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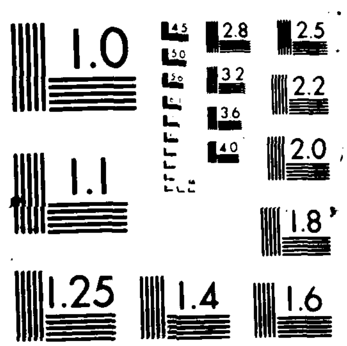
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Technical Report Documentation Page

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16. Abstract

The air quality impact of the proposed runway expansion program at Stapleton International Airport is determined in this report. The method of analysis is to model the dispersion of pollutants from motor vehicles and aircraft under both 1-hour and 8-hour worst case conditions.

Results show that aircraft pollution concentrations are reduced and in some cases completely disappear when the new runways are added. This is caused primarily by a reduction in takeoff delays, which are a major objective of the runway expansion program at the airport.

17. Key Words: AIR, POLLUTION, DISPERSION MODEL, EMISSIONS MODEL, MICROCOMPUTERS

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SUMMARY

Most pollution from aircraft at Stapleton International Airport (DEN) is the result of pre-takeoff delays. These delays result in aircraft queues which increase the time that aircraft engines must operate on the ground. In just about every case these queues, and the pollution they create, are reduced or completely eliminated when new runways are added.

This conclusion was based upon current estimates of peak hour motor vehicle and aircraft activity at the airport and the application of these peak hour values to all hours modeled. This approach provided conservative air quality estimates for the two 8-hour meteorolgical data sets provided by the Colorado Department of Health (CDH) since both data sets extended into the late evening hours where there was little aircraft or motor vehicle activity.

A major result expected from the runway expansion at Stapleton International Airport is reduced delays and therefore reduced pollution from aircraft.

BACKGROUND

At the request of Colorado Department of Health (CDH), the Federal Aviation Administration (FAA) conducted an analysis of motor vehicle pollution at DEN. This study was performed in conjunction with the runway expansion investigations at the airport. On July 1, the documentation of this study was transmitted to the CDH as report FAA-EE-86-7 (Reference 1).

After reviewing this report, the CDH requested the following information:

1. An assessment of pollution from both aircraft and motor vehicles using two sets of 8-hour meteorological data provided by the CDH.

2. An assessment of the pollution from motor vehicles and aircraft using 1-hour "worst case" meteorology. This assessment would consist of the addition of aircraft to the motor vehicle analysis of Reference 1.

3. The expansion of the motor vehicle analysis of Reference 1 to include a wider variety of wind directions. The CDH recommended that wind directions of 180, 200, 225 and 330 degrees be modeled since only westerly wind directions (240 and 270 degrees) were modeled in the original study.

4. Nitrogen oxides (NO_x) estimates.

5. A determination of the air quality impact of motor vehicles at the I-70/Quebec Street interchange. (Vehicular flow rates to be provided by the state.)

6. A documentation of the Mobile 3 data base.

DISCUSSION

The air quality impact of the runway expansion program at DEN was determined by calculating carbon monoxide (CO) concentrations at seven receptors placed in the terminal area. The geometrical location of these receptors as related to the runways and roadways at the airport is shown in Figures 1 through 5. The tool used in assessing pollution at the airport was the Graphical Input Microcomputer Model (GIMM) (Reference 2).

Two "worst case" scenarios were prepared in order to calculate concentrations from aircraft and motor vehicles operating at the existing and expanded runway systems. Results from the first scenario analysis, which included weather observations for two specific 8-hour time periods, are plotted in Figures 6 and 7. In all instances aircraft concentrations were reduced when the new runways were added.

Results from the second scenario analysis, which employed estimated "worst case" 1-hour meteorology, is plotted in Figures 8 through 21. The highest combined aircraft-motor vehicle concentrations are shown in Figure 17. These concentrations are significantly reduced with the introduction of the expanded runway system. Appendix B lists the computer reports from which Figures 6 through 21 were prepared.

MODEL

GIMM is a complex source emissions/dispersion model with an emissions front end which allows fast and accurate data entry and "what if" analysis. The model, described in detail in Reference 2, is conceptually displayed in Figure 22.

GIMM is compared to two Environmental Protection Agency (EPA) models: Point-Area-Line (PAL) and HIWAY 2 in Figure 23 and Reference 2. The comparison shows GIMM results to be very close to those of the EPA models.

Before running GIMM it was necessary to: (1) establish source and receptor locations, (2) estimate vehicular activity, and (3) select source emission rates.

Source and receptor locations are shown in Figures 1 through 5, and the rationale for developing data on aircraft and motor vehicle activity and emission rates is described below.

DATA DEVELOPMENT - AIRCRAFT

The EPA has identified four operational modes for aircraft pollution assessment purposes: takeoff, climbout, approach and taxi-idle. For the purpose of this study, the taxi-idle mode has been further divided into a taxi and a queue mode.

Only the queue and takeoff modes are included in the model analysis because climbout and approach contribute very little to the pollution burden at an airport (Reference 3). The queue times selected for this study were 15 minutes for the existing runways and 3 minutes for the proposed runway configuration. These times are consistent with capacity/demand estimates in Reference 6. Appendix C describes the adaptation of Reference 6 data to this study.

When making a screening analysis, conservative estimates should be used. Peak vehicular activity was therefore used throughout this study. The peak hour activity of aircraft was determined after reviewing documentation on actual aircraft departures and estimates of these departures that were listed in computer printouts from the Official Airline Guide (OAG). Aircraft activity at 1700 hours on August 19, 1986, was selected for this study. Eighty-one commercial, general aviation, and air taxi aircraft were estimated to depart from DEN during that hour.

Emission rates were extracted from Reference 4.

DATA DEVELOPMENT - MOTOR VEHICLES

Roadway activity was calculated from hourly traffic counts obtained from Centennial Engineering Company. Two traffic count data sets were provided by Centennial Engineering--one covering motor vehicle activity on city streets and the other covering activity along terminal roadways. Parking lot activity was also observed on August 9, 1986. Traffic counts at the Quebec/Interstate 70 (I-70) interchange were also provided verbally by Centennial Engineering. From these data, a roadway throughput analysis was prepared and vehicular flow on each roadway segment was determined. The results are listed in Figure 5.

Traffic counts on December 20, 1985, and August 9, 1986--two peak activity times for motor vehicles--were used for this roadway analysis. The traffic at the I-70/Quebec interchange was not included in the modeling analysis since we had not received these data from Colorado State personnel at the time the model was run. This information can be easily added to the study when received. Because of the great distance between this interchange and the terminal, concentrations should change little when this additional data become available.

Peak hour activity was assumed for all hours modeled regardless of whether the hour modeled was at a peak value or not. This approach provided conservative air quality estimates for the 8-hour data sets since both 8-hour data sets extended into the late evening hours when there is significantly less than peak hour activity.

Emission rates are calculated by a Mobile 3 submodel of GIMM. The Mobile 3 data was arranged into GIMM format by performing Lagrangian and hyperbolic interpolations of the data in Appendix I of Reference 5 for sources operating at high altitudes. Mobile 3 outputs are listed in the emission rate columns of each GIMM printout.

RESULTS

Results from the investigation of the 6 items noted by the CDH are as follows:

Item 1 -- An assessment of pollution from both aircraft and motor vehicles using two sets of 8 consecutive hours of meteorological data provided by the CDH.

Most pollution from aircraft is the result of pre-takeoff delays. These delays result in aircraft queues which increase the time that aircraft engines must operate on the ground. In just about every case, these queues and the pollution they create, are reduced or completely eliminated when new runways are added. A major result of runway expansion at Stapleton International Airport will be reduced delays and therefore reduced pollution from aircraft.

The air quality impact of motor vehicles alone is documented in Reference 1 and Item 3 below.

Item 2 -- An assessment of the pollution from motor vehicles and aircraft using 1-hour "worst case" meteorology. This assessment would consist of the addition of aircraft to the motor vehicle analysis of Reference 1.

The conclusion of Item 1, which was for the 8-hour analysis, also applies to the 1-hour analysis.

Item 3 -- The expansion of the motor vehicle analysis of Reference 1 to include a wider variety of wind directions. The CDH suggested the modeling of 180, 200, 225, and 330 degree wind directions because only westerly wind directions (240 and 270 degrees) were modeled in the original study.

After modeling the dispersion of pollutants under the four additional meteorological cases noted above, the assumption in Reference 1 that the highest concentrations would occur at the three receptors closest to the terminal was confirmed. However, the wind angle at which peak concentrations occured changed. Revised peak concentrations are as follows: Receptor 1 - 30 mg/m3 at a wind angle of 330 degrees; Receptor 2 - 30 mg/m3 at a wind angle of 200 degrees; and Receptor 3 - 29 mg/m3 at a wind angle of 240 degrees. These values were obtained from the passenger vehicle listings of Appendix A plus an assumed average concentration for buses of 1 mg/m3.

Item 4 -- NOx Estimates

For all the modeling runs, NOx as well as CO concentrations were printed out. Appendix B lists these data.

Item 5 -- A Determination of the Air Quality Impact of Motor Vehicles at the I-70 Quebec Street Interchange. (Vehicular flow rates to be provided by the state.)

This portion was not completed because traffic counts which were to be provided by Colorado State personnel were not received. However, it appears that I-70/Quebec Street traffic will not appreciably affect the conclusions of this study.

Item 6 -- Documentation of the Mobile 3 Data Base.

The Mobile 3 submodel of GIMM performs Lagrangian and hyperbolic interpolations of the data in Appendix I of Reference 5. Mobile 3 outputs are listed in the emission rate columns of each GIMM printout.

TAKEOFF RUNWAYS AND QUEUE LENGTHS - STAPLETON INTERNATIONAL AIRPORT
(north depatures - existing runway system - peak aircraft activity)

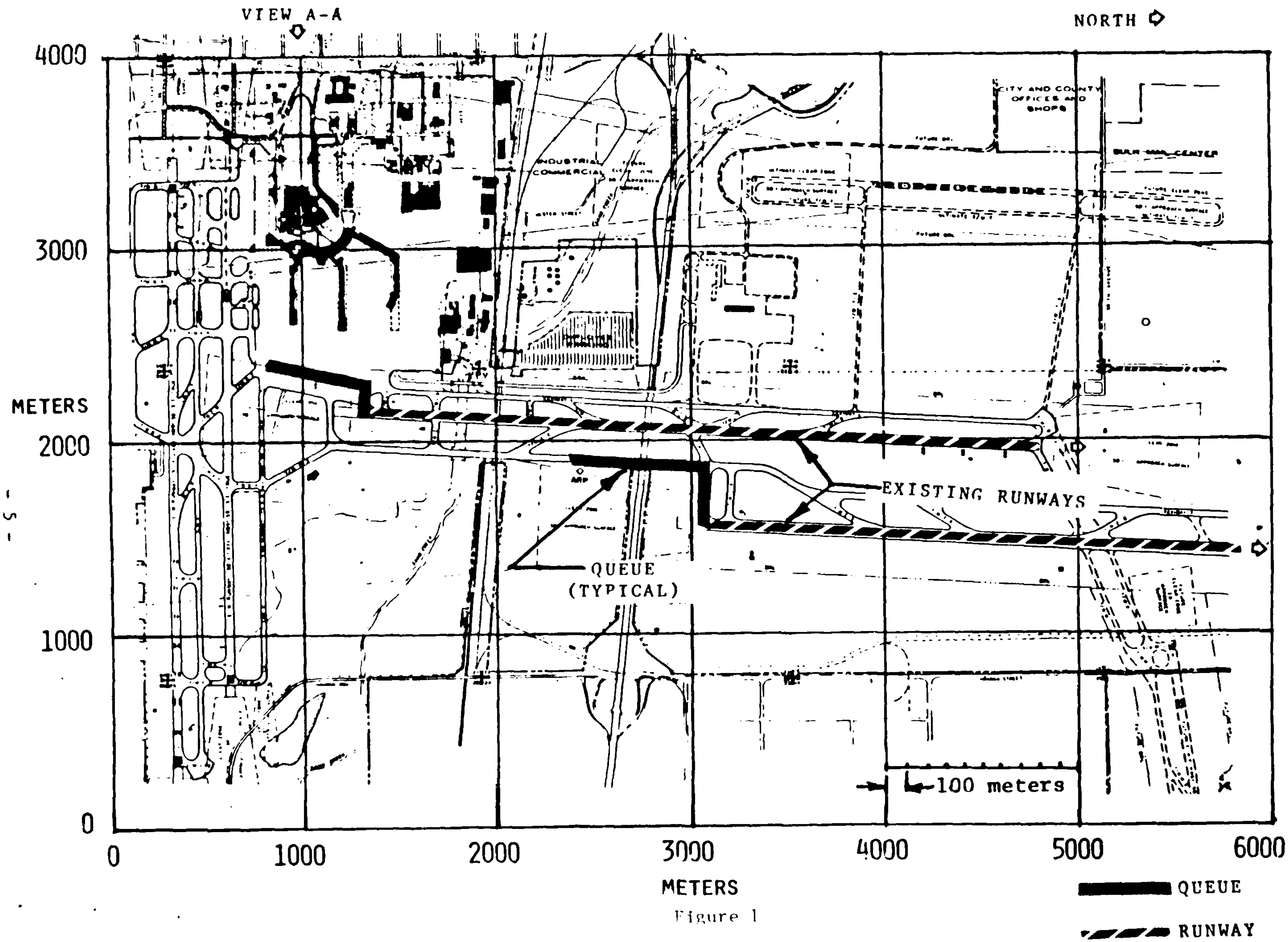


Figure 1

TAKEOFF RUNWAYS AND QUEUE LENGTHS - STAPLETON INTERNATIONAL AIRPORT
(north departures - expanded runway system - peak aircraft activity)

