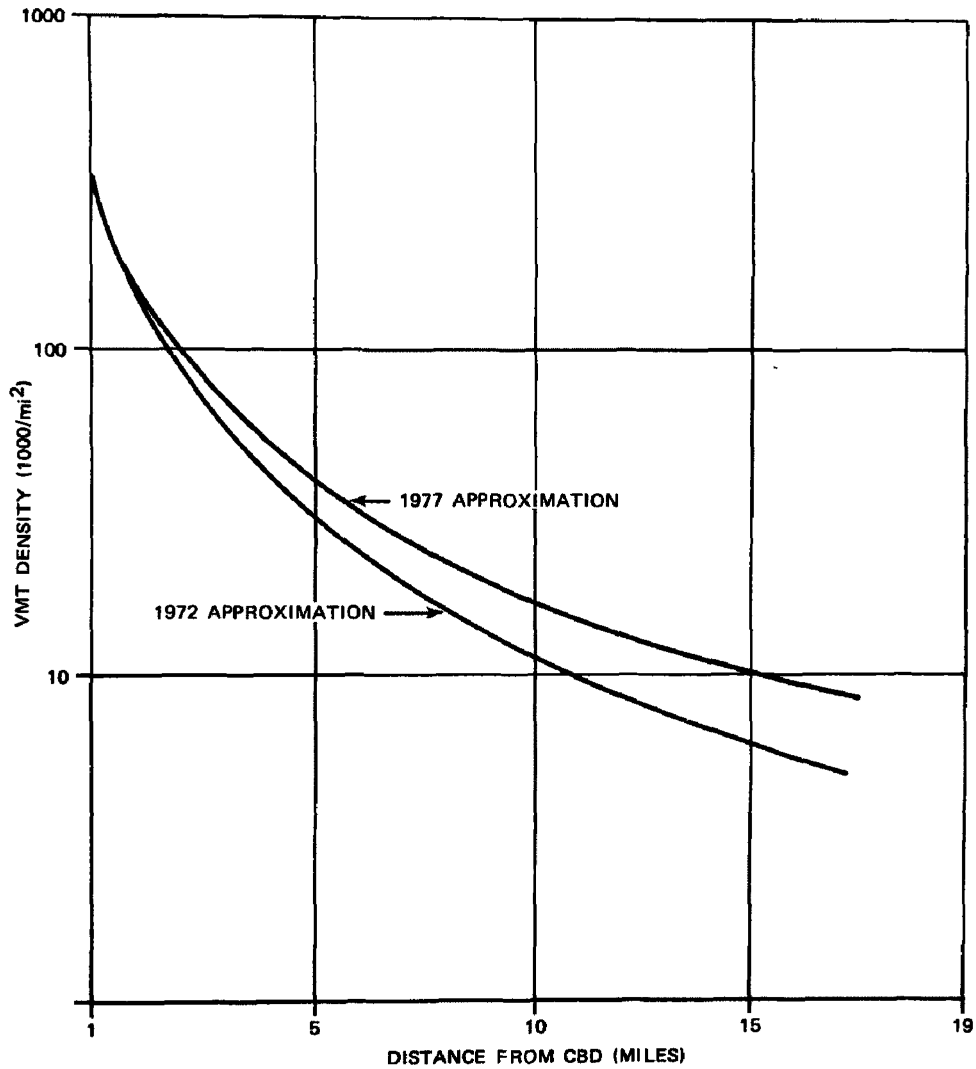



Figure II-11. 1972 and 1977 VMT density (1000/mi$^2$) vs. distance from CBD (miles) Pittsburgh.

checks of employment, dwelling units, population and automobiles available. One of the most significant checks is called the Screenline Check. This check establishes the accuracy of the trip data by making a traffic assignment of all vehicle trips reported in the travel surveys and comparing the assigned traffic volumes on major bridges in the region with traffic counts taken at these same locations. The results of these various accuracy checks have established that the base year survey information meets the required quality standards and can be used for transportation planning.

## Highway and Transit Networks

One of the most important tools in the transportation planning process is traffic assignment. By using traffic assignment, future highway and transit trips can be assigned to proposed networks and the assigned volumes evaluated to determine the user demand characteristics of proposed systems. But before traffic assignments can be used with confidence to test future systems, the base year highway and transit networks must simulate existing traffic volumes. This is accomplished by coding the existing networks in a form acceptable for computer application and then assigning existing highway and transit trips from the travel surveys. Minor adjustments are then made to the existing network until the desired degree of simulation accuracy is achieved.

## Trip Generation Models

Trip generation is the process of developing mathematical relationships between the amount of travel produced (going) and attracted (coming) in each traffic zone of the region, and the factors which are most directly related to the reasons for this travel. Equations are developed with base year data and are then used to forecast travel for the year 2000.

Trip Distribution Models

Trip distribution is the process of linking up the person trip productions and attractions that are developed for each zone in trip generation to produce tables to trip movements from zone to zone. The model used for trip distribution at SPRPC is called the Gravity Model and it operates on the general principle that trips between two zones are directly proportional to the size of the zones and inversely proportional to some function of the travel time between them.

Modal Split Models

When the steps of trip generation and trip distribution have produced a table of future travel, the next question that must be answered is which transportation modes will these people choose? The modal split model is developed to answer this question and to determine what percent of persons will ride transit in the planning year. At SPRPC the modal split model work has been divided into two parts. The first part is the development of a model to predict captive transit ridership. (A captive transit trip is a transit trip made by a person who did not have the choice to go by auto at the time his trip was made.) The captive model predicts the number of captive transit trips by relating them to such factors as auto ownership, density of development and the level of transit service available as represented by accessibility to desired destinations. The second part of the SPRPC modal split work is the choice model (for persons who have the opportunity to choose between transit and auto). The transit trips predicted by the captive and choice modal split models will then be assigned to coded future transit systems for testing and evaluation.

TOPICS Planning

SPRPC has contracted with the City of Pittsburgh and PennDOT to undertake a TOPICS planning program for the City of Pittsburgh, TOPICS being a federal highway program that is designed to improve the capacity and safety of existing arterial streets in urban areas. SPRPC's staff have been working with the City of Pittsburgh's staff in developing a series of recommendations for short range improvements on city streets and state roads within the City. These will be published in the form of an early action report. In addition, a second phase of TOPICS planning involves the adaption and adjustment of a model which will be used to evaluate such possible improvements as one-way street systems within the Golden Triangle or the impacts of major new traffic generators on traffic patterns. (End of quoted material.)

## D. DERIVATION OF 1977 AIR QUALITY LEVELS

### 1. Present and Projected Non-Vehicular Source Emissions

#### a. Point Sources

All data used in this section were based on information contained in Pennsylvania's Implementation Plan, the Allegheny County Emissions Inventories for 1971 and 1972, and the results of meetings and discussions with personnel of the Allegheny County Health Department BAPC and the SPRPC.

A summary of the available data on point sources in and around Pittsburgh is presented in Table II-6. Although this information is fragmentary, it supposedly includes all major point sources within the County and to that extent may be taken as at least an indication of the distribution of non-vehicular emissions of CO and HC in that area of 745 square miles. The "Zone" column again refers to the AMV Districts which are shown in Figures II-2 and II-3. Details of plans for control of industrial emissions, other than those included in the tabulation of the "major point sources", and the number of new industrial installations to be built during the period of interest, are not known at this time, although a very general indication of growth rates is included in the IBM Study prepared for the EPA in February, 1972 (see references). According to this document, point sources (primarily industrial sources) in the Pittsburgh area are expected to "grow" at a negative rate of 7.7 percent, or about -1.54 percent per year, for the period 1970 to 1975. Area sources (incineration, residential, and others, including transportation), on the other hand, are expected to grow at a rate of 1.1 percent, or about 0.22 percent per year,

TABLE II-6

PITTSBURGH AND ALLEGHENY COUNTY, PENNSYLVANIA
POINT SOURCES

Definition of a "Major Point Source" = emissions of ≥ 25 T/yr (62 kg/day). All units are kg/day.

| | 1972 | | 1977 | |
|---|---|---|---|---|
| Zone | CO | HC | CO | HC |
| 1 | 248.5 | 124 | 248.5 | 124 |
| 5 | | 2,833 | | 2,833 |
| 9 | 323 | 162 | 323 | 162 |
| 10 | | 944 | | 944 |
| 14 | 934 | 467 | --- | --- |
| 15 | | 945 | | 945 |
| 16 | 149 | | 149 | |
| 24 | | 944 | | 944 |
| 25 | 2,277 | 1,629 | 2,277 | 1,628 |
| 30 | | 596 | | 596 |
| 31 | | 398 | | 398 |
| 34 | 1,337 | 2,287 | 1,337 | 2,287 |
| 35 | 36,585 | 5,120 | 35,806 | 1,144 |
| 38 | | 944 | | 945 |
| 40 | 482 | 870 | 482 | 870 |
| 44 | 31,316 | 2,112 | 6,959 | 124 |
| 50 | 124 | 447 | 6 | 447 |
| Totals: | 73,775 | 20,822 | 47,587 | 14,391 |

CO: $\frac{73,775 - 47,587}{73,775}$ = 35.5% reduction, 1972 to 1977

HC: $\frac{20,822 - 14,391}{20,822}$ = 30.9% reduction, 1972 to 1977 over the five-year period. Other references, however, give much more sanguine estimates of future growth rates in the various categories of industrial and commercial enterprise; for example, the Implementation Plan gives growth factors for various industries ranging from 1.1 to over 7 percent. In this study an average overall growth factor of 3.5 percent per year was assumed for long-range planning purposes, effective over the period 1977-1987. The values computed for 1972 and 1977 incorporate the effects of the FMVECP and the growth incorporated in the vehicle-miles-traveled (VMT) data; this growth in VMT amounts to 1.5 percent per year for Pittsburgh and 2.8 percent for Allegheny County, between 1972 and 1977.

b. Area Sources

Point and area sources are combined in the summary tabulations given below. These data, taken from the 1972 Allegheny County Emissions Inventory (hereafter referred to as "the Inventory"), are presented in Tables II-7 and II-8 for CO and HC, respectively. A considerable difference exists between the data in the Inventory and those computed by the computer program prepared at GCA Corporation. The following comparison of the data from the 1972 Emission Inventory for Allegheny County and the output of the VEHEMI2 computer program is made for the purpose of trying to resolve the discrepancy between the emissions reported in the Inventory and those computed for the present study.

Based on the emission factor of 2000 lb CO generated for every 1000 gallons of fuel burned, the 1972 Emission Inventory prepared by the

TABLE II-7

ABSTRACT OF THE 1972 EMISSIONS INVENTORY FOR ALLEGHENY COUNTY
CARBON MONOXIDE

**Motor Vehicles**

| | Tons/yr | kg/day |
|---|---|---|
| Passenger cars | 592,000 | 1,467,359 |
| Commercial vehicles (trucks) | 285,000 | 706,414 |
| Buses (diesel-fueled) | 2,500 | 6,197 |
| Tractor-trailers | 11,800 | 29,248 |
| Total vehicular | 891,300 | 2,209,218 |
| | 28,812 | 71,415 |
| Total transportation | 920,112 | 2,280,633 |
| Total non-transport | 37,659 | 93,343 |
| Total, all sources | 957,771 | 2,373,976 |

| | |
|---|---|
| Vehicular sources: | 93% |
| Non-vehicular sources: | 7% |
| | 100% |

Conversion factor:

907.1846 kg = 1 ton,

366 day = 1 year (in 1972),

2.4786 ton/yr = 1 kg/day

**Other Sources**

| | Tons/yr | kg/day |
|---|---|---|
| RR engines | 710 | 1,760 |
| River boats | 200 | 496 |
| Aircraft | 27,902 | 69,159 |
| Total | 28,812 | 71,415 |
| Industrial Sources: | | |
| Metallurgical | (none) | |
| Cement mfg. | (none) | |
| Asphalt plts. | (none) | |
| Food prod. | 7 | 17 |
| Printing | (none) | |
| Petroleum & Coal Prod. | 7 | 17 |
| Chemical prod. | 30,000 | 74,359 |
| Rubber Prod. | 4 | 10 |
| Stone, clay, & glass prod. | 4 | 10 |
| Non-ferrous metal | 7 | 17 |
| Metal fabrication | 13 | 32 |
| Gasoline industry | (none) | |
| Dry cleaning | (none) | |
| Paints & varnishes | (none) | |
| Total industrial | 30,042 | 74,463 |
| Power generating | 2,336 | 5,790 |
| Space Heatng. | 4,628 | 11,471 |
| Solid waste disposal | 653 | 1,619 |
| Total | 7,617 | 18,880 |
| Total non-vehicular | 66,471 | 164,758 |
| | -28,812 | -71,415 |
| Total, non-transport | 37,659 | 93,343 |

TABLE II-8

ABSTRACT OF THE 1972 EMISSION INVENTORY FOR ALLEGHENY COUNTY
HYDROCARBONS

| Motor Vehicles | Tons/yr | kg/day |
|---|---|---|
| Private cars | 88,000 | 218,121 |
| Commercial vehicles (trucks) | 45,000 | 111,539 |
| Buses | 495 | 1,227 |
| Truck-tractors | 2,360 | 5,850 |
| Total vehicular | 135,855 | 336,737 |
| | 9,904 | 24,549 |
| Total transportation | 145,759 | 361,285 |
| Total non-transport | 28,574 | 70,825 |
| Total, all sources | 174,333 | 432,110 |

| | |
|---|---|
| Vehicular sources: | 78% |
| Non-vehicular sources: | 22% |
| | 100% |

| Other Sources | tons/yr | kg/day |
|---|---|---|
| RR Engines | 505 | 1,252 |
| River boats | 140 | 347 |
| Aircraft | 9,259 | 22,950 |
| Total | 9,904 | 24,549 |
| Industrial Sources: | | |
| Metallurgical | (none) | |
| Cement mfg. | 97 | 240 |
| Asphalt plants | (negligible) | --- |
| Food Prod. | 16 | 40 |
| Printing | 500 | 1,239 |
| Petroleum & coal production | 14 | 35 |
| Chemical prod. | 2,600 | 6,444 |
| Rubber prod. | 8 | 20 |
| Stone, clay, & glass prod. | 12 | 30 |
| Non-ferrous metal | 228 | 565 |
| Metal fabric. | 50 | 124 |
| Gasoline Industry | 14,170 | 35,122 |
| Dry cleaning | 1,700 | 4,214 |
| Paints, etc. | 5,855 | 14,512 |
| Total industrial | 25,250 | 62,586 |
| Power generating | 839 | 2,080 |
| Space heating | 2,325 | 5,763 |
| Solid waste disposal | 160 | 397 |
| Total | 3,324 | 8,239 |
| Total non-vehicular | 38,478 | 95,374 |
| | -9,904 | -24,549 |
| Total non-transport | 28,574 | 70,825 |

Allegheny County Bureau of Air Pollution Control (BAPC) gives total emissions of CO from vehicular sources (passenger cars, trucks, buses, and tractor-trailers) for the year 1972 as 891,300 tons/yr (2,209,218 kg/day). This is 3 2/3 times the output of the VEHEMI2 computer program for Allegheny County (including the city of Pittsburgh) for 1972: 603,590 kg/day. Since these two values purport to represent the same quantity, it was important for the purposes of the present study to try to resolve the apparent discrepancy.

The first thing noted was that the vehicle populations used differed by some 204,275 -- according to the Inventory there were 842,100 vehicles in the four categories of highway motor vehicles registered and operating in Allegheny County in 1971, whereas the information used in this Report gives a value of only 637,826 for the two categories they used for the year 1971 (see Table II-9). The ratio GCA/Inventory, then is 637,826/842,100 = 0.7574. For passenger cars only, the ratio for 1971 is 571714/702500 = 0.8138. Assuming the same rate of annual growth as used in the Inventory, 2.5 percent, we get an LDV population of 586,007 for 1972. The GCA/Inv ratio is 586,007/720,000 = 0.8139. The next thing that became apparent was that the average annual VMT/car numbers used in the two documents were also quite different: whereas the BAPC staff had assumed a figure of about 10,000 miles per car year (a check of their computations indicates an actual value of 9950, at 12 mi/gal average mileage), the VMT's provided by the subcontractor indicate an average annual travel of only about 8480 miles per car. This is a further proportionality factor of 0.8480. These two factors may be

TABLE II-9

MOTOR VEHICLE POPULATION FROM ALLEGHENY COUNTY 1971 & 1972 EMISSION INVENTORIES

| | 1970 | 1971 | 1972 |
|---|---|---|---|
| Passenger cars and station wagons | 682,000 | 702,500 | 720,000 |
| Commercial vehicles (trucks) (gasoline-fueled) | 97,600 | 99,700 | 102,500 |
| Buses (diesel-fueled) | 21,84 | 2,100 | 2,100 |
| Truck tractors (diesel-fueled) | 35,600 | 37,800 | 40,000 |
| Total highway vehicles* | 81/,384 | 842,100 | 864,600 |

*The Emission Inventories also include motorcycles and dealer registrations, which are not included in the data furnished to us by the subcontractor. These have therefore been omitted from the above tabulation.

MOTOR VEHICLE POPULATION, FROM A.M. VOORHEES & ASSOCIATES, INC.

"In operation" as of 1 July 1971

| | Passenger Cars | Trucks | Total |
|---|---|---|---|
| Allegheny County | 571,714 | 66,112 | 637,826 |
| Armstrong County | 31,498 | 7,683 | 39,181 |
| Beaver County | 77,497 | 11,830 | 89,327 |
| Butler County | 51,549 | 12,410 | 63,959 |
| Washington County | 83,876 | 15,519 | 99,395 |
| Westmoreland County | 142,650 | 24,342 | 166,992 |
| Totals for SPRPC Region: | 958,784 | 137,896 | 1,096,680 |

checked by comparing the total VMT's: 13578293/19672131 = 0.6902; 0.8138 x 0.848 = 0.6902. Finally, the emissions index computed by the program VEHEMI3 is 40.25 gm/mi (for the LDV's only), while the emission factor of 2 lb CO/gal fuel burned is equivalent to 75.22 gm/mi, giving a factor of 0.5351. The product of these three factors is 0.3693. The ratio of emissions is, for passenger cars only, 557863/1479752 = 0.3770. (The 1,479,752 kg/day is based on the recomputed value of 597,000 tons/yr of CO instead of the 592,000 given in the Inventory.) There is thus an unexplained residual differential which amounts to only some 2.04% of the emissions ratio. Given the many imponderables and assumptions that went into these numbers, it is felt that this close a result may be considered as having accounted for the observed difference in the two sets of calculated emissions.

For the HC emissions the results are dependent upon the same three factors: of these, only the emission index and the emission factor are new: 6.68 gm/mi from the VEHEMI3 program and 11.095 gm/mi from the Inventory, respectively, giving a ratio of 0.602. The product of this value and the VMT ratio of 0.69 is 0.4156; this compares with the emissions ratio of 92556/218263, or 0.4241. The remaining difference amounts to only about 2.01 percent of the emissions ratio, a result quite close to that obtained for the CO emissions.

The other vehicle categories were not investigated in this manner, partly because of the uncertainties in the ways in which they were defined in the two documents (this report and the Inventory), and partly because the LDV category (passenger cars) is not only better defined but accounts for no less than 95.6 percent of all the VMT's for the year according to this study. Again, the situation is more complicated in the Inventory, since the trucks are handled on an average mileage basis (45 mi/day, or a total of $1.688 \times 10^9$ VMT/yr), while the diesel-fueled vehicles (buses and tractor trailers) are handled on the basis of average fuel consumption for the year with no mileage figures given. However, the VMT's for the HDV category in the present study (supposedly the group which corresponds to the "commercial vehicles" category in the Inventory) are only about 1/10th of the VMT's as calculated from the data given on page 16 of the Inventory. This large difference is only partially accounted for by the vehicle population assumptions made in the two studies: 66,112 trucks in Allegheny County as of 1 July 1971 was the basis for the figure used in our computer runs, while the Inventory gives a figure of 99,700 trucks for 1971, a ratio of 0.6631. Applying this same ratio to the 1972 estimated number of trucks from the Inventory, 102,500, we would have had a corresponding value of 67,968 trucks for our computer input value for the 1972 computations. The obvious problem here, of course, is the very large discrepancy in the average miles per truck assumed in the two instances. Whereas the Inventory study uses the figure of 45 mi/day for trucks (gasoline-fueled), the data used in this report imply a figure of only about 6.63 mi/day/truck if the HDV value of VMT is used, or 9.156 mi/day/truck if the total of HDV + OV is used. This brings to light a minor problem in the data supplied to GCA: while there are three categories of vehicles used as the basis for the VMT's, only two groups of vehicles are broken out in the vehicle population figures. Thus, another possible source of confusion and error creeps in.

The various factors and parameters used in the above discussion are included in the tables which appear below (Tables II-12 through II-16).

To sum up the stationary, or rather the non-vehicular source situation, it appears that only about 7 percent of the total CO emissions come from sources other than vehicular (defined for the purposes of this report as passenger cars, commercial trucks and tractor-trailers, and buses), while about 22 percent of the total HC emissions come from the non-vehicular sources. These figures are used in a later part of the report to derive the most probable values of emissions from non-vehicular sources in later years. A discussion of the rationale behind this procedure is perhaps superfluous in light of the paucity of data mentioned previously and the absence of any really viable alternative. Several methods of modifying these ratios were investigated; among them being the application of the ratios between the CO and HC emissions for Zone 1 for the successive years (see Table II-10) and those for the entire County, the percent reduction figures for the point sources for the 1972-1977 period, and other such derived information. After much thought and several hand calculations, it was decided to use the Inventory ratios essentially as given and to use the planned reductions of CO and HC from the major point sources as an estimate of the amounts of reduced CO and HC emissions, respectively, to be expected from non-vehicular sources over the next five years. The downward trend in industrial emissions of CO between the 1971 and 1972

TABLE II-10 (see also Figure II-12)

ESTIMATED VEHICULAR EMISSIONS FOR ALLEGHENY COUNTY (in kg/day)

| Zone 1 only (computed) | | | Totals for all of Allegheny County (estimated) | | | |
|---|---|---|---|---|---|---|
| Calendar Year | Total CO | Total HC | Total CO | $Z_1$/TC (%) | Total HC | $Z_1$/TC (%) |
| 1970 | 29844.63 | 4851.98 | 642027.11 | 4.6485 | 126139.14 | 3.84653 |
| 1971 | 28903.25 | 4415.93 | 627540.28 | 4.6058 | 114907.51 | 3.84303 |
| 1972 | 27542.52 | 3923.19 | 603589.96* | 4.5631 | 102178.92* | 3.83953 |
| 1973 | 25179.25 | 3505.03 | 557013.76 | 4.5204 | 91371.29 | 3.83603 |
| 1974 | 22915.87 | 3113.12 | 511777.70 | 4.4777 | 81228.85 | 3.83253 |
| 1975 | 20185.92 | 2656.35 | 455160.66 | 4.4349 | 69373.97 | 3.82903 |
| 1976 | 16704.66 | 2154.04 | 380325.58 | 4.3922 | 56306.97 | 3.82553 |
| 1977 | 13829.16 | 1793.87 | 317949.66* | 4.3495 | 46935.10* | 3.82202 |
| 1978 | 11339.56 | 1522.78 | 263294.33 | 4.3068 | 39878.80 | 3.81852 |
| 1979 | 9473.62 | 1288.19 | 222171.62 | 4.2641 | 33766.27 | 3.81502 |
| 1980 | 7657.86 | 1083.60 | 181409.99 | 4.2213 | 28429.60 | 3.81152 |
| 1981 | 6325.90 | 971.03 | 151388.02 | 4.1786 | 25499.60 | 3.80802 |
| 1982 | 5551.40 | 889.88 | 134224.72 | 4.1359 | 23390.69 | 3.80442 |
| 1983 | 5048.92 | 814.60 | 123348.97 | 4.0932 | 21431.65 | 3.80092 |
| 1984 | 4593.02 | 793.34 | 113393.90 | 4.0505 | 20891.55 | 3.79742 |
| 1985 | 4535.49 | 786.61 | 113169.40 | 4.0077 | 20733.44 | 3.79392 |
| 1986 | 4401.01 | 770.84 | 110996.47 | 3.9650 | 20336.53 | 3.79042 |

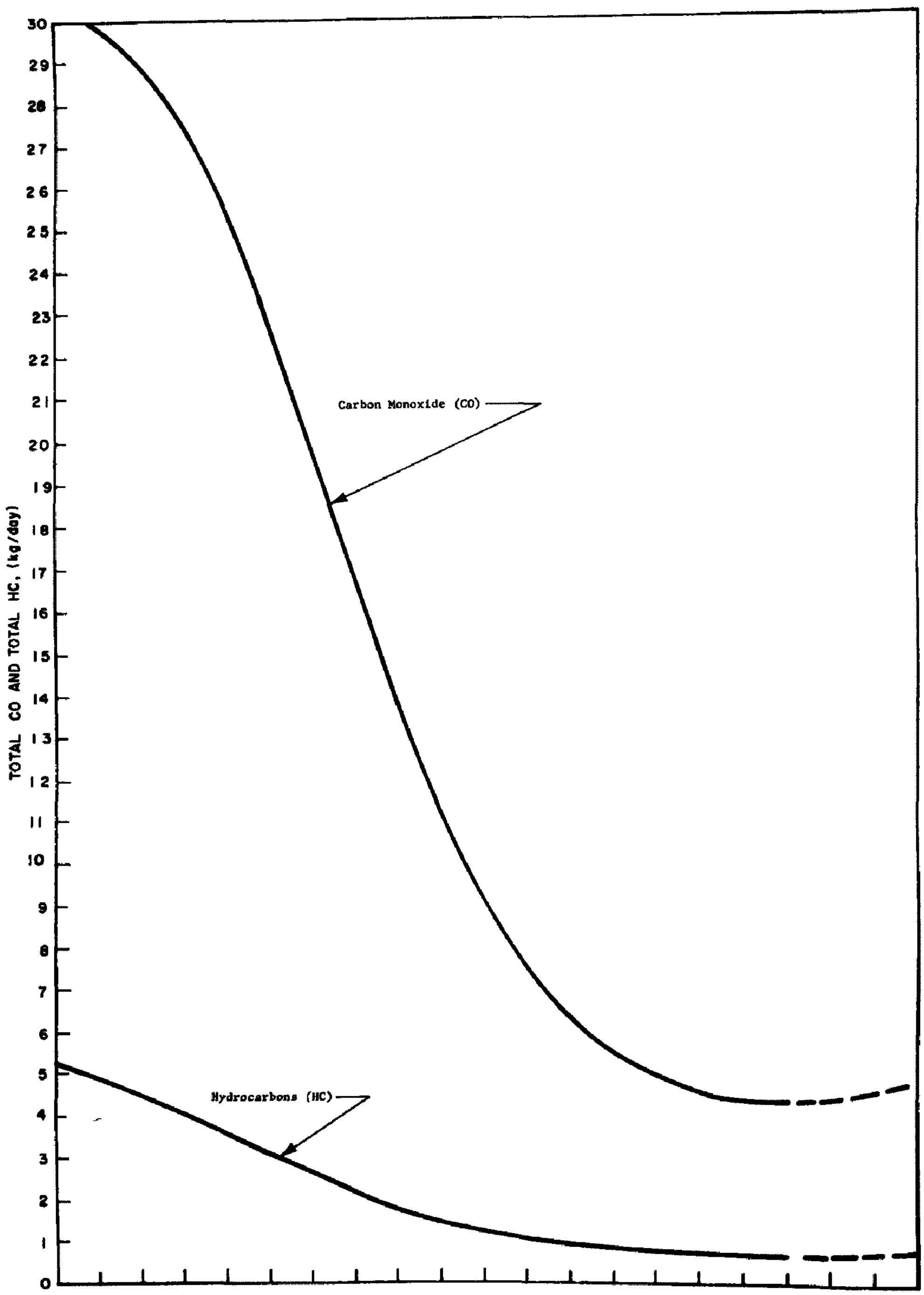
*Computed values - the rest of the County-wide figures are estimates.

Note 1: All percentage reductions shown are based on the 1972 value for total CO emissions for Zone 1 (27,543 kg/day). "Percent reduction" is synonymous with "rollback" in this case, since a negligible background level is assumed. These are all "no strategy" reductions; i.e., due to FMVECP only.

| 1972 | 1975 | 1977 | 1978 | 1979 |
|---|---|---|---|---|
| 27,543 | $\frac{27{,}543-20{,}186}{27543}$ | $\frac{27543-13829}{27543}$ | $\frac{27543-11340}{27543}$ | $\frac{27543-9474}{27543}$ |
| | $= \frac{5357}{27543}$ | $= \frac{13714}{27543}$ | $= \frac{16203}{27543}$ | $= \frac{18069}{27543}$ |
| | = 26.7% | = 49.8% | = 58.8% | = 65.6% reduction |

Note 2: CO and HC between them account for 91.4 to 91.8 percent of total emissions and the HC emissions are consistently 13 to 17 percent of the CO emissions in Zone 1.

Note 3: "$Z_1$/TC" = ratio of Zone 1 to total County emissions.




PITTSBURGH ZONE I ONLY
LINEAR INCREASE IN VMT, CONSTANT SPEED

Figure II-9. FMVECP only - no strategy.

Inventories was at the rate of 6.4 percent per year, which would give a total reduction of 32 percent over the five year period. This compares well with the 35.5 percent reduction employed in the calculations summarized in Table II-18 below. There was a small increase of about 2.8 percent in HC emissions from industrial sources between the two inventories which does not bear out the three year reduction of 30.9 percent used in the HC calculations (Table II-19). The many uncertainties inherent in the planning process make any given value of predicted ambient concentrations as good as any other (within limits, of course). Thus, the forecast values of CO and HC reductions to be expected as a result of planned controls on stationary sources were used as given, with no attempt to second-guess the sources of the estimates.

As for the question of the uniformity of distribution of the various pollutants over the County, the previous discussion on the terrain features and the concentrated industrial activity in the valleys would indicate that we cannot consider the emanations from stationary sources to be sufficiently well mixed over a period of several hours to assume that we can consider point sources in the aggregate as a single area source, at least for directly vehicle-related substances such as CO. In the case of $O_x$, where we are concerned not so much with the immediate emanations of HC as with their photochemical products a few hours later, we must take into account the effects of wind velocity and atmospheric stability as discussed in the section on meteorology (Section II B 1 b). This, of course, is the reason for selecting a site at some distance downwind from the principal source of HC emissions; in this case, the downtown district (Zone 1). Thus, while we are completely justified in limiting our attention to Zone 1 for the CO problem, we must consider a much larger area - at least all of Allegheny County and perhaps the entire SPAQCR (nine counties) or the SPRPC region (six counties). As will be seen, we elected to concentrate our attention on Allegheny County in addressing ourselves to the problem of photochemical oxidants. This was done for two reasons: because the County has by far the greatest concentrations of gaseous pollutants of all types, including hydrocarbons, and because good information was available on a county-wide basis for emission rates of the various pollutants.

### 2. Assessment of the CO and $O_x$ Problems

#### a. Implementation Plan Assessment

According to Pennsylvania's Implementation Plan:

> "Oxidant concentrations presently exceed the standard in the Allegheny County area. The Federal Motor Vehicle Emissions Control Program (FMVECP) and the stationary source control regulations for hydrocarbons will achieve the oxidant standard in Allegheny County by 1977."
>
> (From the Addendum to Pennsylvania's Implementation Plan - undated).

As it happens, the present study does not bear out the above statement. Based on our calculations, it appears that the transportation control strategies which must be adopted in order to bring the CO emissions down to a level where the Federal standard can be reached will, together with the planned reductions of HC emissions from non-vehicular sources, bring the total HC emissions in Allegheny County below the level at which the oxidants standard can be met. This should be accomplished by 1977, according to our calculations (see the computation sheet for HC emissions, below). The FMVECP and stationary source controls by themselves, however, will not quite do the job, falling 3 percent short of the required reduction.

Since the $O_x$ problem is a "non-problem" as far as we can tell at this time, it remains to deal with the CO emissions rate, which does pose a definite problem, as we shall see. Having established that only Zone 1 is of concern in the case of CO emission density (Appendix C), it remains to determine the ratio of emissions to concentrations, use that to compute the so-called "safe" emission rate, and compare that with the expected "no-strategy" rate of emissions in 1977 to find the additional amount of reduction of emissions which will be required to achieve the Federal standard for ambient concentrations of CO. This procedure is developed in the following section; for now, we wish to review the analysis described in the Implementation Plan and try to determine whether it is a realistic portrayal of the CO problem in the Pittsburgh area. Here, another quote may be of value; this time, taken from the Control Strategy Evaluation, <u>Summary</u>, page II-1:

> "Air Quality data indicate that the carbon monoxide standard is presently being exceeded in the Allegheny County area. The Federal Motor Vehicle Emission Control Program (FMVECP) will reduce the present 8-hour maximum concentration from 24 $mg/m^3$

> (21 ppm) to 18 $mg/m^3$ (15.7 ppm) by 1975 and to less than the standard value of 10 $mg/m^3$ (8.7 ppm) by 1979. Since 88% of the CO emissions come from motor vehicles, stationary source control would not have a significant impact on air quality."

In this instance, as in the previous case, we cannot agree completely with the statements from the Implementation Plan. As is shown in the computation sheet for CO (Table II-A), and as was stated earlier in this report, the standard is exceeded by the maximum observed 8-hour average concentration by some 58 percent and the FMVECP will not, by itself, reduce this to the required level by 1977. Our investigation, moreover, indicates that the program will by 1975 reduce CO emissions from motor vehicles in the downtown Pittsburgh area (Zone 1) by about 26.7 percent of the 1972 value, resulting in an ambient concentration (assuming that the present emission to concentration ratio holds) of 15.5 ppm, in excellent agreement with the Implementation Plan. Furthermore, we find, as shown below, that the unassisted Federal program could not reduce the total CO emissions to a level below the standard before 1979, although it comes very close in 1978. As for the last statement, the percentage of CO emissions attributed to non-vehicular sources depends to a large extent on the manner in which these sources are defined. For example, in the Inventory we find that sources are grouped under the headings of "mobile," "industrial processes," "power generation," "domestic, industrial, and commercial space heating," and "solid waste disposal"; it turns out that "mobile" includes all forms of transportation, whereas we are concerned in the present study only with highway transport: cars, trucks and buses. This is the reason for our going to a category called "vehicular" as opposed to "non-vehicular" (i.e., all others, including other types of transport as well as the stationary sources). In a letter to Mr. Ruckelshaus dated 5 May 1972, Governor Shapp stated that "86% of the CO emissions in Allegheny County are generated by mobile sources." This is, of course, in good agreement with the figure of 88% given above for "motor vehicles". However, if we look only at the "vehicular" category as defined by GCA for this study, we find that only 7% of the total CO comes from "non-vehicular" sources (see Table II-7). But if we check the 1971 Inventory (on which the statements quoted above were presumably based), we find that no less than 96.2% of all CO emissions in 1971 came from "mobile" sources, leaving only 3.8% as the contribution from all of the stationary sources. If we try to resolve the seeming discrepancy between the Governor's statement and that of the Inventory we find that "mobile sources" in this instance apparently meant just cars and trucks -- even so, these two categories alone account for 92.4% of all the CO emitted in the County during 1971, while passenger cars alone contributed only 64.6% of the total. It is really difficult to find a combination of sources which add up to either 86% or 88% of the total emissions -- some 828,647 tons or 847,918 tons, respectively, for the year 1971. In the end, we decided to stay with the actual numbers from the Inventory as far as the ratio of vehicular to non-vehicular sources was concerned, although, as we have already seen, the absolute values could not be used.

Perhaps the most important difference between the findings of the Implementation Plan and the results of our study is that the stationary (or, as we have it, the non-vehicular) sources cannot be ignored. Difficult as it may be to derive reasonable figures for future values of emissions from these sources, we found that they must be taken into account for both CO and HC estimates if the standard is to be achieved. Realistically, one might say that if these emissions are only 7% of the total (for CO), they cannot make much difference in the final result. True enough, yet a small difference in the estimate for the year 1977 makes all the difference in the attainment of the standards for both CO and HC emissions, as is shown in Tables II-18 and II-19.

Before leaving this review of the Implementation Plan it would be well to mention a minor discrepancy which, if it were not resolved, would nevertheless have an appreciable effect on the computations of amount of "rollback" required to meet the Federal standards. I refer to the "Additions and Clarifications to Pennsylvania's Implementation Plan" dated 4 May 1972 which accompanied the letter from Governor Shapp to Mr. Ruckelshaus, cited above. In particular, it was noted that in section 51.14, Control Strategy for CO, the maximum 8-hour concentrations for CO in Allegheny County for the period November 1971-February 1972 are given as:

| | | |
|---|---|---|
| 28 ppm | 17 Nov | 1700-2400 |
| 23 ppm | 18 Nov | 0900-1600 |
| 23 ppm | 6 Dec | 1700-2400 |
| 25 ppm | 14 Dec | 1700-2400 |
| 20 ppm | 27 Dec | 0900-1600 |
| 20 ppm | 29 Feb | 1700-2400 |

The raw data were carefully searched for both 1-hour and 8-hour maximum values of both CO and HC emissions; while the HC data were not available in useable form, the CO data were apparently quite accurate - at least they were consistently within "reasonable" limits. The technique for deriving the 8-hour maxima from the tabulated 1-hour high values of CO concentrations was explained earlier. Careful scrutiny of all the available data from the Downtown and Bellevue sites failed to reveal any values as high as the highest ones reported in the referenced document. The 8-hour concentrations corresponding to those reported above are:

| | | Downtown | Bellevue | Implementation Plan |
|---|---|---|---|---|
| 17 Nov | 1700-2400 | 19.8 | (bad data) | 28.0 |
| 18 Nov | 0900-1600 | 18.7 | " " | 23.0 |
| 6 Dec | 1700-2400 | (hourly data not avlbl) | | 23.0 |
| 14 Dec | 1700-2400 | 19.8 | 19.1 | 25.0 |
| 27 Dec | 0900-1600 | (hourly data not avlbl) | | 20.0 |
| 29 Feb | 1700-2400 | 20.4 | 19.9 | 20.0 |

(All of the above data are in parts per million by volume - ppm).

It is, of course, possible that the 8-hour maxima reported in the Implementation Plan were derived from stations other than the two on which our data are based, or that data from other years are available to those who derived the information incorporated in the Plan. It was noted, however, that the figures given in the Plan for the three dates in December correspond to <u>hourly</u> maxima, and that the second number for the month of November corresponds to the <u>hourly</u> maximum for the preceding day (17 November). The first value as given in the plan could not be accounted for at all, and the last one was in agreement with our findings. While this discussion should perhaps have been included in the section on air quality data, it was felt that in our review of the Implementation Plan this was perhaps the most significant area for study since, as we have seen, there was quite good agreement in almost all other areas.

The review conducted for this Report indicates that additional information of potential value should be worked up and made available to EPA. As an example, if we examine not just the highest values for each month, but the second, third, fourth, and fifth highest, we find a significant correlation between the data for Bellevue and those for the Downtown site, with advection from the direction of Bellevue to downtown along the Ohio River valley quite apparent on some days. The significance of a quantification of this effect would be, of course, that a much better idea of the so-called "background" value of CO would be forthcoming and consequently a more accurate "rollback" number could be generated. In terms of economics this could be quite significant in that a possibly unnecessary reduction of emissions could be avoided and the cost associated with this "overkill" could be obviated. It should be emphasized that this is only a tentative finding and requires much more study and analysis before it can be accepted as factual.

## CORRELATION BETWEEN OBSERVED HIGH VALUES OF 8-HOUR CO CONCENTRATION AND METEOROLOGICAL PARAMETERS OF SIGNIFICANCE IN AIR POLLUTION EPISODES

The dates and times of high 8-hour concentrations of CO in the Pittsburgh area are shown in Table II-4, page and in Appendix B. In an effort to determine the reasons for the apparent difference in the hourly data for Pittsburgh as opposed to the common experience in other locations (see discussion on page and Tables in Appendix A, also Figures II-5 and II-7, pages and , respectively), an analysis of the 1-hourly data was attempted to try to discover whether any meteorological phenomena could be found to account for this situation. No significant correlations were apparent, however. The 8-hour data were then examined in a similar manner, with the following results.

| | | AIR POLLUTION METEOROLOGICAL PARAMETERS | | | | | |
|---|---|---|---|---|---|---|---|
| DATE | TIME | INVERSION | TIME OF BREAK | MIXING DEPTH | AVERAGE Sfc WIND | AVG CLDS | WEATHER |
| 18 Aug 71 | 03-17 | Pronounced | 0930 | 845 m. | SE-S 2.2 | clr-sctd | (No Data) |
| 1 Oct 71 | 05-22 | Moderate | 0930 | 750 | NE-E 3.9 | clr-sctd | Fog, haze, smoke |
| 2-3 Oct 71 | 14-06 | Weak to Moderate | 1000 | 990 | NE-SE 1.4 | brkn-ovc | Ground fog, smoke, and haze |
| 17-18 Nov 71 | 17-17 | Moderate to Strong | 1000, 1130 | 800 | SE-SW 3.2 | clr-brkn | Ground fog, smoke, and haze |
| 14-15 Dec 71 | 15-05 | Moderate | 2000, (ND) | 460 | SE-S 2.9 | Overcast | (No Data) |
| 29 Feb - 1 Mar 72 | 15-05 | Weak | 1200 | 970 | NE-S 3.4 | sctd-clr | Smoke and haze |
| 24 Feb 72 (Bellevue) | 11-24 | Weak | DNB | 360 | W-NW 3.8 | Overcast | Fog (early morning) |

While all of the above days contain some meteorological parameters favorable to the formation of high concentrations of air pollutants, there were other days with even stronger meteorological indications which did not display correspondingly high concentrations of CO. Conversely, some days with high average concentrations of CO did not have meteorological phenomena present which were significant in terms of air pollution. The tentative conclusion, based on a rather cursory analysis of limited data, is that no strong correlation exists between the highest observed 8-hour average concentrations and any of the commonly observed meteorological parameters.

b. Current Assessment

(1) General

This section contains a review of the methodology employed in the analysis of the existing and future situations as regards both ambient concentrations and emission rates in the Pittsburgh area, and of the results of the efforts to determine the likely situation in the target year, 1977. Also reviewed in this section are some of the more important factors involved in developing the bases for the strategy recommendations, although a review of the strategies themselves belongs to a succeeding section.

The two factors which form the basis for the development of projected values of emissions and emission densities as given in Appendix C - that is, the parameters which are varied under the control of the computer program which generates the emission values on a zone-by-zone basis, are the vehicle miles traveled (VMT) per car per year, and the mix of vehicle speeds for the highway facilities found in each zone. Repeated runs were made on the computer to assess the effect of each change in these parameters. As would be expected, the emissions varied in a linear fashion with VMT's but in a non-linear manner with speed. A partial matrix constructed of values generated during these sensitivity tests is included below as Table II-11.

To recapitulate the procedure followed in deriving the county-wide data for years other than those for which computer runs

TABLE II-11

CO EMISSIONS FOR ZONE 1 (DOWNTOWN PITTSBURGH) FOR 1977 (kg/day) Area = 1.26 sq. mi.

VEHICLE MILES TRAVELED PER DAY

| Var. in Speeds (VMT Var.) | | $VMT_{77}$-0 | % red., Veh.em. only | % red., total em. | $VMT_{77}$-2.4% | % red., veh.em. only | % red., total em. | $VMT_{77}$-3.0% | % red., veh.em. only | % red., total em. | $VMT_{77}$-5.0% | % red., veh.em. only | % red., total em | $VMT_{77}$-7.0% | % red., veh.em. only | % red., total em. | $VMT_{77}$-16.3% | % red., veh.em. only | % red., total em. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPD+0 | veh. | 13829 | 0.0 | | | | | | | | | | | 12861 | 7.0 | | 11575 | 16.3 | |
| | tot. | 15248 | | 0.0 | | | | | | | | | | 14280* | | 6.3 | 12994* | | 14.8 |
| SPD + | veh. | | | | 13336 | 3.6 | | | | | | | | | | | | | |
| 1.5 | tot. | | | | 14755 | | 3.2 | | | | | | | | | | | | |
| SPD + | veh. | | | | 13285 | 3.9 | | 13205 | 4.5 | | | | | | | | | | |
| 2.0 | tot. | | | | 14704# | | 3.6 | 14624 | | 4.1 | | | | | | | | | |
| SPD + | veh. | | | | | | | | | | 12830 | 7.2 | | 12560 | 9.2 | | | | |
| 3.0 | tot. | | | | | | | | | | 14249* | | 6.6 | 13979* | | 8.3 | | | |
| SPD + | veh. | 12654 | 8.5 | | | | | | | | | | | 11768 | 14.9 | | 10592 | 23.4 | |
| 10.0 | tot. | 14073* | | 7.7 | | | | | | | | | | 13187* | | 13.5 | 12011* | | 21.2 |
| HC Emissions for all of Allegheny County for 1977 (kg/day) Area = 745.4 sq. mi. | | | | | | | | | | | | | | | | | | | |
| SPD+0 | veh. | 46935 | 0.0 | | | | | | | | | | | 43642 | 7.0 | | 39272 | 16.3 | |
| | tot. | 61229 | | 0.0 | | | | | | | | | | 57936* | | 5.4 | 53566* | | 12.5 |
| SPD + | veh. | | | | 45473 | 3.1 | | | | | | | | | | | | | |
| 1.5 | tot. | | | | 59767 | | 2.4 | | | | | | | | | | | | |
| SPD + | veh. | | | | 45395 | 3.3 | | 45107 | 3.9 | | | | | | | | | | |
| 2.0 | tot. | | | | 59689 | | 2.5 | 59401 | | 3.0 | | | | | | | | | |
| SPD + | veh. | | | | | | | | | | 43982 | 6.3 | | 43040 | 8.3 | | | | |
| 3.0 | tot. | | | | | | | | | | 58276 | | 4.8 | 57334* | | 6.4 | | | |
| SPD + | veh. | 44610 | 5.0 | | | | | | | | | | | 41470 | 11.6 | | 37336 | 20.5 | |
| 10.0 | tot. | 58904 | | 3.8 | | | | | | | | | | 55764* | | 8.9 | 51630* | | 15.7 |

#Strategy used by A.M. Voorhees Assoc. It falls 2.4% short of the goal, since 14704 -(.125)14704 = 12866 = 302 kg/day over the desired emission rate.

*These strategies meet the desired goal or better it - i.e., yield lower emission rates.