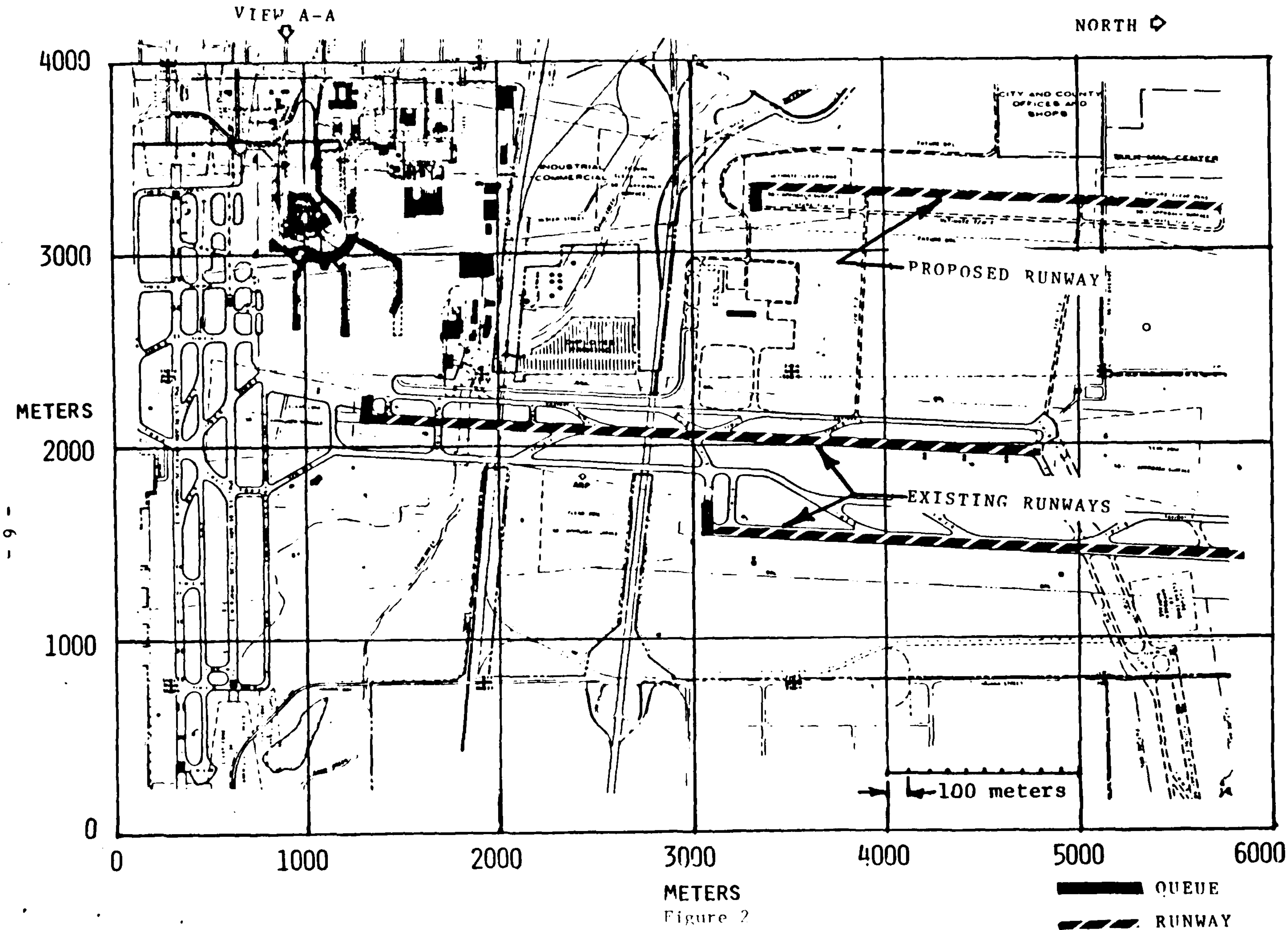


Figure 2

TAKEOFF RUNWAYS AND QUEUE LENGTHS - STAPLETON INTERNATIONAL AIRPORT
(east departures -existing runway system - peak aircraft activity)

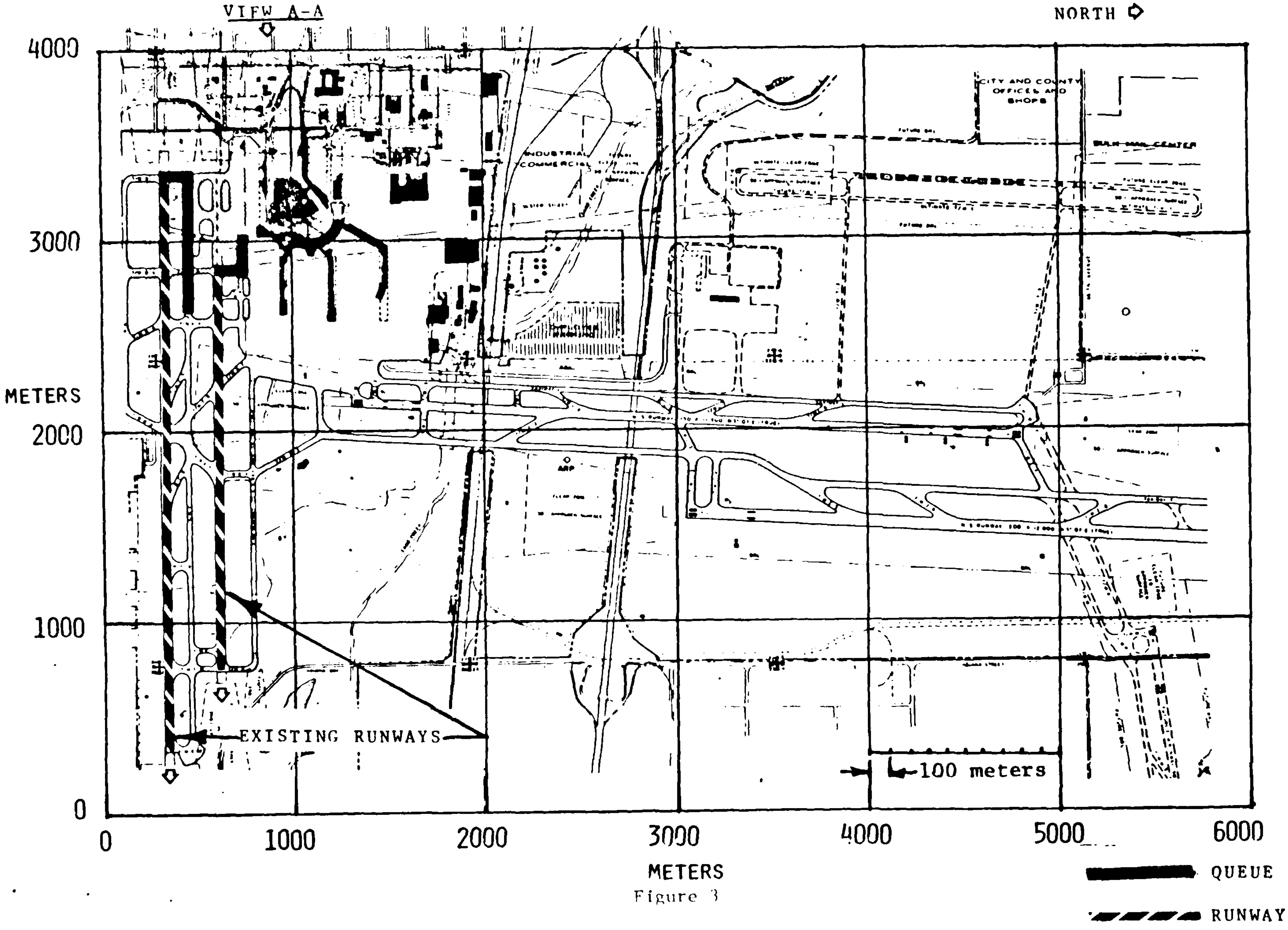


Figure 3

TAKEOFF RUNWAYS AND QUEUE LENGTHS _ STAPLETON INTERNATIONAL AIRPORT
(east departures - expanded runway system - peak aircraft activity)

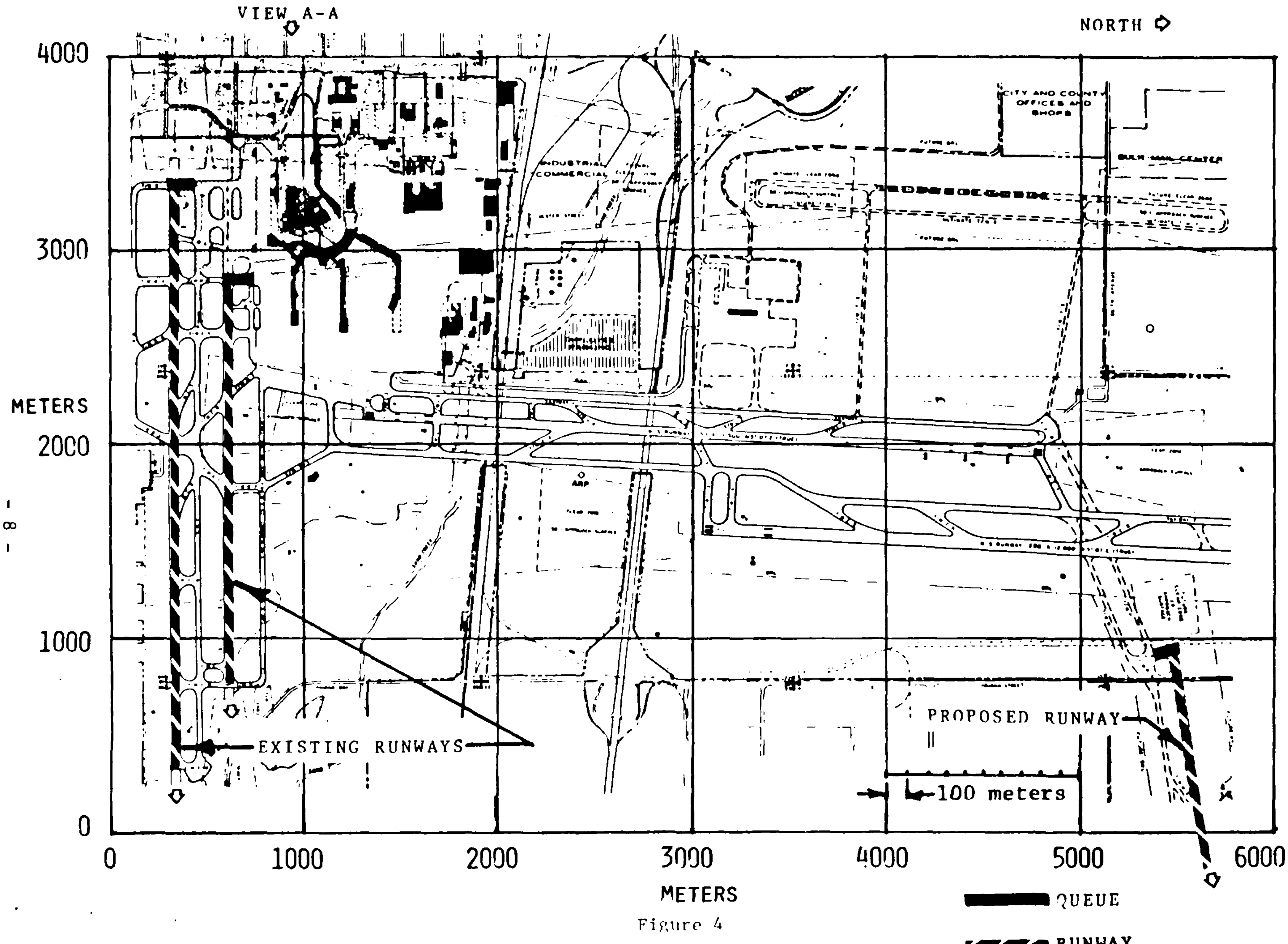


Figure 4

TERMINAL ACCESS ROADWAYS - STAPLETON INTERNATIONAL AIRPORT
(view A-A of Figures 1-4)

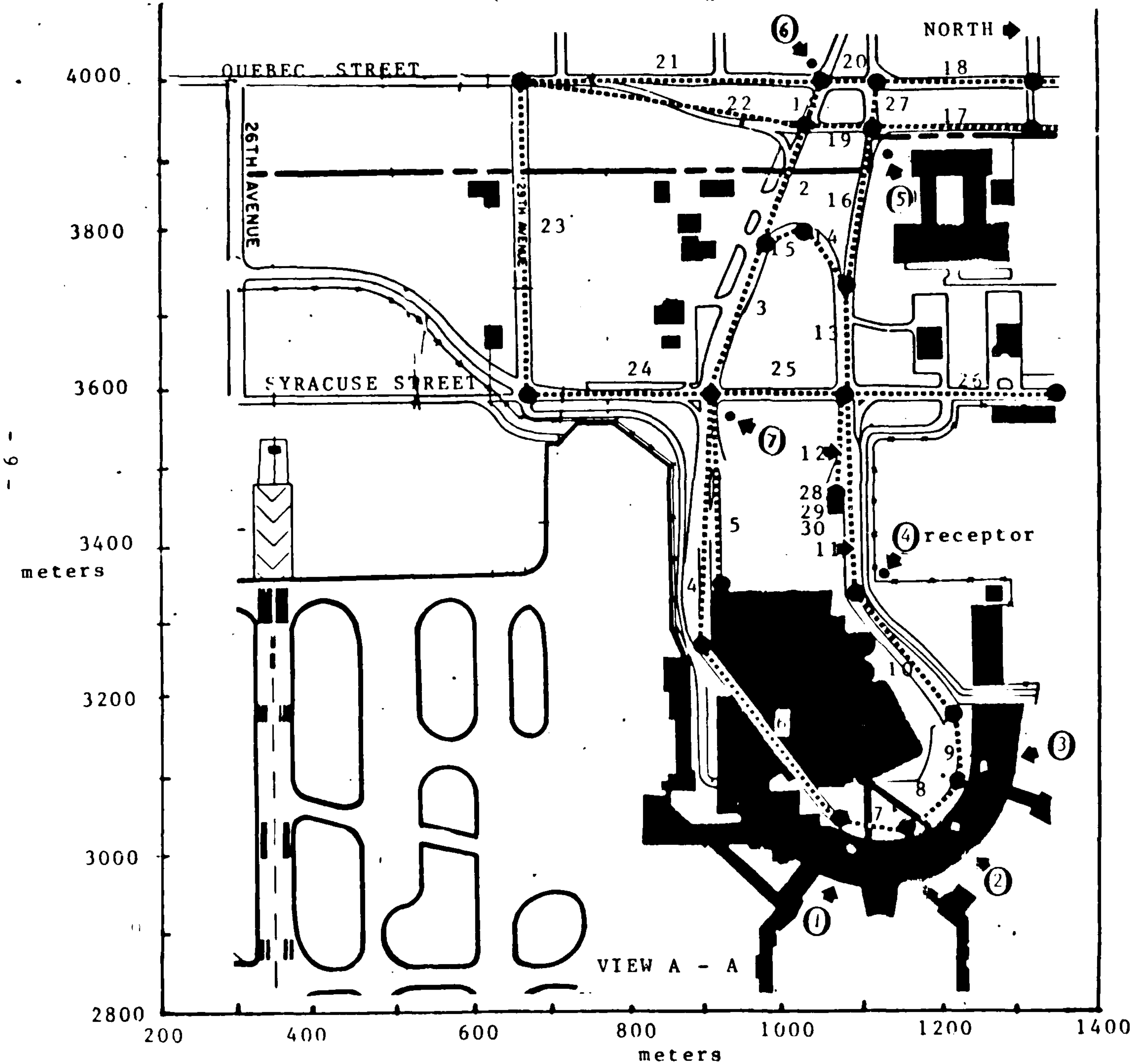
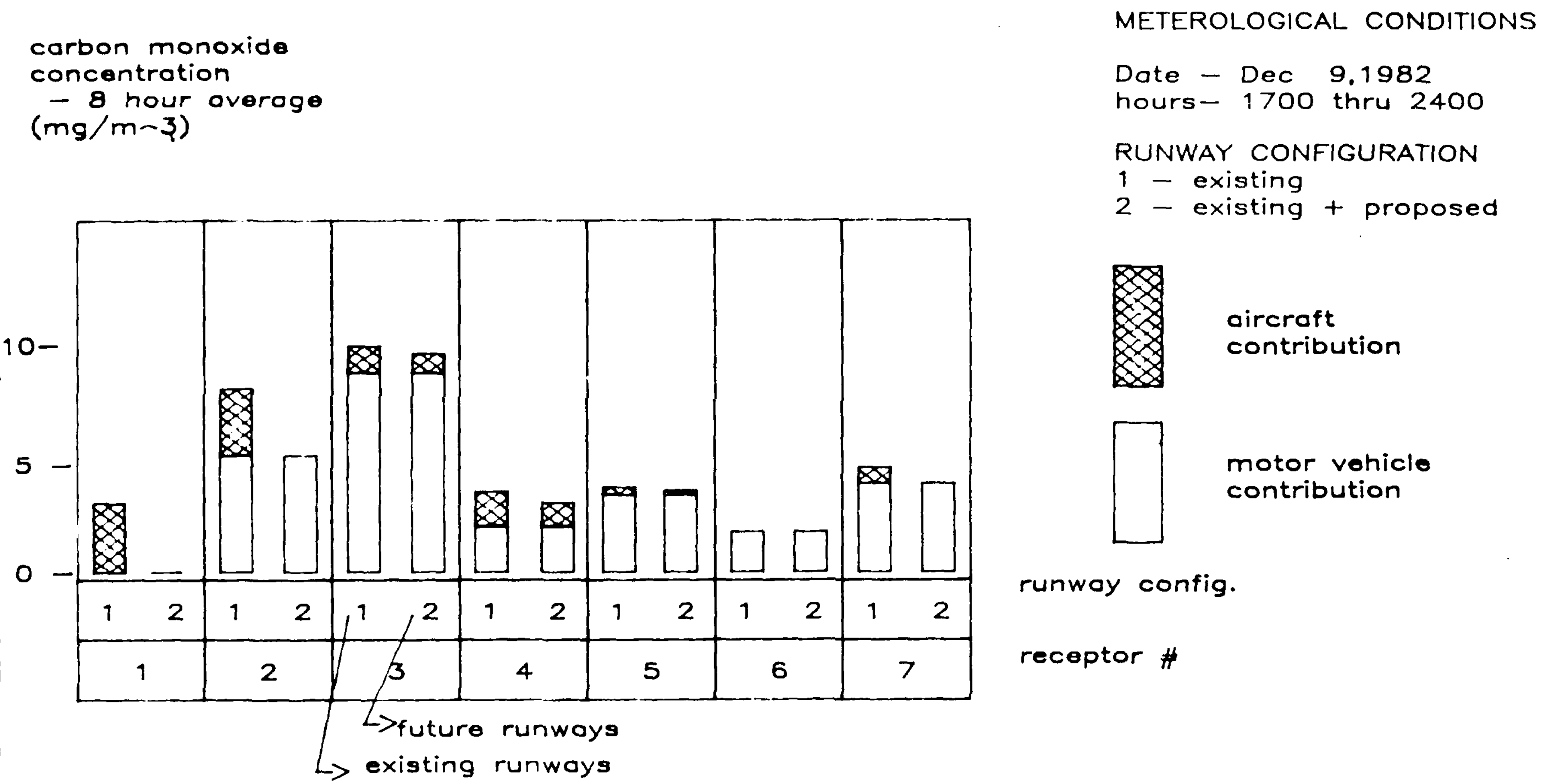


Figure 5

PEAK HOUR DATA

road #	spd. (mph)	veh. per hr.	% cold starts
1	10	1535	10
2	30	1967	10
3	30	2647	10
4	30	2130	10
5	25	1098	10
6	20	2130	10
7	5	2130	10
8	5	2130	10
9	5	2130	10
10	20	2130	10
11	30	2130	20
12	15	1000	50
13	30	2735	30
14	30	680	20
15	30	680	20
16	35	2055	20
17	40	1797	10
18	35	2612	10
19	10	1590	10
20	10	2422	10
21	40	2219	10
22	35	1345	10
23	30	500	10
24	30	1000	10
25	30	100	10
26	30	495	20
27	10	1895	20
28	0	3-Q	60
29	0	3-Q	60
30	0	3-Q	60

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
8 HOUR AVERAGE CONCENTRATIONS
(December 9, 1982 meterology)