Baseline values: CO: vehicular emissions only, 1977: 13,829 kg/day, Zone 1 only. Required to meet standard: 11,145 kg/day
total emissions: 15,248 kg/day, Zone 1 only. Required to meet standard: 12,564 kg/day
HC: vehicular emissions only, 1977: 46,935 kg/day, Allegheny C. Required to meet standard: 43,939 kg/day
total emissions: 61,229 kg/day, Allegheny C. Required to meet standard: 58,233 kg/day

were made (1972 and 1977), and in obtaining the relationships between vehicular and non-vehicular emissions, CO and HC emissions for a given area and year, and expected future values of emission reductions from non-vehicular sources, the following summary may be of assistance.

| GIVEN QUANTITIES: | Source: |
|---|---|
| a. Federal standards for CO and $O_x$ | 40 CFR 50, 25 Nov 71 (p. 22385) (see also Table II-12) |
| b. All-source emissions, CO and HC. (NOTE: modified to be compatible with results of computer program.) | Emissions Inventory (see Section IID1 and Tables II-7 and II-8) |
| c. VMT's for years 1972 and 1977 (totals by zone for the SPAQCR less Fayette, Greene, and Indiana Counties); % VMT by vehicle type. | AMV Assoc., Inc. (see Appendix D) |
| d. SPDC & FSPD values by highway facility type for each zone of 72 zones. NOTE: SPDC = peak and off-peak speeds in mph; FSPD = fraction of total VMT to each speed class. | AMV Assoc., Inc. (see Appendix D) |
| e. Zonal areas (sq. mi., for each of 72 zones) | AMV Assoc., Inc. (Appendix D) |
| f. Age distribution of motor vehicles for each of 6 counties in SPRPC Region, 2 categories only (LDV = passenger car; HDV = truck). | AMV Assoc., Inc. (Table II-13) |
| g. Average annual miles driven per LDV by model year (vehicle age). | Table 14, Kircher & Armstrong |
| h. Average annual miles driven per HDV by model year (vehicle age). | Table 20, K & A. |
| i. Emission factors (gm/mi), 1975 Federal test procedure emission rates (gm/mi) by model year, deterioration factors, weighted speed adjustment factors by model year, | K & A; Table 6, Table 17, Tables 8 & 9, Figs 2 & 3 & Table B-2, Tables 15 & B-3, and Fig. 1. |

| | Source: |
|---|---|
| evaporative and crankcase emission rates by model year, and emission factor geographic area (Area V for Pittsburgh). | |
| j. Ambient concentrations of CO and $O_3$. | Air quality data |

DERIVED QUANTITIES:

| | |
|---|---|
| a. Partial VMT's by Zone for each vehicle type (LDV, HDV, and OV) for 1972 and 1977. | Hand computations |
| b. Partial VMT's by vehicle type for all years, 1970-1986 (except 1972 and 1977), Zone 1 only. | Straight-line interpolation (Table II-14) |
| c. Adjusted vehicle age distribution for 1/2-year adjustment (1 July to 31 December), LDV's and HDV's for Allegheny County and entire SPRPC Region. | Hand computations (Table II-15 and Figure II-10) |
| d. % of total vehicle population by model year (vehicle age), Allegheny County and SPRPC Region. | Hand computations (Table II-15 |
| e. Emissions of CO and HC by vehicle type and zone. | Computer program VEHEMI2 and hand calculations (these agreed within 0.8%). |
| f. Emission densities by vehicle type for each zone, CO and HC. | VEHEMI2 (Appendix C) |
| g. Total emissions of CO and HC, by zone, for 1972 and 1977. | VEHEMI2 (Appendix C) |
| h. Sensitivity analyses for VMT and SPDC variations, Zone 1 only, for 1977. | VEHEMI2 (Tables II-11 and II-17) |
| i. CO and HC emission indices by vehicle age for calendar years 1972 & 1977, Zone 1 only. | VEHEMI3 (Appendix C) |
| j. Total emissions of CO and HC, 1972 and 1977, by counties (City of Pittsburgh = 20 zones, Allegheny County = 31 zones, other 5 counties = 21 zones). | Hand computations (Table II-16) |

TABLE II-12

From 40 CFR 85, "New Motor Vehicles and New Motor Vehicle Engines - Control of Air Pollution," Federal Register, vol. 37, No. 221, Part II, 15 November 1972, pp. 24249-24320.

| LDV | HDV |
|---|---|
| Emission standards for 1973 model year vehicles: | |
| A. Exhaust: | |
| (1) HC: 3.4 gm/VMT<br>(2) CO: 39.0 gm/VMT<br>(3) $NO_x$: 3.0 gm/VMT | HC: 275 ppm<br>CO: 1.5% (by volume)<br>Crankcase: 0.0 |
| B. Evaporative:<br>(1) HC: 2 gm/test<br>C. Crankcase: 0.0 | 1974 model year vehicles:<br>HC + $NO_x$ (as $NO_2$): 16 gm/bhph<br>CO : 40 gm/bhph |
| Emission standards for 1974 model year vehicles: (same as for 1973) | Crankcase: 0.0 |
| Emission standards for 1975 model year vehicles: | |
| A. Exhaust:<br>(1) HC: 0.41 gm/VMT<br>(2) CO: 3.4 gm/VMT<br>(3) $NO_x$: 3.1 gm/VMT | OV (Diesel)<br>1974 model year vehicles:<br>HC + $NO_x$(as $NO_2$): 16 gm/bhph<br>CO : 40 gm/bhph |
| B. Evaporative:<br>(1) HC: 2 gm/test<br>C. Crankcase: 0.0 | LEV (low-emission vehicle)<br>(1) HC: 3 gm/VMT |
| Emission standards for 1976 model year vehicles: (same as for 1975, except)<br>A. Exhaust<br>(1) HC: 0.41 gm/VMT<br>(2) CO: 3.4 gm/VMT<br>(3) $NO_x$: 0.40 gm/VMT | (2) CO: 28 gm/VMT<br>(3) $NO_x$: 3.1 gm/VMT |

## TABLE II-13

### COMPARISON OF PASSENGER CAR AGE DISTRIBUTION BETWEEN ALLEGHENY COUNTY AND THE SOUTHWEST PENNSYLVANIA AIR QUALITY CONTROL REGION AS OF 1 JULY 1971

| Model Year | Allegheny County (incl. Pittsburgh) | % Total | SW Pennsylvania RPCR (6 Counties) | % of Total |
|---|---|---|---|---|
| 1971 | 50,731 | 8.9 | 76,687 | 8.0 |
| 1970 | 78,011 | 13.7 | 121,833 | 12.7 |
| 1969 | 72,736 | 12.7 | 115,079 | 12.0 |
| 1968 | 70,052 | 12.2 | 113,417 | 11.8 |
| 1967 | 58,466 | 10.2 | 97,465 | 10.2 |
| 1966 | 63,280 | 11.1 | 108,010 | 11.3 |
| 1965 | 57,875 | 10.1 | 101,389 | 10.6 |
| 1964 | 43,353 | 7.6 | 78,010 | 8.1 |
| 1963 | 31,199 | 5.5 | 57,445 | 6.0 |
| 1962 | 19,915 | 3.5 | 37,419 | 3.9 |
| 1961 | 8,637 | 1.5 | 16,282 | 1.7 |
| 1960 | 5,678 | 1.0 | 11,401 | 1.2 |
| 1959 | 2,413 | 0.4 | 4,899 | 0.5 |
| 1958 | 1,279 | 0.2 | 2,467 | 0.2 |
| 1957 | 1,747 | 0.3 | 3,606 | 0.4 |
| 1956 | 1,302 | 0.2 | 2,641 | 0.3 |
| < 1956 | 5,040 | 0.9 | 10,734 | 1.1 |
| TOTALS: | 571,714* | 100.0 | 958,784 | 100.0 |

*This figure represents 59.6% of the passenger cars "in operation" in the SPRPC Region as of 1 July 1971.

There were also 137,896 trucks in operation in the six counties making up the Southwestern Pennsylvania RPCR as of 1 July 1971, for a total number of vehicles = 1,096,080, 87.4% passenger cars and 12.6% trucks. For Allegheny County alone, there was a marked difference in these proportions: of the 637,826 vehicles in operation there as of 1 July 1971, only 66,112 or 10.4% were trucks. These made up only 47.9% of the trucks in the entire region, showing the far greater numbers of trucks operating in rural areas in proportion to the total numbers of vehicles. It was also noted that trucks tend to be kept in service somewhat longer than cars: cars of model years 1958 and older made up only 1.8% of the total, while trucks of the same vintage made up 12.7% of their total.

A slight shift in the age distribution toward older cars is noted in the outlying areas. There are more "new" cars ( <4 yrs old) in the metropolitan Pittsburgh area, and fewer "old" cars (≥ 5 yrs old), than there are in the Southwest Penn. AQCR as a whole. 1967 is the nodal year for the calendar year 1971; cars older than that are more numerous in the outlying areas, while cars newer than the 1967 model year are relatively more common in the city. Thus, for 1977, the 1973 model year would be the nodal year used.

TABLE II-14

EXTRAPOLATED "NO-STRATEGY" VMT'S FOR ZONE 1, PITTSBURGH
(mi/day)

| Year | Code | LDV (.934) | HDV (.048) | OV (.018) | TOTALS |
|---|---|---|---|---|---|
| 1970 | 13 | 399,772 | 20,545 | 7,704 | 428,021 |
| 1971 | 14 | 407,054 | 20,919 | 7,845 | 435,818 |
| 1972 | 15 | 414,336 | 21,294 | 7,985 | 443,615 |
| 1973 | 16 | 421,619 | 21,668 | 8,125 | 451,412 |
| 1974 | 17 | 428,901 | 22,042 | 8,266 | 459,209 |
| 1975 | 18 | 436,185 | 22,41 | 8,406 | 467,007 |
| 1976 | 19 | 443,467 | 22,791 | 8,546 | 474,804 |
| 1977 | 20 | 450,749 | 23,165 | 8,687 | 482,601 |
| 1978 | 21 | 458,032 | 23,539 | 8,827 | 490,398 |
| 1979 | 22 | 465,314 | 23,913 | 8,968 | 498,195 |
| 1980 | 23 | 472,597 | 24,288 | 9,108 | 505,993 |
| 1981 | 24 | 479,880 | 24,662 | 9,248 | 513,790 |
| 1982 | 25 | 487,162 | 25,036 | 9,389 | 521,587 |
| 1983 | 26 | 494,445 | 25,410 | 9,529 | 529,384 |
| 1984 | 27 | 501,727 | 25,785 | 9,669 | 537,181 |
| 1985 | 28 | 509,010 | 26,159 | 9,810 | 544,979 |
| 1986 | 39 | 516,293 | 26,533 | 9,950 | 552,776 |
| (1987) | 30 | (523,575) | (26,908) | (10,090) | (560,573) |

Note: The last line is not usable in the computer program VEHEMI2 as it is presently constituted.

$\Delta(\text{VMT})/\text{yr} = 7797.2 \approx 1.758\% \ (\text{VMT})_{72}$.

TABLE II-15

MOTOR VEHICLE AGE DISTRIBUTION, ALLEGHENY COUNTY AND ENTIRE SPRPC REGION
(as of 31 December 1971)

Derived for the VEHEMI2 program from figures supplied by AMV Assoc., Inc.

| | Passenger Cars | | | | Trucks | | | |
|---|---|---|---|---|---|---|---|---|
| Model Year | Allegheny County | % of total | SPRPC Region | % of total | Allegheny County | % of total | SPRPC Region | % of total |
| 1972 | 18,770 | 3.3 | 28,374 | 3.0 | 2,014 | 3.1 | 3,785 | 2.7 |
| 1971 | 64,371 | 11.4 | 99,260 | 10.4 | 6,616 | 10.0 | 12,588 | 9.1 |
| 1970 | 75,374 | 13.3 | 118,456 | 12.4 | 8,141 | 12.3 | 15,732 | 11.4 |
| 1969 | 71,394 | 12.6 | 114,248 | 12.0 | 7,530 | 11.4 | 14,704 | 10.7 |
| 1968 | 64,259 | 11.3 | 105,441 | 11.1 | 6,048 | 9.2 | 12,058 | 8.7 |
| 1967 | 60,873 | 10.8 | 102,738 | 10.8 | 5,594 | 8.5 | 11,350 | 8.2 |
| 1966 | 60,578 | 10.7 | 104,700 | 11.0 | 5,310 | 8.0 | 10,791 | 7.8 |
| 1965 | 50,614 | 8.9 | 89,700 | 9.4 | 4,525 | 6.9 | 9,330 | 6.8 |
| 1964 | 37,276 | 6.6 | 67,727 | 7.1 | 3,517 | 5.3 | 7,399 | 5.4 |
| 1963 | 25,557 | 4.5 | 47,432 | 5.0 | 2,670 | 4.0 | 5,648 | 4.1 |
| 1962 | 14,276 | 2.5 | 26,851 | 2.8 | 2,103 | 3.2 | 4,514 | 3.3 |
| 1961 | 7,158 | 1.3 | 13,841 | 1.5 | 1,812 | 2.7 | 4,019 | 2.9 |
| 1960 | 4,046 | 0.7 | 8,150 | 0.9 | 1,522 | 2.3 | 3,484 | 2.5 |
| 1959 and earlier | 11,781 | 2.1 | 24,347 | 2.6 | 8,621 | 13.1 | 22,617 | 16.4 |
| Totals: | 566,327 | 100.0 | 951,265 | 100.0 | 66,023 | 100.0 | 138,019 | 100.0 |
| Totals, original AMV data | 571,714 | | 958,784 | | 66,112 | | 137,896 | |
| % Diff.: | 0.9 | | 0.8 | | 0.1 | | 0.1 | |

The above age distributions for the two vehicle categories were created by an averaging procedure, as shown graphically in Figure II-13. The necessity for shifting the initial age curve forward in time by six months to achieve compatibility with the VMT data gives rise to a small inaccuracy, as can be seen by comparing the shape of the original distribution to that of the derived one. As shown in the table above, the differences in total vehicle population are very small -- less than 1% in every case. In light of the many other assumptions which have had to be made during the course of this study, some of which undoubtedly contribute much larger errors to the final results, and since any other approach would have required much more time and labor, this distribution was the one selected for use with the computer program which computes emissions.

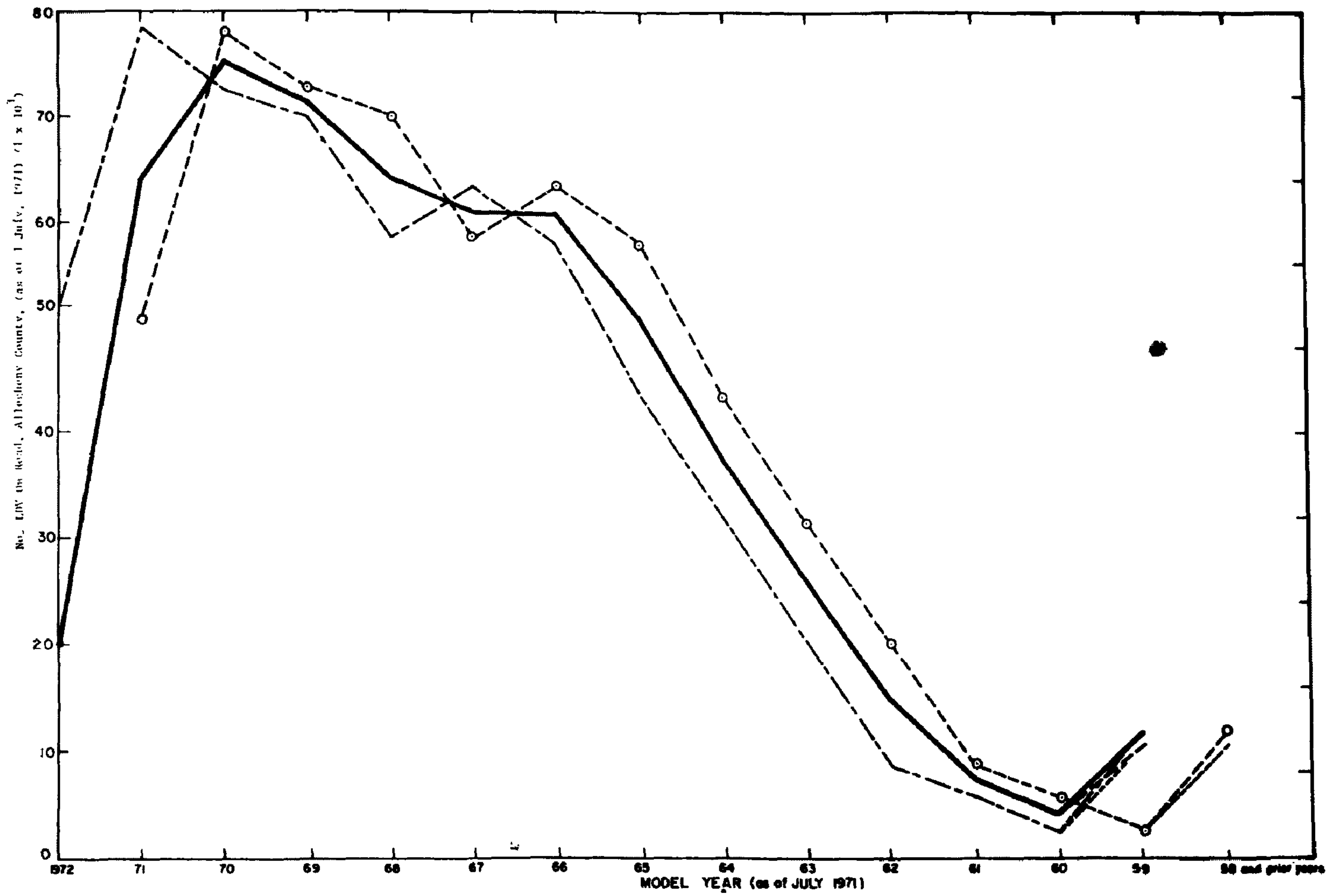



Figure II-10. Derivation of vehicle age distribution (for use with VMT data in VEHEMI2).

TABLE II-16

TOTAL VMT'S BY COUNTY FOR THE YEARS 1972 AND 1977 (mi/day)

| | 1972 | | | | | 1977 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DISTRICT # | LDV'S | HDV'S | OV'S | TOTALS | % OF TOTAL | LDV'S | HDV'S | OV'S | TOTALS | % OF TOTAL |
| 1 City of Pittsburgh | 3,458,169 | 177,722 | 66,646 | 3,702,537 | 13.4 | 3,713,750 | 190,857 | 71,571 | 3,976,178* | 12.5 |
| 2 Rest of County | 10,120,124 | 272,949 | 104,981 | 10,498,054 | 38.0 | 11,745,900 | 316,798 | 121,845 | 12,184,543 | 38.2 |
| Allegheny County | 13,578,293 | 450,671 | 171,627 | 14,200,591 | 51.4 | 15,459,650 | 507,655 | 193,416 | 16,160,721** | 50.7 |
| 3 Butler County | 2,086,405 | 34,133 | 12,800 | 2,133,338 | 7.7 | 2,398,682 | 39,242 | 14,716 | 2,452,640 | 7.7 |
| 4 Armstrong County | 1,029,916 | 44,779 | 17,475 | 1,092,170 | 3.9 | 1,220,602 | 53,070 | 20,710 | 1,294,382 | 4.0 |
| 5 Westmore-land County | 4,931,992 | 138,280 | 51,215 | 5,121,487 | 18.5 | 5,765,001 | 161,636 | 59,865 | 5,986,502 | 18.8 |
| 6 Washington City | 3,015,601 | 62,049 | 24,820 | 3,102,470 | 11.2 | 3,587,162 | 73,810 | 29,524 | 3,690,496 | 11.6 |
| 7 Beaver County | 1,905,955 | 80,675 | 30,253 | 2,016,883 | 7.3 | 2,185,843 | 92,522 | 34,696 | 2,313,061 | 7.2 |
| TOTALS-SPRPC | 26,548,162 | 810,587 | 308,190 | 27,666,939 | 100.0 | 30,616,940 | 927,935 | 352,927 | 31,897,802 | 100.0 |

* 7.4% growth = 1.48%/year
** 13.8% growth = 2.76%/year

A small redistribution of VMT's is noted between the City of Pittsburgh and the rest of Allegheny County. A slightly larger percentage of VMT's is present in the County in 1977 as compared to 1972. Similarly, there is a little more activity in the counties of Westmoreland and Washington, and a little less in Allegheny County as a whole, in 1977 as compared to 1972. Since the general idea is to get the vehicles out of the city, these small differences are in the right direction to spread the pollution around more evenly. There is ample leeway in the other zones and districts to allow for a small amount of dispersion of exhaust emissions to the outlying areas; this will not violate either the letter or the spirit of the EPA regulations directing the maintenance of existing air quality levels in those areas where the air quality is already better than the federal standards.

TABLE II-17

VMT'S USED IN SENSITIVITY TESTS

| | WITHOUT STRATEGIES | | WITH THE STRATEGY PACKAGES DEFINED BELOW | | |
|---|---|---|---|---|---|
| | 1972 | 1977 | 1977, Pkg 1 | 1977, Pkg 2 | 1977, Pkg 3 |
| LDV: | 414,336 | 450,749 | 419,196 | 377,276 | 439,883 |
| HDV: | 21,294 | 23,165 | 21,543 | 19,389 | 22,606 |
| OV : | 7,985 | 8,687 | 8,079 | 7,271 | 8,477 |
| TOTAL: | 443,615 | 482,601 | 448,818 | 403,936 | 470,966 |

The average "off-peak" speeds corresponding to the above VMT's, categorized by type of highway facility, are as follows (in mph):

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fwy: | 39. | 39. | 39. | 43. | 40.2 | 40.6 | 39.58 | 39.78 |
| Art: | 19. | 19. | 19. | 21. | 19.6 | 19.8 | 19.28 | 19.38 |
| Lcl: | 17. | 17. | 17. | 19. | 17.5 | 17.7 | 17.26 | 17.34 |

("Fwy" = Freeway, "Art" = Arterial, "Lcl" = Local Street)

The entries in Table II-11 are the computed emissions of CO and HC in Zone 1 and Allegheny County, respectively, which would result from the application of the several strategy packages as defined below.

Package 1 consists of a 7% reduction in VMT with no change in the average speeds.

Package 2 entails a further 10% reduction of VMT from that used in pkg 1, above, for a net reduction of 16.3% from the baseline ("no-strategy") value for 1977, coupled with a 10% increase in each of the three average speed categories.

Package 3 assumes a 2.4% decrease in VMT with four different sets of speeds: increases of 3.0%, 4.0%, 1.5% and 2.0% over the baseline values of 39, 19, and 17.

The first combination was to be achieved through a program of increasing parking costs, increasing transit service, and using existing park areas for fringe parking. The second package was used only for sensitivity analysis. The third program consisted of a 12.5% rollback from the 1977 "no-strategy" emission rate attributable to an inspection and maintenance program, plus an additional 3.4% reduction in emissions due to the reduction in VMT as shown above. The increases in average speeds on the various highway facilities were presumed to arise as a result of the reduced VMT's.

(2) CO Problem

With the caveats and assumptions outlined above, we can now proceed to a discussion of the specific findings and results of our study and analysis of the air pollution situation in Pittsburgh as regards CO and $O_x$ emissions and concentrations, both present and expected in future years.

With respect to the CO problem, the following tabulation presents the situation as of now (see Table II-18, below). The data are self-explanatory; however, a word on the assumptions and methodology employed to achieve them should be included. The vehicular emissions data come directly from the computer program VEHEMI2 (see Appendix C for a complete listing of these data). The assumptions and methodology inherent in this program have been discussed in the general introduction to this Report. The non-vehicular emissions were derived, as explained previously, by applying the 7.0% of total CO emissions due to non-vehicular sources in the Inventory to the computed value of vehicular emissions. The 35.5% reduction in non-vehicular emissions between 1972 and 1975 came from the point source data we collected during our visits to Pittsburgh. Since we had no definitive information on planned reductions beyond 1975, the same level was assumed for 1977. Beyond that year, the annual growth rate of 3.5% was assumed to take over, as far as non-vehicular emissions are concerned. The successive ambient levels of CO concentrations expected were computed using the e/c ratio (e.g., 21605/1396 = 15.5, etc.). The final result is that in order to achieve the federal standard of 9 ppm per maximum 8-hr. average by 1977, we

TABLE II-18

SUMMARY SHEET FOR PITTSBURGH
CARBON MONOXIDE

Emissions computed for Zone 1 (downtown Pittsburgh) only. Area = 1.26 sq. mi. All emission rates are in Kg/day, and all concentration levels are in ppm.

| | Present (1972) | 1975 (without strategies) | 1977 (without strategies) | 1977 (with $O_x$ strategy only)* | 1977 (with CO strategy only) |
|---|---|---|---|---|---|
| Vehicular Emissions | 27,543 | 20,186 | 13,829 | 13,829 | 11,145 |
| Non-Vehicular Emissions | 2,200 | 1,419 | 1,419 | 1,419 | 1,419 |
| Total Emissions | 29,743 | 21,605 | 15,248 | 15,248 | 12,564** |

e/c Ratio: 29743/21.3 = 1396.4

* No separate $O_x$ strategy is planned - see Summary Sheet for Oxidants)

** 57.8% rollback in total emissions = 59.5% rollback in vehicular emissions required to meet federal standards.

| | Present (1972) | 1975 | 1977 | 1977 ($O_x$) | 1977 (CO) |
|---|---|---|---|---|---|
| CO Ambient Level (maximum 8-hour average concentration) | 21.3 | 15.5 | 10.9 | 10.9 | 9.0 (fed. std.) |

Background CO Level — 2-4 ppm, based on emissions of known point sources in the Zone and an allowance for advection of CO from adjacent zones.

Estimates for future years (without strategies):

| | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| Vehicular Emissions | 11,340 | 9,474 | 7,656 | 6,326 | 5,551 |
| Non-Vehicular Emissions* | 1,469 | 1,520 | 1,573 | 1,628 | 1,685 |
| Total Emissions | 12,809 | 10,994 | 9,229 | 7,954 | 7,236 |

* Assumed overall annual growth rate for industry in the Pittsburgh area = 3.5%.

| | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| CO Ambient Level (maximum 8-hour average) | 9.2 | 7.9 | 6.6 | 5.7 | 5.2 |

Background CO Level — 2 ppm, (allowance made for some improvement in control of emissions from non-vehicular sources outside the Zone).

need to reduce the vehicular CO emissions from the present 27,543 kg/day to 11,145 kg/day; this represents a reduction ("rollback") of 59.5%. Since the federal program (the FMVECP) will achieve a reduction of 49.8% all by itself (under the assumptions outlined above), this leaves another 9.7% of the 1972 emission rate to be achieved. Another way of stating the requirement is that we need to reduce CO emissions from motor vehicles an additional 19.4% of the 1977 rate which will be achieved without any transportation strategies. Obviously, it makes a lot of difference what base year one uses in stating the percent reduction required to achieve a standard. As it turns out, it also makes a difference whether one includes emissions from other sources in his calculations of reduction required. Even though such sources contribute only 7.0% of the total CO emissions (according to our assumptions), they are not being reduced at as fast a rate as are the emissions from motor vehicles; this disparity must be compensated for by "over-correcting" the vehicular emissions, so that the actual ambient concentrations, which come from all sources, will reach the desired level.

(3) $O_x$ Problem

The Summary Sheet for oxidants (Table II-19) is also self-explanatory. As before, the top line, vehicular emissions, comes directly from the zone-by-zone computations of the computer program VEHEMI2 which, in turn, is based on and follows exactly the procedure set forth in the paper by Kircher and Armstrong. The non-vehicular emissions are based on the ratio between vehicular and non-vehicular emissions in the 1972

TABLE II-19

SUMMARY SHEET FOR PITTSBURGH
OXIDANTS

Emissions computed for all of Allegheny County. Area = 745.4 sq. mi.

All emission rates are in kg/day, and all concentration levels are in ppm.

| | Present (1972) | 1975 (without | 1977 strategies) | 1977 (with $O_x$ Strategy only) | 1977 (with CO Strategy only) |
|---|---|---|---|---|---|
| Vehicular Emissions | 102,179 | 69,374 | 46,935 | (44,014) | 43,034* |
| Non-Vehicular Emissions | 28,820 | 19,915 | 14,936 | (14,936) | 14,936 |
| Total Emissions | 131,000 | 89,289 | 61,871 | (58,950) | 57,970 |
| Percent Reduction from 1972 emission rate (tot. emissions) | 0.0 | 31.8 | 52.8 | (55.0) (no $O_x$ strategy planned) | 55.7 |
| Oxidant level (max. 1-hr. average) | 0.165 | 0.124 | 0.087 | 0.080** | < 0.080 |

*57.9% reduction in vehicular emissions only

**Federal standard

(amounts in parentheses are those required to just meet the federal standard)

---

Estimates for future years (without strategies):

| | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| ▽Vehicular Emissions | 39,879 | 33,766 | 28,430 | 25,500 | 23,391 |
| ▽▽Non-Vehicular Emissions | 15,459 | 16,000 | 16,560 | 17,140 | 17,740 |
| Total Emissions | 55,338 | 49,766 | 44,990 | 42,640 | 41,131 |
| Oxidant level (max. 1-hr. average) | (all levels are below the federal standard of 0.08 ppm) | | | | |

▽Assumed ratio of Zone 1 emissions to total County emissions = 3.8% (see Table II-10).

▽▽Assumed same growth factor as for CO calculations; i.e., 3.5% per year.

Emissions Inventory: according to that document, 77.9% of the total HC emissions in Allegheny County in 1972 came from sources we define in this Report as "vehicular"; thus, we have applied the same proportion to the computed HC emissions from the three categories of motor vehicles (LDV, HDV, and OV); 22.1% of the total gives the value 28,820 kg/day. Now, following the same procedure as for the CO emissions, we noted that according to the point source information given to us in Pittsburgh, a 30.9% reduction in HC emissions from these stationary sources is planned between now and 1975 (Table II-6). In the case of hydrocarbons, however, there was additional information given to us verbally to the effect that an additional 25% reduction was planned between 1975 and 1977. This gives a total reduction of 48.2% based on the 1972 emissions of 28,820 kg/day. The accuracy of the forecast figure for non-vehicular emissions is of some importance, since it turns out that, with the amount of reduction assumed, the federal program and the amount of rollback required to meet the CO standard will just meet the standard for oxidants with no special strategy required for oxidants by themselves. Based on that assumption, the numbers in parentheses show the nominal values for vehicular and total emissions which will just attain the 55% reduction in HC emissions required to meet the standard for oxidants. As can be seen, the next column of figures doesn't beat these values by very much. The oxidant problem is somewhat peculiar in that oxidants, unlike CO and hydrocarbons, are secondary pollutants, i.e., they are formed in the atmosphere as the result of an extremely complicated series of photochemical reactions which require some period of time (on the order of a few hours, ordinarily) to generate the irritating and harmful products - ozone and the other oxidizing agents - lumped together as "total oxidants". Because of the time delay implicit in the generation of oxidants resulting from photochemical reactions in the atmosphere, it is necessary to consider larger areas than are of interest in studying the CO problem. Moreover, it is not possible to measure the oxidizing agents directly under test conditions as is commonly done with CO and the other "primary" pollutants which are generated directly as a result of the combustion of gasoline in an internal combustion engine. This difficulty has been handled up to now by recognizing the close relationship between the amounts and types of hydrocarbons coming out the tail pipe and the amount of photochemical oxidants appearing somewhere downstream later on. This admittedly imperfect procedure has the advantage of being fairly straightforward computationally (the basis for the HC-$O_x$ relationship being the curve in Appendix J of 40 CFR 51). To facilitate computation and help to insure uniformity of results, I made a tabulation of this relationship by exercising the closest possible care in reading off the values of required hydrocarbon emission control as functions of the observed photochemical oxidant concentration (maximum 1-hour average). A copy of this is attached as Table II-20. As stated in an earlier section, it was necessary to make some sort of assumption as the basis for deriving the HC emission rates for the whole of Allegheny County for the "off-years" (years other than 1972 and 1977); the one selected was that the relationship between the Zone 1 emissions and those for all of Allegheny County for the two years for which computed values were available would also hold for all the other years falling within the purview of this study. Table II-10 shows the details of this derivation.

TABLE II-20

TABLE OF VALUES OF REQUIRED HYDROCARBON EMISSION CONTROL AS A FUNCTION OF PHOTOCHEMICAL OXIDANT CONCENTRATION

(From Appendix J, 42 CFR 51, Federal Register, vol. 36, no. 228 25 November 1971, p. 22413)

| Maximum Measured 1-hour Photochemical Oxidant Concentration (ppm) | Reduction in Hydrocarbon Emissions Required to Achieve National Standard for Photochemical Oxidant (%) |
|---|---|
| 0.080 | 0 |
| .085 | 4 |
| .090 | 8 |
| .095 | 13 |
| .100 | 18 |
| .105 | 22 |
| .110 | 26 |
| .115 | 29 |
| .120 | 32 |
| .125 | 35 |
| .130 | 38 |
| .135 | 41 |
| .140 | 43 |
| .145 | 46 |
| .150 | 48 |
| .155 | 51 |
| .160 | 53 |
| .165 | 55 |
| .170 | 57 |
| .175 | 59 |
| .180 | 60 |
| .185 | 62 |
| .190 | 63 |
| .195 | 65 |
| .200 | 67 |
| .210 | 69 |
| .220 | 73 |
| .230 | 76 |
| .240 | 79 |
| .250 | 82 |
| .260 | 85 |
| .270 | 88 |
| .280 | 91 |
| .290 | 95 |
| .300 | 98 |

It should be emphasized that a constant ratio was not assumed; rather, it was assumed that the rate of change in the ratio as measured over the five year period 1972 - 1977 (i.e., 0.0035% per year, decreasing with time) was applicable to all the years 1970 - 1986. Since this assumption resulted in a function which follows closely the curve shown in Figure II-12 for the computed Zone 1 values, it was felt that this was probably the most logical course to take, given the lack of time or manpower to compute the large number of VMT's, SPD's, and FSPD's needed to compute the county-wide values more accurately (that is, directly from the computer program).

## E. SUMMARY AND RATIONALE FOR SELECTION OF MODELING TECHNIQUES AND AREAS FOR AVERAGING

### 1. Determination of Measurements of CO and $O_x$

It has been determined from the measurements of CO and $O_x$ that:

(a) The present ambient concentrations of CO and HC in Pittsburgh and Allegheny County, respectively, do exceed the federal standards to be attained by the year 1977.

(b) The amount of rollback required in each case has been determined.

(c) The federal program (FMVECP) will not, of and by itself, or in combination with the stationary source controls planned in the Pittsburgh area, achieve that amount of reduction in expected emissions.

It therefore becomes necessary to consider other measures for the reduction of emissions from vehicular sources in the Region. Following the dichotomy presented in the pertinent federal regulations with respect to sources (40 CFR 51, as amended), two types of reduction measures or strategies may be considered:

(a) Those which have their effect more or less uniformly over an entire Air Quality Control Region or a major subregion such as a county, and

(b) Those which affect directly only small, localized zones or districts.

As shown in Appendix C, we have determined, at least for the "no strategy" case, precisely which zones within the SPRPC Region make the largest contributions to the maximum concentration levels which exceed the standards. We have seen that, for reasons of economy of effort, a simple proportional or "rollback" model was used to derive the relationships between future emission rates and ambient concentrations (air quality levels). As we have also seen, the meteorological and emissions data were not of sufficient fineness of mesh to permit the use of diffusion techniques for each of the 72 zones chosen by the subcontractor to represent the Region. The subcontractor selected these zones on the bases of similarity of terrain and exposure to the prevailing meteorological elements, population and traffic density, and type of highway facilities present within each zone. Our review disclosed no reason to change any of the zone selections made by the subcontractor (see maps, Figures II-2 and II-3).

Since the downtown Pittsburgh district (Zone 1) was the only area where CO emissions constituted a serious problem, the method chosen was to establish the present ratio of emissions to concentration (e/c ratio), then, using that as the relationship between emissions and expected ambient concentrations in future years, to calculate the amount of rollback required to meet the federal standard by 1977. This, in turn, led to the determination of the "safe" emission rate from <u>all</u> sources of CO which would, assuming the 1972 e/c ratio was valid for 1977, result in the desired level of concentration of CO in Zone 1.

In the case of the oxidants problem, the area chosen was all of Allegheny County. The basic reason for this selection has already been given: the physical and chemical nature of generation of photochemical oxidants is such that the immediate, direct, localized emanations from the tailpipe are not of paramount concern; rather, it is the secondary contaminants arising from the complex photochemical reactions occurring in the atmosphere over an appreciable period of time (several hours) that is the problem in this case. Since the ambient air in which these pollutants are being generated is moving itself under the influence of meteorological elements as discussed above, a much larger region is required for study and evaluation. As stated above, the ideal positioning for an oxidant-measuring site is some three to five hours (5 to 15 miles) downwind of the principal source of HC emanations (usually the downtown area, as in this case). We have seen that, partly due to fortuitous circumstances, the site from which the measurements of ozone were made during the summer of 1971 in Pittsburgh was very well suited to its purpose. As with CO, albeit on a much larger geographical scale, the single sampling site was deemed adequate for the present purpose since it represents the greatest ambient concentration to be expected within the entire SPRPC Region. The three additional counties which, with the six counties making up the SPRPC Region, compose the SPAQCR, were surveyed briefly in the early stages of the present study. The conclusion reached was that, while there are a few point sources, some of considerable magnitude, located within these counties (e.g., the large power plant near Indiana, Pennsylvania), the ambient concentrations of CO and HC at no point approach critical levels affecting any appreciable population groups. The terrain, meteorology, and population and vehicle densities are similar to those in the adjacent counties included within the SPRPC Region (Washington, Westmoreland, and Armstrong, respectively) and further study of these three counties was deemed both unnecessary and inappropriate in view of the terms of the present contract which is couched in terms of cities rather than AQCR's.

It was apparent that the observed concentrations of CO do not follow the distributions in space and time commonly observed elsewhere; i.e., for CO, the greatest 8-hour concentrations elsewhere usually tend to be grouped in the evening or nighttime hours during periods of limited atmospheric dispersion (low mixing, or high stability conditions), typically during the fall and winter months, while, as we have seen, the situation in Pittsburgh seems to be quite different. The highest $O_x$ concentrations tend to occur in the late morning or early afternoon during the season of greatest insolation (June, July and August, usually), following high emanations of HC during the early morning hours. The fact that this disparity between the time of maximum expected concentrations of CO and $O_x$ exists dictates that certain strategies will be more effective in reducing one of the two pollutants than they will be on the other; indeed, it is possible that some measures taken to alleviate, say, the CO problem could actually exacerbate the $O_x$ situation, or vice versa. This constitutes an additional constraint on the choice of strategies, whether applied to a small neighborhood, an area as large as a traffic analysis zone or one of our larger air pollution analysis zones, a whole county, or the entire SPRPC Region. Given the amount and kinds of meteorological and air quality data available to us at this time, the terrain and vehicle density in the various portions of the Region, and the physical nature of the two pollutants studied in this Report, it is felt that the methodology and area sizes selected are optimum for the present purposes.

Two important things to keep in mind are: (1) it is the VMT's (vehicle miles traveled), not the number of cars, that are of importance in the above discussion; (2) it is <u>not</u> the absolute tonnage of CO or HC emissions that is important in making comparisons between, say, the Allegheny County BAPC's emission figures and those generated from the SPRPC's VMT figures, but rather the <u>ratios</u> between vehicular and non-vehicular emissions, between successive yearly emission data, between CO and HC emission rates, and so on. As long as we are consistent in our choice of baseline figures, we are interested at this stage primarily in determining the percentage reduction required (the "rollback") rather than the absolute values of the tons per year or kilograms per day of CO, HC, or any other pollutant. As has been repeatedly pointed out, we do need much better information on the actual amounts of the various pollutants being introduced into Pittsburgh's air. To meet the 15 February 1973 deadline imposed by Federal law, however, the ratios, not the absolute values, are what is needed, and these have been pretty well determined.

2. Conclusions

As far as the extent and severity of the CO and $O_x$ problem is concerned, it may be stated in summing up this part of the Report that there is a definite CO problem, that some sort of transportation strategy will be required to meet the Federal standards by the target date, and that if this is done, no separate oxidant problem will exist in Allegheny County by the year 1977; i.e., the Federal standards for photochemical oxidants should be met.

## III. IDENTIFICATION AND EVALUATION OF TRANSPORTATION CONTROL STRATEGIES

### A. STRATEGY EVALUATION METHODOLOGY

This process describes the process used to evaluate the various alternative strategies for the reduction of emissions.

The general methodology used in the evaluation of the alternative strategies is illustrated in Figure III-1. As indicated on this figure, the major steps in the process are:

- Generate Alternatives – A listing of all alternative strategies to be considered, regardless of any constraints.

- Preliminary Screening – Certain alternatives appearing to be immediately infeasible are eliminated from further consideration.

- Impact Evaluation – This set of rankings is the basis for the selection of a recommended control strategy. Major elements of the evaluation process are:

  (1) Technical Effectiveness: Each alternative measure is examined to determine the extent to which it is effective in eliminating emissions.

  (2) Economic Cost: This state of the analysis assesses the cost of the various emission reduction measures in "traditional" economic terms.

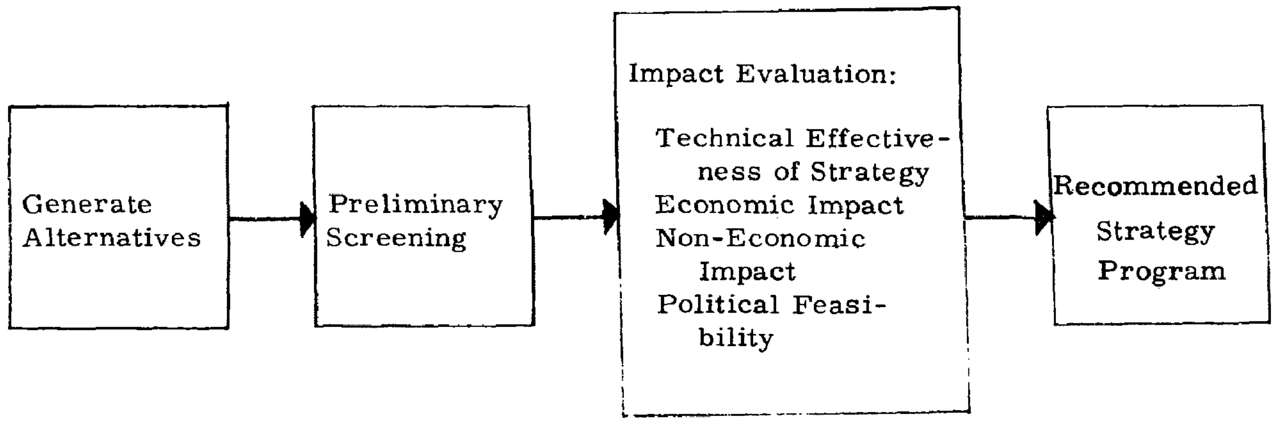



Figure III-1. Development of Recommended Control Strategy Program.

(3) Non-Economic Cost: In addition to economic costs, various other impacts of the alternative emission control strategies are considered. These impacts include social, administrative, legal and technical impact.

(4) Political Feasibility: The political feasibility of the various strategies is also examined as a separate impact.

- Recommended Program — based on the results of evaluation matrix, a recommended program of control strategies was developed.

## B. GENERATE ALTERNATIVES

A basic list of all candidate strategies was compiled and classified according to the manner in which the strategies contributed to the objective of reducing emissions. This list is presented below:

<u>Reduce Emission Rate</u>

Traffic Flow Improvements
- Upgrade Existing Streets
- Loading Zone
- Metering
- Information Systems

Source Control
- Retrofit
- Inspection
- Fuel Conversions
- Idling Controls

Reduce Vehicle Miles of Travel

- Reduce Travel Demand
  - Four-Day Week
  - Communications Substitute for Travel
  - Episode Specific Controls
  - Traffic Flow Restrictions
  - Motor Vehicle Use Restraint
- Increase Transit Use
  - Short-term Transit Improvements
  - Long-term Transit Improvements
  - Transit Fares
  - Tolls
  - Parking Taxes and Charges
  - Parking Restrictions, Modification of Supply
  - Vehicle-free Zones
  - Reserved Bus Lanes
  - Increase Fuel Tax
  - Episode Specific Controls
- Increase Occupancy
  - Car Pools
  - Tolls
  - Metering
  - Episode Specific Controls
  - Vehicle-free Zones
  - Parking Taxes and Charges
- Shift Travel Patterns
  - Staggered Hours
  - Fringe Parking
  - Night Goods Delivery
  - Location of Government Offices
  - Zoning and Parking
  - Through-traffic Bypass

## C. PRELIMINARY SCREENING

A preliminary screening of the preceding list indicated several alternatives that appear to be immediately infeasible. The following alternatives fell into this category, and were eliminated from further considerations.

1. Idling Controls

On the basis of current information, it has not been established that this strategy yields sufficient emission reductions to justify the serious enforcement problems its use would necessitate.

2. Communications Substitutes for Travel

The long range outlook for such technology indicates that considerable amounts of personal travel will be replaced by communications (without travel). However, the point where this will result in measurable decreases in VMT is beyond the time frame of this analysis.

3. Episode Specific Controls

Despite considerable local interest in this measure, it was held to be inappropriate at this time for the attainment of the desired 1977 emissions rollback objectives. As more precise information is developed concerning the frequency with which air quality standards are exceeded, the effectiveness of episode specific controls should be re-evaluated.

4. Motor Vehicle Use Restraint and Traffic Flow Restrictions

The experience in various cities where motor vehicle use restraints have been employed indicated that such restraints are feasible only if a number of conditions are met. A major prerequisite for a successful vehicle-free zone is the provision of transit service at a level which furnishes an attractive alternative to the use of the private automobile. Another important precondition for the success of vehicle-free zones appears to be enthusiasm on the part of employers, employees, institutions and commercial establishments in the affected areas. An additional apparent prerequisite of success for vehicle-free zones is the undertaking of comprehensive planning by the responsible jurisdiction, and the support of downtown merchants.

None of these conditions appears to be met at present in the Pittsburgh area, and it is highly unlikely that this climate will alter significantly before 1977. It is not likely that transit service will be improved to a level such that it could be considered an attractive alternative to automobile use by 1977. It should be noted that this does not imply that no transit improvements and related increases in ridership will be obtained; it is implied, however, that improvements sufficient to permit the implementation of vehicle-free zones will not be forthcoming. Furthermore, there is no reason to believe that employers, employees, institutions and the business community will accept major vehicle restraints. Within the last decade, the CBD area has enjoyed a very substantial increase in office floor area and employment. CBD retail activity has not only held its own, but has actually expanded in the past few years. Both the gains in employment and retail activity have taken place simultaneously with increases in the percentage of trips to the CBD by automobile. Given the lack of attractive transit alternatives, it does not appear reasonable that CBD employers, employees and retail interests would accept the major de-emphasis of automobile trips that is implied by the institution of vehicle-free zones. Incidents such as the recent parking strike, which involuntarily created a vehicle-free zone in the entire Triangle, reinforced much of the downtown community's wariness of this approach.