SOURCE INFORMATION
Peak hour activity assumed for all hours of the day modeled

Figure 6

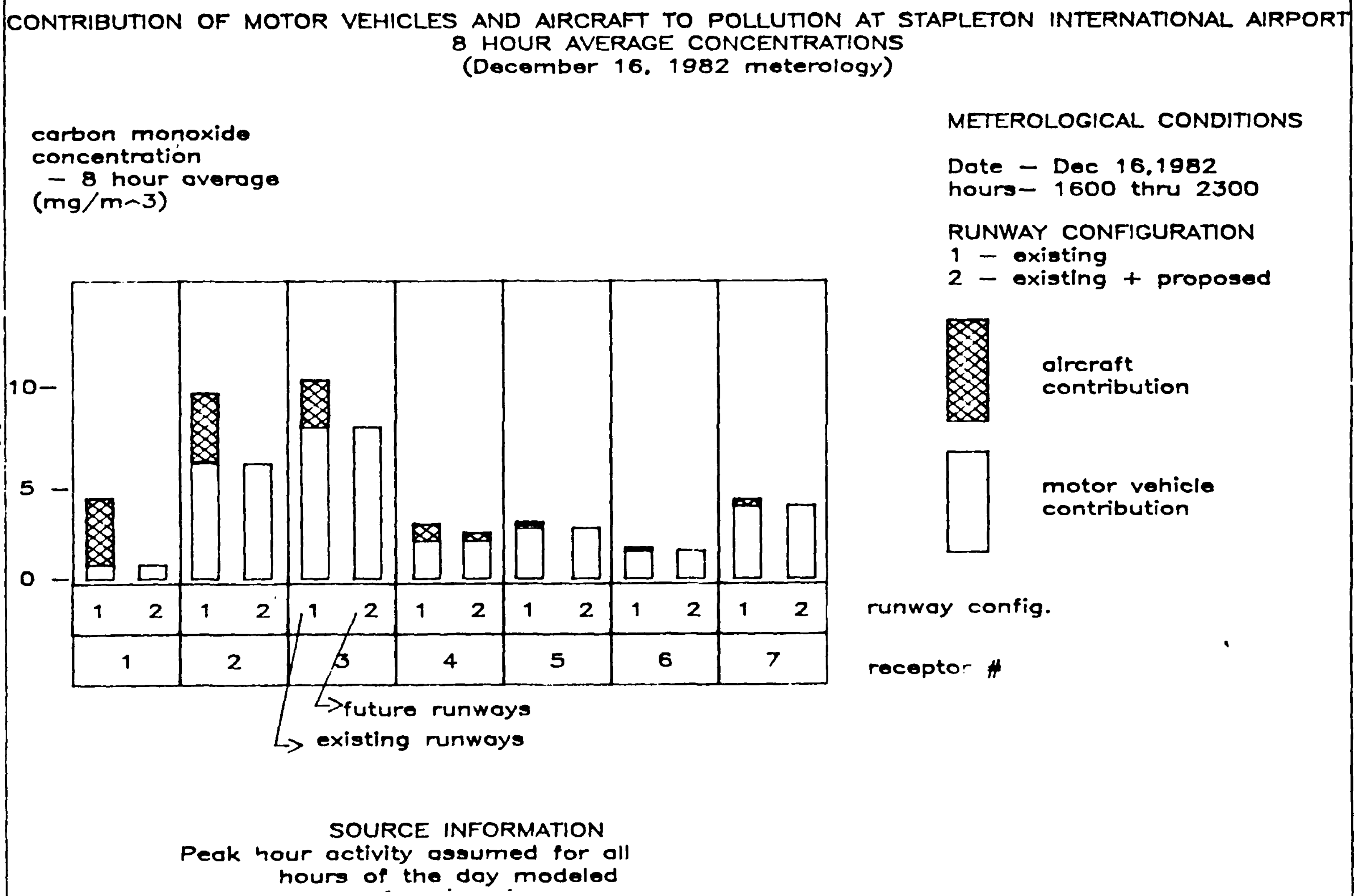
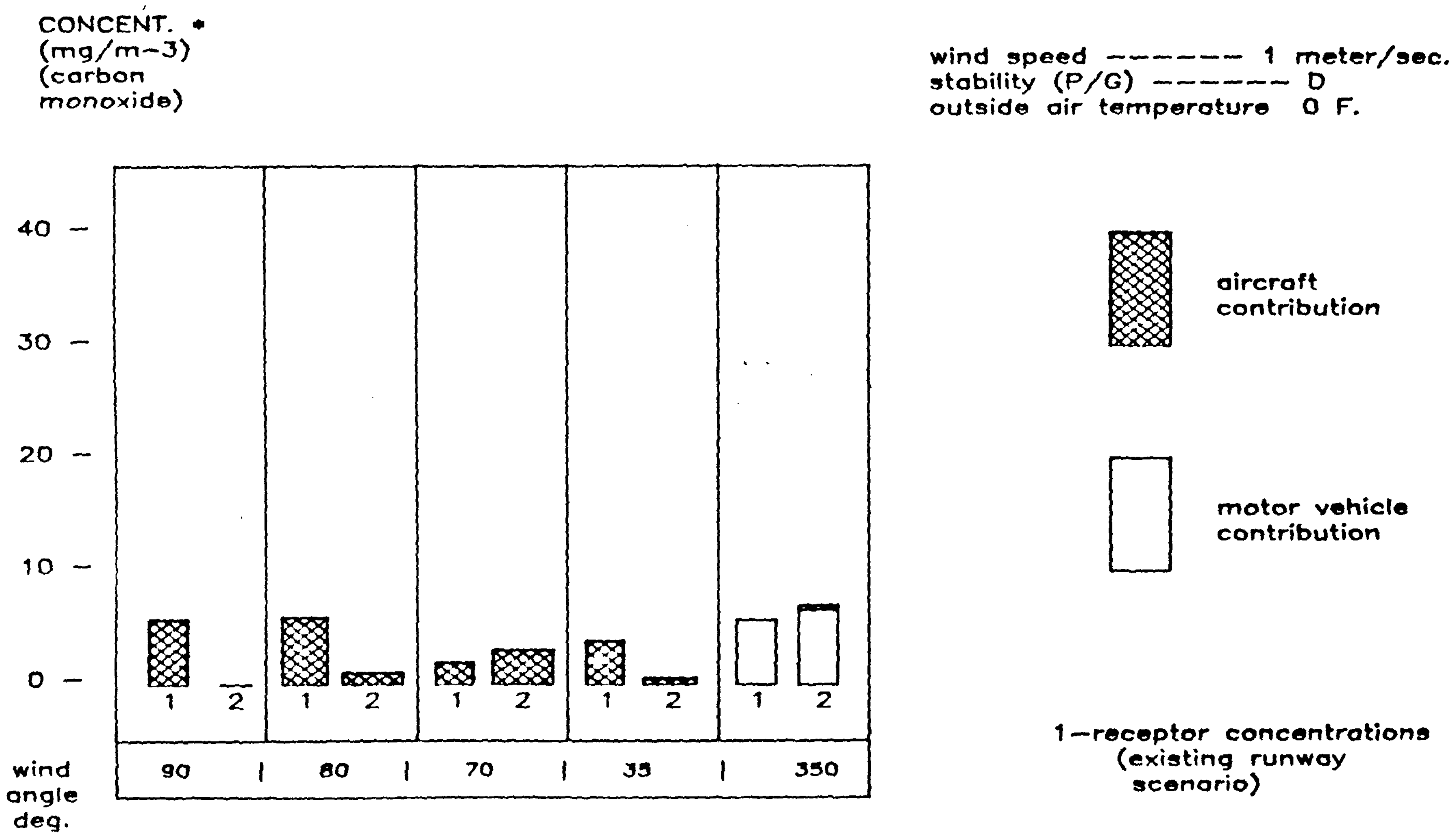

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
8 HOUR AVERAGE CONCENTRATIONS
(December 16, 1982 meterology)
carbon monoxide concentration – 8 hour average (mg/m~3)
10
5
0
1 2 1 2 1 2 1 2 1 2 1 2 1 2
1 2 3 4 5 6 7
runway config.
receptor #
future runways
existing runways
METEROLOGICAL CONDITIONS
Date – Dec 16,1982
hours– 1600 thru 2300
RUNWAY CONFIGURATION
1 – existing
2 – existing + proposed
aircraft contribution
motor vehicle contribution
SOURCE INFORMATION
Peak hour activity assumed for all hours of the day modeled

Figure 7

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 1



* — ONE HOUR AVERAGE

Figure 8

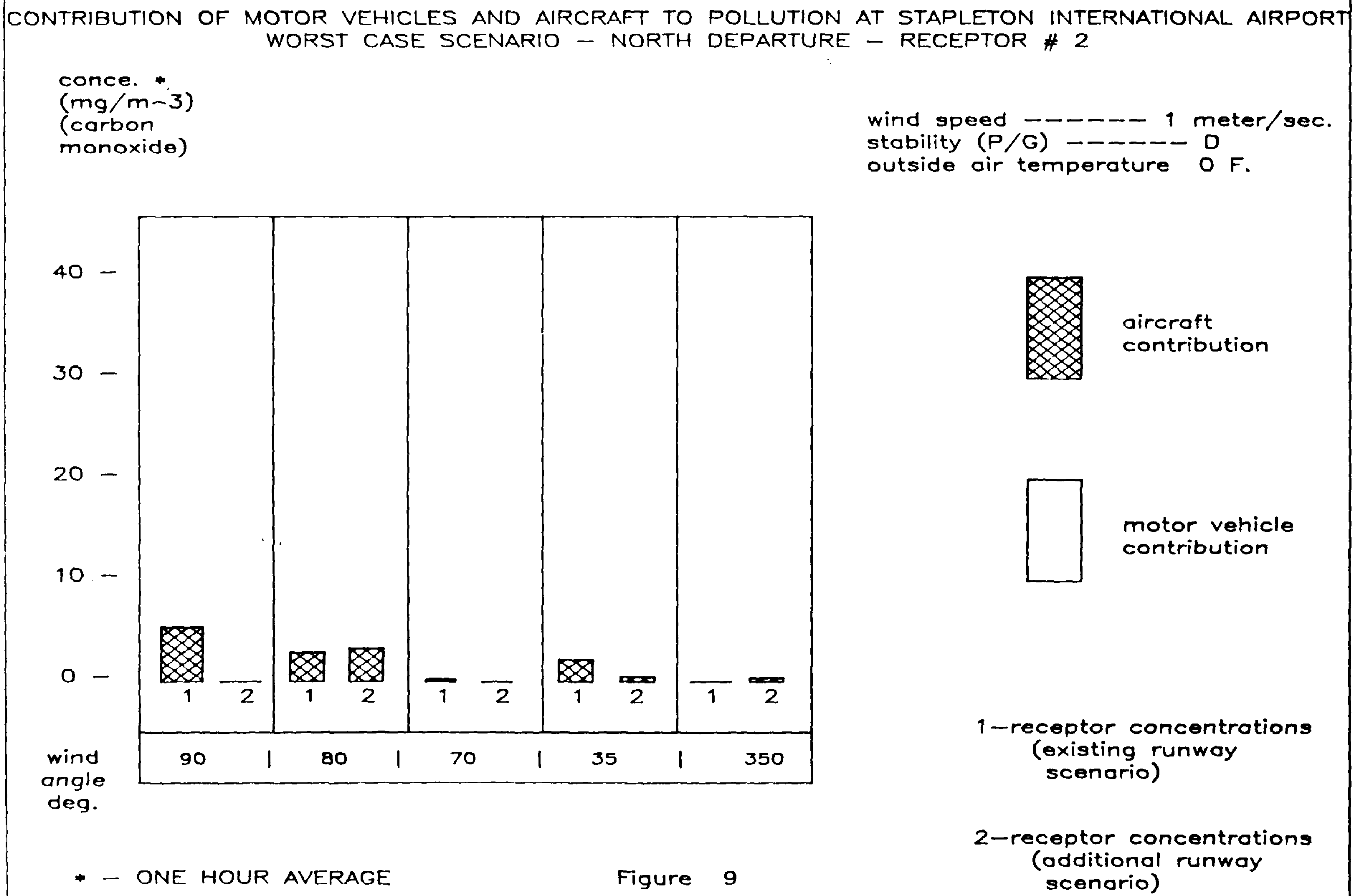
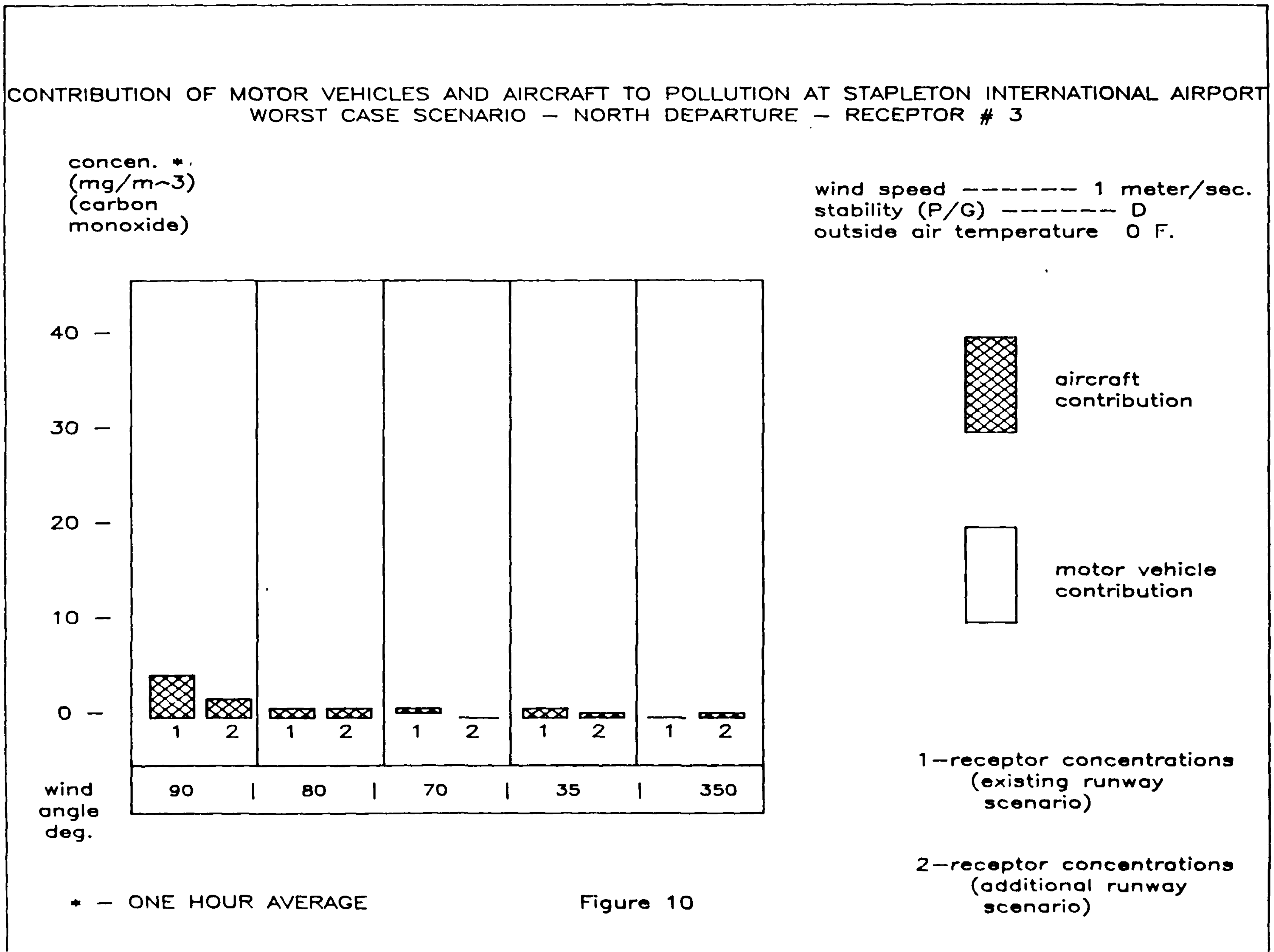

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 2
conce. *
(mg/m~3)
(carbon
monoxide)
wind speed ------- 1 meter/sec.
stability (P/G) ------- D
outside air temperature 0 F.
40
30
20
10
0
1 2 1 2 1 2 1 2 1 2
wind
angle
deg.
90 | 80 | 70 | 35 | 350
aircraft
contribution
motor vehicle
contribution
1—receptor concentrations
(existing runway
scenario)
2—receptor concentrations
(additional runway
scenario)
* — ONE HOUR AVERAGE

Figure 9



CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 3
concen. *
(mg/m~3)
(carbon
monoxide)
wind speed ------- 1 meter/sec.
stability (P/G) ------- D
outside air temperature 0 F.
40
30
20
10
0
1 2 1 2 1 2 1 2 1 2
wind
angle
deg.
90
80
70
35
350
aircraft
contribution
motor vehicle
contribution
1—receptor concentrations
(existing runway
scenario)
2—receptor concentrations
(additional runway
scenario)
* — ONE HOUR AVERAGE

Figure 10

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 4

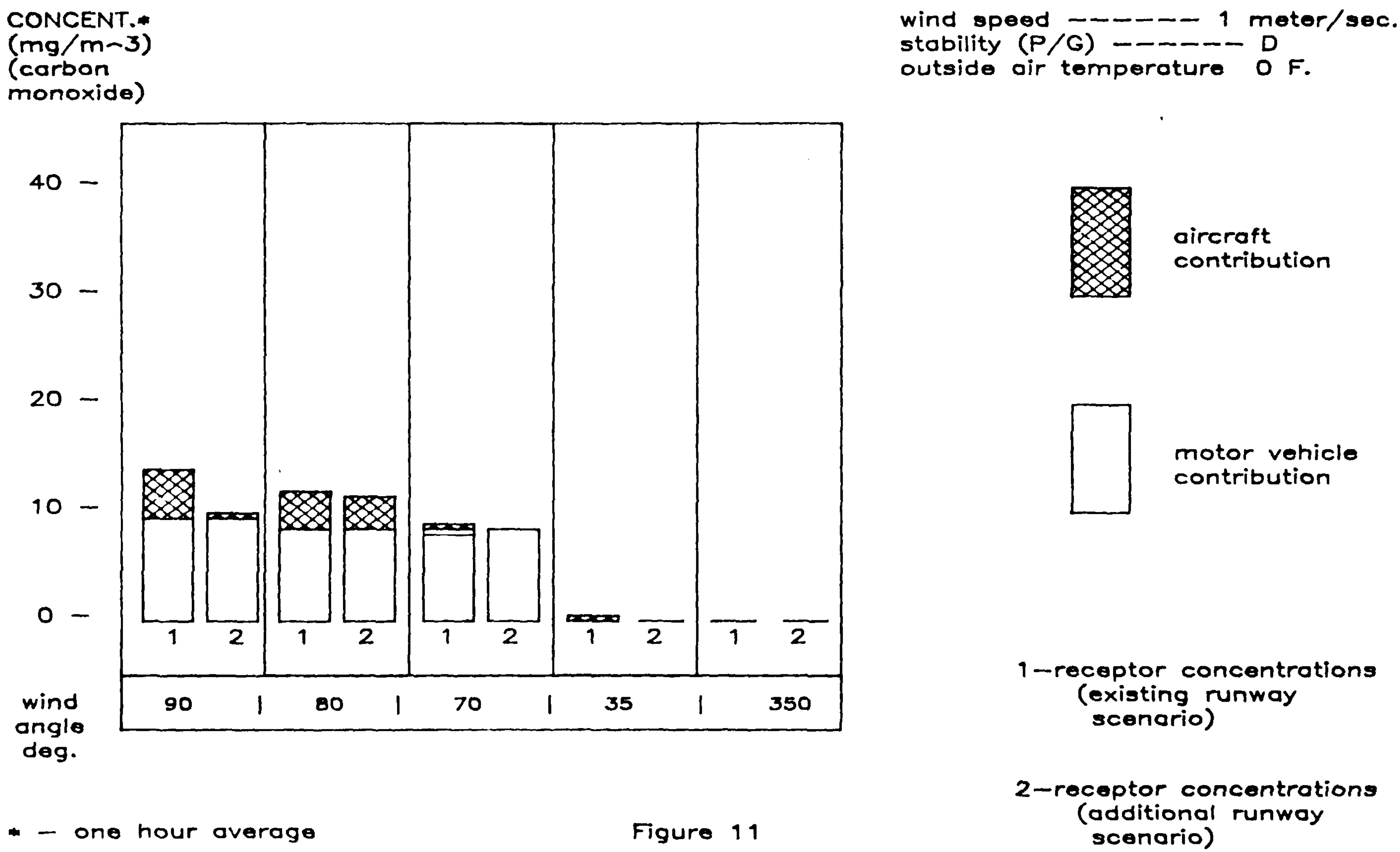


Figure 11

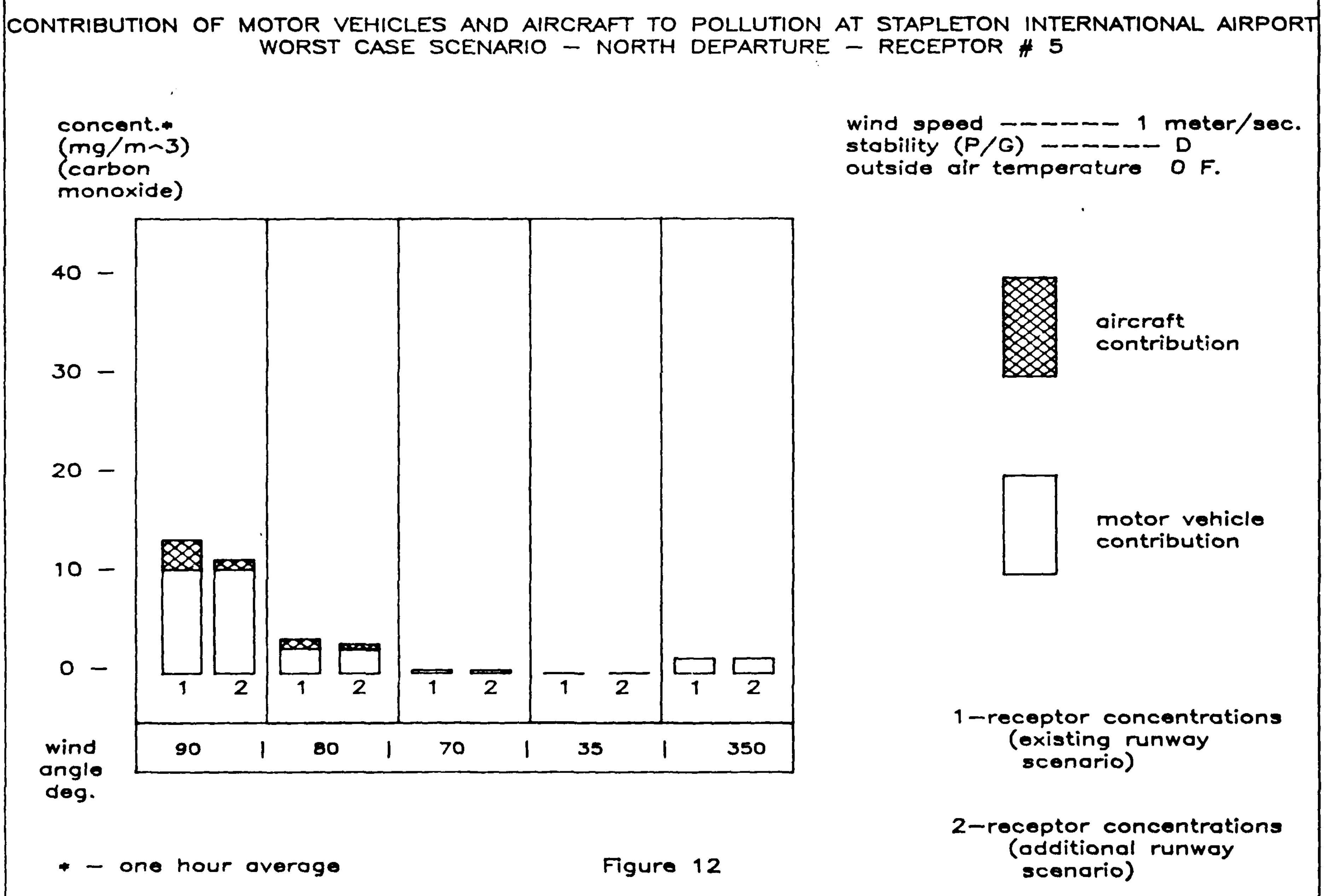
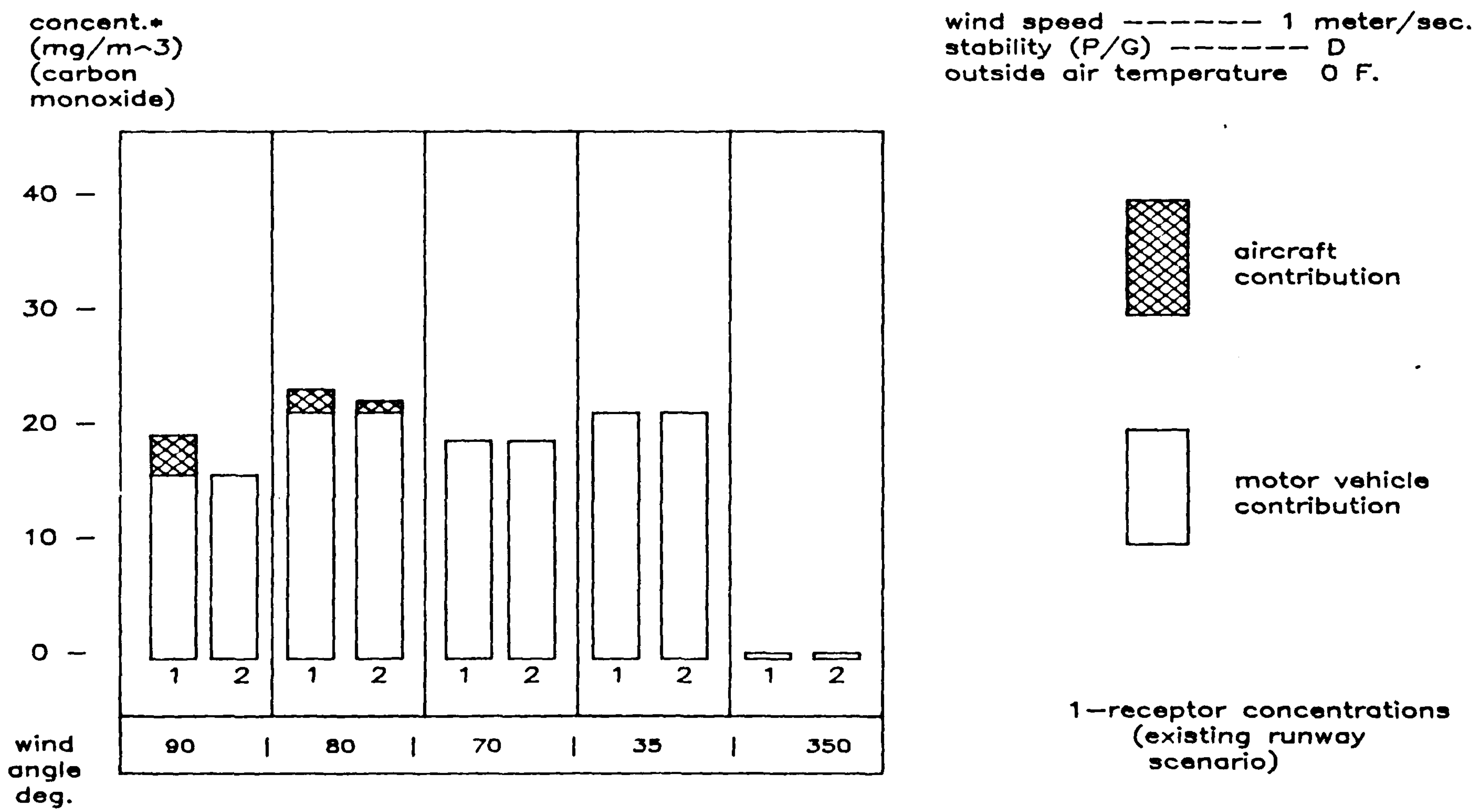