5. Long-term Transit Improvements

It does not now appear that any rapid transit system or segment thereof will be operational by 1977. Even if the legal status of the now-stalled Early Action transit program was clarified, and implementation of this plan started immediately, it is not expected that the rapid transit mileage stipulated in this plan would be operational by 1977. It is furthermore likely that the legal resolution of the Early Action plan will require considerable more time, thus delaying even further the implementation of any major transit improvements therein. It seems safe, therefore, to assume that implementation, if any, of these plans will be delayed to well beyond 1977.

6. Bypass for Through-traffic

Litigation involving many aspects of the freeway and expressway system in the near vicinity of the Triangle is increasing the likelihood that these improvements will not be operational by 1977. Furthermore, it is almost certain that no facility, as yet unplanned, will contribute substantially to the reduction of through-traffic in the Triangle by 1977. It furthermore does not appear to be reasonable to expect that substantial alleviation of through-traffic in the Triangle can be accomplished by further utilization of existing surface streets, since this alternative has undoubtedly been exhausted over the years of traffic increase in the Triangle.

D. IMPACT EVALUATION

This stage of the analysis is the heart of the evaluation process. In this evaluation, the total impact of the various control alternatives is broken up into a spectrum of sub-impacts. Criteria relevant to each of these sub-impacts are derived and applied. Based on the application of such criteria, an overall ranking of the alternatives is developed.

The following sections describe the major elements in the evaluation procedure.

1. Technical Effectiveness

Table III-1 ranks each control strategy from one through five in each of three categories. The three categories are: 1) effective reduction of the rate of emissions in grams per vehicle mile; 2) effective reduction of vehicle miles of travel (VMT) in the analysis area; and 3) effective geographical or temporal shift of vehicle miles of travel for the area analyzed.

The rankings for each criteria are relative, and the degree of effectiveness increases to a maximum value of 5. Least effective strategies would have a ranking of 1. The final ranking of each control strategy represents effectiveness in reducing emissions. A final ranking of 1 represents an expected reduction of VMT or emissions between 0 and 1 percent. Final rankings 2 through 5 represent 1-4 percent, 5-8 percent, 9-19 percent, and 20-100 percent expected VMT or emission reductions, respectively.

## TABLE III-1. RATING OF ALTERNATIVE STRATEGIES TECHNICAL EFFECTIVENESS

| Strategy | Rating* | | | |
|---|---|---|---|---|
| | Emission Red'n | VMT Red'n | Travel Shift | Total |
| **Reduce Emission Rate** | | | | |
| Traffic Flow Improvements | | | | |
| Upgrade Existing Streets | 2 | 1 | 1 | 2 |
| Loading Zone | 1 | 1 | 1 | 1 |
| Metering | 2 | 2 | 2 | 3 |
| Information Systems | 1 | 1 | 1 | 1 |
| Source Control | | | | |
| Retrofit | 4 | 1 | 1 | 3 |
| Inspection | 4 | 1 | 1 | 4 |
| Fuel Conversion | 2 | 1 | 1 | 2 |
| **Reduce Vehicle Miles of Travel** | | | | |
| Reduce Travel Demand | | | | |
| Four Day Week | 2 | 2 | 2 | 2 |
| Increase Transit Use | | | | |
| Short Term Transit Impv. | 2 | 2 | 1 | 2 |
| Transit Fares | 2 | 3 | 2 | 3 |
| Tolls | 2 | 3 | 2 | 4 |
| Parking Taxes and Charges | 2 | 3 | 1 | 3 |
| Parking Restrictions | 2 | 1 | 1 | 2 |
| Vehicle-Free Zone | 5 | 5 | 5 | 5 |
| Reserved Bus Lanes | 2 | 2 | 1 | 2 |
| Increase Fuel Tax | 1 | 2 | 1 | 2 |
| Increase Occupancy | | | | |
| Car Pools | 1 | 1 | 1 | 1 |
| Tolls | ** | ** | ** | ** |
| Metering | ** | ** | ** | ** |
| Vehicle-Free Zones | ** | ** | ** | ** |
| Parking Taxes and Charges | ** | ** | ** | ** |
| **Shift Travel Patterns** | | | | |
| Staggered Hours | 2 | 1 | 1 | 2 |
| Fringe Parking | 2 | 2 | 2 | 2 |
| Night Goods Deliveries | 2 | 2 | 2 | 2 |
| Government Offices | 1 | 2 | 2 | 2 |
| Zoning | 2 | 2 | 2 | 2 |

* Ratings based on findings in this section.
** Strategy rated previously in this table.

The evaluation of each strategy was based upon the probable and reasonable degree of implementation that could be accomplished by 1977 without major expenditures of capital. For particular control strategies, the effectiveness of reducing emissions is very sensitive to the degree to which the strategy is implemented. Therefore, the rankings for those control strategies are not rigid, e.g., increasing parking costs in the CBD by 50 cents per day would be less effective in reducing emissions than a $1.50 increase.

It should be noted that the estimated VMT and emission reductions are applicable on a zonal basis. Retrofit, increased fuel tax, and inspection and maintenance estimated reductions are the only figures that are applicable on a regional basis. All other control strategy reductions are geographically and temporally specific. In particular, the control strategies were predominantly analyzed with respect to the CBD. In order to reduce emissions on a regional basis by more than 5 percent by 1977, retrofit and inspection and maintenance programs should be pursued.

Presently, it is known that approximately 50 percent of the vehicle trips in Zone 1 are local trips.[51] Local trips are defined as trips which begin or end or begin and end in the zone being analyzed. The remaining trips which travel in Zone 1 are defined as through trips. It is estimated that in 1972, 50 percent of the vehicle miles travelled in Zone 1 are generated by local trips. In 1977, there are 241,600 projected auto person trip ends in Zone 1. Since this is approximately the same number of trip ends as exists in 1972, the VMT growth from 1972 to

1977 is expected to be caused by through trips. Under this assumption, 45 percent of total travel in Zone 1 in 1977 will be generated by local trips.[52] In 1977, it is projected that there will be a total of 193,000 transit attractions with 30 percent of this total being choice transit users and the remaining 70 percent being captive users. These projections are used in the following analyses when local and overall reductions are estimated. The following sections describe each strategy.

a. Retrofit

Assuming the same age mix of operating cars that existed in 1971 for the Southwestern Pennsylvania region would exist in 1977 gives:

5.4 percent of all operating cars would be pre-1968 models

39.9 percent of all operating cars would be 1968-1972 models

22.0 percent of all operating cars would be 1973-1974 models

61.9 percent of all operating cars would be 1968-1974 models

32.7 percent of all operating cars would be 1975-1977 models

Appendix F shows the contribution of total vehicle miles of travel by each model year.*

The following references to emission rate reductions apply to gas powered light duty motor vehicles except motorcycles. In estimating emission reductions for the region for 1977, the preceding age mix was assumed and gas powered light duty vehicles were estimated to generate 96 percent of the vehicle travel in the region.

*See Appendix F for the source of the age mix and vehicle miles of travel by model year.

It is estimated that retrofit of pre-1968 vehicles (pre-controlled vehicles) could reduce their emission rate by 12-68 percent for hydrocarbons, 9-63 percent for carbon monoxide, and 0-48 percent for nitrogen oxides, depending on the the retrofit device used. This rate reduction would reduce emissions for the region in 1977 by approximately 0.28-1.56 percent for hydrocarbons, 0.2-1.45 percent for carbon monoxide, and 0-1.10 percent for nitrogen oxides.* For controlled vehicles with model years between 1968 and 1972, exhaust gas recirculation could reduce the nitrogen oxide emission rate by 40 percent, which would reduce the amount of nitrogen oxide emissions for the region by 14.7 percent. For controlled vehicles with model years between 1968 and 1974, an oxidizing catalytic converter could reduce the emission rate of carbon monoxide and hydrocarbons by 50 percent, which would result in a 31.5 percent reduct on of carbon monoxide and hydrocarbon emissions for the region.[53] If the most effective retrofit devices were implemented, the 1977 regional emission reductions would be 33.1 percent for hydrocarbons, 33.0 percent for carbon monoxide, and 15.8 percent for nitrogen oxides. If one-fourth of the maximum reductions were achieved due to cost, deterioration, or quality control, then the estimated reductions would be 8.3 percent for carbon monoxide and hydrocarbons and 4.0 percent for nitrogen oxides.

b. Inspection and Maintenance

The implementation of an inspection and maintenance program using a loaded emissions test has been estimated to reduce initial emissions 25 percent for hydrocarbons, 19 percent for carbon monoxide and

*See Appendix F.

0 percent for nitrogen oxide. Assuming twelve month periods between checks and a linear deterioration rate will result in an average of 12 percent reduction in the rate of emission for hydrocarbon and 10 percent and 0 percent reductions for carbon monoxide and nitrogen oxides, respectively.[54] These average reductions in the rate of emission for each pollutant are applicable to gas powered light duty motor vehicles, and since these vehicles generate approximately 96 percent of all vehicle travel in the region, emission reductions would be slightly less than the rate reductions.

c. Fuel Conversion

Gaseous fuel conversion from gasoline to liquified petroleum gas, compressed natural gas, or liquified natural gas could reduce the emission rate of carbon monoxide significantly for light duty vehicles which do not meet the stringent Federal standards in 1975. Although the magnitude of reduction is significant, three constraints reduce the effectiveness of this control strategy. The first constraint is the limited supply of natural gas or petroleum gas. As long as new deposits of these fuels are not discovered, the conversion to these fuels will be limited. The second constraint is the possible prohibition of vehicles using or transporting these gaseous fuels through tunnels and on bridges. The last constraint is the problem of distributing the fuel to consumers. For these reasons, the probable use of this control strategy would be confined to fleets of vehicles. The reduction in regional emissions by 1977 would not be substantial; however, the reduction of emissions in small areas such as a CBD, could be significant.

It has been estimated that in Manhattan, the conversion of fleet taxis could reduce the emission rate of carbon monoxide by 85.3 percent initially.[55] In Pittsburgh's CBD, approximately 5 percent of the vehicle trip ends are generated by taxis. Since local travel is approximately half of the total travel in the CBD, the travel generated by taxis is approximately 2.5 percent of the total travel. Based on the assumptions above, the conversion of taxis in the CBD of Pittsburgh could reduce carbon monoxide emissions by 2.1 percent daily. In order for this plan to work properly, it is assumed that these converted taxis would be able to use the tunnel that must be traveled when going to the Greater Pittsburgh Airport from the CBD.

d. Upgrading the Existing Streets

The upgrading of the existing street system by decreasing delay time and increasing agerage vehicle speed by improving the signal system and the physical characteristics of roadways and intersections would decrease emissions per vehicle mile for carbon monoxide and hydrocarbons. These improvements generally come under TOPICS programs. Figure III-2 depicts the expected percent decrease in carbon monoxide and hydrocarbons emission rates expected for average speed increases between 15 and 30 miles per hour.

In the core area of Pittsburgh, average speed increases of 10 percent on the street system affected by TOPICS could be realized during the peak 12 hour period. The TOPICS program could have an effect

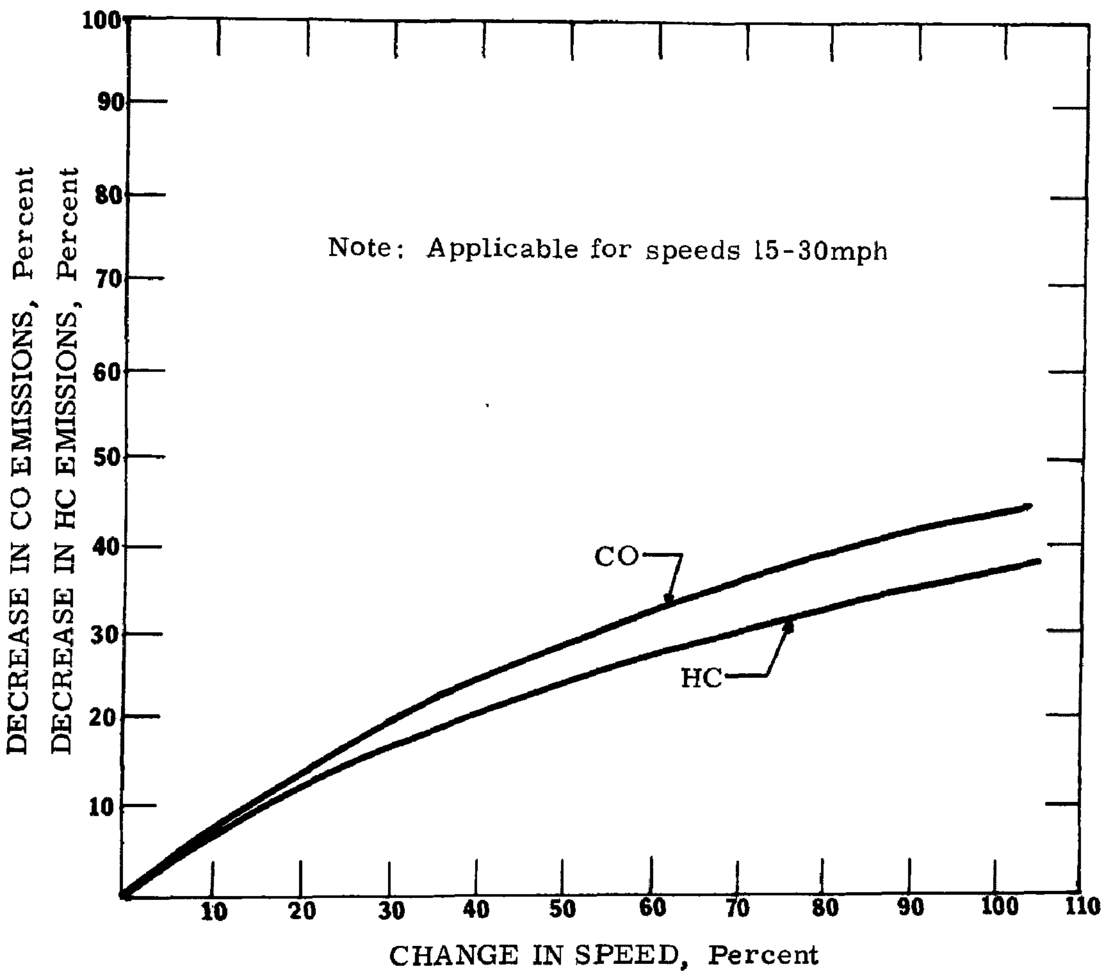



Figure III-2. Emissions Reduction Vs. Speed Increase on approximately 20 percent of vehicle travel during the peak 12 hour period, and thus would have an overall effect of increasing speed by 2.0 percent.

Based on these assumptions and Figure III-2, the rate of carbon monoxide emissions and hydrocarbon emissions during the 12 hour period would decrease by approximately 1.5 percent. For a daily period, carbon monoxide and hydrocarbon emissions would decrease approximately 1.0 percent. During a short time period, the increase in speed on facilities is not liable to attract more users. If this did occur, then the decrease in emissions due to speed increases may be offset.

e. Loading Zones

The major advantages of controlling commercial use of on-street loading zones are to increase capacity of the street and to increase speed. Emission rate reductions can be estimated using Figure III-2 after an estimated speed increase is determined. Capacity increases can be estimated through standard highway capacity analysis. Although increasing capacity is usually desirable in traffic engineering, it would be undesirable in reducing total emissions for a particular area. The impact of this control strategy would also be limited in that the controls would be applied to particular facilities and in most conditions would affect a small percentage of the total problem. The expected reduction in emissions for Pittsburgh s CBD would be less than 1 percent due to improved controlling of loading zones.

### f. Metering

The reduction in emission rates due to freeway metering is treated in a manner similar to the previous control strategy. A major improvement would be the increase in average speed by controlling the density of traffic on the facility. This strategy, if instituted, could be used to strictly control the volume of traffic on the facility and consequently stabilize or reduce vehicle miles of travel. If it is used for this purpose, alternative transportation facilities such as a viable transit alternative must be available. Closing an exit ramp to a CBD to private automobiles while allowing buses to freely use it is a strong example of metering traffic. The effect in the reduction rate of emissions can be measured by using Figure III-2, and by estimating an average speed increase. The reduction due to effective metering could range from 5 to 8 percent.

### g. Information Systems

This strategy is similar to all traffic flow improvement strategies in that one goal of the strategy is to increase average speed for a portion of the auto users. By doing so, Figure III-2 could be used. In order to reduce the rate of emissions by 5 percent or more, the average speed for the entire day for all vehicles in the area must be increased by 5 percent or more. It is estimated that a 1 percent decrease in emissions using this control strategy is maximum for most systems.

h. Four Day Week

The maximum reduction in work trips per day that could be expected due to the institution of the four day week is 43 percent. This assumes the reduction of present work trips from ten trips per week to eight trips per week spread equally over seven days a week. A more reasonable maximum reduction in daily work trips is 20 percent, based on spreading the eight trips equally over five days.[56] An additional benefit realized by reducing work trips is increased average speeds. It is estimated that decreasing work trips by 20 percent during the peak period (assuming auto occupancy and modal split remain constant), would increase average speed by approximately 20 percent on facilities which were carrying volumes near capacity during the peak period. This would reduce carbon monoxide and hydrocarbon rates of emissions by approximately 12 to 15 percent. Since work trips comprise approximately one-third of all trips for the region, they contribute at least 33 percent of the vehicle miles of travel. Therefore, a 20 percent reduction of work trips per day would reduce vehicle miles of travel by approximately 6.6 percent. The emission reduction due to increased speeds would contribute another 0.12 x 0.20 = 2.4 percent (the 0.20 represents the percent of trips occurring during the peak periods). Thus, a 20 percent reduction in work trips per day would cause an approximate 9 percent decrease in emissions

Since Pittsburgh's CBD experiences a greater percentage of work trips than the regional average, emissions produced by local vehicle trips would be reduced by approximately 12 percent. It should be noted here that overall auto occupancy and modal split may decrease but losses should be relatively small, especially for modal split where a majority of transit useres are captives. Even if all workers went to a four day week by 1977, the resulting reduction in emissions anticipated on particular days could be insignificant if the scheduled days off were not spread equally. For example, if all employees were on a four day week, and half were off on Mondays and half on Fridays, the implication would be that work trips would be halved on Mondays and Fridays, and no reduction in emissions would result on Tuesdays, Wednesdays and Thursdays. If the meteorological conditions were unfavorable on a Tuesday, Wednesday, or Thursday, then the control strategy would not be of any help. Switching to a four day week would reduce emissions on particular days, but proper scheduling of the individual's day off is crucial in reducing emissions for all days. Since meteorological conditions are random, the optimal use of the strategy is to spread the reduction equally over all days. Assuming that 25 percent of the CBD work force is on a four day week, and assuming optimal scheduling, the resultant decrease in total emissions would be 1.5 percent. In Pittsburgh's CBD, approximately 15 percent of the workers are government employees. If these workers were on a four day week by 1977, and optimal scheduling were implemented, an overall emission reduction of 0.9 percent would result.

i. Short Term Transit Improvements

The basic short term improvement that can be accomplished is the reduction of transit travel time. The modal split model developed by SPRPC for the region is divided into two parts. The first part estimates captive transit users. The travel time was not found to appreciably affect captive modal split. For this reason, short term transit improvements measured in transit travel time reduction were not assumed to affect captive modal split. The second part of the model estimates choice transit usage, which was found to be sensitive to transit travel time reduction. The estimation of choice transit usage was further divided into two equations.

The first equation estimates choice transit usage for those trips made exclusively on buses in mixed traffic. In this case, modal split varies inversely with the excess travel time ratio. As can be seen in Figure III-3, the excess travel time ratio does not affect choice modal split unless the ratio is less than 0.5. This ratio is difficult to achieve during a short time period. The transit system headways would need to be decreased significantly, transfers would have to be reduced, and coverage would have to be extended so as to practically provide door-to-door service.

For example, let's assume a user's trip takes 40 minutes by transit and 25 minutes by automobile. Furthermore, assume the transit trip time is comprised of 6 minutes walking, 6 minutes waiting, one transfer which is penalized 9 minutes and 19 minutes running time. Let the highway trip be comprised of 10 minutes terminal time and 15 minutes running time. Then the existing excess time ratio is $(6 + 6 + 9)/10 = 2.1$. In order to have a significant increase in usage, the excess transit time must be

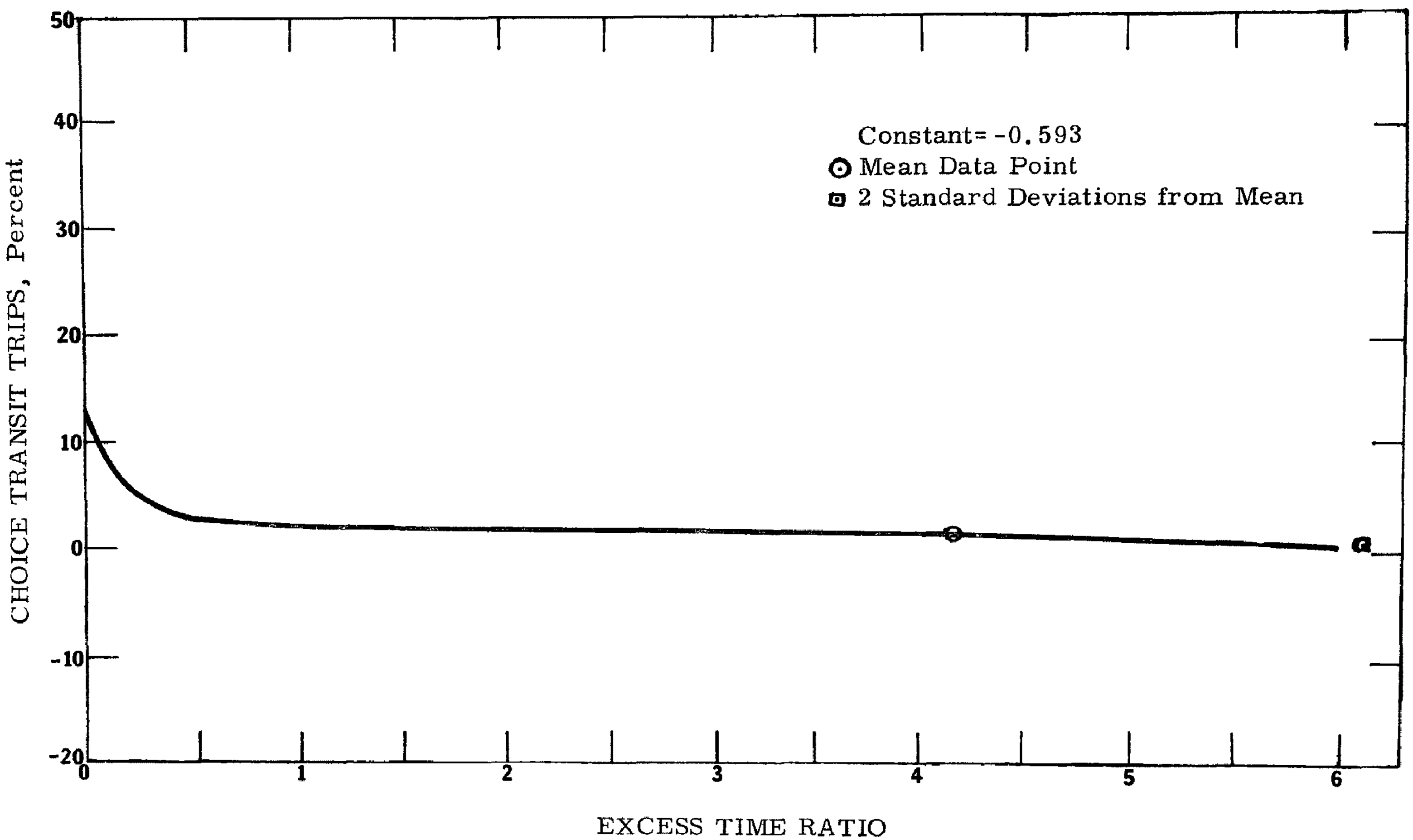



Figure III-3. Percent Choice Bus Transit Trips Sensitivity Analysis reduced from 21 minutes to 5 minutes. To do this, the transfer must be eliminated so that excess time would now be 21 - 9 = 12 minutes. If the waiting time is reduced by half to 3 minutes, then the headways on the bus routes must be halved also. This means doubling the number of buses which are servicing the area. This would now bring the excess time to 12 - 3 = 9 minutes. To reduce the excess time to 5 minutes for transit, the bus stop must be moved 4 minutes closer to the user's home. Since the original total walking time was 6 minutes (0.1 hour), the approximate total distance the user walked was 0.1 hr x 3 mph = 0.3 miles. Hence, reducing walking time to 2 minutes would result in reducing the total distance walked from 0.3 miles to 0.1 mile. The implications are clear from this example that in order to increase modal split for choice bus users significantly, large investments must be made in the transit system.

The second equation estimates choice transit usage for those trips where a rapid transit mode is used. In this case, Figure III-4 shows that the model is sensitive to travel time ratios approaching unity. The model was calibrated for trips originating in South Hills and destined for the CBD. These trips were served by trolleys on predominantly exclusive rights of way. In 1967, approximately 9 percent of all choice transit trips to the CBD were made on the trolleys. Sensitivity analysis showed that for representative data, choice modal split for rapid transit users could be doubled by increasing the running speed from 15 to 30 mph, while keeping other inputs constant. Reducing the headway from 8 to 2 minutes could further increase modal split by an additional 10 percent.[57]

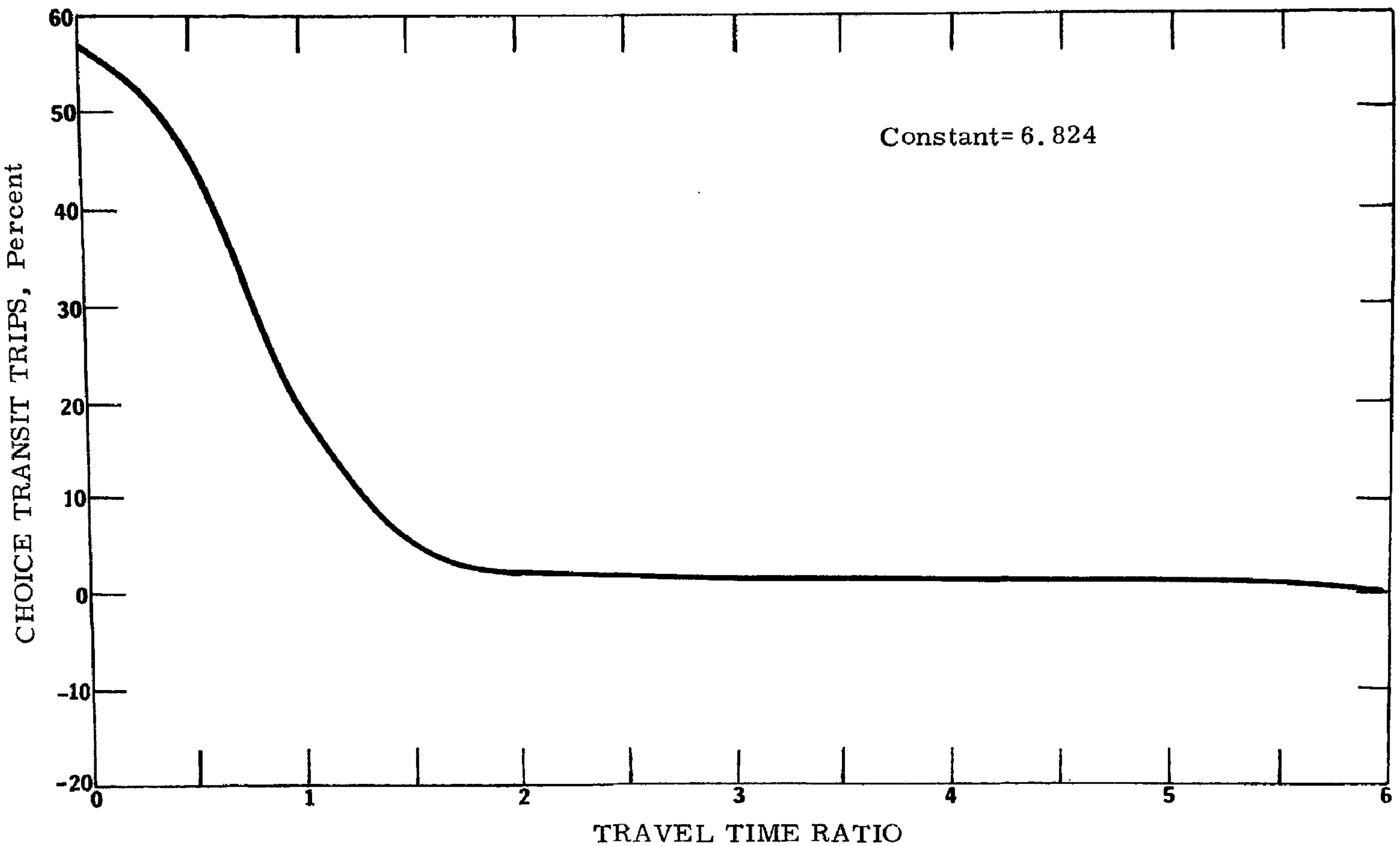



Figure III-4. Percent Choice Rapid Transit Trips Sensitivity Analysis.

Figure III-5 and III-6 relate travel time ratios and employment density to modal split.

By increasing running speed 100 percent, and by reducing headways significantly, the maximum modal split increase would be 0.15 for rapid transit choice users. This would decrease local vehicle miles of travel by 25 percent and total travel by 11 percent in the CBD. If this transit service increase affected 33 percent of the trips attracted to the CBD by 1977, than a 3.67 percent decrease in total travel would result.

j. Transit Fares

The effect of changing the transit fare on transit usage can be estimated based in the following equation:[58]

$$\% \Delta M.S. = -0.33(\% T.F.)$$

where:

% M.S. = Percent change in transit usage or modal split

% T.F. = Percent change in transit fare.

The reliability of this equation has been verified under different conditions. As an example of its use, if the present transit fare is 40 cents and it is to be reduced by 100 percent, then the percent increase in transit usage would be 33 percent. If the initial modal split were 50 percent, then modal split would be 58.2 percent after the fare is

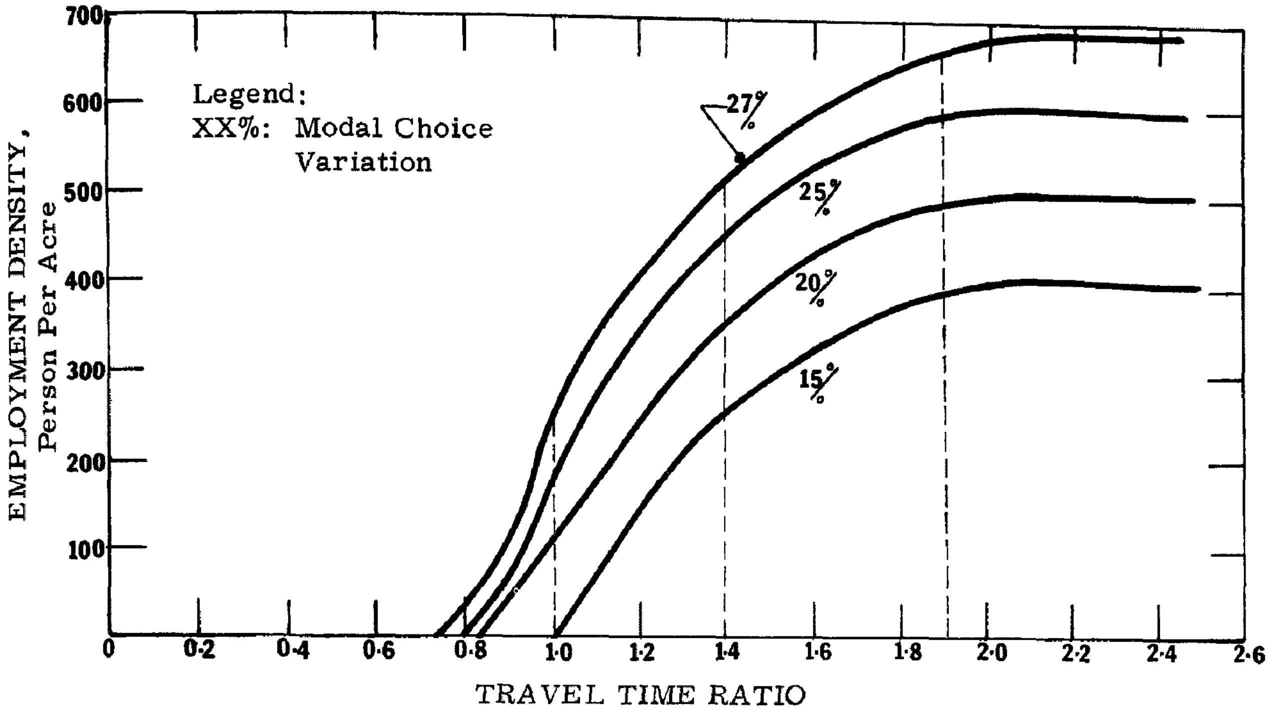



Figure III-5. Isovalue Contours, 15-27% Modal Choice Variations
Employment Density and Travel Time Ratio

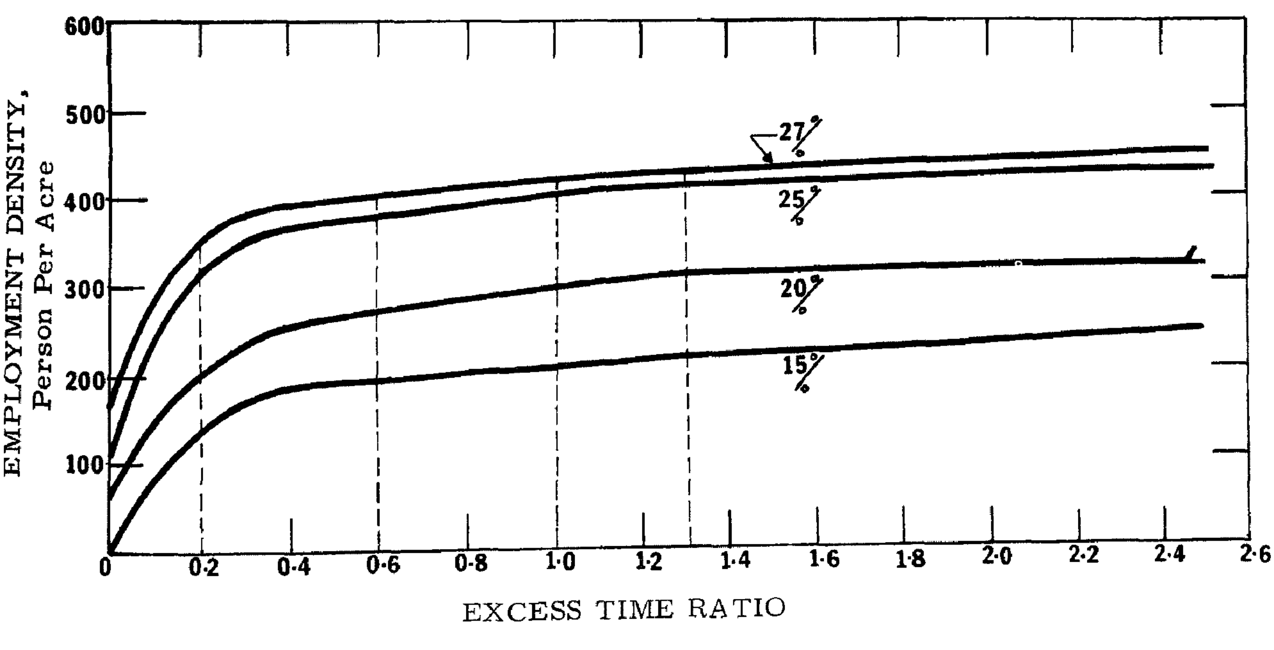



Figure III-6. Isovalue Contours, 15-27% Modal Choice Variations
Employment Density and Excess Time Ratio

reduced. Based on data from Atlanta, a 12 percent increase in transit patronage was experienced during the peak periods, and a 30 percent increase was experienced during the base period.[59] Assuming that the peak period increase was due to persons switching from the automobile mode to transit, and that the base period increase was due to new ridership would indicate that approximately 44 percent of the ridership increase was diverted from automobiles.

For 1977 in Pittsburgh's CBD, daily transit attractions will be approximately 193,000. Therefore, a 100 percent reduction in transit fare would increase daily transit attractions to 256,000, of which approximately 28,000 would have been diverted from automobiles. This increase in ridership would decrease local vehicle miles of travel by approximately 11.6 percent and total travel by 5.2 percent. Figure III-7 shows VMT reduction as a function of fare reduction in the CBD.

k. Tolls

The effect of tolls and road pricing on bridges or streets can be useful in persuading automobile users to use transit or to car pool. One method which could be used to measure the effect of tolls is to relate the toll charge to travel time. It has been estimated that for work trips, users value their time at 5 cents per minute.[60] Therefore, a toll charge of 25 cents per trip would have the effect of increasing travel time by 5 minutes. Applying this revised travel time to the choice modal split and traffic assignment models would result in a higher

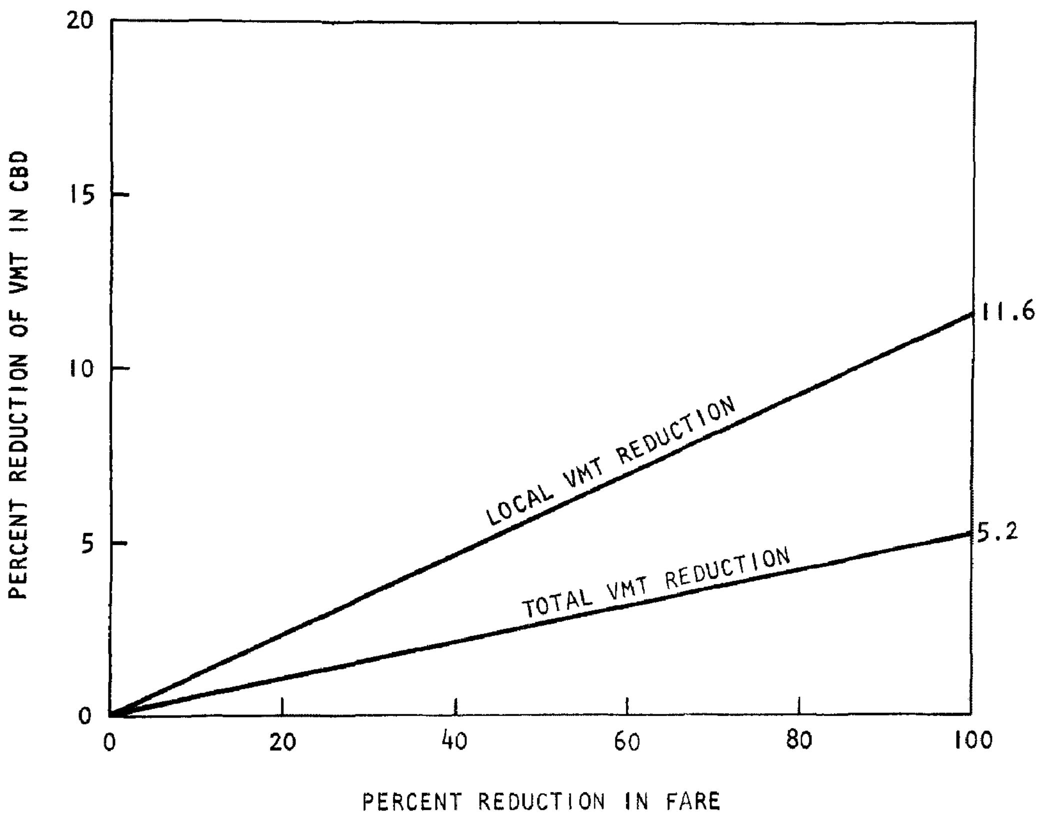



Figure III-7. Percent VMT reduction as a function of transit fare reduction for District I modal split and lower volumes of through traffic. The effect of this increase in travel time on modal split has already been discussed in the section on short term transit improvement. If 50 cent tolls were instituted on all accesses to the CBD, then the highway travel time would increase by 10 minutes for work trips. This would reduce the travel time ratio significantly for rapid transit users. The choice modal split would increase by 27 percent for rapid transit users. If rapid transit were available to 33 percent of the CBD attractions, then this would result in a 2.1 percent reduction in local vehicle miles of travel, or approximately 1 percent of total travel in the CBD. An additional reduction could be realized by the diversion of through trips. If one out of every 20 through vehicle trips were diverted, the total vehicle miles of travel would be reduced by an additional 2.75 percent.

1. Parking Time and Charges

The effect of parking charge on choice modal split, assuming employment density is held constant, is estimated in the following equation:[61]

$$M.S. = 0.685\ (P.C.)$$

where:

M.S. = Change in percent choice transit trips

P.C. = Change in long term parking cost, cents/hour

For example, if a 9.7 cents per hour increase in long term parking cost were instituted, then choice modal split would increase by 6.6 percent. This would represent an 87 cent increase in daily parking cost, or approximately $17.50 per month. The existing average daily rate is $2, or $40 per month. Therefore, an increase to $57.50 per month could increase choice modal split 6.6 percent and reduce local vehicle miles of travel in Pittsburgh's CBD by approximately 5.3 percent, and total vehicle miles of travel in the CBD by 2.4 percent. A significant number of these transit users who used to park in the CBD would probably park in fringe parking areas such as the stadium complex, and then utilize shuttle transit service to arrive at the CBD. An increase in car occupancy would also be experienced, but due to the lack of any reliable data, this impact is presently not known.

m. Parking Restriction and Modifications

Restricting on-street parking during peak and off-peak hours effectively increases capacity substantially and increases average speed. It is questionable, however, whether a significant reduction in emissions would occur due to the probable increase in traffic volume. If a net reduction did occur, its effect would not be substantial unless the strategy were applied to many facilities throughout the district. This is highly unlikely in a CBD, since the probability of having many facilities which still allow on-street parking, especially during peak periods, is low. Time limit restrictions on parking spaces can significantly reduce the supply of long term parkers. Again, this strategy would probably have limited effects in a CBD, since most on-street long term parking has already been banned. Figure III-2 can be used to estimate rate reductions due to speed increases.

n. Vehicle Free Zones

The effectiveness of reducing emissions in the area where vehicles are prohibited would be 100 percent. However, the effect of redistributing the eliminated travel in adjacent zones could be serious and must be examined. This strategy would not have to be implemented for environmental reasons unless emission reductions needed to meet ambient air quality standards were too large to be met by less drastic strategies.

o. Reserved Bus Lanes

The reduction in vehicle miles of travel and emissions due to the implementation of reserved bus lanes can be estimated by determining the reduction in transit travel time and increased highway speeds. The SPRPC choice modal split model for rapid transit usage could be used as discussed earlier. The model does incorporate increases in transit operating speed to estimate corresponding increases in modal split. Under existing conditions in several corridors to the CBD, substantial increases in transit usage could be realized by increasing running speed to 30 mph.

According to the choice modal split for rapid transit usage, instituting reserved bus lanes into the CBD could reduce the appropriate travel time ratio from approximately 1.7 to 1.08. This decrease in travel time would increase transit usage by 0.1435. If rapid transit were available to 25 percent of the non-captive trips to the CBD, then local vehicle miles of travel would be reduced by 3.75 percent, and overall travel would be reduced by 1.69 percent in the CBD.

p. Increase Fuel Tax

The effect of reducing vehicle miles of travel and emissions by increasing fuel tax would not be significant unless the fuel tax were substantial. The increase in cost per gallon of gas could be transformed into an increase in cost to the automobile user per vehicle mile driven. For example, a 25 cent increase in cost per gallon of gas could be equated to an additional user cost of 2 cents per mile. Thus, if the average trip length is 7.5 miles, then the added user cost would be 15 cents. As has already been observed, the impact of a 25 cent fuel tax per gallon of gas would not substantially reduce automobile travel. The 15 cent additional cost per 7.5 mile work trip could be equated to a 3 minute increase in travel time. A 3 minute travel time increase for an automobile user would barely affect transit usage according to the choice modal split model. This does mean, however, that a fuel tax of the magnitude of 50 cents or more could be as effective as instituting tolls and road pricing, and this strategy would have a regional effect on reducing vehicle miles of travel. A substantial fuel tax would also provide automobile users a greater incentive to car pool.

As was shown in the discussion of tolls, a 50 cent toll could decrease total travel in the CBD by 2.75 percent. Thus, under the assumptions previously listed, an 83 cent per gallon increase in fuel tax would be needed to reduce travel by 2.75 percent in the CBD.

q. Car Pools

The voluntary use of car pooling to increase automobile occupancy has not been successful on a large scale basis. The most common used to promote voluntary car pooling is to gather information on origins, destinations, starting and returning times for possible users to eventually try to match driver travel patterns. A recent one-day program in Los Angeles was initiated to promote car pooling and transit usage. Over 100,000 handouts were distributed to the public that informed them of the effort. The use of a computer was offered to companies that wished to set up car pools. Three freeways were monitored before, during and after the program, and no measurable change was recorded.[62] Although this program was based only on one day, it is probable that voluntary car pooling may not in itself increase automobile occupancy significantly. It is felt that simultaneous programs such as increased parking costs in the CBD, or road pricing, should be implemented.

r. Staggered Hours

If the air quality standards are being exceeded during the peak hour, then staggering work hours could reduce emissions greatly during the peak hour. Not only would vehicle miles of travel be reduced during the peak hour, but average speeds would increase. By staggering work hours, the vehicle miles of travel during the peak hour could be reduced by 20 percent, and average speed could increase by 20 percent. This would result in an approximate 12 to 15 percent reduction in emissions. However, if the reduction in emissions is needed in the peak 12 hour period, then staggering work hours would not reduce vehicle miles of travel for the 12 hour period greatly, and the reduction in carbon monoxide and hydrocarbon emissions over the period due to peak hour speed increases would be approximately 2 to 3 percent.

s. Fringe Parking

The development of fringe parking is usually implemented in conjunction with bus service or with a fixed rail rapid transit system.[63] In either case, the goal is to gather users at high volume stations where transit vehicles running on frequent headways can transport the high volume of riders to concentrated destinations. The transit service can consequently run on tight headways and minimize wait time. The fringe parking lot allows potential users to drive to or be dropped off at these stations so that the user has convenient access to transit. Fringe parking in suburban areas which lack extensive feeder service due to low population densities and transit usage affords a potential transit user the opportunity to still utilize the transit system. Fringe parking can also be developed near concentrated areas where emissions need to be reduced. The automobile user could park in the lot and walk or use a shuttle transit service into the dense area. This is applicable in Pittsburgh, for example, in the stadium complex where parking could be utilized by workers in the CBD. It is important to note that the district in which the stadium is located is not projected to experience any increase in VMT since it is assumed that parkers formerly traversed the district on the way to the CBD.