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 5
concent.*
(mg/m^3)
(carbon
monoxide)
wind speed ------- 1 meter/sec.
stability (P/G) ------- D
outside air temperature 0 F.
40
30
20
10
0
1
2
wind
angle
deg.
90
80
70
35
350
aircraft
contribution
motor vehicle
contribution
1—receptor concentrations
(existing runway
scenario)
2—receptor concentrations
(additional runway
scenario)
* — one hour average

Figure 12

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 6



* — one hour average

Figure 13

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — NORTH DEPARTURE — RECEPTOR # 7

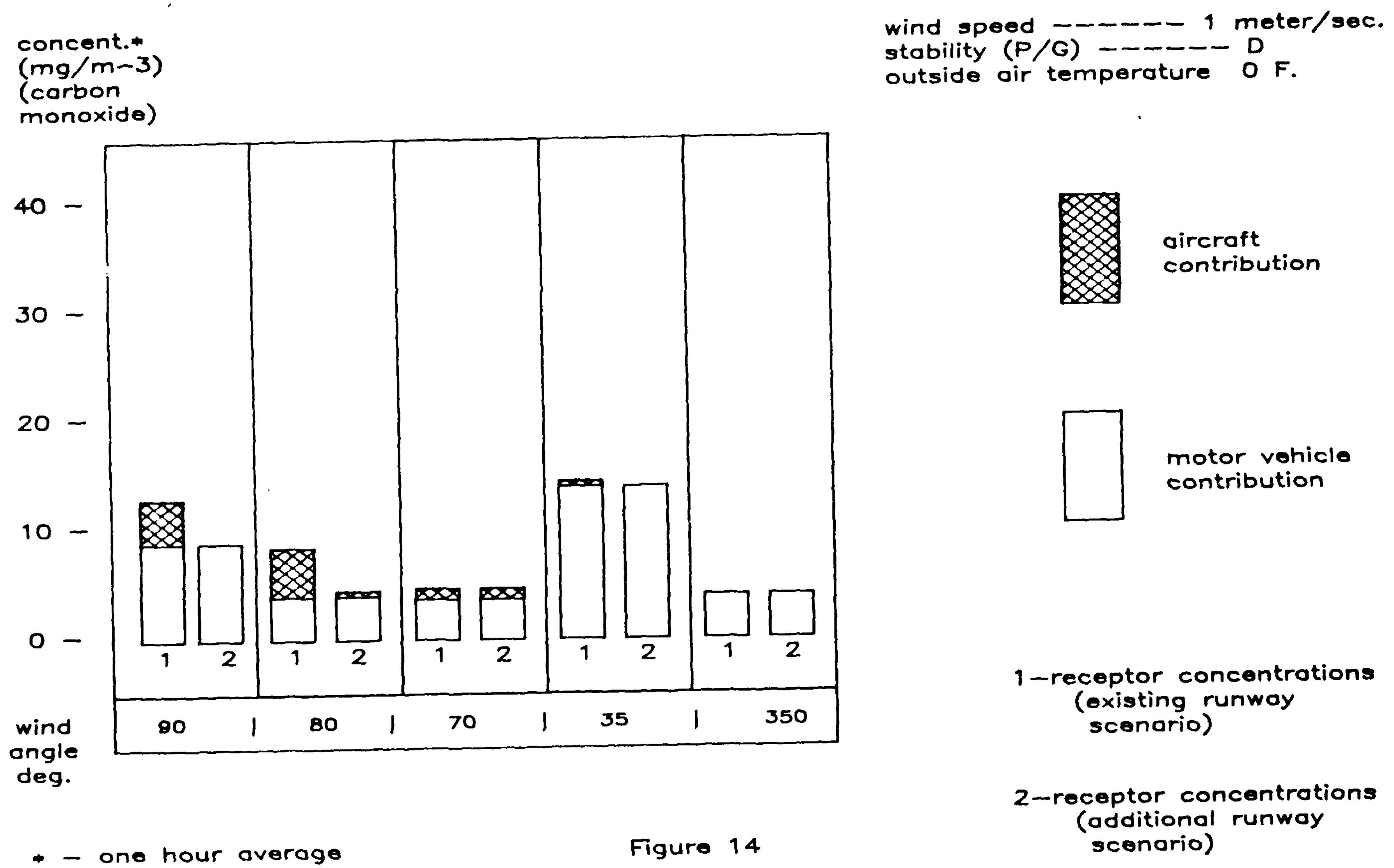


Figure 14

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 1

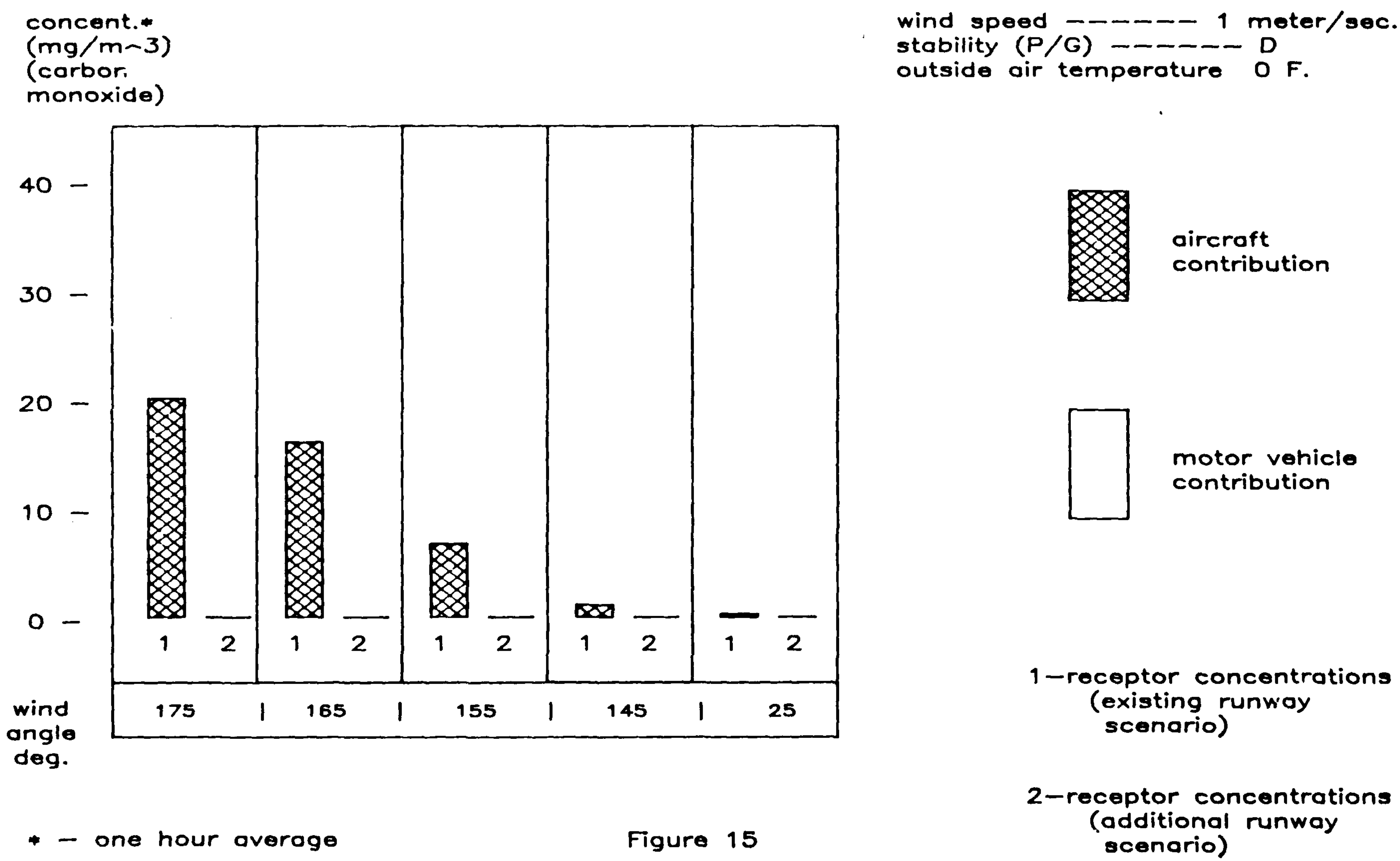
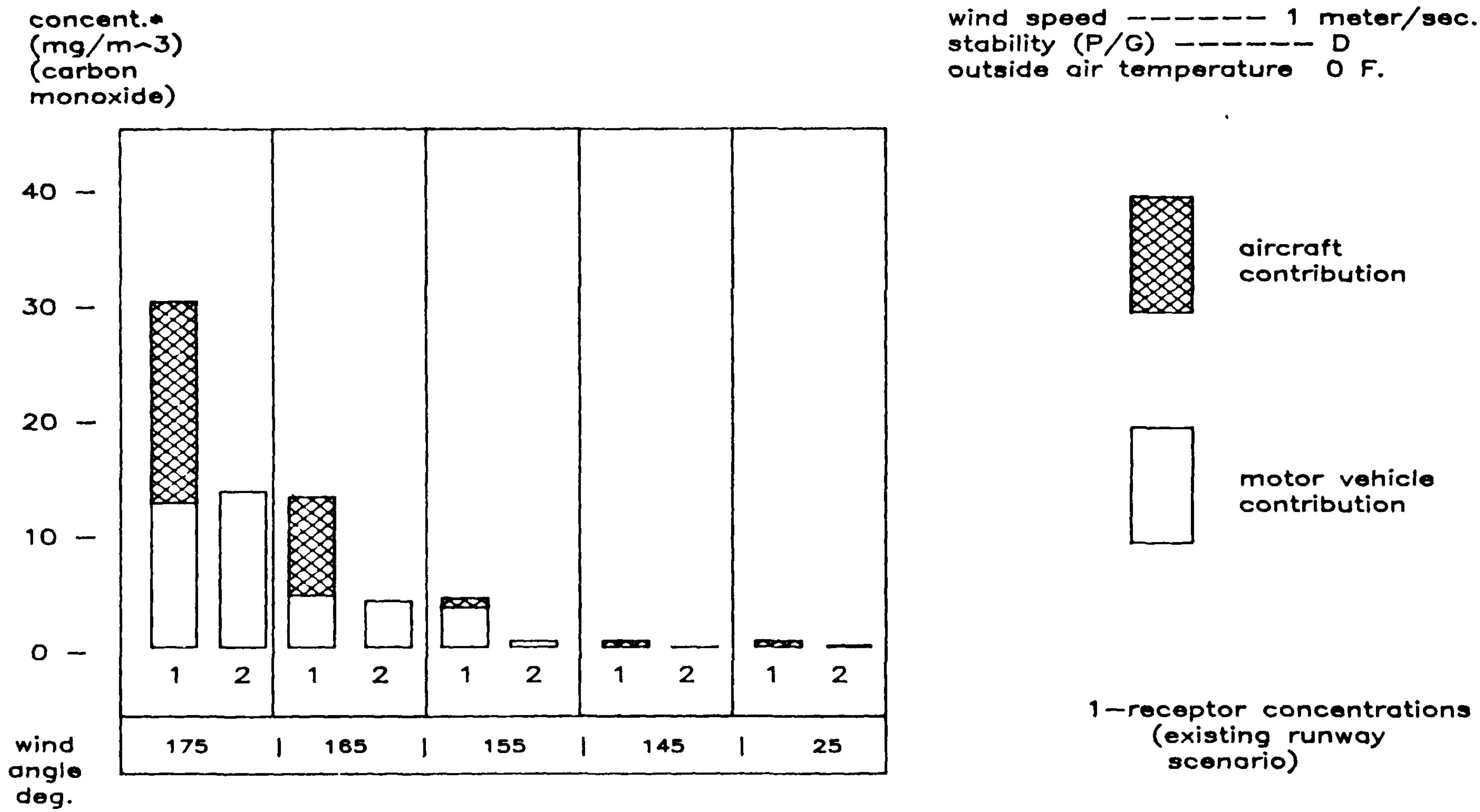