The average existing daily parking cost in Pittsburgh's CBD is $2. If fringe parking were created at nominal cost, then based on the value of time already estimated for work trips, a $2 savings per day could be transformed into 20 minute time savings per trip. It is approximated that the average transit travel time from the fringe lot to the CBD would be 10 minutes. This would result in a net time savings of 10 minutes. The choice modal split model for bus users is not sensitive to transit travel time unless the excess time ratio is reduced. Since the excess time ratio is not reduced by this strategy, the choice modal split for bus users is not expected to change. In 1967, approximately 9 percent of all choice transit trips attracted to the CBD used rapid transit. The choice modal split model for rapid transit users is sensitive to transit travel time. The approximate travel time ratio for rapid transit in 1977 was 1.7. Due to the 10 minute travel time reduction estimated, the travel time ratio for rapid transit would decrease to 1.4. The associated increase in choice modal split for rapid transit users would be approximately 27 percent.

If 33 percent of the trips attracted to the CBD could use rapid transit in 1977, then choice transit usage would increase by 9 percent. This increase in choice transit usage would result in reducing local vehicle miles of travel by 2.1 percent and overall travel by 1 percent.

t. Night Goods Delivery

The vehicle miles generated by heavy trucks in the CBD area account for approximately 7 percent of its total vehicle miles. If half of these trucks were to be allowed into the CBD only during the night or on weekends, then a reduction in emissions of slightly more than 3.5 percent could result during the peak 12 hour period. Although the vehicle miles of travel during the day would not be affected, there would be a redistribution of vehicle miles of travel temporally. Hence, implementing night goods delivery could be effective in reducing local VMT during the 12 hour period by 3.5 percent, but would be ineffective in reducing local VMT for a 24 hour period.

u. Location of Government Offices

The location of government offices could be critical on a short term micro analysis basis or on a long term large area basis. It is known that additional public employment in a district increases the number of work trips which then adds vehicle miles of travel to the system. In the CBD, changes in vehicle miles of travel are highly related to changes in public employment. The location of government offices can be effective in controlling the growth of vehicle miles of travel and can be used to reduce vehicle miles of travel by relocating public office activities from districts which have high vehicle miles of travel, to ones which do not. In Pittsburgh, approximately half of all person trips produced or attracted to the CBD are work trips. This means that approximately half of the vehicle miles of travel generated by trips beginning or ending in the CBD are caused by work trips. The maximum reduction in local VMT by relocating all existing public offices in Pittsburgh's CBD over the next five years would be approximately 7.5 percent. Thus, if 20 percent of the public employees were relocated outside the CBD by 1977, then a 1.5 percent reduction in local VMT could occur.

v. Zoning

Zoning is an important tool in controlling travel within the area. Unlike the strategy of locating government offices, zoning can have a sizable impact in reducing emissions in a short time period. Trip generation projections have been based in large part on expected land use growth. In Pittsburgh's CBD, the control of office space, employment density, and commercial use can affect 75 percent of the local trips. By not allowing further employment and commercial development in the CBD over the next five years,vehicle miles of travel could be reduced 2 to 5 percent. If the growth were cut in half, a 1 to 2.5 percent reduction could occur. Another zoning restriction would be to restrict further parking structures to be built which would drive parking costs up and increase modal split and car pooling.

## 2. Economic Impact

This stage of the analysis assesses the cost of the various emission-reduction measures in "traditional" economic terms.

Major criteria in the evaluation of economic cost are:

(1) Public capital cost

(2) Public operating and maintenance cost

(3) Private capital cost

(4) Private operating and maintenance cost

(5) Other public and private economic costs directly traceable to measure.

The rating of the alternative strategies with respect to economic cost is presented in Tables III-2 and III-3.

## 3. Non-Economic Impact

The alternative emission control strategies were also ranked on the basis of other impacts not readily convertible to economic terms. Four such non-economic impacts were examined: social, administrative, legal and technical. The detailed ratings and criteria for the four impacts are listed in Appendix D. Discussions with representatives of local agencies were used to determine various rankings.

Major criteria are:

(1) (Social) compatibility with expressed community objectives

TABLE III-2. RATING OF ALTERNATIVE STRATEGIES
ECONOMIC IMPACT

| Strategy | Rating* | Comments |
|---|---|---|
| <u>Reduce Emission Rate</u> | | |
| <u>Traffic Flow Improvements</u> | | |
| Upgrade Existing Streets | 5 | |
| Loading Zone | 2 | |
| Metering | 3 | |
| Information Systems | 2 | |
| <u>Source Control</u> | | |
| Retrofit | 2 | |
| Inspection | 2 | |
| Fuel Conversion | 2 | |
| <u>Reduce Vehicle Miles of Travel</u> | | |
| <u>Reduce Travel Demand</u> | | |
| Four Day Week | 5 | |
| <u>Increase Transit Use</u> | | |
| Short Term Transit Impv. | 4 | |
| Transit Fares | 2 | |
| Tolls | 3 | |
| Parking Taxes and Charges | 3 | |
| Parking Restrictions | 4 | |
| Vehicle-Free Zone | 1 | |
| Reserved Bus Lanes | 3 | |
| Increase Fuel Tax | 3 | |
| <u>Increase Occupancy</u> | | |
| Car Pools | 4 | |
| Tolls | ** | |
| Metering | ** | |
| Vehicle-Free Zones | ** | |
| Parking Taxes and Charges | ** | |
| <u>Shift Travel Patterns</u> | | |
| Staggered Hours | 3 | |
| Fringe Parking | 3 | |
| Night Goods Deliveries | 2 | |
| Government Offices | 2 | |
| Zoning | 3 | |

* Criteria defined in Table III-3.
** Strategy rated previously in this table

TABLE III-3. ECONOMIC CRITERIA

| Rating | Criteria |
|---|---|
| 5.0 | Highly cost effective on basis other than emissions reduction. Benefit/Cost ratio on basis other than emissions reduction of greater than 2.0. |
| 4.0 | Substantial cost effectiveness on basis other than emissions reduction. Benefit/Cost ratio on basis other than emissions reduction between 1.0 and 2.0. |
| 3.0 | Questionable cost effectiveness on basis other than emissions reduction. Benefit/Cost ratio assumed to be in the vicinity of 1.0 |
| 2.0 | Not cost effective on basis other than emissions r reduction. Cost per percentage area wide emissions roll-back between 0 and $3 million. |
| 1.0 | Measure generates almost no benefits other than emissions reduction. Cost per percentage area wide emissions roll-back greater than $3 million. |

(2) (Social) compatibility with implied community objectives

(3) (Administrative) ability to administer proposed controls with existing agencies and procedures

(4) (Administrative) ability to implement proposed controls with existing manpower

(5) (Legal) difficulty of overcoming legal obstacles to the implementation of the proposed control strategies

(6) (Technical) probability of alternative being operational technically

The final ration of the alternative strategies with respect to all four non-economic impacts is presented in Table III-4.

4. Political Feasibility

The political feasibility of the various strategies is examined in a separate stage. It is acknowledged that political feasibility may appear to be a surrogate measure for other impacts, such as economic, social, or institutional impacts. However, it is stressed that, in reality, political feasibility can represent an entirely independent dimension which should be separated from other quantifiable impacts. For example, it is likely and perhaps to be expected that certain measures appearing to be highly cost effective in terms of all other observable benefits and costs may still be highly infeasible politically. Examples of this situation are being furnished currently in many states by "no-fault" automobile insurance controversies. Of course, the opposite situation may also prevail; measures that are highly

TABLE III-4. RATING OF ALTERNATIVE STRATEGIES
SUMMARY RATING: NON-ECONOMIC IMPACT

| Strategy | Individual Rating* Social | Administrative | Legal | Technical | Final Rating Non-Economic Rating |
|---|---|---|---|---|---|
| **Reduce Emission Rate** | | | | | |
| **Traffic Flow Improvements** | | | | | |
| Upgrade Existing Streets | 5 | 4 | 5 | 5 | 4.8 |
| Loading Zone | 4 | 2 | 5 | 5 | 4.5 |
| Metering | 4 | 1 | 2 | 3 | 2.5 |
| Information Systems | | 2 | 4 | 2 | 2.0 |
| **Source Control** | | | | | |
| Retrofit | 2 | 2 | 1 | 2 | 1.8 |
| Inspection | 3 | 3 | 2 | 4 | 3.0 |
| Fuel Conversion | 3 | 2 | 1 | 2 | 2.0 |
| **Reduce Vehicle Miles of Travel** | | | | | |
| **Reduce Travel Demand** | | | | | |
| Four Day Week | 5 | 5 | 1 | 5 | 4.0 |
| **Increase Transit Use** | | | | | |
| Short Term Transit Impv. | 5 | 3 | 5 | 5 | 4.5 |
| Transit Fares | 5 | 3 | 2 | 5 | 3.8 |
| Tolls | 3 | 1 | 1 | 5 | 2.5 |
| Parking Taxes and Charges | 4 | 4 | 5 | 5 | 4.5 |
| Parking Restrictions, | 4 | 3 | 4 | 5 | 4.0 |
| Vehicle-Free Zone | 2 | 1 | 3 | 2 | 2.0 |
| Reserved Bus Lanes | 4 | 1 | 3 | 3 | 2.8 |
| Increase Fuel Tax | 4 | 5 | 3 | 5 | 4.3 |
| **Increase Occupancy** | | | | | |
| Car Pools | 4 | 4 | 1 | 4 | 3.3 |
| Tolls | ** | ** | ** | ** | ** |
| Metering | ** | ** | ** | ** | ** |
| Vehicle-Free Zones | ** | ** | ** | ** | ** |
| Parking Taxes and Charges | ** | ** | ** | ** | ** |
| **Shift Travel Patterns** | | | | | |
| Staggered Hours | 3 | 4 | 1 | 4 | 3.0 |
| Fringe Parking | 3 | 3 | 5 | 4 | 3.8 |
| Night Goods Deliveries | 3 | 4 | 2 | 3 | 3.0 |
| Government Offices | 2 | 4 | 3 | 4 | 3.3 |
| Zoning | 2 | 3 | 3 | 4 | 3.0 |

* From Tables in Appendix G
** Strategy rated previously in this table

attractive on a total benefit/cost basis may also be politically attractive.

Major criteria used in the rating of political feasibility:

(1) Degree of endorsement by political leadership

(2) Degree of public acceptance

The rating of the alternative strategies with respect to political feasibility is presented in Tables III-5 and III-6.

5. Evaluation Matrix

Table III-7 summarizes the ratings obtained with respect to effectiveness, economic costs, non-economic impacts and political feasibility. Also in this table, these ratings are accumulated and the strategies are ranked on the basis of total rating.

Note that on this basis, the strategies of upgrading existing streets, short term transit improvement, increasing parking charges, implementing fringe parking and requiring inspection and maintenance emerge as the most attractive control strategies. The only other strategy achieving a final rating greater than 3.0 is the four day week. The effects from this strategy depend on voluntary actions, and since the degree to which it would be implemented in 1977 is not predictable, the strategy was not recommended. If a significant voluntary effort does occur by 1977, then the degree to which the recommended program is implemented could be reduced.

TABLE III-5. RATING OF ALTERNATIVE STRATEGIES ON BASIS OF POLITICAL CRITERIA

| Strategy | Rating* | Comments |
|---|---|---|
| **Reduce Emission Rate** | | |
| **Traffic Flow Improvements** | | |
| **Upgrade Existing Streets** | 5 | Underway, well accepted |
| **Loading Zone** | 2 | Minor but very vocal opposition |
| **Metering** | 2 | Inconsistent with CBD goals |
| **Information Systems** | 3 | No apparent opposition |
| **Source Control** | | |
| **Retrofit** | 2 | Believed regressive, costly |
| **Inspection** | 4 | Outgrowth of present inspection |
| **Fuel Conversion** | 3 | No reaction, jurisdiction unclear |
| **Reduce Vehicle Miles of Travel** | | |
| **Reduce Travel Demand** | | |
| **Four Day Week** | 3 | Neutral if voluntary |
| **Increase Transit Use** | | |
| **Short Term Transit Impv.** | 4 | Favored in principle |
| **Transit Fares** | 3 | Mixed positions |
| **Tolls** | 2 | Implied opposition, CBD goals |
| **Parking Taxes and Charges** | 4 | Rates already changing |
| **Parking Restrictions** | 1 | Opposed without transit |
| **Vehicle-Free Zone** | 1 | Large latent opposition |
| **Reserved Bus Lanes** | 4 | Acceptable in principle |
| **Increase Fuel Tax** | 2 | Unlikely; legislative problem |
| **Increase Occupancy** | | |
| **Car Pools** | 3 | Indifference; considered ineffective |
| **Tolls** | ** | |
| **Metering** | ** | |
| **Vehicle-Free Zones** | ** | |
| **Parking Taxes and Charges** | ** | |
| **Shift Travel Patterns** | | |
| **Staggered Hours** | 3 | Hesitant to require |
| **Fringe Parking** | 4 | Moving in this direction |
| **Night Goods Deliveries** | 3 | Acceptable as voluntary measure |
| **Government Offices** | 1 | Incompatible with CBD goals |
| **Zoning** | 2 | Conflict with CBD goals |

* Criteria defined in Table III-6

** Strategy rated previously in this table

TABLE III-6. POLITICAL CRITERIA

| Rating | Criteria |
|---|---|
| 5.0 | Actively endorsed by all levels of public officials. Wide public acceptance. Previous public acceptance of similar measures. |
| 4.0 | Endorsed by some levels of government officials. Generally favored by elected officials. General public acceptance likely. Generally favorable reaction to similar adopted measures. |
| 3.0 | Position not taken. Public official reaction mixed between endorsement and lack of position. Public reaction indifferent and/or mixed. |
| 2.0 | Publicly opposed by some levels of government officials. General political endorsement not probable. Substantial public opposition. Opposition to similar adopted measures. |
| 1.0 | Actively opposed by most levels of government officials. Wide public opposition. Widespread public dissatisfaction with similar measures previously adopted. |

TABLE III-7. FINAL RATING OF ALTERNATIVE STRATEGIES
ALL CRITERIA

| Strategy | Sub-Ratings | | | | Final Rating |
|---|---|---|---|---|---|
| | Tech. Effectiveness* | Economic* | Non Econ.* | Political* | |
| **Reduce Emission Rate** | | | | | |
| **Traffic Flow Improvements** | | | | | |
| Upgrade Existing Streets | 2 | 5 | 4.8 | 5 | 4.2 |
| Loading Zone | 1 | 2 | 4.5 | 2 | 2.4 |
| Metering | 3 | 3 | 2.5 | 2 | 2.6 |
| Information Systems | 1 | 2 | 2.0 | 3 | 2.0 |
| **Source Control** | | | | | |
| Retrofit | 3 | 2 | 1.8 | 2 | 2.2 |
| Inspection | 4 | 2 | 3.0 | 4 | 3.2 |
| Fuel Conversion | 2 | 2 | 2.0 | 3 | 2.3 |
| **Reduce Vehicle Miles of Travel** | | | | | |
| **Reduce Travel Demand** | | | | | |
| Four Day Week | 2 | 5 | 4.0 | 3 | 3.5 |
| **Increase Transit Use** | | | | | |
| Short Term Transit Impv. | 2 | 4 | 4.5 | 4 | 3.6 |
| Transit Fares | 3 | 2 | 3.8 | 3 | 2.9 |
| Tolls | 4 | 3 | 2.5 | 2 | 2.8 |
| Parking Taxes and Charges | 3 | 3 | 4.5 | 4 | 3.6 |
| Parking Restrictions | 2 | 4 | 4.0 | 1 | 2.8 |
| Vehicle-Free Zone | 5 | 1 | 2.0 | 1 | 2.3 |
| Reserved Bus Lanes | 2 | 3 | 2.8 | 4 | 3.0 |
| Increase Fuel Tax | 2 | 3 | 4.3 | 2 | 2.8 |
| **Increase Occupancy** | | | | | |
| Car Pools | 1 | 4 | 3.3 | 3 | 2.8 |
| Tolls | ** | ** | ** | ** | ** |
| Metering | ** | ** | ** | ** | ** |
| Vehicle-Free Zones | ** | ** | ** | ** | ** |
| Parking Taxes and Charges | ** | ** | ** | ** | ** |
| **Shift Travel Patterns** | | | | | |
| Staggered Hours | 2 | 3 | 3.0 | 3 | 2.8 |
| Fringe Parking | 2 | 3 | 3.8 | 4 | 3.2 |
| Night Goods Deliveries | 2 | 2 | 3.0 | 3 | 2.3 |
| Government Offices | 2 | 2 | 3.3 | 1 | 2.1 |
| Zoning | 2 | 3 | 3.0 | 2 | 2.5 |

* Summarized from Tables
** Strategy rated previously in this table

## IV. RECOMMENDED TRANSPORTATION CONTROL PROGRAM AND IMPACT ON AIR QUALITY

### A. RECOMMENDED PROGRAM

Based on the results of the four ratings developed for each control strategy and the 15.9 percent carbon monoxide emission reduction required in the Golden Triangle, Zone 1 for 1977, the following four part transportation control program is recommended.

The first control strategy is the implementation of an inspection and maintenance program which is estimated to reduce carbon monoxide emissions by approximately 9 percent. Although not rated high in the cost ranking, its effectiveness is reducing CO emissions in the CBD was surpassed only by creating a vehicle free zone. This strategy was also recommended because it would not only be instrumental in achieving the 1977 air quality standards, but would be vitally needed in the long-term air quality program. The expected benefits derived from the significant national investment,which will be incurred when producing and installing vehicle anti-pollution devices, could be substantially reduced if these devices are allowed to deteriorate, to be disconnected or to be improperly used. If this strategy were not implemented, the consequences of achieving the 1977 air quality standards would be monumental in limiting urban mobility in the CBD. An alternative program to meet the 1977 standard in the CBD without inspection and maintenance would require significant transit improvement in terms of busways and overall travel time reductions which would increase transit usage by approximately 44 percent, reduct transit fares by 100 percent, increase daily parking costs in the CBD by $2.34, reduce parking demand by 33 percent, and require the development of extensive fringe parking.

The second transportation control strategy in the recommended program is to continue aggressively with upgrading the existing street system, in the form of the TOPICS program and its probable successor. A 12 hour and daily overall speed increase of 2 percent is estimated to occur by 1977 due to these traffic flow improvements. The expected reduction in carbon monoxide and hydrocarbon emissions would be approximately 1.4 percent for the 12 hour and daily periods.

The third transportation control strategy would be to increase long-term parking costs by $1.45 per day. This 16.1 cent per hour increase would increase choice modal split by 11 percent. This results in reducing local vehicle miles of travel by 8.4 percent and total travel by 3.8 percent. The reduction in parking demand would be approximately 8.4 percent less than the existing demand. Since the parking authority presently has control over approximately 6,000 spaces in the CBD, strong upward pressure would be exerted on rates at the remaining privately owned facilities, and these rates would tend to follow the authority's. Parking demand elasticity suggests that no revenue loss would be experienced by private facility owners.

Besides increasing transit usage, a $1.45 increase in the daily cost would also encourage all day parkers in the CBD to park their cars in the fringe lots. This increase in parking costs would reduce VMT in Zone 1 by 1.7 percent and reduce parking demand in the CBD by approximately 3.6 percent. The two existing fringe parking areas are located at the stadium and civic arena complexes.

Together, their existing parking supply would be adequate to meet the demand diverted from the CBD. Frequent transit shuttle service could be implemented to link the fringe lots to the CBD. The creation of fringe parking lots was not considered at this point since it was believed that these high initial cost projects should be planned with long range transit improvements. It was felt that construction of close-in (1-3 miles) fringe parking lots could prove to be inconsistent with the long term goal of rapid transit.

Although the total reduction in parking demand is projected to be 12 percent, this does not imply that parking supply could be reduced by 12 percent. The present parking demand-to-supply ratio is approaching a value of one. In order to properly and efficiently provide parking for users, this ratio should be in the vicinity of 0.85. Therefore, a 12-percent reduction in parking demand would reduce the parking demand-to-supply ratio to an acceptable level in the CBD and would not necessitate reducing the parking supply. Also, the parking demand reduction would probably reduce the number of illegal parkers and therefore improve traffic flow.

The last transportation control strategy in the recommended program is the improvement of the transit system. An increase in modal split

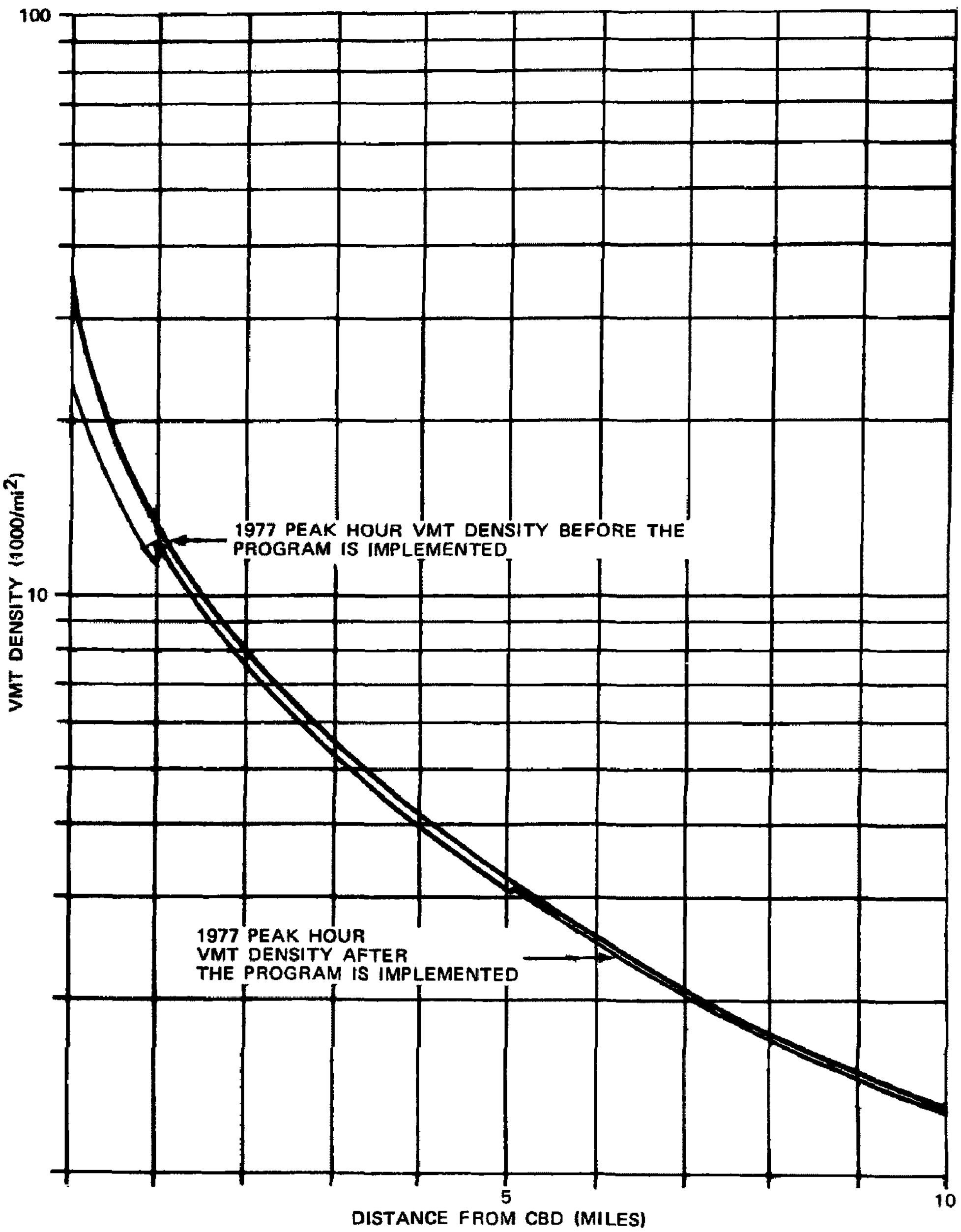



Figure IV-1. Peak Hour VMT Density (1000/mi$^2$) vs. Distance from CBD (miles) Pittsburgh.

TABLE IV-1

PROJECTED VMT REDUCTIONS FOR 1977
AFTER THE RECOMMENDED CONTROL PROGRAM IS INSTITUTED

(PERCENT REDUCTION)

| Districts | Daily | Peak 12 Hours | Peak Hour |
|---|---|---|---|
| 1 | 5.5 | 7.3 | 18.3 |
| 2-20 | 1.5 | 1.9 | 4.9 |
| 21-51 | .4 | .5 | 1.3 |
| 52-72 | .08 | .11 | .27 |
| Region | .43 | .57 | 1.44 |

of 5 percent to the CBD was assumed in the initial determination of 1977 vehicle miles of travel. This is based on the assumption of increased employment density in the CBD and some non-capital intensive improvements in the transit system. In order to increase modal split over the next five years, it is recommended that express bus service be instituted to the CBD and that maximum use of traffic engineering techniques (bus priority signal systems, one-way streets, etc.) be pursued.

Figure IV-1 shows a linear approximation of the 1977 peak hour VMT density as a function of the zone's distance from the CBD before and after the control program is instituted. Table IV-1 summarizes the approximate 1977 VMT reductions projected after the Recommended Control Program is implemented.

## B. IMPACT ON AIR QUALITY OF RECOMMENDED STRATEGIES

(1) The reductions expected from the several strategies are as follows:

| | |
|---|---|
| 1972 CO emissions from motor vehicles, Zone 1 | 27,543 kg/day |
| Less expected reduction from FMVECP (49.8 percent of baseline) | 13,714 |
| 1977 "no strategy" emission rate of CO, Zone 1 only | 13,829 |
| Less 1.4 percent reduction expected from traffic flow improvements | 194 |
| | 13,635 |
| Less 5.5 percent reduction expected from parking strategies and improvements in short-term mass transit | 760 |
| | 12,875 |

| | |
|---|---|
| Less 9.0 percent reduction expected from inspection and maintenance program | 1,159 |
| | 11,716 |
| Less 8.2 percent reduction expected from retrofit program (oxidizing catalytic converters on 1968-1974 model year cars) | 961 |
| | 10,755 kg/day |

(2) The net emissions resulting from the above combination of strategies represents a 22.3 percent rollback from the expected 1977 "no strategy" emission rate. Since a reduction of only 19.6 percent from the 1977 vehicular emission rate is required to meet the Federal standards, the combination of strategies listed above represents an "overkill" of some 2.7 percent. In this connection, it should be pointed out that our contract and instructions from the EPA call for a transportation control program that will meet the standards for CO and $O_x$ by 1977. If it is deemed advisable, in light of the considerable degree of uncertainty surrounding all the numbers in this report, to try for a level which will exceed the standard, then the above program will provide such a cushion.

(3) The above strategies are not listed in order of desirability. The priority listing is as follows:

| | | |
|---|---|---|
| (a) | Inspection and maintenance (mandatory program): (No decrease in VMT) | 9.0% decrease in CO emission |
| (b) | Traffic flow improvements through the upgrading of existing streets (no decrease in VMT) | 1.4 % decrease in emissions |
| (c) | Increase parking rates, fringe parking, and improved short-term mass transit (does decrease VMT) | 5.5 % decrease in emissions |
| (d) | Retrofit program — oxidizing catalytic converters on 1968 to 1974 model year cars (no decrease in VMT) | 8.2 % decrease in emissions |

(4) The interested reader is referred to the draft amendments to 40 CFR 51, Requirements for Preparation, Adoption, and Submittal of Implementation Plans — Transportation Control Measures, the latest version of which is dated 14 November 1972, for further information on the inspection and maintenance and retrofit options listed above.

## V. IMPLEMENTATION OBSTACLES

The following agencies participated in meetings and discussions concerning implementation obstacles:

Southwestern Pennsylvania Regional Planning Commission

Pennsylvania Department of Transportation

Pittsburgh Department of City Planning

Pittsburgh Public Parking Authority

Port Authority of Allegheny County

Allegheny County Transportation Department

### A. INSPECTION AND MAINTENANCE

Legislative action on at least a regional basis is required for the effective implementation of an inspection and maintenance program. The most likely form of such action is the adoption of a uniform maintenance and inspection measure by all counties in the SPRPC region, or perhaps in western Pennsylvania. In the absence of total regional agreement to proceed with a program, legislation could be adopted by individual counties, and even by the City of Pittsburgh. However, exceptions to a uniform regional policy would seriously erode the effectiveness of the measure.

The possibility of State or even Federal adoption of an inspection and maintenance program is a factor influencing the use of such measures at a more local level. Transitional problems should be anticipated in the adoption of measures at a local or regional level.

The overlaying of a regional inspection and maintenance program on the existing inspection mechanisms will require substantial planning and legislative effort.

Technical procedures required for an inspection and maintenance program represent "off the shelf" capabilities, and no further technical development is foreseen. It is expected that the program will function as an extension of the current vehicle inspection procedures. A technical implementation time of one year (from completion of legislative and planning activity to commencement of inspection) is projected.

It is anticipated that the program will involve an increased administrative effort on a permanent basis. The incorporation of this additional administrative effort into the existing state inspection administrative machinery requires careful planning and legislation. Similarly, allocation of the costs of additional administration will require detailed planning. Uniform legislation throughout the region will be necessary to initiate any additional administrative machinery.

It is likely that objections will be made to any inspection and maintenance program on the grounds that its cost to motorists is regressive with respect to personal income. If these objections become serious enough to jeopardize the adoption of the program, then it will be necessary to devise methods of reducing or eliminating the "user cost" aspect of the program. This could be accomplished by additional fuel taxes, local registration fees, etc., applied to all motorists in the region.

Potential political obstacles involve the generation of support, on a regional basis, for problems that are identified on a subregional basis. Another potential source of political resistance may arise from the out-of-pocket costs associated with the program. However, experience with out-of-pocket costs for safety related automobile equipment indicates that objections diminish as the control becomes more widespread.

The primary economic obstacle is the capital expenditure required to plan and initiate the measure. Specific funding sources (if any) for this type of program are not clearly identified. In estimating capital costs required to implement an inspection and maintenance program, these assumptions were made: A 20-minute inspection time, 60-hour week, $35,000 per lane for equipment, approximately 1.5 million vehicles to test in 1977, $145,000 per lane for land and building capital costs, and an 80 percent utilization factor. Utilizing the assumptions above, approximately 210 lanes would be needed at an approximate capital cost of $180,000 per lane. The approximate capital cost for the program would therefore be $38 million.

B. UPGRADE EXISTING STREETS

It is expected that this strategy can be implemented with little resistance. Legislation has already been provided for this type of program and it is expected that additional programs will, in the near future, supplement existing programs for the upgrading of urban streets. It is also anticipated that Federal allocations for this type of improvement program will increase significantly in the near future.

Administrative difficulties in the implementation of future urban street improvement programs are expected to receive attention at the State and Federal levels. Significant administrative capacity for this type of program already exists at the local level.

Street improvement programs typically are estimated to yield a benefit/cost ratio of 2.0 or greater, based on delay and accident reductions. Since the costs of this program are already justified on a delay and accident reduction, the cost for emission reductions would be minimal.

## C. PARKING RATES AND FRINGE PARKING

The public parking program in Pittsburgh affords opportunities to implement some emission control strategies with a minimum of risk due to obstacles that jeopardize other measures. The Authority has demonstrated a capability for aggressive implementation of programs and a willingness to support its programs against various pressures.

No serious legislative difficulties are foreseen in the implementation of the recommended measures of parking rate changes and fringe parking. The legal capability to undertake both of these measures exists and has been exercised previously.

Additional studies of demand elasticity, fringe parking availability and accessibility, and triangle parking rate structure will be required. Depending on the scope of these studies, temporary supplementation of the Parking Authority's planning capability may be required. Control of the ongoing parking program should not add materially to the Authority's responsibilities, however.

Any effort to contain the parking supply in the Triangle will draw opposition on the grounds that such measures conflict with the stated objectives of maximum physical growth in this area. Thus, it is important that proper attention be given to the infrastructure necessary for the successful diversion of long-term parking from the triangle area (shuttle transit, pedestrian routes, escalators, etc.).

The economic impact of the recommended control strategies will require careful analysis. In particular, the effect on net parking revenues resulting from the proposed rate changes will need careful evaluation. A decrease in such revenues, while relatively small in comparison to the total costs of other recommended emission control strategies, could have a major impact on the operation of the Authority, and this possibility must be explored in depth.

Vocal opposition from affected parking facility users can be expected and should be met with a public relations type of program explaining the need for the measures and the consequences of alternative measures.

## D. SHORT TERM TRANSIT IMPROVEMENTS

Implementation of any capital-intensive transit improvements is considered infeasible due to time limitations and legal complications. However, it is expected that short range transit improvements with low capital costs can proceed by 1977. No legislation or resolution of legal problems is necessary for improvements such as express bus service, shuttle service to parking areas or utilization of traffic engineering techniques to improve bus operations.

The planning of short range improvements presents some difficulties and will probably involve a detailed study of alternatives. Technical obstacles are minor, since short term operation changes do not represent a significant departure from existing technology.

Some political opposition to short term transit improvements is probable, either on economic grounds or because even short term measures are closely identified with controversial long range transit issues in Pittsburgh. It is possible that this opposition may be reduced by "outside" funding of improvements and by careful efforts to dissociate short term programs from existing transit proposals.

The funding of short term transit improvements appears to be a significant obstacle which is best overcome by careful review of available capital improvement programs and timely action toward such funding. Approximately 16,200 additional transit users are estimated to arrive in District 1 during the peak hour for 1977. Assuming a load of 50-70 passengers per bus would indicate a need for approximately 290 buses. Assuming $40,000 per bus would result in an $11.6 million capital cost.

VI. <u>SURVEILLANCE AND IMPLEMENTATION PROCESS</u>

A. INTRODUCTION

This section deals with the establishment of the schedule for implementation and surveillance of the recommended control strategy program. An implementation schedule assuming existing conditions is developed first. Serious potential inadequacies arising from the application of a static program are then identified. A methodology for overcoming these difficulties is suggested, and its application to the recommended air quality improvement program is outlined.

B. SURVEILLANCE AND IMPLEMENTATION: CURRENT CONDITIONS

Figure VI-1 indicates a schedule for the implementation of the recommended control strategy program (see Section IV). Implementation of the program is staged to achieve the target      percent reduction in emissions (see Chapter II). Projected implementation times for various control measures represent a schedule designed to meet 1977 air quality standards, with reasonable slack times (10 to 20 percent) incorporated for all stages of implementation. Hence, the schedule is developed by "working backwards" from the 1977 deadline and programming the implementation of improvements on this basis.

It should be noted that a "crash program", oriented toward maximum emission reductions within a minimum time period, could result in a more condensed schedule, with nearly simultaneous undertaking of control measures at the outset of the improvement in the immediate future. However, it should also be recognized that this type of programming of emission reduction control measures would involve higher implementation costs, reduced cost/effectiveness and public acceptance problems not accounted for in the rating of strategies that accompanied the analysis in this report.

The PERT chart (Figure VI-1) indicates that, of the four major strategies recommended in the emissions reduction program, two are independent in the sense that the critical paths of their implementation processes are not a function of the implementation of other measures. Specifically, the implementation of the arterial street improvement program and the maintenance and inspection programs are not related to progress on the other recommended strategies. However, the recommended strategies of parking rates, fringe parking and short term transit improvements are closely related, and the critical task for the implementation of the entire subpackage of improvements is derived from elements in the implementation phases of each of the various individual strategies.

The activities and events outlined in the chart in Figure VI-1 are discussed in further detail in the section of this report dealing with implementation obstacles.

## C. INADEQUACIES OF A STATIC SURVEILLANCE PROGRAM

The PERT approach has long been established as a useful tool for the planning and execution of complex programs. Adaptations of this methodology have also proven useful in circumstances where only sparse

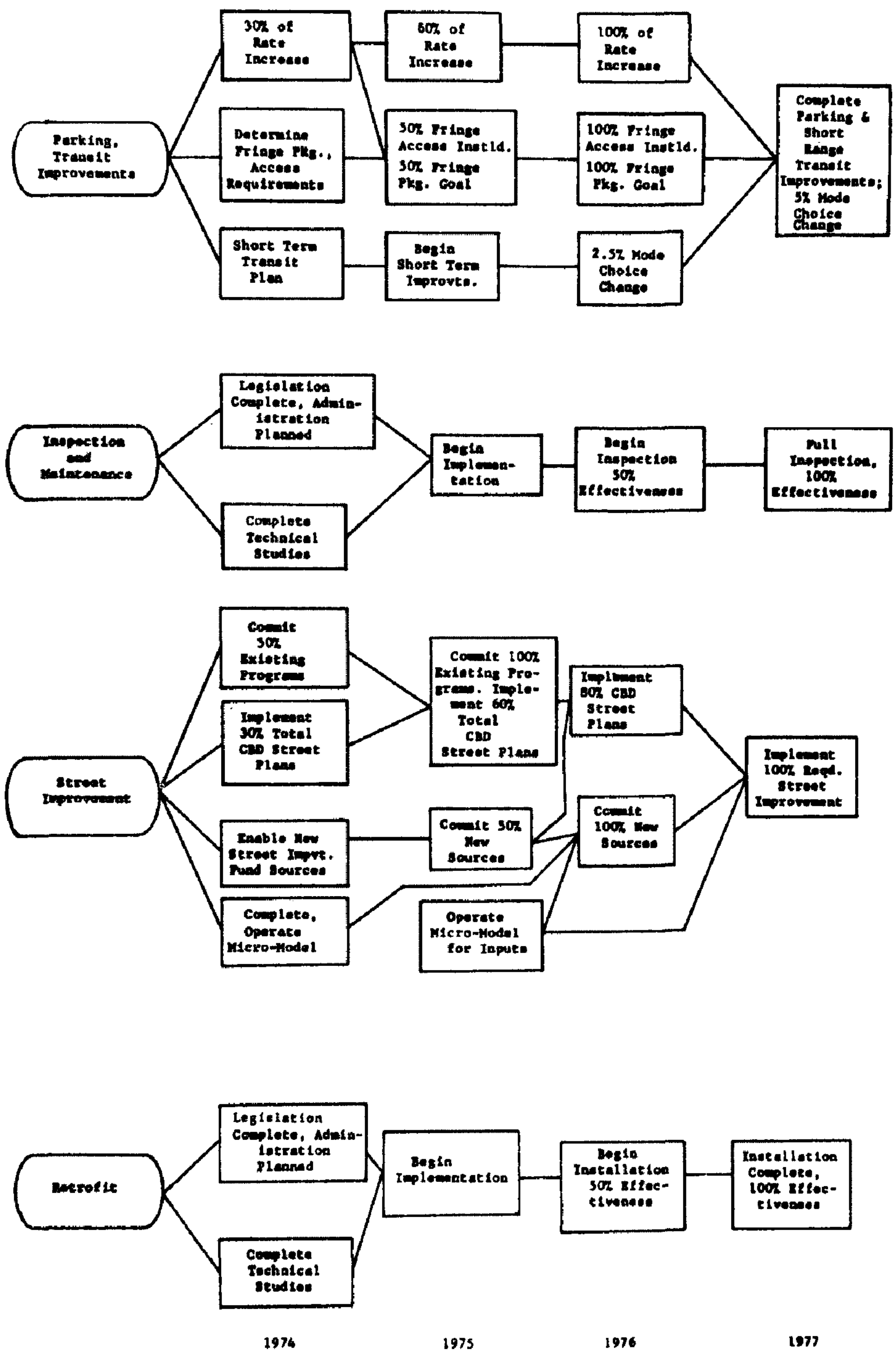



Figure VI-1. Implementation schedule for the recommended transportation control program.

data is available with respect to activity execution time. However, two serious limitations of the PERT approach emerge as the approach is considered for the Pittsburgh emissions reduction program:

- The PERT process assumes a known objective. Although quantitative variations in the objective can be accommodated under the process, the complete substitution of one objective by another objective cannot be systematically accommodated by a single PERT process.

- The PERT process depends on known activities (i.e., the "lines" connecting the event nodes of the PERT network). As noted earlier, the PERT process can function with nothing more than estimates of the times required for these activities. However, the PERT process does not systematically accommodate the removal of an activity entirely, nor its replacement by other activities.

It is highly probable that the objectives of any emission reduction program will, by 1977, vary significantly from objectives now adopted or adopted in the near future. At least two significant factors contribute to this likelihood:

- The definition of the problem may change. As surveillance devices and techniques are improved, entirely new parameters of air quality may be defined. For example, it is expected that very localized measurements of air quality will be routine in the near future. The mere disaggregation of the geographic area considered as a single unit for the measurement of air quality will change the nature of any air quality improvement objective drastically. Thus, it is possible that air quality may eventually be defined on the basis of areas smaller than a conventional city block, rather than on the presently used zones of more than a square mile.

- The programmed activities may not occur, and activities not programmed at present may be included. Some uncertainty must be assumed along with most activities in the implementation program for Pittsburgh. These uncertainties arise primarily from the fact that the technical effectiveness of most suggested strategies is not accurately known at this point. Hence, the assumption of a certain reduction in emissions as a result of the adoption of a strategy is only an estimate at this point. In addition to uncertainties concerning technical effectiveness, there are also uncertainties involving the political feasibility of adopting any recommended measure.

As noted earlier, it is also possible that air quality improvements measures not now considered may prove to be feasible in the future. Furthermore, it is also possible that measures not presently known or considered as emission control strategies will be developed by 1977.

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# APPENDIX A

APPENDIX A

DAILY MAXIMA OF HOURLY CO CONCENTRATION FOR THE DOWNTOWN PITTSBURGH ZONE, WITH MONTHLY MAXIMA

(July 1971 to June 1972)

| HOUR | JULY | AUG | SEPT | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUNE | MAX FOR THE HOUR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13 | 12 | 11 | 22 | 18 | 20 | (1t9) | 14 | 22 | 15 | 16 | 12 | 21.8 |
| 2 | 14 | 12 | 12 | 18 | 11 | 16 | (1t9) | 10 | 17 | 15 | 12 | 10 | 18.4 |
| 3 | 12 | 12 | 4 | 13 | 11 | 15 | (1t9) | 10 | 12 | 12 | 8 | 8 | 14.6 |
| 4 | 13 | 11 | 10 | 13 | 10 | 11 | (1t9) | 10 | 9 | 11 | 8 | 8 | 13.0 |
| 5 | 12 | 11 | 6 | 13 | 9 | (1t9) | (1t9) | 10 | 9 | 9 | 9 | 9 | 13.0 |
| 6 | 13 | 12 | 15 | 13 | 10 | (1t9) | (1t9) | 8 | 9 | 7 | 10 | 11 | 15.1 |
| 7 | 32 | 21 | 16 | 16 | 13 | (1t9) | (1t9) | 8 | 12 | 9 | 15 | 18 | 31.8 |
| 8 | 32 | 31 | 19 | 27 | 20 | (1t9) | 11 | 11 | 18 | 11 | 21 | 23 | 32.1 |
| 9 | 20 | 22 | 17 | 24 | 28 | (1t9) | 15 | 11 | 24 | 20 | 22 | 18 | 28.4 |
| 10 | 13 | 34 | 24 | 24 | 26 | (1t9) | 11 | 9 | 27 | 14 | 14 | 19 | 34.0 |
| 11 | 13 | 38 | 34 | 44* | 34 | 14 | 21 | 11 | 23 | 11 | 12 | 17 | 44.2* |
| 12 | 13 | 18 | 20 | 16 | 39** | 14 | 9 | 12 | 14 | (1t9) | 12 | 16 | 38.6** |
| 13 | ~~(80.8)~~ | 19 | 14 | 15 | 11 | 14 | 7 | 17 | 14 | (1t9) | 20 | 17 | 20.0 |
| 14 | 12 | 15 | 20 | ~~(45)~~ | 12 | 13 | 7 | 22 | 16 | (1t9) | 18 | 17 | 22.3 |
| 15 | 16 | 15 | 13 | 18 | 7 | 13 | 8 | 19 | 15 | (1t9) | 11 | 16 | 19.0 |
| 16 | 19 | 13 | 19 | 19 | 7 | 13 | 12 | 13 | 17 | (1t9) | 14 | 22 | 22.0 |
| 17 | 15 | 16 | 18 | 23 | 20 | 15 | 16 | 17 | 19 | (1t9) | 16 | 19 | 22.5 |
| 18 | 12 | 12 | 13 | 15 | 17 | 16 | 21 | 19 | 22 | (1t9) | 14 | 13 | 22.0 |
| 19 | 11 | 12 | 12 | 16 | 22 | 21 | 15 | 12 | 17 | (1t9) | 10 | 9 | 22.0 |
| 20 | 12 | 15 | 11 | 22 | 23 | 14 | 19 | 17 | 18 | 16 | 13 | 10 | 23.0 |
| 21 | 12 | 14 | 11 | 23 | 23 | 23 | 16 | 24 | 21 | 12 | 20 | 11 | 24.3 |
| 22 | 13 | 18 | 9 | 23 | 17 | 22 | 17 | 24 | 15 | 13 | 16 | 12 | 24.3 |
| 23 | 13 | 19 | 10 | 23 | 22 | 24 | 16 | 25 | 12 | 19 | 16 | 16 | 24.7 |
| 24 | 14 | 16 | 10 | 23 | 15 | 25 | 18 | 25 | 12 | 12 | 14 | 13 | 24.6 |
| AVG. | 6.4 | 8.1 | 7.1 | 7.9 | 5.3 | 4.6 | 3.6 | 5.6 | 7.5 | 8.7 | 6.8 | 7.2 | |
| MAX. | 32.2 | 37.9 | 34.2 | 44.2 | 38.6 | 24.6 | 21.3 | 24.7 | 26.8 | 20.0 | 21.5 | 22.0 | |

Two bad data points have been lined out. "1t9" = less than 9 ppm

*highest recorded 1-hour observation during the period

** second highest reading during the period

TABLE A-2

AVERAGE VALUES OF DAILY HIGH READINGS OF CO CONCENTRATION, DOWNTOWN PITTSBURGH, 1971-1972, WITH AVERAGE TIME OF OCCURRENCE

| MONTH | AVERAGE DAILY HIGH CO CONCENTRATION (PPM) | AVERAGE TIME OF OCCURRENCE (HR) | AVERAGE OF TWO HIGHEST READINGS FOR THE MONTH | MONTHLY AVERAGES |
|---|---|---|---|---|
| June - 1971 | 14.6 | 1336 | 20.75 ppm | 8.24 ppm |
| July | 14.0 | 1200 | 33.65 | 6.40 |
| August | 16.1 | 1142 | 34.50 | 8.09 |
| September | 15.3 | 1318 | 34.65 | 7.06 |
| October | 18.1 | 1336 | 35.80 | 7.93 |
| November | 13.5 | 1442 | 35.00 | 5.34 |
| December | 11.0 | 1448 | 23.85 | 4.58 |
| January - 1972 | 8.8 | 1424 | 20.90 | 3.61 |
| February | 10.7 | 1506 | 23.30 | 5.57 |
| March | 13.7 | 1506 | 25.00 | 7.45 |
| April | 14.8 | 1330 | 21.10 | 8.66 |
| May | 14.0 | 1324 | 20.85 | 6.79 |
| June | 12.7 | 1312 | 22.45 | 7.23 |
| July | 14.1 | 1230 | 27.20 | 8.45 |
| August | 13.0 | 1230 | 24.15 | 8.38 |

The data from the two right-hand columns have been plotted in Figure II-5.

The "daily high" and "two highest" averages are based on daily maxima only, while the "monthly averages" are based on <u>all</u> hourly readings.

The winter minimum is clearly visible in the left-hand and right-hand columns, but is somewhat obscured in the next-to-right column. A tendency toward earlier maximum readings during the summer is also noted, with the smaller daily maxima during the winter months occurring later in the day.

TABLE A-3

HIGHEST DAILY MAXIMUM CO CONCENTRATIONS (PPM) BY HOUR, WITH DATES

DOWNTOWN PITTSBURGH (ZONE 1)

Period of Record: June 1971 to August 1972

| HOUR | HIGHEST DAILY MAXIMUM RECORDED | SECOND HIGHEST DAILY MAXIMUM RECORDED | FREQUENCY OF DAILY MAXIMUM READING, BY HOUR* |
|---|---|---|---|
| 01 | 21.5, 1 Mar 72 | 19.9, 15 Dec 71 | 19 |
| 02 | 14.9, 30 Jul 71 | 14.4, 2 Jul 72 | 11 |
| 03 | 16.0, 1 Apr 72 | 10.7, 22 Jan 72 | 2 |
| 04 | ----- (Daily maxima never occurred at these hours) | ----- | 0 |
| 05 | ----- | ----- | 0 |
| 06 | 14.1, 13 Jul 72 | ----- | 1 |
| 07 | 20.6, 23 Jul 71 | 18.3, 6 Jun 72 | 18 |
| 08 | 32.1, 8 Jul 71 | 31.1, 30 Aug 71 | 53 |
| 09 | 26.8, 21 Mar 72 | 22.2, 6 Apr 72 | 35 |
| 10 | 24.2, 27 Sep 71 | 19.8, 1 Sep 71 | 23 |
| 11 | 44.2, 1 Oct 71 | 37.9, 18 Aug 71 | 32 |
| 12 | 38.6, 3 Nov 71 | 17.1, 7 Dec 71 | 11 |
| 13 | 20.8, 22 Jul 71 | 19.5, 30 Apr 72 | 11 |
| 14 | 35.2, 21 Jul 71 | 22.3, 22 Oct 71 | 11 |
| 15 | 19.5, 26 Apr 72 | 15.6, 17 Jul 71 | 13 |
| 16 | 20.9, 7 Jun 71 | 18.9, 9 Sep 71 | 25 |
| 17 | 23.1, 6 Dec 71 | 22.5, 17 Oct 71 | 40 |
| 18 | 22.1, 29 Mar 72 | 20.5, 10 Jan 72 | 29 |
| 19 | 18.3, 14 Nov 71 | 16.8, 21 Oct 71 | 4 |
| 20 | 15.3, 13 Dec 71 | 15.3, 12 Mar 72 | 14 |
| 21 | 23.2, 2 Oct 71 | 23.0, 17 Nov 71 | 19 |
| 22 | 18.3, 14 Aug 71 | 14.3, 19 Aug 72 | 8 |
| 23 | 23.6, 11 Jul 72 | 20.8, 19 Jul 72 | 23 |
| 24 | 24.7, 29 Feb 72 | 24.6, 14 Dec 71 | 26 |
| | | | 428 Data Points |

* See histogram, Figure II-7.

Underlined values are monthly high or second high readings.

Values underlined twice are the highest and second highest recorded at any time during the period of record (See also Table II-3.)

# APPENDIX B

APPENDIX B

RUNS OF HIGH HOURLY CO CONCENTRATIONS, PITTSBURGH, ZONE 1 (ppm)

| DATE | HOURS | 8-HOUR AVG. CONCENTRATION | DATE | HOURS | 8-HOUR AVG. CONCENTRATION |
|---|---|---|---|---|---|
| 18 Aug 71 | 03-10 | 14.4 | 17-18 Nov 71 | 17-24 | 19.8 |
| | 04-11 | 18.3 | | 18-01 | 19.5 |
| | 05-12 | 18.3 | | 19-02 | 18.8 |
| | 06-13 | 18.3 | | 20-03 | 17.4 |
| | 07-14 | 18.7 | | 21-04 | 15.8 |
| | 08-15 | 18.1 | | | |
| | 09-16 | 17.8 | 18 Nov 71 | 03-10 | 15.8 |
| | 10-17 | 17.5 | | 04-11 | 18.4 |
| | | | | 05-12 | 20.7 |
| 1 Oct 71 | 05-12 | 16.5 | | 06-13 | 20.9 |
| | 06-13 | 18.1 | | 07-14 | 21.27 * |
| | 07-14 | 19.3 | | 08-15 | 20.3 |
| | 08-15 | 20.4 | | 09-16 | 18.7 |
| | 09-16 | 20.2 | | 10-17 | 16.2 |
| | 10-17 | 20.1 | | | |
| | 11-18 | 20.1 | 14-15 Dec 71 | 15-22 | 17.0 |
| | 12-19 | 16.4 | | 16-23 | 18.4 |
| | 13-20 | 16.6 | | 17-24 | 19.8 |
| | 14-21 | 16.5 | | 18-01 | 20.4 |
| | 15-22 | 16.2 | | 19-02 | 20.4 |
| | | | | 20-03 | 19.6 |
| 2-3 Oct 71 | 14-21 | 16.2 | | 21-04 | 19.3 |
| | 15-22 | 17.2 | | 22-05 | 17.4 |
| | 16-23 | 18.4 | | | |
| | 17-24 | 19.6 | 29 Feb-1 Mar 72 | 15-22 | 17.7 |
| | 18-01 | 20.4 | | 16-23 | 18.9 |
| | 19-02 | 20.9 | | 17-24 | 20.4 |
| | 20-03 | 21.2** | | 18-01 | 20.9 |
| | 21-04 | 20.2 | | 19-02 | 20.7 |
| | 22-05 | 18.7 | | 20-03 | 20.7 |
| | 23-06 | 17.2 | | 21-04 | 19.4 |
| | | | | 22-05 | 17.0 |

* Highest recorded for the period.
** Second highest recorded for the period.

RUNS OF HIGH HOURLY CO CONCENTRATIONS, PITTSBURGH, ZONE 30 (PPM)

| DATE | HOURS | 8-HOUR AVG. CONCENTRATION |
|---|---|---|
| 14-15 Dec 71 | 16-23 | 18.4 |
| | 17-24 | 19.1 |
| | 18-01 | 19.1 |
| | 19-02 | 18.9 |
| | 20-03 | 18.8 |
| | 21-04 | 18.0 |
| 24 Feb 72 | 11-18 | 20.0 |
| | 12-19 | 19.5 |
| | 13-20 | 18.9 |
| | 14-21 | 18.8 |
| | 15-22 | 19.0 |
| | 16-23 | 18.9 |
| | 17-24 | 18.4 |
| 29 Feb-1 Mar 72 | 16-23 | 18.1 |
| | 17-24 | 19.9 |
| | 18-01 | 20.3 |
| | 19-02 | 20.6* |
| | 20-03 | 19.8 |
| | 21-04 | 18.0 |

*highest 8-hour average recorded at Bellevue location during the period

# APPENDIX C

CITY OF PITTSBURGH          CALENDAR YEAR IS 1972

REGION NO. 5          POLLUTANT SPECIES IS CARBON MONOXIDE

MODEL YEARS CONSIDERED IS FROM 1960 TO 1973

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY - | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) |
| 1 | 1.260 | 24724.85 | 19622.91 | 2654.71 | 2106.91 | 152.97 | 129.34 | 27542.52 | 21859.16 |
| 2 | 2.070 | 14729.28 | 7115.59 | 1581.47 | 764.00 | 102.37 | 49.59 | 16413.62 | 7929.28 |
| 3 | 3.850 | 22244.99 | 5777.92 | 2398.40 | 620.36 | 149.75 | 38.90 | 24783.13 | 6437.18 |
| 4 | 2.890 | 2950.56 | 1020.96 | 316.74 | 109.60 | 18.53 | 6.41 | 3285.84 | 1136.97 |
| 5 | 5.820 | 8290.42 | 1424.47 | 890.17 | 152.95 | 51.35 | 8.62 | 9231.93 | 1586.24 |
| 6 | 4.230 | 22841.70 | 5399.93 | 2452.52 | 579.79 | 153.61 | 36.31 | 25447.82 | 6016.03 |
| 7 | 4.540 | 11431.11 | 2517.86 | 1227.38 | 270.35 | 71.37 | 15.72 | 12729.85 | 2803.93 |
| 8 | 1.960 | 2553.17 | 1302.64 | 274.08 | 139.84 | 15.41 | 7.86 | 2842.66 | 1450.34 |
| 9 | 2.550 | 13641.27 | 5349.52 | 1464.59 | 574.35 | 96.62 | 33.97 | 15192.48 | 5957.84 |
| 10 | 6.990 | 8227.40 | 1177.02 | 883.36 | 126.37 | 55.27 | 7.91 | 9166.03 | 1311.31 |
| 11 | 1.520 | 4385.58 | 2885.25 | 470.83 | 309.75 | 29.37 | 19.32 | 4885.77 | 3214.32 |
| 12 | 3.060 | 4839.05 | 1581.39 | 519.50 | 169.77 | 32.86 | 10.74 | 5391.41 | 1761.90 |
| 13 | 2.270 | 4297.40 | 1888.72 | 460.37 | 202.81 | 27.55 | 12.14 | 4775.32 | 2103.67 |
| 14 | 3.890 | 21730.57 | 5586.27 | 2333.12 | 599.77 | 174.40 | 44.83 | 24238.09 | 6230.87 |
| 15 | 5.510 | 5367.35 | 974.11 | 576.34 | 104.60 | 35.72 | 6.48 | 5979.40 | 1085.19 |
| 16 | 1.280 | 8471.90 | 6618.67 | 909.66 | 710.67 | 56.90 | 44.46 | 9438.46 | 7373.80 |
| 17 | 1.210 | 5656.31 | 4674.64 | 607.28 | 501.89 | 37.33 | 30.85 | 6300.92 | 5207.37 |
| 18 | 2.550 | 9318.21 | 3654.20 | 1000.51 | 392.35 | 63.80 | 25.02 | 10382.52 | 4071.58 |
| 19 | 1.850 | 2234.35 | 1207.75 | 239.85 | 129.65 | 15.10 | 8.16 | 2489.30 | 1345.57 |
| 20 | 1.690 | 3015.11 | 1784.09 | 298.16 | 176.43 | 19.45 | 11.51 | 3332.72 | 1972.03 |
| 21 | 7.170 | 12857.12 | 1793.18 | 724.43 | 101.04 | 71.39 | 9.96 | 13652.94 | 1904.18 |
| 22 | 24.780 | 25607.84 | 1033.41 | 1442.95 | 58.23 | 151.65 | 6.12 | 27202.43 | 1097.76 |
| 23 | 3.070 | 7223.39 | 2352.89 | 407.04 | 132.59 | 41.47 | 13.51 | 7671.90 | 2498.99 |
| 24 | 3.890 | 3404.93 | 875.30 | 194.07 | 49.89 | 20.02 | 5.15 | 3619.02 | 930.34 |
| 25 | 9.190 | 9708.55 | 1056.43 | 547.06 | 59.53 | 623.69 | 67.87 | 10879.29 | 1183.82 |
| 26 | 12.200 | 7704.05 | 631.48 | 434.13 | 35.58 | 46.09 | 3.78 | 8184.26 | 670.84 |
| 27 | 71.500 | 8235.78 | 115.89 | 466.88 | 6.53 | 49.56 | 0.69 | 8802.22 | 123.11 |
| 28 | 15.420 | 2450.41 | 158.91 | 138.05 | 8.95 | 14.65 | 0.95 | 2603.12 | 168.81 |
| 29 | 9.020 | 2246.12 | 249.02 | 126.59 | 14.03 | 13.43 | 1.49 | 2386.14 | 264.54 |
| 30 | 10.340 | 9666.53 | 934.87 | 544.69 | 52.68 | 59.62 | 5.77 | 10270.83 | 993.31 |
| 31 | 5.150 | 4405.74 | 855.48 | 248.23 | 48.20 | 26.35 | 5.12 | 4680.32 | 908.80 |
| 32 | 93.150 | 17847.54 | 191.60 | 1005.64 | 10.80 | 106.76 | 1.15 | 18959.94 | 203.54 |
| 33 | 6.770 | 3174.11 | 468.85 | 178.87 | 26.42 | 18.98 | 2.80 | 3371.96 | 498.07 |
| 34 | 10.990 | 7812.18 | 710.84 | 440.19 | 40.05 | 46.74 | 4.25 | 8299.10 | 755.15 |
| 35 | 4.790 | 4998.13 | 1043.45 | 281.65 | 58.80 | 29.90 | 6.24 | 5309.68 | 1108.49 |
| 36 | 12.820 | 11203.52 | 873.91 | 631.27 | 49.24 | 74.03 | 5.77 | 11908.81 | 928.92 |
| 37 | 44.990 | 6362.34 | 141.42 | 358.48 | 7.97 | 38.06 | 0.85 | 6758.89 | 150.23 |
| 38 | 38.720 | 7228.39 | 186.68 | 407.29 | 10.52 | 43.25 | 1.12 | 7678.93 | 198.32 |
| 39 | 11.300 | 12621.91 | 1116.98 | 711.20 | 62.94 | 75.50 | 6.68 | 13408.60 | 1186.60 |
| 40 | 22.870 | 25170.46 | 1100.59 | 1418.32 | 62.02 | 152.26 | 6.66 | 26741.04 | 1169.26 |
| 41 | 19.580 | 6145.77 | 313.88 | 346.30 | 17.69 | 40.04 | 2.05 | 6532.11 | 333.61 |
| 42 | 13.010 | 11036.73 | 848.33 | 621.87 | 47.80 | 66.03 | 5.08 | 11724.62 | 901.20 |
| 43 | 50.620 | 7793.48 | 153.96 | 439.16 | 8.63 | 47.88 | 0.95 | 8280.52 | 163.58 |
| 44 | 20.230 | 27161.34 | 1342.63 | 1530.46 | 75.65 | 165.81 | 8.20 | 28857.63 | 1426.48 |
| 45 | 34.440 | 7336.60 | 213.03 | 413.42 | 12.00 | 43.09 | 1.25 | 7793.10 | 226.28 |
| 46 | 20.510 | 17628.13 | 859.49 | 993.29 | 48.43 | 105.78 | 5.16 | 18727.20 | 913.08 |
| 47 | 58.340 | 14356.13 | 246.08 | 808.90 | 13.87 | 87.52 | 1.50 | 15252.54 | 261.44 |
| 48 | 8.280 | 10007.20 | 1208.60 | 563.91 | 68.11 | 57.11 | 6.90 | 10628.21 | 1283.60 |
| 49 | 11.380 | 5445.22 | 478.49 | 306.85 | 26.96 | 30.74 | 2.70 | 5782.80 | 508.15 |
| 50 | 25.780 | 51059.28 | 1980.58 | 2877.06 | 111.60 | 306.15 | 11.88 | 54242.49 | 2104.05 |
| 51 | 18.640 | 8973.43 | 481.41 | 505.67 | 27.13 | 50.43 | 2.71 | 9529.53 | 511.24 |
| 52 | 25.130 | 10128.97 | 403.06 | 346.22 | 13.78 | 38.25 | 1.52 | 10513.43 | 418.36 |
| 53 | 189.390 | 25018.59 | 132.10 | 855.12 | 4.52 | 93.68 | 0.49 | 25967.38 | 137.11 |
| 54 | 339.420 | 17579.57 | 51.79 | 600.84 | 1.77 | 65.25 | 0.19 | 18245.66 | 53.76 |
| 55 | 239.000 | 16602.44 | 69.47 | 567.48 | 2.37 | 64.07 | 0.27 | 17233.98 | 72.11 |
| 56 | 38.230 | 7296.04 | 190.85 | 662.72 | 17.33 | 74.29 | 1.94 | 8033.05 | 210.12 |
| 57 | 251.770 | 14212.66 | 56.45 | 1290.99 | 5.13 | 144.79 | 0.58 | 15648.43 | 62.15 |
| 58 | 375.250 | 13503.15 | 35.98 | 1226.58 | 3.27 | 137.56 | 0.37 | 14867.29 | 39.62 |
| 59 | 91.090 | 48268.38 | 529.90 | 2327.37 | 31.04 | 317.52 | 3.49 | 51413.26 | 564.42 |
| 60 | 20.500 | 598[illegible].45 | 292.02 | 350.64 | 17.10 | 37.25 | 1.82 | 6374.34 | 310.94 |
| 61 | 17.290 | 8187.59 | 473.54 | 479.55 | 27.74 | 53.74 | 3.11 | 8720.88 | 504.39 |
| 62 | 233.970 | 31577.23 | 134.96 | 1849.63 | 7.91 | 200.61 | 0.86 | 33627.46 | 143.73 |
| 63 | 513.300 | 35690.96 | 69.53 | 2090.63 | 4.07 | 232.18 | 0.45 | 38013.77 | 74.06 |
| 64 | 173.830 | 27885.47 | 160.42 | 1633.43 | 9.40 | 203.98 | 1.17 | 29722.87 | 170.99 |
| 65 | 62.340 | 31097.82 | 498.84 | 1336.81 | 21.44 | 164.28 | 2.64 | 32598.90 | 522.92 |
| 66 | 344.910 | 25198.93 | 73.03 | 1082.81 | 3.14 | 125.45 | 0.36 | 26397.21 | 76.53 |
| 67 | 431.110 | 31853.86 | 73.91 | 1369.76 | 3.18 | 157.46 | 0.39 | 33401.08 | 77.48 |
| 68 | 24.480 | 9482.23 | 387.35 | 407.58 | 16.65 | 49.35 | 2.02 | 9939.16 | 406.01 |
| 69 | 53.660 | 17972.72 | 334.31 | 1589.36 | 29.61 | 170.67 | 3.18 | 19732.74 | 367.60 |
| 70 | 46.990 | 23067.63 | 490.91 | 2039.89 | 43.41 | 223.53 | 4.76 | 25331.04 | 539.07 |
| 71 | 243.210 | 17144.86 | 70.49 | 1516.11 | 6.23 | 163.16 | 0.67 | 18824.13 | 77.40 |
| 72 | 94.610 | 6316.43 | 66.76 | 558.59 | 5.90 | 60.11 | 0.64 | 6935.13 | 73.30 |

CITY OF PITTSBURGH CALENDAR YEAR IS 1972

REGION NO. 5 POLLUTANT SPECIES IS HYDROCARBONS

MODEL YEARS CONSIDERED IS FROM 1960 TO 1973

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY – | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) |
| 1 | 1.260 | 3392.29 | 2692.30 | 504.09 | 400.08 | 26.81 | 21.27 | 3923.19 | 3113.65 |
| 2 | 2.070 | 2076.51 | 1003.14 | 307.05 | 148.33 | 16.92 | 8.17 | 2400.48 | 1159.65 |
| 3 | 3.850 | 3082.60 | 800.68 | 457.26 | 118.77 | 24.63 | 6.40 | 3564.49 | 925.84 |
| 4 | 2.890 | 397.03 | 137.38 | 59.25 | 20.50 | 3.05 | 1.05 | 459.32 | 158.94 |
| 5 | 5.820 | 1107.83 | 190.35 | 165.55 | 28.44 | 8.45 | 1.45 | 1281.83 | 220.24 |
| 6 | 4.230 | 3162.90 | 747.73 | 469.20 | 110.92 | 25.26 | 5.97 | 3657.36 | 864.62 |
| 7 | 4.540 | 1533.56 | 337.79 | 229.01 | 50.44 | 11.74 | 2.59 | 1774.31 | 390.82 |
| 8 | 1.960 | 336.93 | 171.91 | 50.44 | 25.74 | 2.53 | 1.29 | 389.91 | 198.93 |
| 9 | 2.550 | 1844.87 | 723.48 | 275.12 | 107.89 | 14.25 | 5.59 | 2134.24 | 836.96 |
| 10 | 6.990 | 1143.55 | 163.60 | 169.77 | 24.29 | 9.09 | 1.30 | 1322.41 | 189.19 |
| 11 | 1.520 | 608.60 | 400.40 | 90.37 | 59.45 | 4.83 | 3.18 | 703.80 | 463.03 |
| 12 | 3.060 | 676.35 | 221.03 | 100.31 | 32.78 | 5.40 | 1.77 | 782.06 | 255.58 |
| 13 | 2.270 | 583.31 | 256.96 | 86.91 | 38.29 | 4.53 | 2.00 | 674.75 | 297.25 |
| 14 | 3.890 | 3288.64 | 845.41 | 480.65 | 123.56 | 28.69 | 7.37 | 3797.97 | 976.34 |
| 15 | 5.510 | 742.52 | 134.76 | 110.33 | 20.02 | 5.87 | 1.07 | 858.73 | 155.85 |
| 16 | 1.280 | 1177.53 | 919.95 | 174.83 | 136.58 | 9.36 | 7.31 | 1361.72 | 1063.84 |
| 17 | 1.210 | 779.48 | 644.20 | 115.88 | 95.77 | 6.14 | 5.07 | 901.49 | 745.04 |
| 18 | 2.550 | 1307.67 | 512.81 | 193.84 | 76.02 | 10.49 | 4.12 | 1512.00 | 592.94 |
| 19 | 1.850 | 311.54 | 168.40 | 46.22 | 24.98 | 2.48 | 1.34 | 360.25 | 194.73 |
| 20 | 1.690 | 410.82 | 243.09 | 56.36 | 33.35 | 3.20 | 1.89 | 476.34 | 27[illegible].33 |
| 21 | 7.170 | 2234.44 | 311.64 | 167.75 | 23.40 | 11.74 | 1.64 | 2413.94 | 336.67 |
| 22 | 24.780 | 4597.20 | 185.52 | 342.88 | 13.84 | 24.94 | 1.01 | 4965.02 | 200.36 |
| 23 | 3.070 | 1277.21 | 416.03 | 95.56 | 31.13 | 6.82 | 2.22 | 1379.62 | 449.39 |
| 24 | 3.890 | 609.55 | 156.70 | 46.03 | 11.83 | 3.29 | 0.85 | 658.87 | 169.38 |
| 25 | 9.190 | 1815.30 | 197.53 | 134.21 | 14.60 | 102.58 | 11.16 | 2052.10 | 223.30 |
| 26 | 12.200 | 1392.03 | 114.10 | 103.75 | 8.50 | 7.58 | 0.62 | 1503.36 | 123.23 |
| 27 | 71.500 | 1497.14 | 20.94 | 111.58 | 1.56 | 8.15 | 0.11 | 1616.87 | 22.61 |
| 28 | 15.420 | 442.76 | 28.71 | 32.99 | 2.14 | 2.41 | 0.16 | 478.16 | 31.01 |
| 29 | 9.020 | 405.85 | 44.99 | 30.25 | 3.35 | 2.21 | 0.24 | 438.31 | 48.59 |
| 30 | 10.340 | 1768.41 | 171.03 | 131.29 | 12.70 | 9.81 | 0.95 | 1909.50 | 184.67 |
| 31 | 5.150 | 796.06 | 154.58 | 59.32 | 11.52 | 4.33 | 0.84 | 859.72 | 166.94 |
| 32 | 93.150 | 3224.83 | 34.62 | 240.33 | 2.58 | 17.56 | 0.19 | 3482.72 | 37.39 |
| 33 | 6.770 | 573.52 | 84.72 | 42.75 | 6.31 | 3.12 | 0.46 | 619.39 | 91.49 |
| 34 | 10.990 | 1411.56 | 128.44 | 105.20 | 9.57 | 7.69 | 0.70 | 1524.45 | 138.71 |
| 35 | 4.790 | 903.10 | 188.54 | 67.31 | 14.05 | 4.92 | 1.03 | 975.33 | 203.62 |
| 36 | 12.820 | 2124.29 | 165.70 | 156.55 | 12.21 | 12.18 | 0.95 | 2293.02 | 178.86 |
| 37 | 44.990 | 1149.60 | 25.55 | 85.67 | 1.90 | 6.26 | 0.14 | 1241.53 | 27.60 |
| 38 | 38.720 | 1306.08 | 33.73 | 97.33 | 2.51 | 7.11 | 0.18 | 1410.53 | 36.43 |
| 39 | 11.300 | 2280.62 | 201.83 | 169.96 | 15.04 | 12.42 | 1.10 | 2463.01 | 217.97 |
| 40 | 22.870 | 4572.18 | 199.92 | 340.33 | 14.88 | 25.04 | 1.10 | 4937.55 | 215.90 |
| 41 | 19.580 | 1159.09 | 59.20 | 85.58 | 4.37 | 6.59 | 0.34 | 1251.26 | 63.91 |
| 42 | 13.010 | 1994.20 | 153.28 | 148.62 | 11.42 | 10.86 | 0.83 | 2153.68 | 165.54 |
| 43 | 50.620 | 1426.87 | 28.19 | 106.04 | 2.09 | 7.88 | 0.16 | 1540.79 | 30.44 |
| 44 | 20.230 | 4959.71 | 245.17 | 368.86 | 18.23 | 27.27 | 1.35 | 5355.84 | 264.75 |
| 45 | 34.440 | 1314.23 | 38.16 | 98.15 | 2.85 | 7.09 | 0.21 | 1419.47 | 41.22 |
| 46 | 20.510 | 3191.16 | 155.59 | 237.76 | 11.59 | 17.40 | 0.85 | 3446.31 | 168.03 |
| 47 | 58.340 | 2618.73 | 44.89 | 194.77 | 3.34 | 14.39 | 0.25 | 2827.89 | 48.47 |
| 48 | 8.280 | 1768.87 | 213.63 | 132.53 | 16.01 | 9.39 | 1.13 | 1910.79 | 230.77 |
| 49 | 11.380 | 957.84 | 84.17 | 71.85 | 6.31 | 5.06 | 0.44 | 1034.74 | 90.93 |
| 50 | 25.780 | 9243.66 | 358.56 | 688.84 | 26.72 | 50.35 | 1.95 | 9982.85 | 387.23 |
| 51 | 18.640 | 1575.10 | 84.50 | 118.21 | 6.34 | 8.30 | 0.45 | 1701.61 | 91.29 |
| 52 | 25.130 | 1889.57 | 75.19 | 84.81 | 3.37 | 6.29 | 0.25 | 1980.67 | 78.82 |
| 53 | 189.390 | 4646.86 | 24.54 | 208.75 | 1.10 | 15.41 | 0.08 | 4871.02 | 25.72 |
| 54 | 339.420 | 3250.75 | 9.58 | 146.17 | 0.43 | 10.73 | 0.03 | 3407.65 | 10.04 |
| 55 | 239.000 | 3131.88 | 13.10 | 140.24 | 0.59 | 10.54 | 0.04 | 3282.66 | 13.73 |
| 56 | 38.230 | 1343.69 | 35.15 | 160.71 | 4.20 | 12.22 | 0.32 | 1516.62 | 39.67 |
| 57 | 251.770 | 2618.05 | 10.40 | 313.11 | 1.24 | 23.81 | 0.09 | 2954.98 | 11.74 |
| 58 | 375.250 | 2487.36 | 6.63 | 297.49 | 0.79 | 22.63 | 0.06 | 2807.47 | 7.48 |
| 59 | 91.090 | 9138.89 | 100.33 | 700.76 | 7.69 | 52.22 | 0.57 | 9891.88 | 108.59 |
| 60 | 20.500 | 1101.60 | 53.74 | 84.98 | 4.15 | 6.13 | 0.30 | 1192.70 | 58.18 |
| 61 | 17.290 | 1548.29 | 89.55 | 118.74 | 6.87 | 8.84 | 0.51 | 1675.87 | 96.93 |
| 62 | 233.970 | 5872.52 | 25.10 | 451.99 | 1.93 | 33.00 | 0.14 | 6357.50 | 27.17 |
| 63 | 513.300 | 6718.59 | 13.09 | 515.80 | 1.00 | 38.19 | 0.07 | 7272.58 | 14.17 |
| 64 | 173.830 | 5585.72 | 32.13 | 423.41 | 2.44 | 33.55 | 0.19 | 6042.68 | 34.76 |
| 65 | 62.340 | 5928.04 | 95.09 | 333.11 | 5.34 | 27.02 | 0.43 | 6288.17 | 100.87 |
| 66 | 344.910 | 4658.82 | 13.51 | 263.46 | 0.76 | 20.64 | 0.06 | 4942.92 | 14.33 |
| 67 | 431.110 | 6057.50 | 14.05 | 340.58 | 0.79 | 27.54 | 0.06 | 6425.63 | 14.90 |
| 68 | 24.480 | 1793.51 | 73.26 | 100.94 | 4.12 | 8.12 | 0.33 | 1902.57 | 77.72 |
| 69 | 53.680 | 3304.87 | 61.57 | 384.95 | 7.17 | 28.07 | 0.52 | 3717.90 | 69.26 |
| 70 | 46.990 | 4285.40 | 91.20 | 499.07 | 10.60 | 36.77 | 0.78 | 4820.24 | 102.58 |
| 71 | 243.210 | 3155.90 | 12.98 | 367.50 | 1.51 | 26.84 | 0.11 | 3550.24 | 14.60 |
| 72 | 54.610 | 1162.68 | 12.29 | 135.40 | 1.43 | 9.89 | 0.10 | 1307.97 | 13.82 |

CITY OF PITTSBURGH CALENDAR YEAR IS 1977

REGION NO. 5 POLLUTANT SPECIES IS CARBON MONOXIDE

MODEL YEARS CONSIDERED IS FROM 1965 TO 1978

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY - | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) |
| 1 | 1.260 | 11494.10 | 9122.30 | 2157.77 | 1712.51 | 177.30 | 140.72 | 13829.16 | 10975.53 |
| 2 | 2.070 | 6779.83 | 3275.28 | 1288.19 | 622.31 | 110.44 | 53.35 | 8178.45 | 3950.94 |
| 3 | 3.850 | 10118.42 | 2628.16 | 1907.72 | 495.51 | 159.22 | 41.36 | 12185.35 | 3165.03 |
| 4 | 2.890 | 1331.29 | 460.66 | 247.50 | 85.64 | 19.63 | 6.79 | 1598.43 | 553.09 |
| 5 | 5.820 | 3521.21 | 605.02 | 652.83 | 112.17 | 51.21 | 8.80 | 4225.24 | 725.99 |
| 6 | 4.230 | 10527.31 | 2488.73 | 1984.46 | 469.14 | 165.48 | 39.12 | 12677.26 | 2996.99 |
| 7 | 4.540 | 5213.04 | 1148.25 | 968.06 | 213.23 | 76.39 | 16.83 | 6257.49 | 1378.30 |
| 8 | 1.960 | 1180.54 | 602.32 | 217.80 | 111.12 | 16.74 | 8.54 | 1415.08 | 721.98 |
| 9 | 2.550 | 6283.28 | 2464.03 | 1170.65 | 459.08 | 93.56 | 36.69 | 7547.49 | 2959.80 |
| 10 | 6.990 | 3745.67 | 535.86 | 705.88 | 100.98 | 58.82 | 8.42 | 4510.36 | 645.26 |
| 11 | 1.520 | 1913.55 | 1258.91 | 360.40 | 237.10 | 29.96 | 19.71 | 2303.91 | 1515.73 |
| 12 | 3.060 | 2042.32 | 667.43 | 385.75 | 126.06 | 32.41 | 10.59 | 2460.48 | 804.08 |
| 13 | 2.270 | 1794.22 | 790.41 | 335.14 | 147.64 | 27.02 | 11.90 | 2156.38 | 949.95 |
| 14 | 3.890 | 10108.20 | 2598.51 | 1980.98 | 509.25 | 187.61 | 48.23 | 12276.79 | 3155.99 |
| 15 | 5.510 | 2272.55 | 412.44 | 427.40 | 77.57 | 35.37 | 6.42 | 2735.32 | 496.43 |
| 16 | 1.280 | 4697.62 | 3670.01 | 885.29 | 691.63 | 73.76 | 57.63 | 5656.66 | 4419.27 |
| 17 | 1.210 | 2663.40 | 2201.16 | 500.15 | 413.35 | 41.13 | 33.99 | 3204.68 | 2648.50 |
| 18 | 2.550 | 4192.75 | 1644.22 | 793.37 | 311.13 | 67.05 | 26.29 | 5053.16 | 1981.63 |
| 19 | 1.850 | 886.65 | 479.27 | 167.32 | 90.44 | 14.00 | 7.57 | 1067.97 | 577.28 |
| 20 | 1.690 | 1567.59 | 927.57 | 293.00 | 173.38 | 23.68 | 14.01 | 1884.27 | 1114.95 |
| 21 | 7.170 | 6593.18 | 919.55 | 722.3[illegible] | 100.74 | 83.11 | 11.59 | 7398.63 | 1031.89 |
| 22 | 24.780 | 12190.81 | 491.96 | 1359.5[illegible] | 54.87 | 162.97 | 6.58 | 13713.34 | 553.40 |
| 23 | 3.070 | 3516.56 | 1145.46 | 388.7[illegible] | 126.64 | 45.70 | 14.89 | 3951.03 | 1286.98 |
| 24 | 3.890 | 1925.16 | 494.90 | 214.23 | 55.07 | 25.55 | 6.57 | 2164.94 | 556.54 |
| 25 | 9.190 | 5443.68 | 592.35 | 321.41 | 67.62 | 78.35 | 8.53 | 6143.44 | 668.49 |
| 26 | 12.200 | 4177.26 | 342.40 | 467.21 | 38.30 | 56.35 | 4.62 | 4700.82 | 385.31 |
| 27 | 71.500 | 4526.21 | 63.30 | 506.1[illegible] | 7.08 | 61.07 | 0.85 | 5093.47 | 71.24 |
| 28 | 15.420 | 1299.28 | 84.26 | 145.30 | 9.42 | 17.53 | 1.14 | 1462.12 | 94.82 |
| 29 | 9.020 | 1144.14 | 126.85 | 127.93 | 14.18 | 15.43 | 1.71 | 1287.50 | 142.74 |
| 30 | 10.340 | 5008.98 | 484.43 | 560.20 | 54.18 | 67.58 | 6.54 | 5636.75 | 545.14 |
| 31 | 5.150 | 2116.92 | 411.05 | 236.73 | 45.97 | 28.55 | 5.54 | 2382.21 | 462.56 |
| 32 | 93.150 | 9837.25 | 105.61 | 1100.16 | 11.81 | 132.73 | 1.42 | 11070.13 | 118.84 |
| 33 | 6.770 | 1765.38 | 260.77 | 197.43 | 29.16 | 23.82 | 3.52 | 1986.62 | 293.45 |
| 34 | 10.990 | 3653.57 | 332.44 | 408.58 | 37.18 | 49.29 | 4.48 | 4111.44 | 374.11 |
| 35 | 4.790 | 2286.01 | 477.25 | 255.66 | 53.37 | 30.84 | 6.44 | 2572.52 | 537.06 |
| 36 | 12.820 | 6668.52 | 520.16 | 767.58 | 59.87 | 98.46 | 7.68 | 7534.55 | 587.72 |
| 37 | 44.990 | 3783.60 | 84.10 | 423.16 | 9.41 | 51.05 | 1.13 | 4257.80 | 94.64 |
| 38 | 38.720 | 3737.41 | 96.52 | 417.95 | 10.79 | 50.43 | 1.30 | 4205.79 | 108.62 |
| 39 | 11.300 | 6495.13 | 574.79 | 726.39 | 64.28 | 87.64 | 7.76 | 7309.15 | 646.83 |
| 40 | 22.870 | 12490.07 | 546.17 | 1401.[illegible] | 61.27 | 170.24 | 7.44 | 14061.62 | 614.85 |
| 41 | 19.580 | 3436.25 | 175.50 | 393.91 | 20.12 | 50.11 | 2.56 | 3880.26 | 198.18 |
| 42 | 13.010 | 5705.65 | 438.56 | 638.09 | 49.05 | 76.99 | 5.92 | 6420.72 | 493.52 |
| 43 | 50.620 | 4648.64 | 91.83 | 523.83 | 10.35 | 64.27 | 1.27 | 5236.75 | 103.45 |
| 44 | 20.230 | 14445.94 | 714.08 | 1624.94 | 80.32 | 198.55 | 9.81 | 16269.43 | 804.22 |
| 45 | 34.440 | 3686.70 | 107.05 | 410.19 | 11.91 | 48.90 | 1.42 | 4145.79 | 120.38 |
| 46 | 20.510 | 8675.24 | 422.98 | 971.12 | 47.35 | 117.38 | 5.72 | 9763.73 | 476.05 |
| 47 | 58.340 | 7273.82 | 124.68 | 817.88 | 14.02 | 99.83 | 1.71 | 8191.52 | 140.41 |
| 48 | 8.290 | 4758.07 | 574.65 | 525.18 | 63.43 | 61.50 | 7.43 | 5344.74 | 645.50 |
| 49 | 11.380 | 2662.13 | 233.93 | 293.03 | 25.75 | 34.06 | 2.99 | 2989.22 | 262.67 |
| 50 | 25.780 | 25453.34 | 987.33 | 2848.58 | 110.50 | 344.15 | 13.35 | 28646.07 | 1111.17 |
| 51 | 18.640 | 4269.89 | 229.07 | 469.33 | 25.18 | 54.41 | 2.92 | 4793.63 | 257.17 |
| 52 | 25.130 | 4758.34 | 189.35 | 328.92 | 13.09 | 40.29 | 1.60 | 5127.55 | 204.04 |
| 53 | 189.390 | 13155.59 | 69.46 | 907.05 | 4.79 | 110.52 | 0.58 | 14173.16 | 74.84 |
| 54 | 339.420 | 9096.24 | 26.80 | 625.60 | 1.84 | 75.82 | 0.22 | 9797.66 | 28.87 |
| 55 | 239.000 | 8537.97 | 35.72 | 593.92 | 2.49 | 73.72 | 0.31 | 9205.61 | 38.52 |
| 56 | 38.230 | 3730.73 | 97.59 | 680.30 | 17.79 | 85.37 | 2.23 | 4496.40 | 117.61 |
| 57 | 251.770 | 7679.18 | 30.50 | 1400.53 | 5.56 | 175.81 | 0.70 | 9255.52 | 36.76 |
| 58 | 375.250 | 7054.70 | 18.80 | 1286.64 | 3.43 | 161.50 | 0.43 | 8502.84 | 22.66 |
| 59 | 91.090 | 25055.28 | 275.06 | 2993.23 | 32.86 | 368.52 | 4.05 | 28417.02 | 311.97 |
| 60 | 20.500 | 2858.36 | 139.43 | 335.97 | 16.39 | 39.95 | 1.95 | 3234.29 | 157.77 |
| 61 | 17.290 | 3908.68 | 226.07 | 466.62 | 26.99 | 57.37 | 3.32 | 4432.67 | 256.37 |
| 62 | 233.970 | 16629.33 | 71.07 | 1966.43 | 8.40 | 237.00 | 1.01 | 18832.76 | 80.49 |
| 63 | 513.300 | 19476.69 | 37.95 | 2313.22 | 4.51 | 282.86 | 0.55 | 22022.76 | 42.90 |
| 64 | 173.830 | 14593.05 | 83.95 | 1800.58 | 10.36 | 236.10 | 1.36 | 16629.73 | 95.67 |
| 65 | 62.340 | 16086.80 | 258.05 | 1415.92 | 22.71 | 189.77 | 3.04 | 17692.49 | 283.81 |
| 66 | 344.910 | 14184.45 | 41.13 | 1227.13 | 3.56 | 158.67 | 0.46 | 15570.24 | 45.14 |
| 67 | 431.110 | 17111.61 | 39.69 | 1503.73 | 3.49 | 200.92 | 0.47 | 18816.26 | 43.65 |
| 68 | 24.480 | 4573.92 | 186.34 | 400.78 | 16.37 | 53.23 | 2.17 | 5027.92 | 205.39 |
| 69 | 53.680 | 9092.23 | 169.38 | 1612.67 | 30.04 | 194.10 | 3.62 | 10898.95 | 203.04 |
| 70 | 46.990 | 11303.87 | 240.56 | 2016.68 | 42.92 | 245.78 | 5.23 | 13566.32 | 288.71 |
| 71 | 243.210 | 9348.30 | 38.44 | 1659.11 | 6.82 | 199.94 | 0.82 | 11207.35 | 46.08 |
| 72 | 94.610 | 3195.00 | 33.77 | 567.01 | 5.99 | 68.33 | 0.72 | 3830.34 | 40.49 |

CITY OF PITTSBURGH CALENDAR YEAR IS 1977

REGION NO. 5 POLLUTANT SPECIES IS HYDROCARBONS

MODEL YEARS CONSIDERED IS FROM 1965 TO 1978

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY - | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) |
| 1 | 1.260 | 1390.03 | 1103.20 | 374.68 | 297.36 | 29.16 | 23.14 | 1793.87 | 1423.70 |
| 2 | 2.070 | 838.48 | 405.06 | 226.92 | 109.62 | 18.16 | 8.78 | 1083.57 | 523.46 |
| 3 | 3.850 | 1233.80 | 320.47 | 333.04 | 86.50 | 26.19 | 6.80 | 1593.02 | 413.77 |
| 4 | 2.890 | 158.52 | 54.85 | 42.57 | 14.73 | 3.23 | 1.12 | 204.32 | 70.70 |
| 5 | 5.820 | 416.83 | 71.62 | 111.84 | 19.22 | 8.42 | 1.45 | 537.10 | 92.28 |
| 6 | 4.230 | 1282.78 | 303.26 | 346.26 | 81.86 | 27.22 | 6.43 | 1656.26 | 391.55 |
| 7 | 4.540 | 619.16 | 136.38 | 166.22 | 36.61 | 12.57 | 2.77 | 797.94 | 175.76 |
| 8 | 1.960 | 138.29 | 70.55 | 37.05 | 18.90 | 2.75 | 1.40 | 178.09 | 90.86 |
| 9 | 2.550 | 751.34 | 294.64 | 201.92 | 79.19 | 15.39 | 6.03 | 968.66 | 379.86 |
| 10 | 6.990 | 458.28 | 65.56 | 123.62 | 17.69 | 9.67 | 1.38 | 591.58 | 84.63 |
| 11 | 1.520 | 233.82 | 153.83 | 63.06 | 41.49 | 4.93 | 3.24 | 301.80 | 198.56 |
| 12 | 3.060 | 251.05 | 82.04 | 67.76 | 22.15 | 5.33 | 1.74 | 324.14 | 105.93 |
| 13 | 2.270 | 215.63 | 94.99 | 58.00 | 25.55 | 4.44 | 1.96 | 278.07 | 122.50 |
| 14 | 3.890 | 1325.77 | 340.81 | 362.18 | 93.10 | 30.85 | 7.93 | 1718.80 | 441.85 |
| 15 | 5.510 | 276.96 | 50.26 | 74.66 | 13.55 | 5.82 | 1.06 | 357.43 | 64.87 |
| 16 | 1.280 | 574.76 | 449.03 | 155.04 | 121.13 | 12.13 | 9.48 | 741.93 | 579.63 |
| 17 | 1.210 | 323.54 | 267.39 | 87.18 | 72.05 | 6.76 | 5.59 | 417.48 | 345.02 |
| 18 | 2.550 | 517.13 | 202.80 | 139.68 | 54.78 | 11.03 | 4.32 | 667.84 | 261.90 |
| 19 | 1.850 | 108.77 | 58.80 | 29.35 | 15.87 | 2.30 | 1.24 | 140.43 | 75.91 |
| 20 | 1.690 | 188.62 | 111.61 | 50.75 | 30.03 | 3.89 | 2.30 | 243.27 | 143.94 |
| 21 | 7.170 | 968.44 | 135.07 | 141.22 | 19.70 | 13.67 | 1.91 | 1123.33 | 156.67 |
| 22 | 24.790 | 1835.92 | 74.09 | 269.10 | 10.86 | 26.81 | 1.08 | 2131.83 | 86.03 |
| 23 | 3.070 | 523.53 | 170.53 | 76.53 | 24.93 | 7.52 | 2.45 | 607.58 | 197.91 |
| 24 | 3.890 | 289.38 | 74.39 | 42.38 | 10.89 | 4.20 | 1.08 | 335.97 | 86.37 |
| 25 | 9.190 | 845.33 | 91.98 | 124.75 | 13.57 | 12.89 | 1.40 | 982.96 | 106.96 |
| 26 | 12.200 | 632.45 | 51.84 | 92.76 | 7.60 | 9.27 | 0.76 | 734.49 | 60.20 |
| 27 | 71.500 | 685.29 | 9.58 | 100.50 | 1.41 | 10.04 | 0.14 | 795.84 | 11.13 |
| 28 | 15.420 | 196.72 | 12.76 | 28.85 | 1.87 | 2.88 | 0.19 | 228.45 | 14.82 |
| 29 | 9.020 | 173.23 | 19.21 | 25.40 | 2.82 | 2.54 | 0.28 | 201.17 | 22.30 |
| 30 | 10.340 | 758.39 | 73.35 | 111.22 | 10.76 | 11.12 | 1.07 | 880.73 | 85.18 |
| 31 | 5.150 | 320.51 | 62.24 | 47.00 | 9.13 | 4.70 | 0.91 | 372.21 | 72.27 |
| 32 | 93.150 | 1489.41 | 15.99 | 218.43 | 2.34 | 21.83 | 0.23 | 1729.68 | 18.57 |
| 33 | 6.770 | 267.29 | 39.48 | 39.20 | 5.79 | 3.92 | 0.58 | 310.40 | 45.85 |
| 34 | 10.990 | 553.17 | 50.33 | 81.12 | 7.38 | 8.11 | 0.74 | 642.40 | 58.45 |
| 35 | 4.790 | 346.11 | 72.26 | 50.76 | 10.60 | 5.07 | 1.06 | 401.95 | 83.91 |
| 36 | 12.820 | 1046.25 | 81.61 | 154.77 | 12.07 | 16.19 | 1.26 | 1217.21 | 94.95 |
| 37 | 44.990 | 572.86 | 12.73 | 84.02 | 1.87 | 8.40 | 0.19 | 665.27 | 14.79 |
| 38 | 38.720 | 565.87 | 14.61 | 82.98 | 2.14 | 8.30 | 0.21 | 657.14 | 16.97 |
| 39 | 11.300 | 983.40 | 87.03 | 144.22 | 12.76 | 14.41 | 1.28 | 1142.03 | 101.07 |
| 40 | 22.870 | 1898.51 | 83.01 | 278.71 | 12.19 | 28.00 | 1.22 | 2205.22 | 96.42 |
| 41 | 19.580 | 537.28 | 27.44 | 79.36 | 4.05 | 8.24 | 0.42 | 624.88 | 31.91 |
| 42 | 13.010 | 853.87 | 65.40 | 126.69 | 9.74 | 12.66 | 0.97 | 1003.22 | 77.11 |
| 43 | 50.620 | 710.84 | 14.04 | 104.49 | 2.06 | 10.57 | 0.21 | 825.89 | 16.32 |
| 44 | 20.230 | 2204.96 | 108.99 | 323.90 | 16.01 | 32.66 | 1.61 | 2561.52 | 126.62 |
| 45 | 34.440 | 554.62 | 16.10 | 81.21 | 2.36 | 8.04 | 0.23 | 643.88 | 18.70 |
| 46 | 20.510 | 1315.46 | 64.14 | 192.97 | 9.41 | 19.31 | 0.94 | 1527.73 | 74.49 |
| 47 | 58.340 | 1109.27 | 19.01 | 162.94 | 2.79 | 16.42 | 0.28 | 1288.64 | 22.09 |
| 48 | 8.280 | 708.75 | 85.60 | 103.52 | 12.50 | 10.11 | 1.22 | 822.38 | 99.32 |
| 49 | 11.380 | 395.12 | 34.72 | 57.67 | 5.07 | 5.60 | 0.49 | 458.38 | 40.28 |
| 50 | 25.780 | 3860.34 | 149.74 | 566.20 | 21.96 | 56.61 | 2.20 | 4483.14 | 173.90 |
| 51 | 18.640 | 632.74 | 33.95 | 92.29 | 4.95 | 8.95 | 0.48 | 733.98 | 39.38 |
| 52 | 25.130 | 737.80 | 29.36 | 66.00 | 2.63 | 6.63 | 0.26 | 810.43 | 32.25 |
| 53 | 189.390 | 2033.11 | 10.74 | 181.74 | 0.96 | 18.18 | 0.10 | 2233.03 | 11.79 |
| 54 | 339.420 | 1401.09 | 4.13 | 125.16 | 0.37 | 12.47 | 0.04 | 1538.72 | 4.53 |
| 55 | 239.000 | 1334.97 | 5.59 | 119.63 | 0.50 | 12.13 | 0.05 | 1466.73 | 6.14 |
| 56 | 38.230 | 572.88 | 14.99 | 135.91 | 3.56 | 14.04 | 0.37 | 722.83 | 18.91 |
| 57 | 251.770 | 1179.38 | 4.68 | 279.81 | 1.11 | 28.92 | 0.11 | 1488.11 | 5.91 |
| 58 | 375.250 | 1083.47 | 2.89 | 257.06 | 0.69 | 26.56 | 0.07 | 1367.10 | 3.64 |
| 59 | 91.090 | 3928.45 | 43.13 | 603.69 | 6.63 | 60.61 | 0.67 | 4592.75 | 50.42 |
| 60 | 20.500 | 438.66 | 21.40 | 67.10 | 3.27 | 6.57 | 0.32 | 512.33 | 24.99 |
| 61 | 17.290 | 612.28 | 35.41 | 94.07 | 5.44 | 9.44 | 0.55 | 715.77 | 41.40 |
| 62 | 233.970 | 2572.43 | 10.99 | 394.18 | 1.68 | 38.98 | 0.17 | 3005.57 | 12.85 |
| 63 | 513.300 | 3032.71 | 5.91 | 465.63 | 0.91 | 46.52 | 0.09 | 3544.86 | 6.91 |
| 64 | 173.830 | 2386.61 | 13.73 | 359.99 | 2.13 | 38.83 | 0.22 | 2795.42 | 16.08 |
| 65 | 62.340 | 2535.15 | 40.67 | 236.23 | 4.59 | 31.21 | 0.50 | 2852.59 | 45.76 |
| 66 | 344.910 | 2185.16 | 6.34 | 245.51 | 0.71 | 26.10 | 0.08 | 2456.77 | 7.12 |
| 67 | 431.110 | 2691.12 | 6.24 | 303.69 | 0.70 | 33.05 | 0.08 | 3027.86 | 7.02 |
| 68 | 24.480 | 716.60 | 29.27 | 80.80 | 3.30 | 8.76 | 0.36 | 806.16 | 32.93 |
| 69 | 53.650 | 1394.59 | 25.98 | 327.01 | 6.00 | 31.93 | 0.59 | 1748.53 | 32.57 |
| 70 | 46.990 | 1747.25 | 37.18 | 404.12 | 8.60 | 40.42 | 0.86 | 2191.79 | 46.64 |
| 71 | 243.210 | 1434.96 | 5.90 | 331.40 | 1.36 | 32.89 | 0.14 | 1799.24 | 7.40 |
| 72 | 94.510 | 490.43 | 5.18 | 113.20 | 1.20 | 11.24 | 0.12 | 614.93 | 6.50 |