Figure 15

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 2



* — one hour average

FIGURE 16

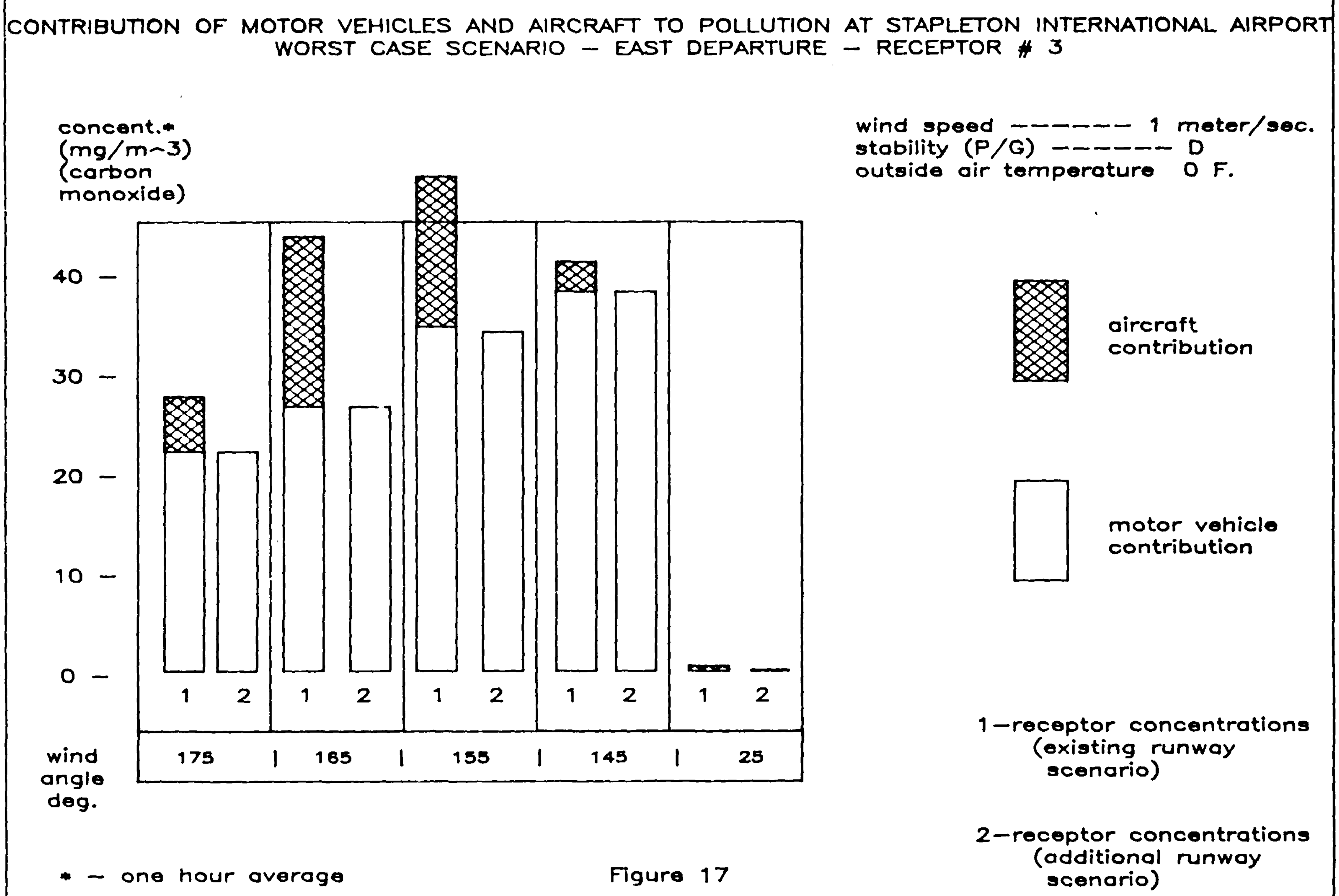

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 3
concent.* (mg/m~3) (carbon monoxide)
wind speed ------- 1 meter/sec.
stability (P/G) ------- D
outside air temperature 0 F.
40
30
20
10
0
1 2 1 2 1 2 1 2 1 2
wind angle deg.
175 | 165 | 155 | 145 | 25
aircraft contribution
motor vehicle contribution
1—receptor concentrations (existing runway scenario)
2—receptor concentrations (additional runway scenario)
* — one hour average