CITY OF PITTSBURGH CALENDAR YEAR IS 1972

REGION NO. 5 POLLUTANT SPECIES IS CARBON MONOXIDE

EMISSION INDICES AND TOTAL EMISSIONS BY MODEL YEAR
FOR ZONE NO. 1

| VEHICLE CATEGORY - | LIGHT DUTY | | HEAVY DUTY | |
|---|---|---|---|---|
| CALENDAR YEAR | INDEX (GM/MILE) | EMISSIONS (KGM) | INDEX (GM/MILE) | EMISSIONS (KGM) |
| 1960 | 0.65 | 8856.07 | 5.63 | 2537.48 |
| 1961 | 0.22 | 3041.48 | 0.99 | 447.98 |
| 1962 | 0.40 | 5380.85 | 1.18 | 533.34 |
| 1963 | 0.97 | 13208.17 | 2.25 | 1012.90 |
| 1964 | 2.37 | 32216.80 | 2.85 | 1285.99 |
| 1965 | 2.73 | 37074.35 | 4.59 | 2070.37 |
| 1966 | 4.44 | 60291.20 | 5.91 | 2663.76 |
| 1967 | 5.16 | 70058.50 | 8.20 | 3694.21 |
| 1968 | 5.06 | 68739.50 | 8.64 | 3891.78 |
| 1969 | 4.49 | 60976.19 | 11.35 | 5113.89 |
| 1970 | 4.46 | 60552.40 | 12.26 | 5524.60 |
| 1971 | 7.26 | 98641.63 | 13.81 | 6225.43 |
| 1972 | 1.90 | 25794.53 | 7.01 | 3161.06 |
| 1973 | 0.14 | 1928.30 | 0.52 | 232.14 |
| | 40.25 | 546759.97 | 85.19 | 38394.93 |

40.25 × .8956 + 85.19 × .1044 = 44.97

CITY OF PITTSBURGH          CALENDAR YEAR IS 1972

REGION NO. 5          POLLUTANT SPECIES IS CARBON MONOXIDE

MODEL YEARS CONSIDERED IS FROM 1960 TO 1973

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY - | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) |
| 1 | ****** (745.400) | 546759.33 | 733.51 | 38394.91 | 51.51 | 3502.90 | 4.70 | 588657.13 | 789.72 |

$\frac{603589.96 - 588657.13}{603589.96} = 2.47\%$

CITY OF PITTSBURGH CALENDAR YEAR IS 1972

REGION NO. 5 POLLUTANT SPECIES IS HYDROCARBONS

EMISSION INDICES AND TOTAL EMISSIONS BY MODEL YEAR
FOR ZONE NO. 1

| VEHICLE CATEGORY – | LIGHT DUTY | | HEAVY DUTY | |
|---|---|---|---|---|
| CALENDAR YEAR | INDEX (GM/MILE) | EMISSIONS (KGM) | INDEX (GM/MILE) | EMISSIONS (KGM) |
| 1960 | 0.17 | 2276.08 | 1.41 | [illegible] |
| 1961 | 0.06 | 781.68 | 0.25 | 111.85 |
| 1962 | 0.10 | 1382.92 | 0.30 | 133.16 |
| 1963 | 0.19 | 2598.00 | 0.56 | 252.89 |
| 1964 | 0.47 | 6336.93 | 0.71 | 321.07 |
| 1965 | 0.54 | 7292.40 | 1.15 | 516.90 |
| 1966 | 0.87 | 11859.07 | 1.48 | 665.05 |
| 1967 | 1.01 | 13780.26 | 2.05 | 922.32 |
| 1968 | 0.70 | 9561.12 | 1.67 | 752.58 |
| 1969 | 0.83 | 11240.44 | 2.19 | 988.91 |
| 1970 | 0.86 | 11610.34 | 2.63 | 1185.40 |
| 1971 | 0.57 | 7683.39 | 3.03 | 1366.58 |
| 1972 | 0.29 | 3914.64 | 1.61 | 723.89 |
| 1973 | 0.02 | 330.24 | 0.11 | 51.19 |
| | 6.68 | 0647.51 | 19.15 | 8625.32 |

6.68 x .8956 + 19.15 x .1044 = 7.98

CITY OF PITTSBURGH CALENDAR YEAR IS 1972

REGION NO. 5 POLLUTANT SPECIES IS HYDROCARBONS

MODEL YEARS CONSIDERED IS FROM 1960 TO 1973

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY - | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | |
| 1 | 745.406 ****** | 90647.44 | 121.61 | 8525.29 | 11.57 | 576.15 | 0.77 | 99848.81 | 133.95 | $\frac{102178.92 - 99848.81}{102178.92} = 2.28\%$ |

CITY OF PITTSBURGH CALENDAR YEAR IS 1977

REGION NO. 5 POLLUTANT SPECIES IS CARBON MONOXIDE

EMISSION INDICES AND TOTAL EMISSIONS BY MODEL YEAR
FOR ZONE NO. 1

| VEHICLE CATEGORY - | LIGHT DUTY | | HEAVY DUTY | |
|---|---|---|---|---|
| CALENDAR YEAR | INDEX (GM/MILE) | EMISSIONS (KGM) | INDEX (GM/MILE) | EMISSIONS (KGM) |
| 1965 | 0.65 | 10083.14 | 5.63 | 2858.33 |
| 1966 | 0.22 | 3462.90 | 0.99 | 504.63 |
| 1967 | 0.40 | 6126.40 | 1.18 | 600.78 |
| 1968 | 0.91 | 14108.59 | 2.25 | 1140.97 |
| 1969 | 1.91 | 29477.90 | 2.85 | 1448.59 |
| 1970 | 1.66 | 25661.10 | 4.72 | 2396.74 |
| 1971 | 3.55 | 54826.77 | 5.93 | 3009.80 |
| 1972 | 1.87 | 28933.09 | 7.97 | 4046.07 |
| 1973 | 2.16 | 33322.38 | 8.13 | 4127.58 |
| 1974 | 2.16 | 33321.90 | 5.52 | 2800.93 |
| 1975 | 0.57 | 8735.88 | 9.27 | 4707.21 |
| 1976 | 0.60 | 9304.17 | 10.45 | 5304.35 |
| 1977 | 0.29 | 4446.30 | 5.31 | 2693.36 |
| 1978 | 0.02 | 292.70 | 0.39 | 197.80 |
| | 16.97 | 262103.22 | 70.59 | 33837.14 |

16.97 × .8956 + 70.59 × .1044 = 22.57

CITY OF PITTSBURGH                    CALENDAR YEAR IS 1977

REGION NO. 5                    POLLUTANT SPECIES IS CARBON MONOXIDE

MODEL YEARS CONSIDERED IS FROM 1965 TO 1978

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY - | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) |
| 1 | ****** (745.400) | 262102.56 | 351.63 | 35837.12 | 48.08 | 3947.62 | 5.30 | 301887.19 | 405.00 |

$\frac{317949.66 - 301887.19}{317949.66} = 5.05\%$

CITY OF PITTSBURGH CALENDAR YEAR IS 1977

REGION NO. 5 POLLUTANT SPECIES IS HYDROCARBONS

EMISSION INDICES AND TOTAL EMISSIONS BY MODEL YEAR
FOR ZONE NO. 1

VEHICLE CATEGORY - LIGHT DUTY / HEAVY DUTY

| CALENDAR YEAR | LIGHT DUTY INDEX (GM/MILE) | LIGHT DUTY EMISSIONS (KGM) | HEAVY DUTY INDEX (GM/MILE) | HEAVY DUTY EMISSIONS (KGM) |
|---|---|---|---|---|
| 1965 | 0.13 | 1983.32 | 1.41 | 713.63 |
| 1966 | 0.04 | 681.14 | 0.25 | 125.99 |
| 1967 | 0.08 | 1205.04 | 0.30 | 149.99 |
| 1968 | 0.12 | 1811.41 | 0.43 | 220.64 |
| 1969 | 0.33 | 5102.71 | 0.55 | 280.12 |
| 1970 | 0.30 | 4709.11 | 0.92 | 466.78 |
| 1971 | 0.27 | 4099.64 | 1.17 | 592.94 |
| 1972 | 0.26 | 3986.59 | 1.60 | 811.75 |
| 1973 | 0.30 | 4578.42 | 1.46 | 739.62 |
| 1974 | 0.30 | 4634.70 | 1.02 | 517.91 |
| 1975 | 0.11 | 1705.45 | 1.57 | 794.86 |
| 1976 | 0.12 | 1893.83 | 1.80 | 914.12 |
| 1977 | 0.06 | 983.46 | 0.95 | 481.69 |
| 1978 | 0.00 | 69.92 | 0.08 | 39.56 |
| | 2.42 | 37444.74 | 13.51 | 6849.60 |

2.42 × .8956 + 13.51 × .1044 = 3.58

CITY OF PITTSBURGH          CALENDAR YEAR IS 1977

REGION NO. 5          POLLUTANT SPECIES IS HYDROCARBONS

MODEL YEARS CONSIDERED IS FROM 1965 TO 1978

LENGTH OF TIME PERIOD IS 24 HOURS

| VEHICLE CATEGORY – | | LIGHT DUTY | | HEAVY DUTY | | OTHER | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ZONE NO. | AREA (SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | EMISSIONS (KGM) | EMISSION DENSITY (KGM/SQ.MI) | |
| 1 | 745.400 ****** | 37444.67 | 50.23 | 6849.61 | 9.19 | 649.30 | 0.87 | 44943.57 | 60.29 | $\frac{46935.10 - 44943.57}{46935.10} = 4.24\%$ |

# APPENDIX D

# 1972 AND 1977 VMT

Vehicle Miles of Travel (VMT)

Metropolitan Area Pittsburgh

Year 1972

Time Period Peak Hour

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 1 | Freeway | 31 | 7,044 | 362 | 136 | |
| | Arterial | 17 | 5,386 | 277 | 104 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 29,004 | 1,491 | 559 | |
| | TOTAL | | 41,434 | 2,130 | 799 | 1.26 |
| 2 | Freeway | 31 | 6,276 | 323 | 121 | |
| | Arterial | 17 | 7,583 | 390 | 146 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 12,290 | 632 | 237 | |
| | TOTAL | | 26,149 | 1,345 | 504 | 2.07 |
| 3 | Freeway | 31 | 7,234 | 372 | 139 | |
| | Arterial | 17 | 8,376 | 430 | 161 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 22,463 | 1,154 | 4 | |
| | TOTAL | | 38,073 | 1,956 | 734 | 3.85 |
| 4 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 2,545 | 131 | 49 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 2,168 | 111 | 42 | |
| | TOTAL | | 4,713 | 242 | 91 | 2.89 |
| 5 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 5,222 | 268 | 101 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 7,833 | 403 | 151 | |
| | TOTAL | | 13,055 | 671 | 252 | 5.82 |
| 6 | Freeway | 31 | 7,810 | 401 | 151 | |
| | Arterial | 17 | 6,248 | 321 | 120 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 24,993 | 1,284 | 482 | |
| | TOTAL | | 39,051 | 2,006 | 753 | 4.23 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 7 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 8, 711 | 448 | 168 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 9, 437 | 485 | 182 | |
| | TOTAL | | 18, 148 | 933 | 350 | 4. 54 |
| 8 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 548 | 28 | 11 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 3, 367 | 173 | 65 | |
| | TOTAL | | 3, 915 | 201 | 76 | 1. 96 |
| 9 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 14, 094 | 724 | 272 | |
| | Collector | | -- | -- | -- | |
| | Local | 13 | 7, 928 | 407 | 153 | |
| | TOTAL | | 22, 022 | 1,131 | 425 | 2. 55 |
| 10 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 6, 463 | 332 | 125 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 7, 586 | 390 | 146 | |
| | TOTAL | | 14, 049 | 722 | 271 | 6. 99 |
| 11 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 3, 285 | 169 | 63 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 4, 180 | 215 | 81 | |
| | TOTAL | | 7, 465 | 384 | 144 | 1. 52 |
| 12 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 4, 429 | 228 | 85 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 3, 928 | 202 | 76 | |
| | TOTAL | | 8, 357 | 430 | 161 | 3. 06 |
| 13 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 1, 262 | 65 | 24 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 5, 747 | 295 | 110 | |
| | TOTAL | | 7, 009 | 360 | 134 | 2. 27 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 14 | Freeway | 31 | 13,301 | 684 | 256 | |
| | Arterial | 18 | 23,498 | 1,208 | 453 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 7,537 | 387 | 145 | |
| | TOTAL | | 44,336 | 2,279 | 854 | 3.89 |
| 15 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 3,632 | 187 | 70 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 5,447 | 280 | 105 | |
| | TOTAL | | 9,079 | 467 | 175 | 5.51 |
| 16 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 6,655 | 342 | 128 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 7,812 | 402 | 151 | |
| | TOTAL | | 14,467 | 744 | 279 | 1.28 |
| 17 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 3,322 | 171 | 64 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 6,170 | 317 | 119 | |
| | TOTAL | | 9,492 | 488 | 183 | 1.21 |
| 18 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 9,409 | 484 | 182 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 6,813 | 350 | 131 | |
| | TOTAL | | 16,222 | 834 | 313 | 2.55 |
| 19 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 1,920 | 99 | 37 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 1,920 | 99 | 37 | |
| | TOTAL | | 3,840 | 198 | 74 | 1.85 |
| 20 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 989 | 51 | 19 | |
| | Collector | | -- | -- | -- | |
| | Local | 14 | 3,955 | 203 | 76 | |
| | TOTAL | | 4,944 | 254 | 95 | 1.69 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 21 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 21,918 | 591 | 227 | |
| | Collector | | -- | -- | -- | |
| | Local | 22 | 11,802 | 318 | 122 | |
| | TOTAL | | 33,720 | 909 | 349 | 7.17 |
| 22 | Freeway | 36 | 7,162 | 193 | 74 | |
| | Arterial | 28 | 55,151 | 1,488 | 572 | |
| | Collector | -- | -- | -- | -- | |
| | Local | 22 | 9,311 | 251 | 97 | |
| | TOTAL | | 71,624 | 1,932 | 743 | 24.78 |
| 23 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 15,865 | 428 | 165 | |
| | Collector | | -- | -- | -- | |
| | Local | 22 | 3,722 | 100 | 39 | |
| | TOTAL | | 19,587 | 528 | 204 | 3.07 |
| 24 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 8,697 | 235 | 90 | |
| | Collector | | -- | -- | -- | |
| | Local | 22 | 756 | 20 | 8 | |
| | TOTAL | | 9,453 | 255 | 98 | 3.89 |
| 25 | Freeway | 36 | 10,898 | 294 | 113 | |
| | Arterial | 28 | 14,138 | 382 | 147 | |
| | Collector | -- | -- | -- | -- | |
| | Local | 28 | 4,418 | 119 | 46 | |
| | TOTAL | | 29,454 | 795 | 306 | 9.19 |
| 26 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 19,155 | 517 | 199 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 2,612 | 70 | 27 | |
| | TOTAL | | 21,767 | 587 | 226 | 12.20 |
| 27 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 22,240 | 600 | 231 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 1,171 | 32 | 12 | |
| | TOTAL | | 23,411 | 632 | 243 | 71.50 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 28 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 2,562 | 69 | 27 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 4,362 | 118 | 45 | |
| | TOTAL | | 6,924 | 187 | 72 | 15.42 |
| 29 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 2,983 | 80 | 31 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 3,363 | 91 | 35 | |
| | TOTAL | | 6,346 | 171 | 66 | 9.02 |
| 30 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 27,311 | 737 | 283 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 845 | 23 | 9 | |
| | TOTAL | | 28,156 | 760 | 292 | 10.34 |
| 31 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 9,212 | 248 | 96 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 3,236 | 87 | 34 | |
| | TOTAL | | 12,448 | 335 | 130 | 5.15 |
| 32 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 41,853 | 1,129 | 434 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 8,572 | 231 | 89 | |
| | TOTAL | | 50,425 | 1,360 | 523 | 93.15 |
| 33 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 8,071 | 218 | 84 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 897 | 24 | 9 | |
| | TOTAL | | 8,968 | 242 | 93 | 6.77 |
| 34 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 18,982 | 512 | 197 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 3,090 | 83 | 32 | |
| | TOTAL | | 22,072 | 595 | 229 | 10.99 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 35 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 6,920 | 187 | 72 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 7,202 | 194 | 75 | |
| | TOTAL | | 14,122 | 381 | 147 | 4.79 |
| 36 | Freeway | 36 | 17,832 | 481 | 185 | |
| | Arterial | 28 | 5,594 | 151 | 58 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 11,538 | 311 | 120 | |
| | TOTAL | | 34,964 | 943 | 363 | 12.82 |
| 37 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 13,481 | 3,733 | 144 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 4,135 | 112 | 43 | |
| | TOTAL | | 17,976 | 485 | 187 | 44.99 |
| 38 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 15,930 | 430 | 165 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 4,493 | 121 | 47 | |
| | TOTAL | | 20,423 | 551 | 212 | 38.72 |
| 39 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 31,026 | 837 | 322 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 4,636 | 125 | 48 | |
| | TOTAL | | 35,662 | 962 | 370 | 11.30 |
| 40 | Freeway | 36 | 4,315 | 116 | 45 | |
| | Arterial | 28 | 58,252 | 1,571 | 604 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 9,349 | 252 | 97 | |
| | TOTAL | | 71,916 | 1,939 | 746 | 22.87 |
| 41 | Freeway | 44 | 5,297 | 143 | 55 | |
| | Arterial | 28 | 10,026 | 270 | 104 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 3,594 | 97 | 37 | |
| | TOTAL | | 18,917 | 510 | 196 | 19.58 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 42 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 19,022 | 513 | 197 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 12,161 | 328 | 126 | |
| | TOTAL | | 31,183 | 841 | 323 | 13.01 |
| 43 | Freeway | 44 | 2,036 | 55 | 21 | |
| | Arterial | 28 | 14,248 | 384 | 148 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 6,333 | 171 | 616 | |
| | TOTAL | | 22,617 | 610 | 235 | 50.62 |
| 44 | Freeway | 44 | 13,314 | 359 | 138 | |
| | Arterial | 28 | 46,207 | 1,247 | 479 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 18,796 | 507 | 195 | |
| | TOTAL | | 78,317 | 2,113 | 812 | 20.23 |
| 45 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 17,299 | 467 | 179 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 3,053 | 82 | 32 | |
| | TOTAL | | 20,352 | 549 | 211 | 34.44 |
| 46 | Freeway | 44 | 3,498 | 94 | 36 | |
| | Arterial | 28 | 39,472 | 1,065 | 410 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 6,996 | 189 | 73 | |
| | TOTAL | | 49,966 | 1,348 | 519 | 20.51 |
| 47 | Freeway | 44 | 4,546 | 123 | 47 | |
| | Arterial | 28 | 32,239 | 870 | 334 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 4,545 | 123 | 47 | |
| | TOTAL | | 41,331 | 1,116 | 428 | 58.34 |
| 48 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 16,453 | 444 | 171 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 10,520 | 284 | 109 | |
| | TOTAL | | 26,973 | 728 | 280 | 8.28 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 49 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 7,551 | 204 | 78 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 6,971 | 188 | 72 | |
| | TOTAL | | 14,522 | 392 | 150 | 11.38 |
| 50 | Freeway | 44 | 23,136 | 624 | 240 | |
| | Arterial | 28 | 69,408 | 1,872 | 720 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 52,056 | 1,404 | 540 | |
| | TOTAL | | 144,600 | 3,900 | 1,500 | 25.78 |
| 51 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 11,435 | 308 | 119 | |
| | Collector | | -- | -- | -- | |
| | Local | 24 | 12,387 | 334 | 129 | |
| | TOTAL | | 23,822 | 642 | 248 | 13.64 |
| 52 | Freeway | 50 | 2,749 | 45 | 17 | |
| | Arterial | 30 | 23,522 | 385 | 144 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 4,277 | 70 | 26 | |
| | TOTAL | | 30,548 | 500 | 187 | 25.13 |
| 53 | Freeway | 50 | 4,489 | 73 | 28 | |
| | Arterial | 30 | 60,597 | 991 | 372 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 9,725 | 159 | 60 | |
| | TOTAL | | 74,811 | 1,223 | 460 | 189.39 |
| 54 | Freeway | 50 | 1,563 | 26 | 10 | |
| | Arterial | 30 | 43,772 | 716 | 269 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 6,774 | 111 | 42 | |
| | TOTAL | | 52,109 | 853 | 321 | 339.42 |
| 55 | Freeway | 50 | 8,187 | 134 | 50 | |
| | Arterial | 30 | 37,867 | 620 | 232 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 5,117 | 84 | 31 | |
| | TOTAL | | 51,171 | 838 | 313 | 239.00 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 56 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 19,310 | 840 | 328 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 2,146 | 93 | 37 | |
| | TOTAL | | 21,456 | 933 | 365 | 38.23 |
| 57 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 38,467 | 1,673 | 653 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 3,345 | 145 | 57 | |
| | TOTAL | | 41,812 | 1,818 | 710 | 251.77 |
| 58 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 36,547 | 1,589 | 620 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 3,178 | 138 | 54 | |
| | TOTAL | | 39,725 | 1,727 | 674 | 375.25 |
| 59 | Freeway | 50 | 28,466 | 798 | 296 | |
| | Arterial | 30 | 92,889 | 2,604 | 965 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 28,466 | 798 | 296 | |
| | TOTAL | | 149,821 | 4,200 | 1,557 | 91.09 |
| 60 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 14,410 | 404 | 150 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 3,163 | 89 | 33 | |
| | TOTAL | | 17,573 | 493 | 183 | 20.50 |
| 61 | Freeway | 50 | 4,564 | 128 | 47 | |
| | Arterial | 30 | 16,734 | 469 | 174 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 4,057 | 114 | 42 | |
| | TOTAL | | 25,355 | 711 | 263 | 17.29 |
| 62 | Freeway | 50 | 6,626 | 186 | 69 | |
| | Arterial | 30 | 73,832 | 2,070 | 767 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 14,199 | 398 | 147 | |
| | TOTAL | | 94,657 | 2,654 | 983 | 233.97 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 63 | Freeway | 50 | 16,433 | 461 | 171 | |
| | Arterial | 30 | 76,687 | 2,150 | 796 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 16,433 | 461 | 171 | |
| | TOTAL | | 109,553 | 3,072 | 1,138 | 513.30 |
| 64 | Freeway | 50 | 50,046 | 1,403 | 520 | |
| | Arterial | 30 | 30,797 | 864 | 320 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 15,399 | 432 | 160 | |
| | TOTAL | | 96,242 | 2,699 | 1,000 | 173.83 |
| 65 | Freeway | 50 | 22,494 | 463 | 185 | |
| | Arterial | 30 | 60,635 | 1,248 | 500 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 14,670 | 302 | 121 | |
| | TOTAL | | 97,799 | 2,013 | 806 | 62.34 |
| 66 | Freeway | 50 | 2,241 | 46 | 18 | |
| | Arterial | 30 | 64,241 | 1,322 | 529 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 8,217 | 169 | 68 | |
| | TOTAL | | 74,699 | 1,537 | 615 | 344.91 |
| 67 | Freeway | 50 | 20,934 | 431 | 173 | |
| | Arterial | 30 | 67,787 | 1,395 | 558 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 10,966 | 226 | 90 | |
| | TOTAL | | 99,687 | 2,052 | 821 | 431.11 |
| 68 | Freeway | 50 | 5,288 | 109 | 44 | |
| | Arterial | 30 | 19,976 | 411 | 164 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 4,113 | 85 | 34 | |
| | TOTAL | | 29,377 | 605 | 242 | 24.48 |
| 69 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 39,511 | 1,672 | 627 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 13,170 | 558 | 209 | |
| | TOTAL | | 52,681 | 2,230 | 836 | 53.68 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 70 | Freeway | 50 | 4,830 | 204 | 77 | |
| | Arterial | 30 | 46,918 | 1,986 | 745 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 17,249 | 730 | 274 | |
| | TOTAL | | 68,997 | 2,920 | 1,096 | 46.99 |
| 71 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 42,808 | 1,812 | 680 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 7,554 | 320 | 120 | |
| | TOTAL | | 50,362 | 2,132 | 800 | 243.21 |
| 72 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 15,771 | 668 | 251 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 2,783 | 118 | 44 | |
| | TOTAL | | 18,554 | 786 | 295 | 94.61 |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | TOTAL | TOTAL | TOTAL | VMT Total for All Vehicle Types |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | 2,654,827 | 81,069 | 30,833 | 2,766,729 |

Vehicle Miles of Travel (VMT)

Metropolitan Area Pittsburgh

Year 1972

Time Period 12 hour

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 1 | Freeway | 39 | 52,828 | 2,715 | 1,018 | |
| | Arterial | 19 | 40,398 | 2,076 | 779 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 217,527 | 11,179 | 4193 | |
| | TOTAL | | 310,753 | 15,970 | 5,990 | 1.26 |
| 2 | Freeway | 39 | 47,069 | 2,419 | 907 | |
| | Arterial | 19 | 56,876 | 2,923 | 1,096 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 92,178 | 4,739 | 1,777 | |
| | TOTAL | | 196,123 | 10,081 | 3,780 | 2.07 |
| 3 | Freeway | 39 | 54,253 | 2,789 | 1,046 | |
| | Arterial | 19 | 62,819 | 3,228 | 1,211 | |
| | Collector | -- | -- | -- | -- | |
| | Local | 17 | 168,469 | 8,658 | 3,247 | |
| | TOTAL | | 285,541 | 14,675 | 5,504 | 3.85 |
| 4 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 19,090 | 981 | 368 | |
| | Collector | -- | -- | -- | -- | |
| | Local | 17 | 16,262 | 836 | 314 | |
| | TOTAL | | 35,352 | 1,817 | 682 | 2.89 |
| 5 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 39,161 | 2,012 | 755 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 58,744 | 3,019 | 1,132 | |
| | TOTAL | | 97,905 | 5,031 | 1,887 | 5.82 |
| 6 | Freeway | 39 | 58,578 | 3,011 | 1,129 | |
| | Arterial | 19 | 46,862 | 2,408 | 903 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 187,450 | 9,633 | 3,613 | |
| | TOTAL | | 292,890 | 15,052 | 5,645 | 4.23 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 7 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 65,333 | 3,358 | 1,259 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 70778 | 3,638 | 1,364 | |
| | TOTAL | | 136,111 | 6,996 | 2,623 | 4.54 |
| 8 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 4,112 | 212 | 80 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 25,256 | 1,298 | 487 | |
| | TOTAL | | 29,368 | 1,510 | 567 | 1.96 |
| 9 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 105,703 | 5,432 | 2,037 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 59,459 | 3,056 | 1,146 | |
| | TOTAL | | 165,162 | 8488 | 3183 | 2.55 |
| 10 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 48,469 | 2,492 | 934 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 56,898 | 2,924 | 1097 | |
| | TOTAL | | 105,367 | 5,416 | 2,031 | 6.99 |
| 11 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 24,635 | 1,266 | 475 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 31,352 | 1,611 | 605 | |
| | TOTAL | | 55,987 | 2,877 | 1,080 | 1.52 |
| 12 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 33,216 | 1,707 | 641 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 29,456 | 1,514 | 568 | |
| | TOTAL | | 62,672 | 3,221 | 1,209 | 3.06 |
| 13 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 9462 | 486 | 182 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 43,100 | 2215 | 832 | |
| | TOTAL | | 52,562 | 2,701 | 1,014 | 2.27 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 14 | Freeway | 39 | 99,758 | 5127 | 1922 | |
| | Arterial | 22 | 176,238 | 9057 | 3397 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 56,528 | 2906 | 1090 | |
| | TOTAL | | 332,524 | 17090 | 6409 | 3.89 |
| 15 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 27,235 | 1,400 | 525 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 40,853 | 2,099 | 788 | |
| | TOTAL | | 68,088 | 3,499 | 1,313 | 5.51 |
| 16 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 49,910 | 2,565 | 962 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 58,589 | 3,011 | 1,130 | |
| | TOTAL | | 108,499 | 5,576 | 2,092 | 1.28 |
| 17 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 24,917 | 1,280 | 480 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 46,274 | 2,379 | 892 | |
| | TOTAL | | 71,191 | 3,659 | 1,372 | 1.21 |
| 18 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 70,565 | 3,626 | 1,360 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 51,099 | 2,627 | 985 | |
| | TOTAL | | 121,664 | 6,253 | 2,345 | 2.55 |
| 19 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 14,399 | 740 | 278 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 14,399 | 740 | 278 | |
| | TOTAL | | 28,798 | 1,480 | 556 | 1.85 |
| 20 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 7417 | 381 | 143 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 29,661 | 1,524 | 572 | |
| | TOTAL | | 37,078 | 1,905 | 715 | 1.69 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 21 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 164,381 | 4,433 | 1,705 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 88,514 | 2,387 | 918 | |
| | TOTAL | | 252,895 | 6,820 | 2,623 | 7.17 |
| 22 | Freeway | 45 | 53,718 | 1,449 | 557 | |
| | Arterial | 36 | 413,632 | 11,156 | 4,291 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 69,835 | 1,883 | 725 | |
| | TOTAL | | 537,185 | 14,488 | 5,573 | 24.78 |
| 23 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 118,989 | 3,209 | 1235 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 27,911 | 753 | 290 | |
| | TOTAL | | 146,900 | 3,962 | 1,525 | 3.07 |
| 24 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 65,226 | 1,760 | 677 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 5,673 | 153 | 59 | |
| | TOTAL | | 70,899 | 1,913 | 736 | 3.89 |
| 25 | Freeway | 45 | 81,734 | 2,204 | 848 | |
| | Arterial | 36 | 106,033 | 2,860 | 1,100 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 33,135 | 894 | 344 | |
| | TOTAL | | 220,902 | 5,958 | 2,292 | 9.19 |
| 26 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 143,660 | 3,875 | 1,490 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 19,591 | 528 | 203 | |
| | TOTAL | | 163,251 | 4,403 | 1,693 | 12.20 |
| 27 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 165,798 | 4,499 | 1,730 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 8,779 | 237 | 92 | |
| | TOTAL | | 175,577 | 4,736 | 1,822 | 71.50 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 28 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 19,212 | 518 | 200 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 32,713 | 882 | 339 | |
| | TOTAL | | 51,925 | 1,400 | 539 | 15.42 |
| 29 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 22,371 | 603 | 232 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 25,226 | 680 | 262 | |
| | TOTAL | | 47,597 | 1,283 | 494 | 9.02 |
| 30 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 204,836 | 5,525 | 2,125 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 6335 | 171 | 66 | |
| | TOTAL | | 211,171 | 5,696 | 2,191 | 10.34 |
| 31 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 69,086 | 1,863 | 716 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 24,273 | 655 | 252 | |
| | TOTAL | | 93,359 | 2,518 | 968 | 5.15 |
| 32 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 313,900 | 8,466 | 3,257 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 64,293 | 1,734 | 667 | |
| | TOTAL | | 378,193 | 10,200 | 3,924 | 93.15 |
| 33 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 60,534 | 1,633 | 628 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 6726 | 182 | 70 | |
| | TOTAL | | 67,260 | 1,815 | 698 | 6.77 |
| 34 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 142,367 | 3,840 | 1,477 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 23,176 | 625 | 240 | |
| | TOTAL | | 165,543 | 4,465 | 1,717 | 10.99 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 35 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 51,897 | 1,400 | 539 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 54,015 | 1,457 | 560 | |
| | TOTAL | | 105,912 | 2,857 | 1,099 | 4.79 |
| 36 | Freeway | 45 | 133,741 | 3,607 | 1,388 | |
| | Arterial | 36 | 41,958 | 1,132 | 435 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 86,537 | 2,334 | 898 | |
| | TOTAL | | 262,236 | 7,073 | 2,721 | 12.82 |
| 37 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 103,811 | 2,800 | 1,077 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 31,009 | 836 | 322 | |
| | TOTAL | | 134,820 | 3,636 | 1,399 | 44.99 |
| 38 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 119,474 | 3,222 | 1,239 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 33,698 | 909 | 350 | |
| | TOTAL | | 153,172 | 4,131 | 1,589 | 38.72 |
| 39 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 232,691 | 6,276 | 2,414 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 34,770 | 938 | 361 | |
| | TOTAL | | 267,461 | 7,214 | 2,775 | 11.30 |
| 40 | Freeway | 45 | 32,363 | 873 | 336 | |
| | Arterial | 36 | 436,893 | 11,783 | 4,532 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 70,119 | 1,892 | 728 | |
| | TOTAL | | 539,375 | 14,548 | 5,596 | 22.87 |
| 41 | Freeway | 54 | 39,725 | 1,072 | 413 | |
| | Arterial | 36 | 75,194 | 2,028 | 780 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 26,957 | 727 | 280 | |
| | TOTAL | | 141,876 | 3,827 | 1,473 | 19.58 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 42 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 142,661 | 3,848 | 1,480 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 91,209 | 2,460 | 947 | |
| | TOTAL | | 233,870 | 6,308 | 2,427 | 13.01 |
| 43 | Freeway | 54 | 15,266 | 412 | 158 | |
| | Arterial | 36 | 106,861 | 2,882 | 1,109 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 47,494 | 1,281 | 493 | |
| | TOTAL | | 169,621 | 4,575 | 1,760 | 50.62 |
| 44 | Freeway | 54 | 99,854 | 2,693 | 1,036 | |
| | Arterial | 36 | 346,553 | 9,347 | 3,595 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 140,971 | 3,802 | 1,463 | |
| | TOTAL | | 587,378 | 15,842 | 6,094 | 20.23 |
| 45 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 129,737 | 3,499 | 1,346 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 22,895 | 617 | 238 | |
| | TOTAL | | 152,632 | 4,116 | 1,584 | 34.44 |
| 46 | Freeway | 54 | 26,232 | 707 | 272 | |
| | Arterial | 36 | 296,043 | 7,985 | 3,071 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 52,464 | 1,415 | 545 | |
| | TOTAL | | 374,739 | 10,107 | 3,888 | 20.51 |
| 47 | Freeway | 54 | 34,098 | 920 | 354 | |
| | Arterial | 36 | 241,789 | 6,521 | 2,508 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 34,098 | 920 | 354 | |
| | TOTAL | | 309,985 | 8,361 | 3,216 | 58.34 |
| 48 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 123,397 | 3,328 | 1,280 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 78,893 | 2,128 | 818 | |
| | TOTAL | | 202,290 | 5,456 | 2,098 | 8.28 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 49 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 56,636 | 1,528 | 587 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 52,279 | 1,410 | 542 | |
| | TOTAL | | 108,915 | 2,938 | 1,129 | 11.38 |
| 50 | Freeway | 54 | 173,520 | 4,680 | 1,800 | |
| | Arterial | 36 | 520,559 | 14,040 | 5,400 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 390,420 | 10,530 | 4,050 | |
| | TOTAL | | 1,084,499 | 29,250 | 11,250 | 25.78 |
| 51 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 85,760 | 2,313 | 890 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 92,906 | 2,506 | 964 | |
| | TOTAL | | 178,666 | 4819 | 1,854 | 13.64 |
| 52 | Freeway | 56 | 20,621 | 338 | 127 | |
| | Arterial | 38 | 176,417 | 2,886 | 1,082 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 32,076 | 525 | 197 | |
| | TOTAL | | 229,114 | 3,749 | 1,406 | 25.13 |
| 53 | Freeway | 56 | 33,665 | 551 | 206 | |
| | Arterial | 38 | 454,474 | 7,436 | 2,789 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 72,940 | 1,193 | 448 | |
| | TOTAL | | 561,079 | 9,180 | 3443 | 189.39 |
| 54 | Freeway | 56 | 11,725 | 192 | 72 | |
| | Arterial | 38 | 328,293 | 5,371 | 2,014 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 50,807 | 831 | 312 | |
| | TOTAL | | 390,825 | 6,394 | 2,398 | 339.42 |
| 55 | Freeway | 56 | 61,406 | 1,004 | 377 | |
| | Arterial | 38 | 284,003 | 4,646 | 1,742 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 38,379 | 628 | 236 | |
| | TOTAL | | 383,788 | 6,278 | 2,355 | 239.00 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 56 | Freeway | -- | 0 | 0 | 0 | |
| | Arterial | 38 | 144,821 | 6,296 | 2,457 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 16,091 | 700 | 273 | |
| | TOTAL | | 160,912 | 6,996 | 2,730 | 38.23 |
| 57 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 288,503 | 12,544 | 4,895 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 25,087 | 1,091 | 425 | |
| | TOTAL | | 313,590 | 13,635 | 5,320 | 251.77 |
| 58 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 274,100 | 11,918 | 4,651 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 23,835 | 1,037 | 404 | |
| | TOTAL | | 297,935 | 12,955 | 5,055 | 375.25 |
| 59 | Freeway | 56 | 213,494 | 5,986 | 2,217 | |
| | Arterial | 38 | 696,665 | 19,532 | 7,235 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 213,494 | 5,986 | 2,217 | |
| | TOTAL | | 1123,653 | 31,504 | 11,669 | 91.09 |
| 60 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 108,078 | 3,030 | 1,122 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 23,725 | 665 | 247 | |
| | TOTAL | | 131,803 | 3,695 | 1,369 | 20.50 |
| 61 | Freeway | 56 | 34,228 | 960 | 356 | |
| | Arterial | 38 | 125,501 | 3,519 | 1,304 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 30,425 | 853 | 316 | |
| | TOTAL | | 190,154 | 5,332 | 1,976 | 17.29 |
| 62 | Freeway | 56 | 49,695 | 1,394 | 516 | |
| | Arterial | 38 | 553,742 | 15,526 | 5,750 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 106,490 | 2,986 | 1,106 | |
| | TOTAL | | 709,927 | 19,906 | 7,372 | 233.97 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 63 | Freeway | 56 | 123,247 | 3,455 | 1,280 | |
| | Arterial | 38 | 575,154 | 16,126 | 5,972 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 123,247 | 3,455 | 1,280 | |
| | TOTAL | | 821,648 | 23,036 | 8,532 | 513.30 |
| 64 | Freeway | 56 | 375,343 | 10,523 | 3,898 | |
| | Arterial | 38 | 230,980 | 6,476 | 2,399 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 115,490 | 3,238 | 1,199 | |
| | TOTAL | | 721,813 | 20,237 | 7,496 | 173.83 |
| 65 | Freeway | 56 | 168,702 | 3,471 | 1,388 | |
| | Arterial | 38 | 454,765 | 9,357 | 3,743 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 110,024 | 2,264 | 905 | |
| | TOTAL | | 733,491 | 15,092 | 6,036 | 62.34 |
| 66 | Freeway | 56 | 16,807 | 346 | 138 | |
| | Arterial | 38 | 481,805 | 9,914 | 3,966 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 61,626 | 1,268 | 507 | |
| | TOTAL | | 560,238 | 11,528 | 4,611 | 344.91 |
| 67 | Freeway | 56 | 157,007 | 3,230 | 1,292 | |
| | Arterial | 38 | 508,406 | 10,461 | 4,184 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 82,242 | 1,692 | 676 | |
| | TOTAL | | 747,655 | 15,383 | 6,152 | 431.11 |
| 68 | Freeway | 56 | 39,658 | 816 | 326 | |
| | Arterial | 38 | 149,820 | 3,083 | 1,233 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 30,845 | 635 | 254 | |
| | TOTAL | | 220,323 | 4,534 | 1,813 | 24.48 |
| 69 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 296,333 | 12,543 | 4,704 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 98,777 | 4,181 | 1,568 | |
| | TOTAL | | 395,110 | 16,724 | 6,272 | 53.68 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 70 | Freeway | 56 | 36,224 | 1,533 | 575 | |
| | Arterial | 38 | 351,887 | 14895 | 5,586 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 129,370 | 5,476 | 2,054 | |
| | TOTAL | | 517,481 | 21,904 | 8,215 | 46.99 |
| 71 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 321,061 | 13,590 | 5,096 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 56,658 | 2,399 | 899 | |
| | TOTAL | | 377,719 | 15,989 | 5,995 | 243.21 |
| 72 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 118,284 | 5,007 | 1,878 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 20,873 | 884 | 332 | |
| | TOTAL | | 139,157 | 5,891 | 2,210 | 94.61 |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway<br>Arterial<br>Collector<br>Local | | TOTAL | TOTAL | TOTAL | VMT Total for All Vehicle Types |
| | TOTAL | | 19,911,154 | 607,954 | 231,169 | 20,750,277 |

Vehicle Miles of Travel (VMT)

Metropolitan Area Pittsburgh

Year 1972

Time Period 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 1 | Freeway | 39 | 70,437 | 3,620 | 1,357 | |
| | Arterial | 19 | 53,864 | 2,768 | 1,038 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 290,036 | 14,905 | 5,590 | |
| | TOTAL | | 414,337 | 21,293 | 7,985 | 1.26 |
| 2 | Freeway | 39 | 62,759 | 3,225 | 1,209 | |
| | Arterial | 19 | 75,834 | 3,897 | 1,461 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 122,904 | 6,316 | 2,369 | |
| | TOTAL | | 261,497 | 13,438 | 5,039 | 2.07 |
| 3 | Freeway | 39 | 72,337 | 3,718 | 1,394 | |
| | Arterial | 19 | 83,758 | 4,304 | 1,614 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 224,625 | 11,544 | 4,329 | |
| | TOTAL | | 380,720 | 19,566 | 7,337 | 3.85 |
| 4 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 25,453 | 1,308 | 491 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 21,683 | 1,114 | 418 | |
| | TOTAL | | 47,136 | 2,422 | 909 | 2.89 |
| 5 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 52,215 | 2,683 | 1,006 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 78,325 | 4,025 | 1,509 | |
| | TOTAL | | 130,540 | 6,708 | 2,515 | 5.82 |
| 6 | Freeway | 39 | 78,104 | 4,014 | 1,505 | |
| | Arterial | 19 | 62,483 | 3,211 | 1,204 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 249,933 | 12,844 | 4,817 | |
| | TOTAL | | 390,520 | 20,069 | 7,526 | 4.23 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 7 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 87,110 | 4,477 | 1,679 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 94,370 | 4,850 | 1,819 | |
| | TOTAL | | 181,480 | 9,327 | 3,498 | 4.54 |
| 8 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 5,482 | 282 | 106 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 33,674 | 1,731 | 649 | |
| | TOTAL | | 39,156 | 2,013 | 755 | 1.96 |
| 9 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 140,937 | 7,243 | 2,716 | |
| | Collector | | -- | -- | -- | |
| | Local | 17 | 79,278 | 4,074 | 1,528 | |
| | TOTAL | | 220,215 | 11,317 | 4,244 | 2,55 |
| 10 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 64,625 | 3,322 | 1,245 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 75,864 | 3,899 | 1,462 | |
| | TOTAL | | 140,489 | 7,221 | 2,707 | 6.99 |
| 11 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 32,846 | 1,688 | 633 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 41,803 | 2,148 | 806 | |
| | TOTAL | | 74,649 | 3,836 | 1,439 | 1.52 |
| 12 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 44,288 | 2,276 | 854 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 39,275 | 2,018 | 757 | |
| | TOTAL | | 83,563 | 4,294 | 1,611 | 3.06 |
| 13 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 12,615 | 648 | 243 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 57,467 | 2.953 | 1,108 | |
| | TOTAL | | 70,082 | 3,601 | 1,351 | 2.27 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 14 | Freeway | 39 | 133,010 | 6,836 | 2,563 | |
| | Arterial | 22 | 234,984 | 12,076 | 4,529 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 75,371 | 3,874 | 1,453 | |
| | TOTAL | | 443,365 | 22,786 | 8,545 | 3.89 |
| 15 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 36,313 | 1,866 | 700 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 54,470 | 2,799 | 1,050 | |
| | TOTAL | | 90,783 | 4,665 | 1,750 | 5.51 |
| 16 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 66,546 | 3,420 | 1,282 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 78,118 | 4,015 | 1,506 | |
| | TOTAL | | 144,664 | 7,435 | 2,788 | 1.28 |
| 17 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 33,222 | 1,707 | 640 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 61,699 | 3,172 | 1,189 | |
| | TOTAL | | 94,921 | 4,879 | 1,829 | 1.21 |
| 18 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 94,087 | 4,835 | 1,813 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 68,132 | 3,502 | 1,313 | |
| | TOTAL | | 162,219 | 8,337 | 3,126 | 2.55 |
| 19 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 19,198 | 987 | 370 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 19,199 | 987 | 370 | |
| | TOTAL | | 38,397 | 1,974 | 740 | 1.85 |
| 20 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 9,889 | 508 | 190 | |
| | Collector | | -- | -- | -- | |
| | Local | 18 | 39,548 | 2,032 | 762 | |
| | TOTAL | | 49,437 | 2,540 | 952 | 1.69 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 21 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 219,175 | 5,911 | 2,273 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 118,019 | 3,183 | 1,224 | |
| | TOTAL | | 337,194 | 9,094 | 3,497 | 7.17 |
| 22 | Freeway | 45 | 71,624 | 1,932 | 743 | |
| | Arterial | 36 | 551,509 | 14,875 | 5,721 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 93,113 | 2,511 | 966 | |
| | TOTAL | | 716,246 | 19,318 | 7,430 | 24.78 |
| 23 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 158,652 | 4,279 | 1,646 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 37,215 | 1,004 | 386 | |
| | TOTAL | | 195,867 | 5,283 | 2,032 | 3.07 |
| 24 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 86,968 | 2,346 | 902 | |
| | Collector | | -- | -- | -- | |
| | Local | 28 | 7,563 | 204 | 78 | |
| | TOTAL | | 94,531 | 2,550 | 980 | 3.89 |
| 25 | Freeway | 45 | 108,978 | 2,939 | 1,130 | |
| | Arterial | 36 | 141,377 | 3,813 | 1,467 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 44,180 | 1,192 | 458 | |
| | TOTAL | | 294,535 | 7,944 | 3,055 | 9.19 |
| 26 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 191,547 | 5,166 | 1,987 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 26,121 | 704 | 271 | |
| | TOTAL | | 217,668 | 5,870 | 2,258 | 12.20 |
| 27 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 222,397 | 5,998 | 2,307 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 11,705 | 316 | 122 | |
| | TOTAL | | 234,102 | 6,314 | 2,429 | 71.50 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 28 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 25,616 | 691 | 266 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 43,617 | 1,176 | 452 | |
| | TOTAL | | 69,233 | 1,867 | 718 | 15.42 |
| 29 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 29,828 | 804 | 309 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 33,634 | 907 | 349 | |
| | TOTAL | | 63,462 | 1,711 | 658 | 9.02 |
| 30 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 273,114 | 7,366 | 2,833 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 8,447 | 228 | 88 | |
| | TOTAL | | 281,561 | 7,594 | 2,921 | 10.34 |
| 31 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 92,115 | 2,484 | 955 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 32,364 | 873 | 336 | |
| | TOTAL | | 124,479 | 3,357 | 1,291 | 5.15 |
| 32 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 418,533 | 11,288 | 4,342 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 85,724 | 2,312 | 889 | |
| | TOTAL | | 504,257 | 13,600 | 5,231 | 93.15 |
| 33 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 80,712 | 2,177 | 837 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 8,968 | 242 | 93 | |
| | TOTAL | | 89,680 | 2,419 | 930 | 6.77 |
| 34 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 189,822 | 5,120 | 1,969 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 30,901 | 833 | 320 | |
| | TOTAL | | 220,723 | 5,953 | 2,289 | 10.99 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 35 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 69,196 | 1,866 | 718 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 72,020 | 1,942 | 747 | |
| | TOTAL | | 141,216 | 3,808 | 1,465 | 4.79 |
| 36 | Freeway | 45 | 178,321 | 4,809 | 1,850 | |
| | Arterial | 36 | 55,944 | 1,509 | 580 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 115,383 | 3,112 | 1,197 | |
| | TOTAL | | 349,648 | 9,430 | 3,627 | 12.82 |
| 37 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 138,414 | 3,733 | 1,436 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 41,345 | 1,115 | 429 | |
| | TOTAL | | 179,759 | 4,848 | 1,865 | 44.99 |
| 38 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 159,299 | 4,296 | 1,652 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 44,930 | 1,212 | 466 | |
| | TOTAL | | 204,229 | 5,508 | 2,118 | 38.72 |
| 39 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 310,255 | 8,368 | 3,218 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 46,360 | 1,250 | 481 | |
| | TOTAL | | 356,615 | 9,618 | 3,699 | 11.30 |
| 40 | Freeway | 45 | 43,151 | 1,164 | 448 | |
| | Arterial | 36 | 582,524 | 15,711 | 6,043 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 93,492 | 2,522 | 970 | |
| | TOTAL | | 719,167 | 19,397 | 7,461 | 22.87 |
| 41 | Freeway | 54 | 52,967 | 1,429 | 550 | |
| | Arterial | 36 | 100,258 | 2,704 | 1,040 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 35,942 | 969 | 373 | |
| | TOTAL | | 189,167 | 5,102 | 1,963 | 19.58 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 42 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 190,215 | 5,130 | 1,973 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 121,612 | 3,280 | 1,262 | |
| | TOTAL | | 311,827 | 8,410 | 3,235 | 13.01 |
| 43 | Freeway | 54 | 20,355 | 549 | 211 | |
| | Arterial | 36 | 142,481 | 3,843 | 1,478 | |
| | Collector | | -- | -- | -- | |
| | Local | 36 | 63,325 | 1,708 | 657 | |
| | TOTAL | | 226,161 | 6,100 | 2,346 | 50.62 |
| 44 | Freeway | 54 | 133,139 | 3,591 | 1,381 | |
| | Arterial | 36 | 462,071 | 12,463 | 4,793 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 187,961 | 5,069 | 1,950 | |
| | TOTAL | | 783,171 | 21,123 | 8,124 | 20.23 |
| 45 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 172,982 | 4,665 | 1,794 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 30,526 | 823 | 317 | |
| | TOTAL | | 203,508 | 5,488 | 2,111 | 34.44 |
| 46 | Freeway | 54 | 34,976 | 943 | 363 | |
| | Arterial | 36 | 394,724 | 10,646 | 4,095 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 69,952 | 1,887 | 726 | |
| | TOTAL | | 499,652 | 13,476 | 5,184 | 20.51 |
| 47 | Freeway | 54 | 45,464 | 1,226 | 472 | |
| | Arterial | 36 | 322,385 | 8,695 | 3,344 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 45,464 | 1,226 | 472 | |
| | TOTAL | | 413,313 | 11,147 | 4,288 | 58.34 |
| 48 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 164,529 | 4,437 | 1,707 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 105,191 | 2,837 | 1,091 | |
| | TOTAL | | 269,720 | 7,274 | 2,798 | 8.28 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 49 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 75,514 | 2,037 | 783 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 69,705 | 1,880 | 723 | |
| | TOTAL | | 145,219 | 3,917 | 1,506 | 11.38 |
| 50 | Freeway | 54 | 231,360 | 6,240 | 2,400 | |
| | Arterial | 36 | 694,079 | 18,720 | 7,200 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 520,560 | 14,040 | 5,400 | |
| | TOTAL | | 1,445,999 | 39,000 | 15,000 | 25.78 |
| 51 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 114,346 | 3,084 | 1,186 | |
| | Collector | | -- | -- | -- | |
| | Local | 30 | 123,874 | 3,341 | 1,285 | |
| | TOTAL | | 238,220 | 6,425 | 2,471 | 13.64 |
| 52 | Freeway | 56 | 27,494 | 450 | 169 | |
| | Arterial | 38 | 235,222 | 3,848 | 1,443 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 42,768 | 700 | 262 | |
| | TOTAL | | 305,484 | 4,998 | 1,874 | 25.13 |
| 53 | Freeway | 56 | 44,886 | 734 | 275 | |
| | Arterial | 38 | 605,965 | 9,914 | 3,718 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 97,253 | 1,591 | 597 | |
| | TOTAL | | 748,104 | 12,239 | 4,590 | 189.39 |
| 54 | Freeway | 56 | 15,633 | 256 | 96 | |
| | Arterial | 38 | 437,724 | 7,161 | 2,685 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 67,743 | 1,108 | 416 | |
| | TOTAL | | 521,100 | 8,525 | 3,197 | 339.42 |
| 55 | Freeway | 56 | 81,874 | 1,339 | 502 | |
| | Arterial | 38 | 378,671 | 6,195 | 2,323 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 51,172 | 837 | 314 | |
| | TOTAL | | 511,717 | 8,371 | 3,139 | 239.00 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 56 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 193,095 | 8,395 | 3,276 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 21,455 | 933 | 364 | |
| | TOTAL | | 214,550 | 9,328 | 3,640 | 38.23 |
| 57 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 384,671 | 16,725 | 6,527 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 33,449 | 1,454 | 567 | |
| | TOTAL | | 418,120 | 18,179 | 7,094 | 251.77 |
| 58 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 365,467 | 15,890 | 6,201 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 31,780 | 1,382 | 539 | |
| | TOTAL | | 397,247 | 17,272 | 6,740 | 375.25 |
| 59 | Freeway | 56 | 284,658 | 7,981 | 2,956 | |
| | Arterial | 38 | 928,886 | 26,043 | 9,646 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 284,659 | 7,981 | 2,956 | |
| | TOTAL | | 1,498,203 | 42,005 | 15,558 | 91.09 |
| 60 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 144,104 | 4,040 | 1,496 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 31,633 | 887 | 329 | |
| | TOTAL | | 175,737 | 4,927 | 1,825 | 20.50 |
| 61 | Freeway | 56 | 45,637 | 1,280 | 474 | |
| | Arterial | 38 | 167,335 | 4,692 | 1,738 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 40,566 | 1,137 | 421 | |
| | TOTAL | | 253,538 | 7,109 | 2,633 | 17.29 |
| 62 | Freeway | 56 | 66,260 | 1,858 | 688 | |
| | Arterial | 38 | 738,323 | 20,701 | 7,667 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 141,986 | 3,981 | 1,474 | |
| | TOTAL | | 946,569 | 26,540 | 9,829 | 233.97 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 63 | Freeway | 56 | 164,329 | 4,607 | 1,706 | |
| | Arterial | 38 | 766,872 | 21,501 | 7,963 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 164,329 | 4,607 | 1,706 | |
| | TOTAL | | 1,095,530 | 30,715 | 11,375 | 513.30 |
| 64 | Freeway | 56 | 500,457 | 14,031 | 5,197 | |
| | Arterial | 38 | 307,973 | 8,635 | 3,198 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 153,987 | 4,317 | 1,599 | |
| | TOTAL | | 962,417 | 26,983 | 9,994 | 173.83 |
| 65 | Freeway | 56 | 224,936 | 4,628 | 1,851 | |
| | Arterial | 38 | 606,353 | 12,476 | 4,990 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 146,698 | 3,018 | 1,207 | |
| | TOTAL | | 977,987 | 20,122 | 8,048 | 62.34 |
| 66 | Freeway | 56 | 22,409 | 461 | 184 | |
| | Arterial | 38 | 642,407 | 13,218 | 5,287 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 82,168 | 1,691 | 676 | |
| | TOTAL | | 746,984 | 15,370 | 6,147 | 344.91 |
| 67 | Freeway | 56 | 209,343 | 4,307 | 1,723 | |
| | Arterial | 38 | 677,874 | 13,948 | 5,579 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 109,656 | 2,256 | 902 | |
| | TOTAL | | 996,873 | 20,511 | 8,204 | 431.11 |
| 68 | Freeway | 56 | 52,877 | 1,088 | 435 | |
| | Arterial | 38 | 199,760 | 4,110 | 1,644 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 41,126 | 846 | 338 | |
| | TOTAL | | 293,763 | 6,044 | 2,417 | 24.48 |
| 69 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 395,110 | 16,724 | 6,272 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 131,702 | 5,575 | 2,091 | |
| | TOTAL | | 526,812 | 22,299 | 8,363 | 53.68 |

Pittsburgh - 1972 - 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 70 | Freeway | 56 | 48,298 | 2,044 | 766 | |
| | Arterial | 38 | 469,182 | 19,860 | 7,448 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 172,493 | 7,301 | 2,738 | |
| | TOTAL | | 689,973 | 29,205 | 10,952 | 46.99 |
| 71 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 428,081 | 18,120 | 6,795 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 75,544 | 3,198 | 1,199 | |
| | TOTAL | | 503,625 | 21,318 | 7,994 | 243.21 |
| 72 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 157,712 | 6,676 | 2,504 | |
| | Collector | | -- | -- | -- | |
| | Local | 37 | 27,830 | 1,178 | 442 | |
| | TOTAL | | 185,542 | 7,854 | 2,946 | 94.61 |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | TOTAL | TOTAL | TOTAL | VMT Total for All Vehicle Types |
| | Local | | | | | |
| | TOTAL | | 26,548,174 | 810,580 | 308,185 | 27,666,939 |

Vehicle Miles of Travel (VMT)

Metropolitan Area Pittsburgh

Year 1977

Time Period Peak-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 1 | Freeway | 31 | 7,663 | 394 | 148 | |
| | Arterial | 17 | 5,860 | 301 | 113 | |
| | Collector | | - | - | - | |
| | Local | 13 | 31,553 | 1,622 | 608 | |
| | TOTAL | | 45,076 | 2,317 | 869 | 1.26 |
| 2 | Freeway | 31 | 6,738 | 346 | 130 | |
| | Arterial | 17 | 8,142 | 418 | 157 | |
| | Collector | | - | - | - | |
| | Local | 13 | 13,196 | 678 | 254 | |
| | TOTAL | | 28,076 | 1,442 | 541 | 2.07 |
| 3 | Freeway | 31 | 7,691 | 395 | 148 | |
| | Arterial | 17 | 8,905 | 458 | 172 | |
| | Collector | | - | - | - | |
| | Local | 13 | 23,882 | 1,227 | 460 | |
| | TOTAL | | 40,478 | 2,080 | 780 | 3.85 |
| 4 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 2,694 | 139 | 52 | |
| | Collector | | - | - | - | |
| | Local | 13 | 2,295 | 118 | 44 | |
| | TOTAL | | 4,989 | 257 | 96 | 2.89 |
| 5 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 5,207 | 268 | 100 | |
| | Collector | | - | - | - | |
| | Local | 13 | 7,811 | 401 | 151 | |
| | TOTAL | | 13,018 | 669 | 251 | 5.82 |
| 6 | Freeway | 31 | 8,414 | 432 | 162 | |
| | Arterial | 17 | 6,732 | 346 | 130 | |
| | Collector | | - | - | - | |
| | Local | 13 | 26,926 | 1,384 | 519 | |
| | TOTAL | | 42,072 | 2,162 | 811 | 4.23 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 7 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 9,323 | 479 | 180 | |
| | Collector | | - | - | - | |
| | Local | 13 | 10,100 | 519 | 195 | |
| | TOTAL | | 19,423 | 998 | 375 | 4.54 |
| 8 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 596 | 31 | 12 | |
| | Collector | | - | - | - | |
| | Local | 13 | 3,661 | 188 | 71 | |
| | TOTAL | | 4,257 | 219 | 83 | 1.96 |
| 9 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 17 | 15,222 | 782 | 293 | |
| | Collector | | - | - | - | |
| | Local | 13 | 8,563 | 440 | 165 | |
| | TOTAL | | 23,785 | 1,222 | 458 | 2.55 |
| 10 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 6,878 | 354 | 133 | |
| | Collector | | - | - | - | |
| | Local | 14 | 8,074 | 415 | 156 | |
| | TOTAL | | 14,952 | 769 | 289 | 6.99 |
| 11 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 3,351 | 172 | 65 | |
| | Collector | | - | - | - | |
| | Local | 14 | 4,265 | 219 | 82 | |
| | TOTAL | | 7,616 | 391 | 147 | 1.52 |
| 12 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 4,367 | 225 | 84 | |
| | Collector | | - | - | - | |
| | Local | 14 | 3,873 | 199 | 75 | |
| | TOTAL | | 8,240 | 424 | 159 | 3.06 |
| 13 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 1,237 | 64 | 24 | |
| | Collector | | - | - | - | |
| | Local | 14 | 5,635 | 290 | 109 | |
| | TOTAL | | 6,872 | 354 | 133 | 2.27 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 14 | Freeway | 31 | 14,308 | 735 | 276 | |
| | Arterial | 18 | 25,278 | 1,299 | 487 | |
| | Collector | | - | - | - | |
| | Local | 14 | 8,108 | 417 | 156 | |
| | TOTAL | | 47,694 | 2,451 | 919 | 3.89 |
| 15 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 3,596 | 185 | 69 | |
| | Collector | | - | - | - | |
| | Local | 14 | 5,394 | 277 | 104 | |
| | TOTAL | | 8,990 | 462 | 173 | 5.51 |
| 16 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 8,626 | 443 | 166 | |
| | Collector | | - | - | - | |
| | Local | 14 | 10,126 | 520 | 195 | |
| | TOTAL | | 18,752 | 963 | 361 | 1.23 |
| 17 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 3,660 | 188 | 71 | |
| | Collector | | - | - | - | |
| | Local | 14 | 6,798 | 350 | 131 | |
| | TOTAL | | 10,458 | 538 | 202 | 1.21 |
| 18 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 9,886 | 509 | 191 | |
| | Collector | | - | - | - | |
| | Local | 14 | 7,159 | 369 | 138 | |
| | TOTAL | | 17,045 | 878 | 329 | 2.55 |
| 19 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 1,780 | 92 | 34 | |
| | Collector | | - | - | - | |
| | Local | 14 | 1,780 | 92 | 34 | |
| | TOTAL | | 3,561 | 184 | 68 | 1.85 |
| 20 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 18 | 1,205 | 62 | 23 | |
| | Collector | | - | - | - | |
| | Local | 14 | 4,817 | 248 | 93 | |
| | TOTAL | | 6,022 | 310 | 116 | 1.69 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 21 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 25,513 | 688 | 265 | |
| | Collector | | - | - | - | |
| | Local | 22 | 13,738 | 371 | 143 | |
| | TOTAL | | 39,251 | 1,059 | 408 | 7.17 |
| 22 | Freeway | 36 | 7,697 | 208 | 80 | |
| | Arterial | 28 | 59,270 | 1,599 | 615 | |
| | Collector | | - | - | - | |
| | Local | 22 | 10,007 | 270 | 104 | |
| | TOTAL | | 76,974 | 2,077 | 799 | 24.78 |
| 23 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 17,483 | 472 | 181 | |
| | Collector | | - | - | - | |
| | Local | 22 | 4,101 | 111 | 43 | |
| | TOTAL | | 21,584 | 583 | 224 | 3.07 |
| 24 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 11,108 | 300 | 115 | |
| | Collector | | - | - | - | |
| | Local | 22 | 966 | 26 | 10 | |
| | TOTAL | | 12,074 | 326 | 125 | 3.89 |
| 25 | Freeway | 36 | 13,692 | 369 | 142 | |
| | Arterial | 28 | 17,763 | 480 | 184 | |
| | Collector | | - | - | - | |
| | Local | 28 | 5,551 | 150 | 58 | |
| | TOTAL | | 37,006 | 999 | 384 | 9.19 |
| 26 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 23,425 | 632 | 243 | |
| | Collector | | - | - | - | |
| | Local | 28 | 3,195 | 86 | 33 | |
| | TOTAL | | 26,620 | 718 | 276 | 12.20 |
| 27 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 27,401 | 739 | 284 | |
| | Collector | | - | - | - | |
| | Local | 28 | 1,442 | 39 | 15 | |
| | TOTAL | | 28,843 | 778 | 299 | 71.50 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 28 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 3,063 | 83 | 32 | |
| | Collector | | - | - | - | |
| | Local | 28 | 5,216 | 141 | 54 | |
| | TOTAL | | 8,279 | 224 | 86 | 15.42 |
| 29 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 3,427 | 92 | 36 | |
| | Collector | | - | - | - | |
| | Local | 28 | 3,864 | 104 | 40 | |
| | TOTAL | | 7,291 | 196 | 76 | 9.02 |
| 30 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 30,962 | 835 | 321 | |
| | Collector | | - | - | - | |
| | Local | 28 | 958 | 26 | 10 | |
| | TOTAL | | 31,920 | 861 | 331 | 10.34 |
| 31 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 9,983 | 269 | 104 | |
| | Collector | | - | - | - | |
| | Local | 28 | 3,507 | 95 | 36 | |
| | TOTAL | | 13,490 | 364 | 140 | 5.15 |
| 32 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 52,031 | 1,403 | 540 | |
| | Collector | | - | - | - | |
| | Local | 28 | 10,657 | 287 | 111 | |
| | TOTAL | | 62,688 | 1,690 | 651 | 93.15 |
| 33 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 10,125 | 273 | 105 | |
| | Collector | | - | - | - | |
| | Local | 28 | 1,125 | 30 | 12 | |
| | TOTAL | | 11,250 | 303 | 117 | 6.77 |
| 34 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 20,023 | 540 | 208 | |
| | Collector | | - | - | - | |
| | Local | 28 | 3,260 | 88 | 34 | |
| | TOTAL | | 23,283 | 628 | 242 | 10.99 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 35 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 7,138 | 193 | 74 | |
| | Collector | | - | - | - | |
| | Local | 28 | 7,429 | 200 | 77 | |
| | TOTAL | | 14,567 | 393 | 151 | 4.79 |
| 36 | Freeway | 36 | 23,719 | 640 | 246 | |
| | Arterial | 28 | 7,441 | 201 | 77 | |
| | Collector | | - | - | - | |
| | Local | 28 | 15,347 | 414 | 159 | |
| | TOTAL | | 46,507 | 1,255 | 482 | 12.82 |
| 37 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 18,565 | 501 | 193 | |
| | Collector | | - | - | - | |
| | Local | 28 | 5,546 | 150 | 58 | |
| | TOTAL | | 24,111 | 651 | 251 | 44.99 |
| 38 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 18,577 | 501 | 193 | |
| | Collector | | - | - | - | |
| | Local | 28 | 5,240 | 141 | 54 | |
| | TOTAL | | 23,817 | 642 | 247 | 38.72 |
| 39 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 36,009 | 971 | 374 | |
| | Collector | | - | - | - | |
| | Local | 28 | 5,381 | 145 | 56 | |
| | TOTAL | | 41,390 | 1,116 | 430 | 11.30 |
| 40 | Freeway | 36 | 4,825 | 130 | 50 | |
| | Arterial | 28 | 65,131 | 1,757 | 676 | |
| | Collector | | - | - | - | |
| | Local | 28 | 10,453 | 282 | 109 | |
| | TOTAL | | 80,409 | 2,169 | 835 | 22.87 |
| 41 | Freeway | 44 | 6,627 | 179 | 69 | |
| | Arterial | 28 | 12,544 | 338 | 130 | |
| | Collector | | - | - | - | |
| | Local | 28 | 4,497 | 121 | 47 | |
| | TOTAL | | 23,668 | 638 | 246 | 19.58 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 42 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 22,179 | 598 | 230 | |
| | Collector | | - | - | - | |
| | Local | 28 | 14,180 | 382 | 147 | |
| | TOTAL | | 36,359 | 980 | 377 | 13.01 |
| 43 | Freeway | 44 | 2,732 | 74 | 28 | |
| | Arterial | 28 | 19,122 | 516 | 198 | |
| | Collector | | - | - | - | |
| | Local | 28 | 8,499 | 229 | 88 | |
| | TOTAL | | 30,353 | 819 | 314 | 50.62 |
| 44 | Freeway | 44 | 15,942 | 430 | 165 | |
| | Arterial | 28 | 55,328 | 1,492 | 574 | |
| | Collector | | - | - | - | |
| | Local | 24 | 22,506 | 607 | 234 | |
| | TOTAL | | 93,776 | 2,529 | 973 | 20.23 |
| 45 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 19,637 | 530 | 204 | |
| | Collector | | - | - | - | |
| | Local | 24 | 3,465 | 93 | 36 | |
| | TOTAL | | 23,102 | 623 | 240 | 34.44 |
| 46 | Freeway | 44 | 3,881 | 105 | 40 | |
| | Arterial | 28 | 43,800 | 1,181 | 454 | |
| | Collector | | - | - | - | |
| | Local | 24 | 7,762 | 209 | 81 | |
| | TOTAL | | 55,443 | 1,495 | 575 | 20.51 |
| 47 | Freeway | 44 | 5,187 | 140 | 54 | |
| | Arterial | 28 | 36,780 | 992 | 382 | |
| | Collector | | - | - | - | |
| | Local | 24 | 5,187 | 140 | 54 | |
| | TOTAL | | 47,154 | 1,272 | 490 | 58.34 |
| 48 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 17,716 | 478 | 184 | |
| | Collector | | - | - | - | |
| | Local | 24 | 11,327 | 306 | 118 | |
| | TOTAL | | 29,043 | 784 | 302 | 8.28 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 49 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 8,369 | 226 | 87 | |
| | Collector | | - | - | - | |
| | Local | 24 | 7,725 | 208 | 80 | |
| | TOTAL | | 16,094 | 434 | 167 | 11.38 |
| 50 | Freeway | 44 | 26,008 | 702 | 270 | |
| | Arterial | 28 | 78,023 | 2,104 | 809 | |
| | Collector | | - | - | - | |
| | Local | 24 | 58,517 | 1,578 | 607 | |
| | TOTAL | | 162,548 | 4,384 | 1,686 | 25.78 |
| 51 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 28 | 12,337 | 333 | 128 | |
| | Collector | | - | - | - | |
| | Local | 24 | 13,365 | 361 | 139 | |
| | TOTAL | | 25,702 | 694 | 267 | 13.64 |
| 52 | Freeway | 50 | 2,896 | 47 | 18 | |
| | Arterial | 30 | 24,774 | 405 | 152 | |
| | Collector | | - | - | - | |
| | Local | 30 | 4,505 | 74 | 28 | |
| | TOTAL | | 32,175 | 526 | 198 | 25.13 |
| 53 | Freeway | 50 | 5,296 | 87 | 32 | |
| | Arterial | 30 | 71,496 | 1,170 | 439 | |
| | Collector | | - | - | - | |
| | Local | 30 | 11,475 | 188 | 70 | |
| | TOTAL | | 88,267 | 1,445 | 541 | 189.39 |
| 54 | Freeway | 50 | 1,817 | 30 | 11 | |
| | Arterial | 30 | 50,862 | 832 | 312 | |
| | Collector | | - | - | - | |
| | Local | 30 | 7,871 | 129 | 48 | |
| | TOTAL | | 60,550 | 991 | 371 | 339.42 |
| 55 | Freeway | 50 | 9,420 | 154 | 58 | |
| | Arterial | 30 | 43,569 | 713 | 268 | |
| | Collector | | - | - | - | |
| | Local | 30 | 5,888 | 96 | 36 | |
| | TOTAL | | 58,877 | 963 | 362 | 239.00 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 56 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 22, 189 | 965 | 377 | |
| | Collector | | - | - | - | |
| | Local | 30 | 2, 465 | 107 | 42 | |
| | TOTAL | | 24, 654 | 1, 072 | 419 | 38. 23 |
| 57 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 46, 706 | 2, 031 | 793 | |
| | Collector | | - | - | - | |
| | Local | 30 | 4, 061 | 177 | 69 | |
| | TOTAL | | 50, 767 | 2, 208 | 862 | 251. 77 |
| 58 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 42, 908 | 1, 866 | 728 | |
| | Collector | | - | - | - | |
| | Local | 30 | 3, 731 | 162 | 63 | |
| | TOTAL | | 46, 639 | 2, 028 | 791 | 375. 25 |
| 59 | Freeway | 50 | 33, 037 | 926 | 343 | |
| | Arterial | 30 | 107, 805 | 3, 023 | 1, 120 | |
| | Collector | | - | - | - | |
| | Local | 30 | 33, 037 | 926 | 343 | |
| | TOTAL | | 173, 879 | 4, 875 | 1, 806 | 91. 09 |
| 60 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 15, 465 | 434 | 161 | |
| | Collector | | - | - | - | |
| | Local | 30 | 3, 395 | 95 | 35 | |
| | TOTAL | | 18, 860 | 529 | 196 | 20. 50 |
| 61 | Freeway | 50 | 4, 872 | 137 | 51 | |
| | Arterial | 30 | 17, 865 | 501 | 186 | |
| | Collector | | - | - | - | |
| | Local | 30 | 4, 331 | 121 | 45 | |
| | TOTAL | | 27, 068 | 759 | 282 | 17. 29 |
| 62 | Freeway | 50 | 17, 828 | 220 | 81 | |
| | Arterial | 30 | 87, 223 | 2, 446 | 906 | |
| | Collector | | - | - | - | |
| | Local | 30 | 16, 774 | 470 | 174 | |
| | TOTAL | | 111, 825 | 3, 136 | 1, 161 | 233. 97 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 63 | Freeway | 50 | 20,020 | 561 | 208 | |
| | Arterial | 30 | 93,427 | 2,619 | 970 | |
| | Collector | | - | - | - | |
| | Local | 30 | 20,020 | 561 | 208 | |
| | TOTAL | | 133,467 | 3,741 | 1,386 | 513.30 |
| 64 | Freeway | 50 | 57,929 | 1,624 | 602 | |
| | Arterial | 30 | 35,648 | 1,000 | 370 | |
| | Collector | | - | - | - | |
| | Local | 30 | 17,824 | 500 | 185 | |
| | TOTAL | | 111,401 | 3,124 | 1,157 | 173.83 |
| 65 | Freeway | 50 | 25,983 | 535 | 214 | |
| | Arterial | 30 | 70,041 | 1,441 | 576 | |
| | Collector | | - | - | - | |
| | Local | 30 | 16,945 | 349 | 140 | |
| | TOTAL | | 112,969 | 2,325 | 930 | 62.34 |
| 66 | Freeway | 50 | 2,834 | 58 | 23 | |
| | Arterial | 30 | 81,233 | 1,671 | 669 | |
| | Collector | | - | - | - | |
| | Local | 30 | 10,390 | 214 | 86 | |
| | TOTAL | | 94,457 | 1,943 | 778 | 344.91 |
| 67 | Freeway | 50 | 25,117 | 517 | 207 | |
| | Arterial | 30 | 81,330 | 1,673 | 670 | |
| | Collector | | - | - | - | |
| | Local | 30 | 13,156 | 271 | 108 | |
| | TOTAL | | 119,603 | 2,461 | 985 | 431.11 |
| 68 | Freeway | 50 | 5,704 | 117 | 47 | |
| | Arterial | 20 | 21,548 | 443 | 177 | |
| | Collector | | - | - | - | |
| | Local | 30 | 4,436 | 91 | 37 | |
| | TOTAL | | 31,688 | 651 | 261 | 24.48 |
| 69 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 44,933 | 1,902 | 713 | |
| | Collector | | - | - | - | |
| | Local | 30 | 14,977 | 634 | 238 | |
| | TOTAL | | 59,910 | 2,536 | 951 | 53.68 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 70 | Freeway | 50 | 5,310 | 225 | 84 | |
| | Arterial | 30 | 51,587 | 2,184 | 819 | |
| | Collector | | - | - | - | |
| | Local | 30 | 18,966 | 803 | 301 | |
| | TOTAL | | 75,863 | 3,212 | 1,204 | 46.99 |
| 71 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 52,460 | 2,221 | 833 | |
| | Collector | | - | - | - | |
| | Local | 30 | 9,258 | 392 | 147 | |
| | TOTAL | | 61,718 | 2,613 | 980 | 243.21 |
| 72 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 30 | 17,930 | 759 | 285 | |
| | Collector | | - | - | - | |
| | Local | 30 | 3,164 | 134 | 50 | |
| | TOTAL | | 21,094 | 893 | 335 | 94.61 |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway<br>Arterial<br>Collector<br>Local | | TOTAL | TOTAL | TOTAL | VMT Total for All Vehicle Types |
| | TOTAL | | 3,061,703 | 92,805 | 35,307 | 3,189,815 |

Vehicle Miles of Travel (VMT)

Metropolitan Area Pittsburgh

Year 1977

Time Period 12-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 1 | Freeway | 39 | 57,470 | 2,954 | 1,107 | |
| | Arterial | 19 | 43,949 | 2,258 | 847 | |
| | Collector | | - | - | - | |
| | Local | 17 | 236,644 | 12,161 | 4,562 | |
| | TOTAL | | 338,063 | 17,373 | 6,516 | 1.26 |
| 2 | Freeway | 39 | 50,537 | 2,597 | 974 | |
| | Arterial | 19 | 61,066 | 3,138 | 1,177 | |
| | Collector | | - | - | - | |
| | Local | 17 | 98,969 | 5,086 | 1,907 | |
| | TOTAL | | 210,572 | 10,821 | 4,058 | 2.07 |
| 3 | Freeway | 39 | 57,682 | 2,965 | 1,112 | |
| | Arterial | 19 | 66,789 | 3,432 | 1,287 | |
| | Collector | | - | - | - | |
| | Local | 17 | 179,115 | 9,206 | 3,452 | |
| | TOTAL | | 303,586 | 15,603 | 5,851 | 3.85 |
| 4 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 20,208 | 1,039 | 390 | |
| | Collector | | - | - | - | |
| | Local | 17 | 17,215 | 884 | 332 | |
| | TOTAL | | 37,423 | 1,923 | 722 | 2.89 |
| 5 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 39,053 | 2,007 | 752 | |
| | Collector | | - | - | - | |
| | Local | 17 | 58,581 | 3,011 | 1,129 | |
| | TOTAL | | 97,634 | 5,018 | 1,881 | 5.82 |
| 6 | Freeway | 39 | 63,108 | 3,243 | 1,216 | |
| | Arterial | 19 | 50,486 | 2,594 | 973 | |
| | Collector | | - | - | - | |
| | Local | 17 | 201,946 | 10,379 | 3,893 | |
| | TOTAL | | 315,540 | 16,216 | 6,082 | 4.23 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 7 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 69,924 | 3,594 | 1,348 | |
| | Collector | | - | - | - | |
| | Local | 17 | 75,752 | 3,893 | 1,460 | |
| | TOTAL | | 145,676 | 7,487 | 2,808 | 4.54 |
| 8 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 4,469 | 230 | 86 | |
| | Collector | | - | - | - | |
| | Local | 17 | 27,455 | 1,411 | 530 | |
| | TOTAL | | 31,924 | 1,641 | 616 | 1.96 |
| 9 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 114,165 | 5,867 | 2,200 | |
| | Collector | | - | - | - | |
| | Local | 17 | 64,219 | 3,300 | 1,238 | |
| | TOTAL | | 178,384 | 9,167 | 3,438 | 2.55 |
| 10 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 51,584 | 2,651 | 994 | |
| | Collector | | - | - | - | |
| | Local | 18 | 60,556 | 3,113 | 1,167 | |
| | TOTAL | | 112,140 | 5,764 | 2,161 | 6.99 |
| 11 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 25,132 | 1,292 | 485 | |
| | Collector | | - | - | - | |
| | Local | 18 | 31,986 | 1,643 | 617 | |
| | TOTAL | | 57,118 | 2,935 | 1,102 | 1.52 |
| 12 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 32,751 | 1,683 | 632 | |
| | Collector | | - | - | - | |
| | Local | 18 | 29,045 | 1,493 | 560 | |
| | TOTAL | | 61,796 | 3,176 | 1,192 | 3.06 |
| 13 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 9,278 | 476 | 179 | |
| | Collector | | - | - | - | |
| | Local | 18 | 42,266 | 2,172 | 815 | |
| | TOTAL | | 51,544 | 2,648 | 994 | 2.27 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 14 | Freeway | 39 | 107,312 | 5,516 | 2,068 | |
| | Arterial | 22 | 189,585 | 9,743 | 3,654 | |
| | Collector | | - | - | - | |
| | Local | 18 | 60,809 | 3,125 | 1,172 | |
| | TOTAL | | 357,706 | 18,384 | 6,894 | 3.89 |
| 15 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 26,971 | 1,386 | 520 | |
| | Collector | | - | - | - | |
| | Local | 18 | 40,457 | 2,079 | 780 | |
| | TOTAL | | 67,428 | 3,465 | 1,300 | 5.51 |
| 16 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 64,695 | 3,325 | 1,247 | |
| | Collector | | - | - | - | |
| | Local | 18 | 75,945 | 3,903 | 1,464 | |
| | TOTAL | | 140,640 | 7,228 | 2,711 | 1.28 |
| 17 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 27,453 | 1,411 | 529 | |
| | Collector | | - | - | - | |
| | Local | 18 | 50,986 | 2,621 | 983 | |
| | TOTAL | | 78,439 | 4,032 | 1,512 | 1.21 |
| 18 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 74,144 | 3,810 | 1,429 | |
| | Collector | | - | - | - | |
| | Local | 18 | 53,691 | 2,760 | 1,035 | |
| | TOTAL | | 127,835 | 6,570 | 2,464 | 2.55 |
| 19 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 13,352 | 686 | 257 | |
| | Collector | | - | - | - | |
| | Local | 18 | 13,353 | 687 | 257 | |
| | TOTAL | | 26,705 | 1,373 | 514 | 1.85 |
| 20 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 9,035 | 464 | 173 | |
| | Collector | | - | - | - | |
| | Local | 18 | 36,130 | 1,856 | 697 | |
| | TOTAL | | 45,165 | 2,320 | 870 | 1.69 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 21 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 191,345 | 5,161 | 1,985 | |
| | Collector | | - | - | - | |
| | Local | 28 | 103,034 | 2,779 | 1,069 | |
| | TOTAL | | 294,379 | 7,940 | 3,054 | 7.17 |
| 22 | Freeway | 45 | 57,730 | 1,557 | 599 | |
| | Arterial | 36 | 444,524 | 11,990 | 4,611 | |
| | Collector | | - | - | - | |
| | Local | 28 | 75,050 | 2,024 | 779 | |
| | TOTAL | | 577,304 | 15,571 | 5,989 | 24.78 |
| 23 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 131,121 | 3,537 | 1,361 | |
| | Collector | | - | - | - | |
| | Local | 28 | 30,758 | 830 | 319 | |
| | TOTAL | | 161,879 | 4,367 | 1,680 | 3.07 |
| 24 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 83,307 | 2,247 | 864 | |
| | Collector | | - | - | - | |
| | Local | 28 | 7,245 | 196 | 75 | |
| | TOTAL | | 90,552 | 2,443 | 939 | 3.89 |
| 25 | Freeway | 45 | 102,691 | 2,770 | 1,065 | |
| | Arterial | 36 | 133,221 | 3,593 | 1,382 | |
| | Collector | | - | - | - | |
| | Local | 36 | 41,631 | 1,124 | 431 | |
| | TOTAL | | 277,543 | 7,487 | 2,878 | 9.19 |
| 26 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 175,688 | 4,739 | 1,822 | |
| | Collector | | - | - | - | |
| | Local | 36 | 23,958 | 646 | 248 | |
| | TOTAL | | 199,646 | 5,385 | 2,070 | 12.20 |
| 27 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 205,507 | 5,543 | 2,132 | |
| | Collector | | - | - | - | |
| | Local | 36 | 10,816 | 292 | 113 | |
| | TOTAL | | 216,323 | 5,835 | 2,245 | 71.50 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 28 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 22, 976 | 620 | 239 | |
| | Collector | | - | - | - | |
| | Local | 36 | 39, 122 | 1, 055 | 406 | |
| | TOTAL | | 62, 098 | 1, 675 | 645 | 15. 42 |
| 29 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 25, 702 | 693 | 266 | |
| | Collector | | - | - | - | |
| | Local | 36 | 28, 982 | 782 | 301 | |
| | TOTAL | | 54, 684 | 1, 475 | 567 | 9. 02 |
| 30 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 232, 214 | 6, 263 | 2, 408 | |
| | Collector | | - | - | - | |
| | Local | 36 | 7, 182 | 194 | 75 | |
| | TOTAL | | 239, 396 | 6, 457 | 2, 483 | 10. 34 |
| 31 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 74, 870 | 2, 019 | 776 | |
| | Collector | | - | - | - | |
| | Local | 36 | 26, 306 | 710 | 273 | |
| | TOTAL | | 101, 176 | 2, 729 | 1, 049 | 5. 15 |
| 32 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 390, 229 | 10, 525 | 4, 049 | |
| | Collector | | - | - | - | |
| | Local | 36 | 79, 927 | 2, 156 | 829 | |
| | TOTAL | | 470, 156 | 12, 681 | 4, 878 | 93. 15 |
| 33 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 75, 936 | 2, 048 | 788 | |
| | Collector | | - | - | - | |
| | Local | 36 | 8, 438 | 228 | 88 | |
| | TOTAL | | 84, 374 | 2, 276 | 876 | 6. 77 |
| 34 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 150, 171 | 4, 050 | 1, 558 | |
| | Collector | | - | - | - | |
| | Local | 36 | 24, 446 | 659 | 254 | |
| | TOTAL | | 174, 617 | 4, 709 | 1, 812 | 10. 99 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 35 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 53,536 | 1,444 | 556 | |
| | Collector | | - | - | - | |
| | Local | 36 | 55,721 | 1,502 | 578 | |
| | TOTAL | | 109,257 | 2,946 | 1,134 | 4.79 |
| 36 | Freeway | 45 | 177,890 | 4,797 | 1,846 | |
| | Arterial | 36 | 55,809 | 1,506 | 578 | |
| | Collector | | - | - | - | |
| | Local | 36 | 115,104 | 3,104 | 1,194 | |
| | TOTAL | | 348,803 | 9,407 | 3,618 | 12.82 |
| 37 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 139,240 | 3,755 | 1,445 | |
| | Collector | | - | - | - | |
| | Local | 36 | 41,591 | 1,122 | 431 | |
| | TOTAL | | 180,831 | 4,877 | 1,876 | 44.99 |
| 38 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 139,328 | 3,758 | 1,445 | |
| | Collector | | - | - | - | |
| | Local | 36 | 39,297 | 1,060 | 407 | |
| | TOTAL | | 178,625 | 4,818 | 1,852 | 38.72 |
| 39 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 270,070 | 7,284 | 2,801 | |
| | Collector | | - | - | - | |
| | Local | 36 | 40,355 | 1,088 | 419 | |
| | TOTAL | | 310,425 | 8,372 | 3,220 | 11.30 |
| 40 | Freeway | 45 | 36,185 | 976 | 376 | |
| | Arterial | 36 | 488,480 | 13,175 | 5,068 | |
| | Collector | | - | - | - | |
| | Local | 36 | 78,398 | 2,115 | 814 | |
| | TOTAL | | 603,063 | 16,266 | 6,258 | 22.87 |
| 41 | Freeway | 54 | 49,701 | 1,341 | 516 | |
| | Arterial | 36 | 94,076 | 2,537 | 976 | |
| | Collector | | - | - | - | |
| | Local | 36 | 33,727 | 909 | 350 | |
| | TOTAL | | 177,504 | 4,787 | 1,842 | 19.58 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 42 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 166,343 | 4,487 | 1,726 | |
| | Collector | | - | - | - | |
| | Local | 36 | 106,350 | 2,868 | 1,103 | |
| | TOTAL | | 272,693 | 7,355 | 2,829 | 13.01 |
| 43 | Freeway | 54 | 20,489 | 553 | 212 | |
| | Arterial | 36 | 43,417 | 3,869 | 1,488 | |
| | Collector | | - | - | - | |
| | Local | 36 | 63,741 | 1,719 | 662 | |
| | TOTAL | | 227,647 | 6,141 | 2,362 | 50.62 |
| 44 | Freeway | 54 | 119,564 | 3,225 | 1,241 | |
| | Arterial | 36 | 414,959 | 11,192 | 4,304 | |
| | Collector | | - | - | - | |
| | Local | 30 | 168,797 | 4,553 | 1,751 | |
| | TOTAL | | 703,320 | 18,970 | 7,296 | 20.23 |
| 45 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 147,279 | 3,972 | 1,527 | |
| | Collector | | - | - | - | |
| | Local | 30 | 25,991 | 701 | 270 | |
| | TOTAL | | 173,270 | 4,673 | 1,797 | 34.44 |
| 46 | Freeway | 54 | 29,108 | 785 | 302 | |
| | Arterial | 36 | 328,503 | 8,860 | 3,408 | |
| | Collector | | - | - | - | |
| | Local | 30 | 58,217 | 1,571 | 605 | |
| | TOTAL | | 415,828 | 11,216 | 4,315 | 20.51 |
| 47 | Freeway | 54 | 38,900 | 1,049 | 404 | |
| | Arterial | 36 | 275,843 | 7,440 | 2,861 | |
| | Collector | | - | - | - | |
| | Local | 30 | 38,900 | 1,049 | 404 | |
| | TOTAL | | 353,643 | 9,538 | 3,669 | 58.34 |
| 48 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 132,873 | 3,584 | 1,379 | |
| | Collector | | - | - | - | |
| | Local | 30 | 84,952 | 2,291 | 881 | |
| | TOTAL | | 217,825 | 5,875 | 2,260 | 8.28 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 49 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 62,764 | 1,693 | 651 | |
| | Collector | | - | - | - | |
| | Local | 30 | 57,935 | 1,563 | 601 | |
| | TOTAL | | 120,699 | 3,256 | 1,252 | 11.38 |
| 50 | Freeway | 54 | 195,057 | 5,261 | 2,024 | |
| | Arterial | 36 | 585,171 | 15,782 | 6,071 | |
| | Collector | | - | - | - | |
| | Local | 30 | 438,879 | 11,837 | 4,552 | |
| | TOTAL | | 1,219,107 | 32,880 | 12,647 | 25.78 |
| 51 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 92,529 | 2,495 | 960 | |
| | Collector | | - | - | - | |
| | Local | 30 | 100,240 | 2,704 | 1,040 | |
| | TOTAL | | 192,769 | 5,199 | 2,000 | 13.64 |
| 52 | Freeway | 56 | 21,719 | 356 | 134 | |
| | Arterial | 38 | 185,808 | 3,040 | 1,140 | |
| | Collector | | - | - | - | |
| | Local | 37 | 33,784 | 553 | 207 | |
| | TOTAL | | 241,311 | 3,949 | 1,481 | 25.13 |
| 53 | Freeway | 56 | 39,719 | 650 | 243 | |
| | Arterial | 38 | 536,219 | 8,773 | 3,291 | |
| | Collector | | - | - | - | |
| | Local | 37 | 86,059 | 1,408 | 528 | |
| | TOTAL | | 661,997 | 10,831 | 4,062 | 189.39 |
| 54 | Freeway | 56 | 13,624 | 223 | 84 | |
| | Arterial | 38 | 381,465 | 6,241 | 2,340 | |
| | Collector | | - | - | - | |
| | Local | 37 | 59,036 | 966 | 362 | |
| | TOTAL | | 454,125 | 7,430 | 2,786 | 339.42 |
| 55 | Freeway | 56 | 70,652 | 1,156 | 434 | |
| | Arterial | 38 | 326,769 | 5,346 | 2,005 | |
| | Collector | | - | - | - | |
| | Local | 37 | 44,159 | 722 | 271 | |
| | TOTAL | | 441,580 | 7,224 | 2,710 | 239.00 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 56 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 166,417 | 7,235 | 2,824 | |
| | Collector | | - | - | - | |
| | Local | 37 | 18,491 | 804 | 314 | |
| | TOTAL | | 184,908 | 8,039 | 3,138 | 38.23 |
| 57 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 350,294 | 15,230 | 5,944 | |
| | Collector | | - | - | - | |
| | Local | 37 | 30,460 | 1,325 | 516 | |
| | TOTAL | | 380,754 | 16,555 | 6,460 | 251.77 |
| 58 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 321,807 | 13,992 | 5,460 | |
| | Collector | | - | - | - | |
| | Local | 37 | 27,983 | 1,217 | 475 | |
| | TOTAL | | 349,790 | 15,209 | 5,935 | 375.25 |
| 59 | Freeway | 56 | 247,778 | 6,947 | 2,573 | |
| | Arterial | 38 | 808,541 | 22,669 | 8,396 | |
| | Collector | | - | - | - | |
| | Local | 37 | 247,779 | 6,947 | 2,573 | |
| | TOTAL | | 1,304,098 | 36,563 | 13,542 | 91.09 |
| 60 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 115,988 | 3,252 | 1,204 | |
| | Collector | | - | - | - | |
| | Local | 37 | 25,461 | 714 | 265 | |
| | TOTAL | | 141,449 | 3,966 | 1,469 | 20.50 |
| 61 | Freeway | 56 | 36,542 | 1,025 | 380 | |
| | Arterial | 38 | 133,988 | 3,757 | 1,392 | |
| | Collector | | - | - | - | |
| | Local | 37 | 32,481 | 911 | 337 | |
| | TOTAL | | 203,011 | 5,693 | 2,109 | 17.29 |
| 62 | Freeway | 56 | 58,708 | 1,646 | 610 | |
| | Arterial | 38 | 654,173 | 18,341 | 6,794 | |
| | Collector | | - | - | - | |
| | Local | 37 | 125,804 | 3,527 | 1,306 | |
| | TOTAL | | 838,685 | 23,514 | 8,710 | 233.97 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 63 | Freeway | 56 | 150,150 | 4,210 | 1,559 | |
| | Arterial | 38 | 700,702 | 19,646 | 7,276 | |
| | Collector | | - | - | - | |
| | Local | 37 | 150,150 | 4,210 | 1,559 | |
| | TOTAL | | 1,001,002 | 28,066 | 10,394 | 513.30 |
| 64 | Freeway | 56 | 434,465 | 12,181 | 4,512 | |
| | Arterial | 38 | 267,362 | 7,496 | 2,777 | |
| | Collector | | - | - | - | |
| | Local | 37 | 133,682 | 3,748 | 1,388 | |
| | TOTAL | | 835,509 | 23,425 | 8,677 | 173.83 |
| 65 | Freeway | 56 | 194,871 | 4,010 | 1,604 | |
| | Arterial | 38 | 525,308 | 10,808 | 4,323 | |
| | Collector | | - | - | - | |
| | Local | 37 | 127,091 | 2,615 | 1,046 | |
| | TOTAL | | 847,270 | 17,433 | 6,973 | 62.34 |
| 66 | Freeway | 56 | 21,253 | 437 | 175 | |
| | Arterial | 38 | 609,250 | 12,536 | 5,014 | |
| | Collector | | - | - | - | |
| | Local | 37 | 77,927 | 1,604 | 641 | |
| | TOTAL | | 708,430 | 14,577 | 5,830 | 344.91 |
| 67 | Freeway | 56 | 188,374 | 3,876 | 1,550 | |
| | Arterial | 38 | 609,973 | 12,551 | 5,021 | |
| | Collector | | - | - | - | |
| | Local | 37 | 98,672 | 2,030 | 812 | |
| | TOTAL | | 897,019 | 18,457 | 7,383 | 431.11 |
| 68 | Freeway | 56 | 42,779 | 881 | 352 | |
| | Arterial | 38 | 161,610 | 3,325 | 1,330 | |
| | Collector | | - | - | - | |
| | Local | 37 | 33,272 | 685 | 274 | |
| | TOTAL | | 237,661 | 4,891 | 1,956 | 24.48 |
| 69 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 336,996 | 14,264 | 5,350 | |
| | Collector | | - | - | - | |
| | Local | 37 | 112,331 | 4,755 | 1,784 | |
| | TOTAL | | 449,327 | 19,019 | 7,134 | 53.68 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 70 | Freeway | 56 | 39,828 | 1,685 | 632 | |
| | Arterial | 38 | 386,901 | 16,377 | 6,142 | |
| | Collector | | - | - | - | |
| | Local | 37 | 142,243 | 6,021 | 2,258 | |
| | TOTAL | | 568,972 | 24,083 | 9,032 | 46.99 |
| 71 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 393,449 | 16,654 | 6,245 | |
| | Collector | | - | - | - | |
| | Local | 37 | 69,433 | 2,939 | 1,102 | |
| | TOTAL | | 462,882 | 19,593 | 7,347 | 243.21 |
| 72 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 134,471 | 5,693 | 2,135 | |
| | Collector | | - | - | - | |
| | Local | 37 | 23,729 | 1,004 | 377 | |
| | TOTAL | | 158,200 | 6,697 | 2,512 | 94.61 |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway<br>Arterial<br>Collector<br>Local | | TOTAL LD | TOTAL HD | TOTAL DIESEL | VMT Total for All Vehicle Types |
| | TOTAL | | 22,962,734 | 695,964 | 264,718 | 23,923,416 |

Vehicle Miles of Travel (VMT)

Metropolitan Area Pittsburgh

Year 1977

Time Period 24-Hour

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 1 | Freeway | 39 | 76,627 | 3,938 | 1,476 | |
| | Arterial | 19 | 58,598 | 3,011 | 1,129 | |
| | Collector | | - | - | - | |
| | Local | 17 | 315,525 | 16,215 | 6,082 | |
| | TOTAL | | 450,750 | 23,164 | 8,687 | 1.26 |
| 2 | Freeway | 39 | 67,382 | 3,463 | 1,298 | |
| | Arterial | 19 | 81,421 | 4,184 | 1,569 | |
| | Collector | | - | - | - | |
| | Local | 17 | 131,958 | 6,781 | 2,543 | |
| | TOTAL | | 280,761 | 14,428 | 5,410 | 2.07 |
| 3 | Freeway | 39 | 76,909 | 3,953 | 1,482 | |
| | Arterial | 19 | 89,052 | 4,576 | 1,716 | |
| | Collector | | - | - | - | |
| | Local | 17 | 238,820 | 12,274 | 4,603 | |
| | TOTAL | | 404,781 | 20,803 | 7,801 | 3.85 |
| 4 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 26,944 | 1,385 | 520 | |
| | Collector | | - | - | - | |
| | Local | 17 | 22,953 | 1,179 | 442 | |
| | TOTAL | | 49,897 | 2,564 | 962 | 2.89 |
| 5 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 52,071 | 2,676 | 1,003 | |
| | Collector | | - | - | - | |
| | Local | 17 | 78,108 | 4,014 | 1,505 | |
| | TOTAL | | 130,179 | 6,689 | 2,508 | 5.82 |
| 6 | Freeway | 39 | 84,144 | 4,324 | 1,621 | |
| | Arterial | 19 | 67,315 | 3,459 | 1,297 | |
| | Collector | | - | - | - | |
| | Local | 17 | 269,261 | 13,838 | 5,190 | |
| | TOTAL | | 420,720 | 21,621 | 8,108 | 4.23 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 7 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 93,232 | 4,792 | 1,797 | |
| | Collector | | - | - | - | |
| | Local | 17 | 101,002 | 5,190 | 1,947 | |
| | TOTAL | | 194,234 | 9,982 | 3,744 | 4.54 |
| 8 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 5,959 | 307 | 115 | |
| | Collector | | - | - | - | |
| | Local | 17 | 36,607 | 1,881 | 706 | |
| | TOTAL | | 42,566 | 2,188 | 821 | 1.96 |
| 9 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 19 | 152,220 | 7,823 | 2,933 | |
| | Collector | | - | - | - | |
| | Local | 17 | 85,625 | 4,400 | 1,650 | |
| | TOTAL | | 237,845 | 12,223 | 4,583 | 2.55 |
| 10 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 68,779 | 3,535 | 1,325 | |
| | Collector | | - | - | - | |
| | Local | 18 | 80,741 | 4,150 | 1,556 | |
| | TOTAL | | 149,520 | 7,685 | 2,881 | 6.99 |
| 11 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 33,509 | 1,722 | 646 | |
| | Collector | | - | - | - | |
| | Local | 18 | 42,648 | 2,191 | 822 | |
| | TOTAL | | 76,157 | 3,913 | 1,468 | 1.52 |
| 12 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 43,668 | 2,244 | 842 | |
| | Collector | | - | - | - | |
| | Local | 18 | 38,726 | 1,990 | 746 | |
| | TOTAL | | 82,394 | 4,234 | 1,588 | 3.06 |
| 13 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 12,371 | 635 | 238 | |
| | Collector | | - | - | - | |
| | Local | 18 | 56,354 | 2,896 | 1,087 | |
| | TOTAL | | 68,725 | 3,531 | 1,325 | 2.27 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 14 | Freeway | 39 | 143,083 | 7,354 | 2,757 | |
| | Arterial | 22 | 252,780 | 12,991 | 4,872 | |
| | Collector | | - | - | - | |
| | Local | 18 | 81,079 | 4,167 | 1,563 | |
| | TOTAL | | 476,942 | 24,512 | 9,192 | 3.89 |
| 15 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 35,961 | 1,848 | 693 | |
| | Collector | | - | - | - | |
| | Local | 18 | 53,943 | 2,772 | 1,040 | |
| | TOTAL | | 89,904 | 4,620 | 1,733 | 5.51 |
| 16 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 86,260 | 4,433 | 1,662 | |
| | Collector | | - | - | - | |
| | Local | 18 | 101,260 | 5,204 | 1,952 | |
| | TOTAL | | 187,520 | 9,637 | 3,614 | 1.28 |
| 17 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 36,604 | 1,881 | 705 | |
| | Collector | | - | - | - | |
| | Local | 18 | 67,981 | 3,495 | 1,310 | |
| | TOTAL | | 104,585 | 5,376 | 2,015 | 1.21 |
| 18 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 98,858 | 5,080 | 1,905 | |
| | Collector | | - | - | - | |
| | Local | 18 | 71,588 | 3,680 | 1,380 | |
| | TOTAL | | 170,446 | 8,760 | 3,285 | 2.55 |
| 19 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 17,803 | 915 | 343 | |
| | Collector | | - | - | - | |
| | Local | 18 | 17,804 | 916 | 343 | |
| | TOTAL | | 35,607 | 1,831 | 686 | 1.85 |
| 20 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 22 | 12,046 | 619 | 231 | |
| | Collector | | - | - | - | |
| | Local | 18 | 48,173 | 2,475 | 929 | |
| | TOTAL | | 60,219 | 3,094 | 1,160 | 1.69 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 21 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 255,127 | 6,881 | 2,646 | |
| | Collector | | - | - | - | |
| | Local | 28 | 137,378 | 3,705 | 1,425 | |
| | TOTAL | | 392,505 | 10,586 | 4,071 | 7.17 |
| 22 | Freeway | 45 | 76,973 | 2,076 | 798 | |
| | Arterial | 36 | 592,698 | 15,986 | 6,148 | |
| | Collector | | - | - | - | |
| | Local | 28 | 100,067 | 2,699 | 1,039 | |
| | TOTAL | | 769,738 | 20,761 | 7,985 | 24.78 |
| 23 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 174,828 | 4,716 | 1,814 | |
| | Collector | | - | - | - | |
| | Local | 28 | 41,010 | 1,106 | 425 | |
| | TOTAL | | 215,838 | 5,822 | 2,239 | 3.07 |
| 24 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 111,076 | 2,996 | 1,152 | |
| | Collector | | - | - | - | |
| | Local | 28 | 9,660 | 261 | 100 | |
| | TOTAL | | 120,736 | 3,257 | 1,252 | 3.89 |
| 25 | Freeway | 45 | 136,921 | 3,693 | 1,420 | |
| | Arterial | 36 | 177,628 | 4,791 | 1,843 | |
| | Collector | | - | - | - | |
| | Local | 36 | 55,508 | 1,498 | 575 | |
| | TOTAL | | 370,057 | 9,982 | 3,838 | 9.19 |
| 26 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 234,251 | 6,318 | 2,430 | |
| | Collector | | - | - | - | |
| | Local | 36 | 31,944 | 861 | 331 | |
| | TOTAL | | 266,195 | 7,179 | 2,761 | 12.20 |
| 27 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 274,009 | 7,390 | 2,843 | |
| | Collector | | - | - | - | |
| | Local | 36 | 14,421 | 389 | 150 | |
| | TOTAL | | 288,430 | 7,779 | 2,993 | 71.50 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 28 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 30,634 | 826 | 318 | |
| | Collector | | - | - | - | |
| | Local | 36 | 52,162 | 1,407 | 541 | |
| | TOTAL | | 82,796 | 2,233 | 859 | 15.42 |
| 29 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 34,269 | 924 | 355 | |
| | Collector | | - | - | - | |
| | Local | 36 | 38,642 | 1,042 | 401 | |
| | TOTAL | | 72,911 | 1,966 | 756 | 9.02 |
| 30 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 309,619 | 8,351 | 3,211 | |
| | Collector | | - | - | - | |
| | Local | 36 | 9,576 | 258 | 100 | |
| | TOTAL | | 319,195 | 8,609 | 3,311 | 10.34 |
| 31 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 99,827 | 2,692 | 1,035 | |
| | Collector | | - | - | - | |
| | Local | 36 | 35,074 | 946 | 364 | |
| | TOTAL | | 134,901 | 3,638 | 1,399 | 5.15 |
| 32 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 520,305 | 14,033 | 5,398 | |
| | Collector | | - | - | - | |
| | Local | 36 | 106,569 | 2,874 | 1,105 | |
| | TOTAL | | 626,874 | 16,907 | 6,503 | 93.15 |
| 33 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 101,248 | 2,730 | 1,050 | |
| | Collector | | - | - | - | |
| | Local | 36 | 11,250 | 304 | 117 | |
| | TOTAL | | 112,498 | 3,034 | 1,167 | 6.77 |
| 34 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 200,228 | 5,400 | 2,077 | |
| | Collector | | - | - | - | |
| | Local | 36 | 32,595 | 879 | 338 | |
| | TOTAL | | 232,823 | 6,279 | 2,415 | 10.99 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 35 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 71,381 | 1,925 | 741 | |
| | Collector | | - | - | - | |
| | Local | 36 | 74,294 | 2,003 | 771 | |
| | TOTAL | | 145,675 | 3,928 | 1,512 | 4.79 |
| 36 | Freeway | 45 | 237,186 | 6,396 | 2,461 | |
| | Arterial | 36 | 74,412 | 2,008 | 771 | |
| | Collector | | - | - | - | |
| | Local | 36 | 153,472 | 4,139 | 1,592 | |
| | TOTAL | | 465,070 | 12,543 | 4,824 | 12.82 |
| 37 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 185,653 | 5,007 | 1,926 | |
| | Collector | | - | - | - | |
| | Local | 36 | 55,455 | 1,496 | 575 | |
| | TOTAL | | 241,108 | 6,503 | 2,501 | 44.99 |
| 38 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 185,770 | 5,010 | 1,927 | |
| | Collector | | - | - | - | |
| | Local | 36 | 52,396 | 1,413 | 543 | |
| | TOTAL | | 238,166 | 6,423 | 2,470 | 38.72 |
| 39 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 360,093 | 9,712 | 3,735 | |
| | Collector | | - | - | - | |
| | Local | 36 | 53,807 | 1,451 | 558 | |
| | TOTAL | | 413,900 | 11,163 | 4,293 | 11.30 |
| 40 | Freeway | 45 | 48,246 | 1,301 | 501 | |
| | Arterial | 36 | 651,306 | 17,566 | 6,757 | |
| | Collector | | - | - | - | |
| | Local | 36 | 104,531 | 2,820 | 1,085 | |
| | TOTAL | | 804,083 | 21,687 | 8,343 | 22.87 |
| 41 | Freeway | 54 | 66,268 | 1,788 | 688 | |
| | Arterial | 36 | 125,435 | 3,383 | 1,301 | |
| | Collector | | - | - | - | |
| | Local | 36 | 44,969 | 1,212 | 467 | |
| | TOTAL | | 236,672 | 6,383 | 2,456 | 19.58 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 42 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 221,790 | 5,982 | 2,301 | |
| | Collector | | - | - | - | |
| | Local | 36 | 141,800 | 3,824 | 1,471 | |
| | TOTAL | | 363,590 | 9,806 | 3,772 | 13.01 |
| 43 | Freeway | 54 | 27,318 | 737 | 283 | |
| | Arterial | 36 | 191,222 | 5,158 | 1,984 | |
| | Collector | | - | - | - | |
| | Local | 36 | 84,988 | 2,292 | 882 | |
| | TOTAL | | 303,528 | 8,187 | 3,149 | 50.62 |
| 44 | Freeway | 54 | 159,419 | 4,300 | 1,654 | |
| | Arterial | 36 | 553,278 | 14,922 | 5,739 | |
| | Collector | | - | - | - | |
| | Local | 30 | 225,062 | 6,070 | 2,335 | |
| | TOTAL | | 937,759 | 25,292 | 9,728 | 20.23 |
| 45 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 196,372 | 5,296 | 2,036 | |
| | Collector | | - | - | - | |
| | Local | 30 | 34,654 | 934 | 360 | |
| | TOTAL | | 231,026 | 6,230 | 2,396 | 34.44 |
| 46 | Freeway | 54 | 38,811 | 1,046 | 403 | |
| | Arterial | 36 | 438,004 | 11,813 | 4,544 | |
| | Collector | | - | - | - | |
| | Local | 30 | 77,622 | 2,094 | 806 | |
| | TOTAL | | 554,437 | 14,953 | 5,753 | 20.51 |
| 47 | Freeway | 54 | 51,867 | 1,399 | 538 | |
| | Arterial | 36 | 367,791 | 9,920 | 3,815 | |
| | Collector | | - | - | - | |
| | Local | 30 | 51,867 | 1,399 | 538 | |
| | TOTAL | | 471,525 | 12,718 | 4,891 | 58.34 |
| 48 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 177,164 | 4,778 | 1,838 | |
| | Collector | | - | - | - | |
| | Local | 30 | 113,269 | 3,055 | 1,175 | |
| | TOTAL | | 290,433 | 7,833 | 3,013 | 8.28 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 49 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 83,685 | 2,257 | 868 | |
| | Collector | | - | - | - | |
| | Local | 30 | 77,247 | 2,084 | 801 | |
| | TOTAL | | 160,932 | 4,341 | 1,669 | 11.38 |
| 50 | Freeway | 54 | 260,076 | 7,015 | 2,698 | |
| | Arterial | 36 | 780,228 | 21,042 | 8,094 | |
| | Collector | | - | - | - | |
| | Local | 30 | 585,172 | 15,783 | 6,070 | |
| | TOTAL | | 1,625,476 | 43,840 | 16,862 | 25.78 |
| 51 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 36 | 123,372 | 3,327 | 1,280 | |
| | Collector | | - | - | - | |
| | Local | 30 | 133,653 | 3,605 | 1,386 | |
| | TOTAL | | 257,025 | 6,932 | 2,666 | 13.64 |
| 52 | Freeway | 56 | 28,958 | 474 | 178 | |
| | Arterial | 38 | 247,744 | 4,053 | 1,520 | |
| | Collector | | - | - | - | |
| | Local | 37 | 45,045 | 737 | 276 | |
| | TOTAL | | 321,747 | 5,264 | 1,974 | 25.13 |
| 53 | Freeway | 56 | 52,959 | 866 | 324 | |
| | Arterial | 38 | 714,958 | 11,697 | 4,388 | |
| | Collector | | - | - | - | |
| | Local | 37 | 114,745 | 1,877 | 704 | |
| | TOTAL | | 882,662 | 14,440 | 5,416 | 189.39 |
| 54 | Freeway | 56 | 18,165 | 297 | 112 | |
| | Arterial | 38 | 508,620 | 8,321 | 3,120 | |
| | Collector | | - | - | - | |
| | Local | 37 | 78,714 | 1,288 | 483 | |
| | TOTAL | | 605,499 | 9,906 | 3,715 | 339.42 |
| 55 | Freeway | 56 | 94,203 | 1,541 | 578 | |
| | Arterial | 38 | 435,692 | 7,128 | 2,673 | |
| | Collector | | - | - | - | |
| | Local | 37 | 58,878 | 963 | 361 | |
| | TOTAL | | 588,773 | 9,632 | 3,612 | 239.00 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 56 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 221,889 | 9,647 | 3,765 | |
| | Collector | | - | - | - | |
| | Local | 37 | 24,654 | 1,072 | 418 | |
| | TOTAL | | 246,543 | 10,719 | 4,183 | 38.23 |
| 57 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 467,059 | 20,307 | 7,925 | |
| | Collector | | - | - | - | |
| | Local | 37 | 40,613 | 1,766 | 688 | |
| | TOTAL | | 507,672 | 22,073 | 8,613 | 251.77 |
| 58 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 429,076 | 18,656 | 7,280 | |
| | Collector | | - | - | - | |
| | Local | 37 | 37,311 | 1,623 | 633 | |
| | TOTAL | | 466,387 | 20,279 | 7,913 | 375.25 |
| 59 | Freeway | 56 | 330,371 | 9,263 | 3,431 | |
| | Arterial | 38 | 1,078,054 | 30,225 | 11,195 | |
| | Collector | | - | - | - | |
| | Local | 37 | 330,372 | 9,263 | 3,430 | |
| | TOTAL | | 1,738,797 | 48,751 | 18,056 | 91.09 |
| 60 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 154,651 | 4,336 | 1,605 | |
| | Collector | | - | - | - | |
| | Local | 37 | 33,948 | 952 | 353 | |
| | TOTAL | | 188,599 | 5,288 | 1,958 | 20.50 |
| 61 | Freeway | 56 | 48,723 | 1,367 | 506 | |
| | Arterial | 38 | 178,650 | 5,009 | 1,856 | |
| | Collector | | - | - | - | |
| | Local | 37 | 43,308 | 1,214 | 449 | |
| | TOTAL | | 270,681 | 7,590 | 2,811 | 17.29 |
| 62 | Freeway | 56 | 78,277 | 2,195 | 813 | |
| | Arterial | 38 | 872,231 | 24,455 | 9,058 | |
| | Collector | | - | - | - | |
| | Local | 37 | 167,738 | 4,703 | 1,741 | |
| | TOTAL | | 1,118,246 | 31,353 | 11,612 | 233.97 |

| District | Facility Type | Avg Speed (mph) | VMT | | | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| | | | LD | HD | Diesel | |
| 63 | Freeway | 56 | 200, 200 | 5, 613 | 2, 078 | |
| | Arterial | 38 | 934, 269 | 26, 194 | 9, 701 | |
| | Collector | | - | - | - | |
| | Local | 37 | 200, 200 | 5, 613 | 2, 078 | |
| | TOTAL | | 1,334, 669 | 37, 420 | 13, 857 | 513. 30 |
| 64 | Freeway | 56 | 579, 287 | 16, 241 | 6, 016 | |
| | Arterial | 38 | 356, 483 | 9, 995 | 3, 702 | |
| | Collector | | - | - | - | |
| | Local | 37 | 178, 242 | 4, 997 | 1, 851 | |
| | TOTAL | | 1,114, 012 | 31, 233 | 11, 569 | 173. 83 |
| 65 | Freeway | 56 | 259, 828 | 5, 346 | 2, 138 | |
| | Arterial | 38 | 700, 410 | 14, 411 | 5, 764 | |
| | Collector | | - | - | - | |
| | Local | 37 | 169, 454 | 3, 486 | 1, 394 | |
| | TOTAL | | 1,129, 692 | 23, 243 | 9, 296 | 62. 34 |
| 66 | Freeway | 56 | 28, 337 | 583 | 233 | |
| | Arterial | 38 | 812, 333 | 16, 714 | 6, 685 | |
| | Collector | | - | - | - | |
| | Local | 37 | 103, 903 | 2, 138 | 855 | |
| | TOTAL | | 944, 573 | 19, 435 | 7, 773 | 344. 91 |
| 67 | Freeway | 56 | 251, 165 | 5, 167 | 2, 067 | |
| | Arterial | 38 | 813, 297 | 16, 734 | 6, 694 | |
| | Collector | | - | - | - | |
| | Local | 37 | 131, 563 | 2, 707 | 1, 082 | |
| | TOTAL | | 1,196, 025 | 24, 608 | 9, 843 | 431. 11 |
| 68 | Freeway | 56 | 57, 038 | 1, 174 | 469 | |
| | Arterial | 38 | 215, 480 | 4, 433 | 1, 773 | |
| | Collector | | - | - | - | |
| | Local | 37 | 44, 363 | 913 | 365 | |
| | TOTAL | | 316, 881 | 6, 520 | 2, 607 | 24. 48 |
| 69 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 449, 328 | 19, 019 | 7, 133 | |
| | Collector | | - | - | - | |
| | Local | 37 | 149, 774 | 6, 340 | 2, 378 | |
| | TOTAL | | 599, 102 | 25, 359 | 9, 511 | 53. 68 |

| District | Facility Type | Avg Speed (mph) | VMT LD | VMT HD | VMT Diesel | Area (sq. mi.) |
|---|---|---|---|---|---|---|
| 70 | Freeway | 56 | 53, 104 | 2, 247 | 842 | |
| | Arterial | 38 | 515, 868 | 21, 836 | 8, 189 | |
| | Collector | | - | - | - | |
| | Local | 37 | 189, 657 | 8, 028 | 3, 011 | |
| | TOTAL | | 758, 629 | 32, 111 | 12, 042 | 46. 99 |
| 71 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 524, 599 | 22, 205 | 8, 327 | |
| | Collector | | - | - | - | |
| | Local | 37 | 92, 577 | 3, 919 | 1, 469 | |
| | TOTAL | | 617, 176 | 26, 124 | 9, 796 | 243. 21 |
| 72 | Freeway | | 0 | 0 | 0 | |
| | Arterial | 38 | 179, 295 | 7, 590 | 2, 847 | |
| | Collector | | - | - | - | |
| | Local | 37 | 31, 638 | 1, 339 | 502 | |
| | TOTAL | | 210, 933 | 8, 929 | 3, 349 | 94. 61 |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | | | | |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | | | | |
| | Freeway | | | | | |
| | Arterial | | TOTAL | TOTAL | TOTAL | VMT Total for All Vehicle Types |
| | Collector | | | | | |
| | Local | | | | | |
| | TOTAL | | 30,616,952 | 927, 926 | 352, 924 | 31,897,802 |

# APPENDIX E

# VMT ALGORITHM

# APPENDIX E

There were five important inputs. They are: (1) 1967 VMT, (2) 2000 VMT, (3) 1967 population and employment, (4) 1980 population and employment, and (5) 2000 population and employment. All of these inputs were given by SPRPC zones (968). These inputs were then aggregated into 72 districts by AMV.

The first method used to project VMT by district for 1972 and 1977 was based on VMT increases by county (7) from 1967 to 2000. This VMT increase was then apportioned out to all districts in the county based on relative population and employment growths* in each district. That is,

$$_{i}VMT_{72} = {}_{j}\Delta VMT_{72-67} \; \frac{_{i}PE_{72} - {}_{i}PE_{67}}{_{j}\Delta PE_{72-67}}$$

where:

$_{i}VMT_{72}$ = 1972 VMT for district i

$_{j}\Delta VMT_{72-67}$ = VMT growth for county j between 1967 and 1972

$_{i}PE_{72} - {}_{i}PE_{67}$ = district i population plus employment growth between 1967 and 1972

$_{j}\Delta PE_{72-67}$ = county j population plus employment growth between 1967 and 1972

---

*The district population and employment growths were first represented by a weighted factor equal to:

Population + 2 (Manufacturing Employment)
+ 2.5 (Non-Manufacturing Employment)
+ 0.1 (Total Employment)

This factor was found unsatisfactory as VMT growth factors due to its greater weighting of population in districts with few manufacturing employees. The population-employment factor for each district finally used was the sum of population and employment. This factor is a measure of the activity of the district.

The individual district's $PE_{72}$ was linearly interpolated between 1967 and 1980. A similar procedure was followed for 1977 VMT estimates.

It was found that those districts which were projected to experience heavy growths in population and employment might be unfairly receiving too large a portion of the county's increase in VMT.

Many districts which had relatively small 1967 PE totals had the greatest increases in PE totals from 1967 to 1972. These districts were therefore allocated a large portion of the county's VMT growth. This would be reasonable if most of the VMT growth for the district was generated by trips ending or beginning in the district.

It appears reasonable to assume that this method would be feasible in areas where population and employment changes are the prime indicators of travel activity in the districts, and where the transportation facilities in each district are similar. In particular, transit usage and the ratio of freeway VMT to total VMT should be similar for all districts in the county. Another formidable obstacle can also occur if a number of districts in an area decrease in population and employment. In this case, the equation cannot be used.

The results of allocating county VMT growth to districts by using the ratio of a district's 1972 population-employment factor to the county's 1972 population-employment factor was found to be inadequate at the district level. The lack of sensitivity for districts with high transportation growth and low population-employment growth was again prevalent. This method did, however, eliminate the problem of decreasing population-employment totals.

# APPENDIX F

# RESULTS OF RETROFIT METHODOLOGY

TABLE F-1

SOUTHWESTERN PENNSYLVANIA

Weighted Light Duty Annual Travel

| Year | Average Miles Driven (D) * | Fraction of Total Vehicles in Use (V) + | V x D | M ‡ |
|---|---|---|---|---|
| 1977 | 3,600 | 8.0 | 28,800 | 2.65 |
| 1976 | 11,900 | 12.7 | 151,130 | 13.91 |
| 1975 | 16,100 | 12.0 | 193,200 | 17.78 |
| 1974 | 13,200 | 11.8 | 155,760 | 14.33 |
| 1973 | 11,400 | 10.2 | 116,280 | 10.70 |
| 1972 | 11,700 | 11.3 | 132,210 | 12.16 |
| 1971 | 10,000 | 10.6 | 106,000 | 9.75 |
| 1970 | 10,300 | 8.1 | 83,430 | 7.68 |
| 1969 | 8,600 | 6.0 | 51,600 | 4.75 |
| 1968 | 10,900 | 3.9 | 142,510 | 3.91 |
| 1967 | 8,000 | 1.7 | 13,600 | 1.25 |
| 1966 | 6,500 | 1.2 | 7,800 | .72 |
| 1965 | 6,500 | .5 | 3,250 | .30 |
| 1964 | 6,500 | .2 | 1,300 | .12 |
| | | 98.2 | 1,186,870 | 100.01 |

* E. P. A. National Averages

\+ R. L. Polk, 1971 (see Table 13)

‡ $M = \frac{V \times D}{\sum V \times D}$

TABLE F-2

SOUTHWESTERN PENNSYLVANIA

Gas Powered Light Duty Vehicles

| | 1977 Average Emission Reduction for the Area | | |
|---|---|---|---|
| Pre-Controlled Vehicles | HC | CO | $NO_x$ |
| Lean Idle Air/Fuel Ratio Adjustment and Vacuum Spark Advance Disconnect | 0.60% | 0.22% | 0.53% |
| Oxidizing Catalytic Converter and Vacuum Spark Advance Disconnect | 1.63% | 1.51% | 1.15% |
| Air Bleed to Intake Manifold | 0.50% | 1.39% | 0% |
| Exhaust Gas Recirculation and Vacuum Spark Advance Disconnect | 0.29% | 0.74% | 1.14% |
| Controlled Vehicles | | | |
| Oxidizing Catlytic Converter and Vacuum Spark Advance Disconnect | 32.8% | 32.8% | 0% |
| Exhaust Gas Recirculation and Vacuum Spark Advance Disconnect | 0% | 0% | 15.3% |

Source: E.P.A.
Table F-1

# APPENDIX G

# DETAILED RANKINGS OF THE NON-ECONOMIC IMPACT FOR EACH CONTROL STRATEGY

TABLE G-1. RATING OF ALTERNATIVE STRATEGIES
SOCIAL CRITERIA

| Strategy | Rating* | Comments |
|---|---|---|
| **Reduce Emission Rate** | | |
| **Traffic Flow Improvements** | | |
| **Upgrade Existing Streets** | 5 | Generally acceptable |
| **Loading Zone** | 4 | No obvious conflict with goals |
| **Metering** | 4 | Mixed impact |
| **Information Systems** | | |
| **Source Control** | | |
| **Retrofit** | 2 | May be regressive |
| **Inspection** | 2 | May be regressive |
| **Fuel Conversion** | 3 | Impact uncertain |
| **Reduce Vehicle Miles of Travel** | | |
| **Reduce Travel Demand** | | |
| **Four Day Week** | 5 | No apparent negative impacts |
| **Increase Transit Use** | | |
| **Short Term Transit Impv.** | 5 | Conforms to community goals |
| **Transit Fares** | 5 | Conforms to community goals |
| **Tolls** | 3 | Impact mixed |
| **Parking Taxes and Charges** | 4 | Some aspects adopted |
| **Parking Restrictions** | 4 | Some aspects adopted |
| **Vehicle-Free Zone** | 2 | Tends to conflict with goals |
| **Reserved Bus Lanes** | 4 | Beneficial if justified economically |
| **Increase Fuel Tax** | 4 | User cost |
| **Increase Occupancy** | | |
| **Car Pools** | 4 | No obvious negative impacts |
| **Tolls** | ** | |
| **Metering** | ** | |
| **Vehicle-Free Zones** | ** | |
| **Parking Taxes and Charges** | ** | |
| **Shift Travel Patterns** | | |
| **Staggered Hours** | 3 | Indifferent |
| **Fringe Parking** | 3 | Indifferent |
| **Night Goods Deliveries** | 3 | Indifferent |
| **Government Offices** | 2 | Contrary to stated goals |
| **Zoning** | 2 | Contrary to stated goals |

* Criteria defined in Table G-2
** Strategy rated previously in this table

TABLE G-2. SOCIAL CRITERIA

| Rating | Criteria |
|---|---|
| 5.0 | In conformance with expressed or implied community goals. No obvious negative social impact. Similar program implemented without obvious negative social impact. |
| 4.0 | Tending to be in conformance with expressed or implied community goals. Minor negative impacts outweighed by positive impacts. |
| 3.0 | Indifferent with respect to expressed or implied community goals. Social impact undetermined or apparently evenly mixed. Implemented elsewhere without net negative social impact. |
| 2.0 | Tending to be contrary to expressed or implied community goals. Negative social impact slightly in excess of positive social impact. |
| 1.0 | Obviously contrary to expressed or implied community goals. Negative social impact outweigh positive social impact. Implemented elsewhere with obvious net negative social impact. |

TABLE G-3. RATING OF ALTERNATIVE STRATEGIES
ADMINISTRATIVE CRITERIA

| Strategy | Rating* | Comments |
|---|---|---|
| Reduce Emission Rate | | |
| Traffic Flow Improvements | | |
| Upgrade Existing Streets | 4 | |
| Loading Zone | 2 | |
| Metering | 1 | |
| Information Systems | 2 | |
| Source Control | | |
| Retrofit | 2 | |
| Inspection | 3 | |
| Fuel Conversion | 2 | |
| Reduce Vehicle Miles of Travel | | |
| Reduce Travel Demand | | |
| *Four Day Week* | 5 | |
| Increase Transit Use | | |
| Short Term Transit Impv. | 3 | |
| Transit Fares | 3 | |
| Tolls | 1 | |
| Parking Taxes and Charges | 4 | |
| Parking Restrictions | 3 | |
| Vehicle-Free Zone | 1 | |
| Reserved Bus Lanes | 1 | |
| Increase Fuel Tax | 5 | |
| Increase Occupancy | | |
| Car Pools | 4 | |
| Tolls | ** | |
| Metering | ** | |
| Vehicle-Free Zones | ** | |
| Parking Taxes and Charges | ** | |
| Shift Travel Patterns | | |
| Staggered Hours | 4 | |
| Fringe Parking | 3 | |
| Night Goods Deliveries | 4 | |
| Government Offices | 4 | |
| Zoning | 3 | |

* Criteria defined in Table G-4
** Strategy rated previously in this table

TABLE G-4. ADMINISTRATIVE CRITERIA

| Rating | Criteria |
|---|---|
| 5.0 | Program currently in existence. Similar program currently in existence. No additional agency, manpower or procedures necessary for implementation. |
| 4.0 | Similar program implemented elsewhere. No additional agency or manpower required. Minor additional procedures required for implementation. |
| 3.0 | Adaptation of programs existing in area or elsewhere. Minor additions to existing agencies. Minor manpower and procedural requirements. |
| 2.0 | Similar program not existing in area or elsewhere. Significant additions to existing agency or minor new agency required. Significant manpower and procedural difficulties in implementation of program. |
| 1.0 | Similar program not existing in area or elsewhere. Major new agency or administrative jurisdiction required. Major manpower and procedural difficulties in implementation. |

TABLE G-5. RATING OF ALTERNATIVE STRATEGIES
LEGAL CRITERIA

| Strategy | Rating* | Comments |
|---|---|---|
| **Reduce Emission Rate** | | |
| **Traffic Flow Improvements** | | |
| Upgrade Existing Streets | 5 | Presently performed |
| Loading Zone | 5 | Possible under present arrangements |
| Metering | 2 | No agency authorized currently |
| Information Systems | 4 | Could be added to existing agency |
| **Source Control** | | |
| Retrofit | 1 | Major legislative action |
| Inspection | 1 | Major legislative, implementation |
| Fuel Conversion | 1 | Major legislative action |
| **Reduce Vehicle Miles of Travel** | | |
| **Reduce Travel Demand** | | |
| Four Day Week | 1 | Doubtful as mandatory measure |
| **Increase Transit Use** | | |
| Short Term Transit Impv. | 5 | Also depends on injunction |
| Transit Fares | 2 | Subsidy challenge likely |
| Tolls | 1 | Various challenges probable |
| Parking Taxes and Charges | 5 | Charges presently controlled |
| Parking Restrictions | 4 | Attainable with existing agencies |
| Vehicle-Free Zone | 3 | Precedents mixed |
| Reserved Bus Lanes | 3 | Implementation troublesome |
| Increase Fuel Tax | 3 | Can be done at local level |
| **Increase Occupancy** | | |
| Car Pools | 1 | Doubtful as mandatory measure |
| Tolls | ** | |
| Metering | ** | |
| Vehicle-Free Zones | ** | |
| Parking Taxes and Charges | ** | |
| **Shift Travel Patterns** | | |
| Staggered Hours | 1 | Doubtful as mandatory measure |
| Fringe Parking | 5 | Requires other action (rates, etc.) |
| Night Goods Deliveries | 2 | Questionable as mandatory measure |
| Government Offices | 3 | Local action sufficient |
| Zoning | 3 | Local action sufficient |

* Criteria defined in Table G-6.
** Strategy rated previously in this table

TABLE G-6. LEGAL CRITERIA

| Rating | Criteria |
|---|---|
| 5.0 | No legislative enactment at any level required. Existing jurisdiction sufficient for enforcement. Legality of measure assured, due to similar measures currently in operation in area or elsewhere. |
| 4.0 | Some expansion of existing legislation required. Minor expansion of existing jurisdiction necessary for enforcement. Legality assured due to the establishment of similar measures elsewhere. |
| 3.0 | Local legislative enactment necessary. Enforcement requiring additional responsibility by existing jurisdictions. Legality not assured, due to lack of precedents or mixed precedents. |
| 2.0 | Regional legislation required. Enforcement requiring new responsibilities by existing jurisdictions. Legality not assured, due to lack of precedents and succesful challenge of precedents. |
| 1.0 | Statewide legislation required. New enforcement agencies or major expansion of existing enforcement jurisdictions required. Legality doubtful due to successful challenge of similar measures in area or elsewhere. |

TABLE G-7. RATING OF ALTERNATIVE STRATEGIES
TECHNICAL RATING

| Strategy | Rating* | Comments |
|---|---|---|
| Reduce Emission Rate | | |
| Traffic Flow Improvements | | |
| Upgrade Existing Streets | 5 | |
| Loading Zone | 5 | |
| Metering | 3 | |
| Information Systems | 2 | |
| Source Control | | |
| Retrofit | 2 | |
| Inspection | 3 | |
| Fuel Conversion | 2 | |
| Reduce Vehicle Miles of Travel | | |
| Reduce Travel Demand | | |
| Four Day Week | 5 | |
| Increase Transit Use | | |
| Short Term Transit Impv. | 5 | |
| Transit Fares | 5 | |
| Tolls | 5 | |
| Parking Taxes and Charges | 5 | |
| Parking Restrictions | 5 | |
| Vehicle-Free Zone | 2 | |
| Reserved Bus Lanes | 3 | |
| Increase Fuel Tax | 5 | |
| Increase Occupancy | | |
| Car Pools | 4 | |
| Tolls | ** | |
| Metering | ** | |
| Vehicle-Free Zones | ** | |
| Parking Taxes and Charges | ** | |
| Shift Travel Patterns | | |
| Staggered Hours | 4 | |
| Fringe Parking | 4 | |
| Night Goods Deliveries | 3 | |
| Government Offices | 4 | |
| Zoning | 4 | |

* Criteria defined in Table G-8.

** Strategy rated previously in this table

TABLE G-8. TECHNICAL CRITERIA

| Rating | Criteria |
|---|---|
| 5.0 | No technical innovation required. Technology existing and in wide use. No further technical development required. |
| 4.0 | No significant technical innovation required. Technology existing and in growth stages. Technology somewhat beyond pilot applications. Minor additional development and expansion of existing technology required. |
| 3.0 | Technology developed; no major innovation required. Pilot applications existing. Some expansion and development necessary and currently under way. Technology not in wide use. |
| 2.0 | Further technical innovation necessary. State of the art projects now at pilot stage. Significant development and expansion required. Technology not in actual use. |
| 1.0 | Technical capability not yet developed or in use. Probability of successful development not assured. |

**BIBLIOGRAPHIC DATA SHEET**

**1. Report No.** APTD-1446

**2.**

**3. Recipient's Accession No.**

**4. Title and Subtitle**
Transportation Controls to Reduce Motor Vehicle Emissions in Pittsburgh, Pennsylvania.

**5. Report Date** December 1972

**6.**

**7. Author(s)**

**8. Performing Organization Rept. No.**

**9. Performing Organization Name and Address**
GCA Corporation
GCA Technology Division
Bedford, Massachusetts

**10. Project/Task/Work Unit No.** DU-72-B895

**11. Contract/Grant No.** 68-02-0041

**12. Sponsoring Organization Name and Address**
Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, N.C. 27711

**13. Type of Report & Period Covered** Final Report 8/14/72 to 12/15/72

**14.**

**15. Supplementary Notes** Prepared to assist in the development of transportation control plans by those State Governments demonstrating that National Ambient Air Quality Standards cannot be attained by implementing emission standards for stationary sources only.

**16. Abstracts**

The document demonstrates the nature of the Air Quality problem attributed to motor vehicle operation, the magnitude of the problem and a strategy developed to neutralize these effects in order that National Ambient air quality standard may be attained and maintained.

**17. Key Words and Document Analysis. 17a. Descriptors**

Motor Vehicle emitted pollutants - air pollutants originating within a motor vehicle and released to the atmosphere.

National Ambient Air Quality Standards - Air Quality Standards promulgated by the Environmental Protection Agency and published as a Federal Regulation in the Federal Register.

**17b. Identifiers/Open-Ended Terms**

VMT - Vehicle Miles Traveled
Vehicle Mix - distribution of motor vehicle population by age group.
LDV - light duty vehicle - less than 6500 lbs.
HDV - heavy duty vehicle - greater than 6500 lbs.

**17c. COSATI Field/Group** Environmental Quality Control of Motor Vehicle Pollutants

**18. Availability Statement**
For release to public

**19. Security Class (This Report)** UNCLASSIFIED

**20. Security Class (This Page)** UNCLASSIFIED

**21. No. of Pages** all

**22. Price**

FORM NTIS-35 (REV. 3-72) USCOMM-DC 14952-P72

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