Figure 17

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 4

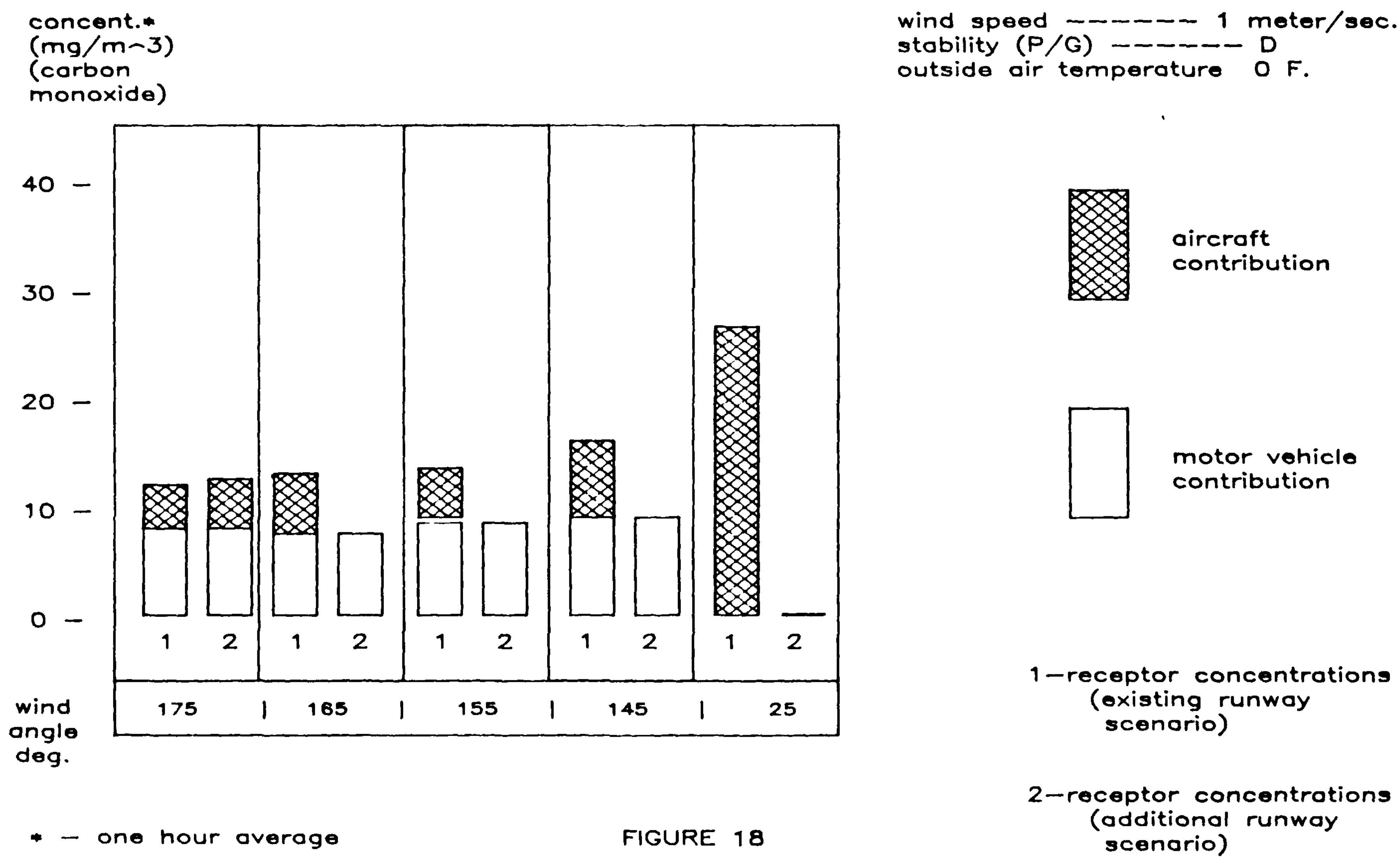


FIGURE 18

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 5

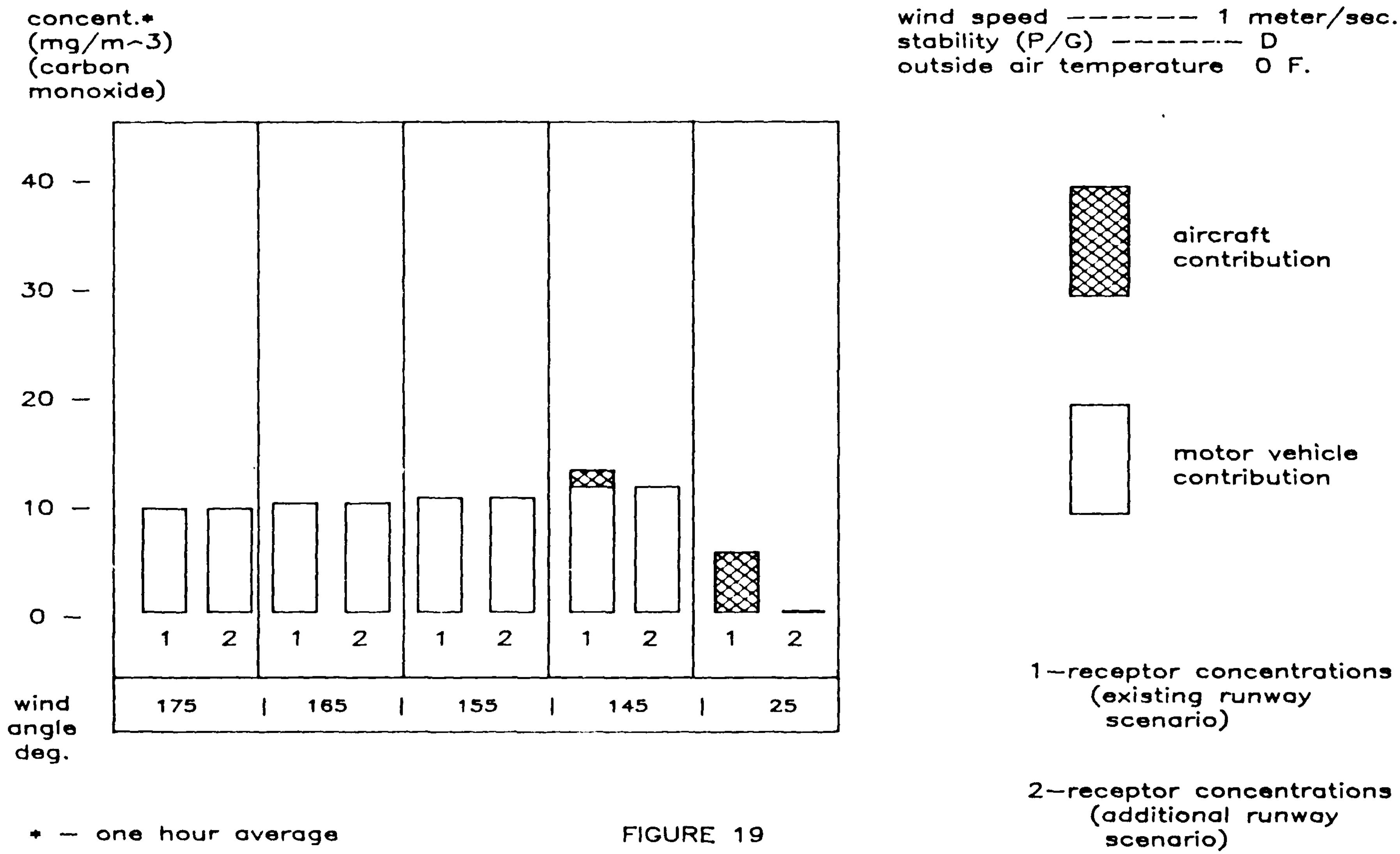
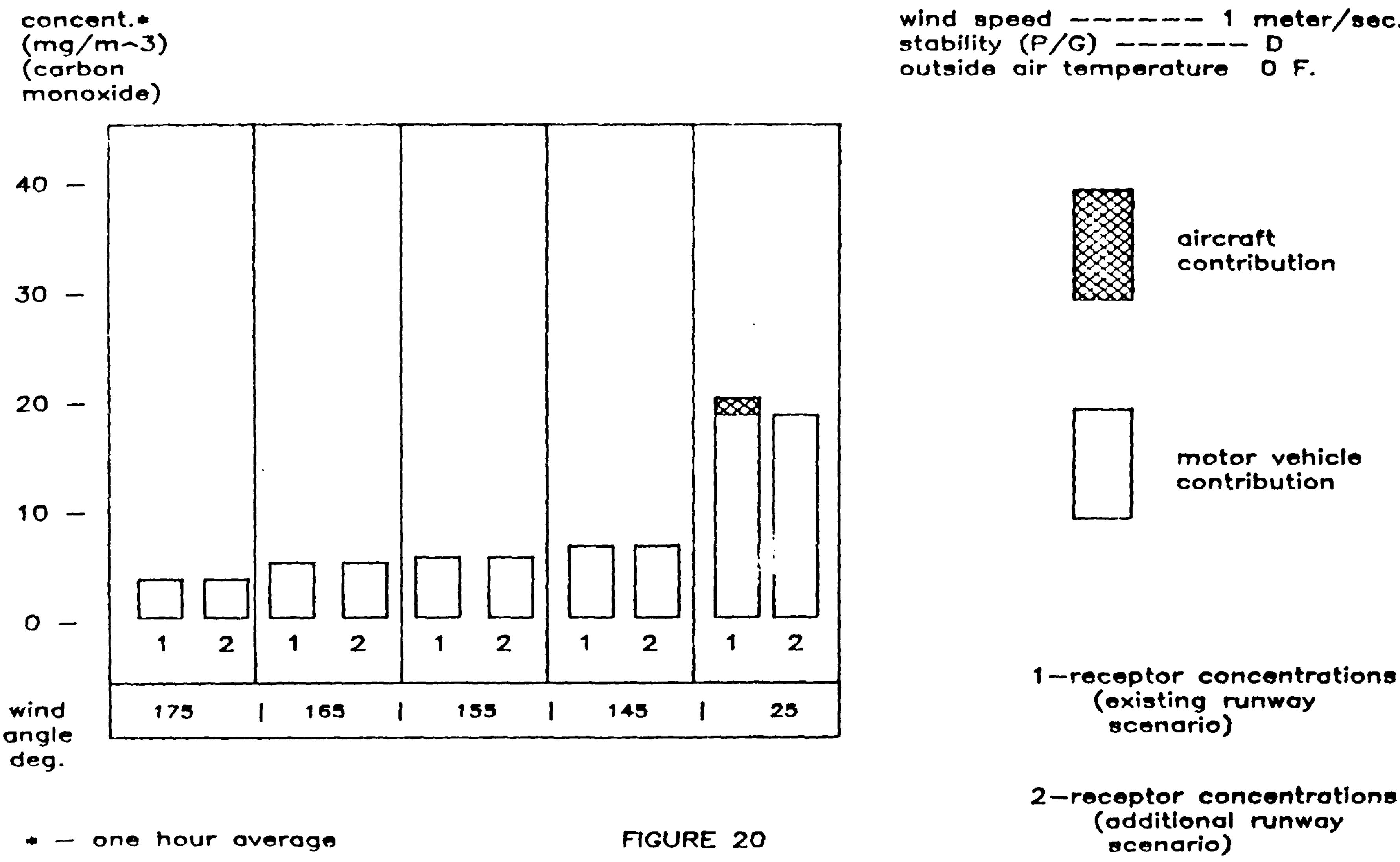


FIGURE 19

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 6



* — one hour average

FIGURE 20

CONTRIBUTION OF MOTOR VEHICLES AND AIRCRAFT TO POLLUTION AT STAPLETON INTERNATIONAL AIRPORT
WORST CASE SCENARIO — EAST DEPARTURE — RECEPTOR # 7

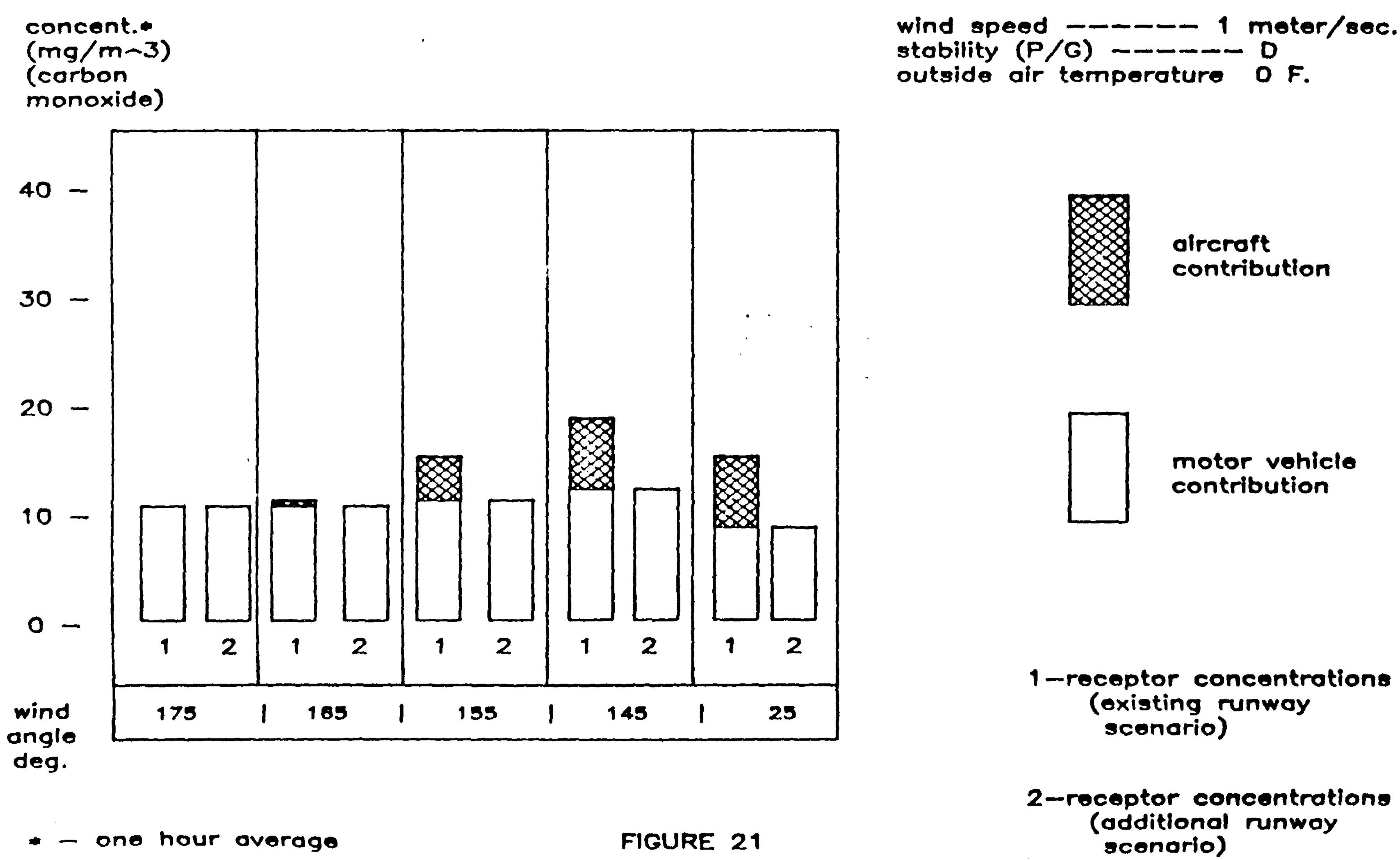


FIGURE 21

GRAPHICAL INPUT MICROCOMPUTER MODEL (GIMM) FLOW DIAGRAM

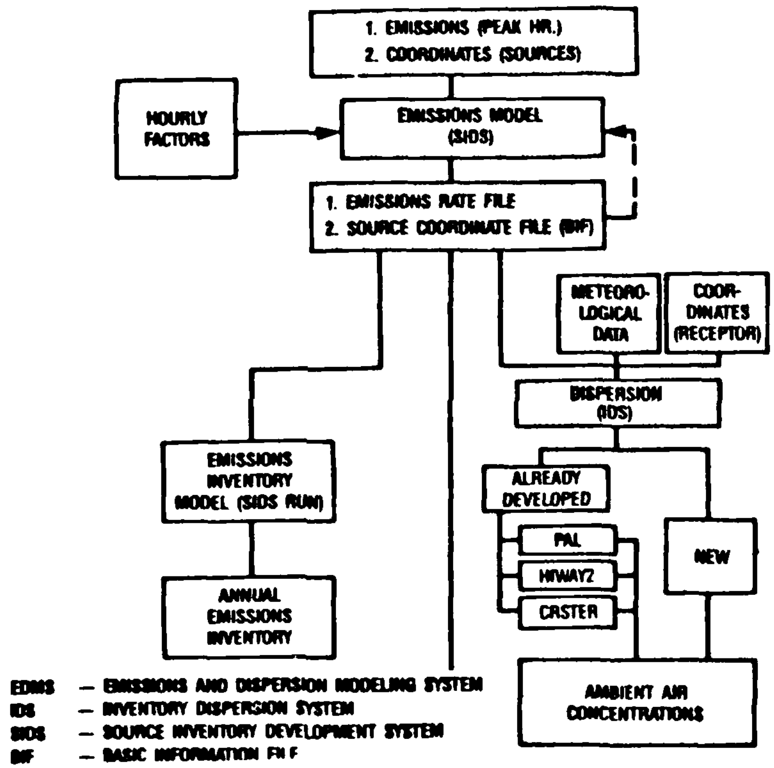


Figure 22

COMPARISON BETWEEN GIMM AND EPA MODELS*

Mg/M^3

Automobile Sources

Receptor #	1	2	3	4	5	6	7
GIMM	0	.5	34.5	8.2	10.5	5.6	11.0
HIWAY2	0	.5	33.4	7.8	9.9	5.6	10.3

Aircraft Sources

Receptor #	1	2	3	4	5	6	7
GIMM	6.2	3.0	16.4	5.4	.0	.0	4.1
PAL	6.8	2.9	16.0	5.5	.0	.0	4.0

*Highest Concentration Case
East Departure
Wind from 155°
Present Runway Configuration

Figure 23

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APPENDIX A

PRINTOUT OF MOTOR VEHICLE POLLUTION
FOR DIFFERENT WIND DIRECTIONS - APPENDAGE
TO REPORT FAA-EE-86-7 (REF. 1)

This appendix is a printout of the motor vehicle pollution for roadways at Stapleton International Airport. It repeats the printout of wind directions 240 degrees and 270 degrees in Ref. 1 and adds the printouts for wind directions of 180, 200, 225, and 330 degrees. The date header on each printout represents the day that the run was made.

TYPICAL PRINTOUT (THERE ARE 6 PRINTOUTS IN THE COMPLETE APPENDIX WHICH IS INCLUDED IN REPORT FAA-EE-86-11

NOV- 7-86 (1600 HR.)

INPUTS													OUTPUTS				
COORDINATES OF SOURCES (M) ORIGIN AT (0 , 0)					INITIAL PARAMETERS(M)			(MOBILE 3)					EMISSION RATES GM/SEC				
ROAD #	X1	Y1	X2	Y2	SIG Z	SIG Y	PLUME HT.	CARS/HR	MPH	%COLD START	TEMP (F)	YEAR	CO	HC	NOX	SOX	PART
1	46,	397	295,	263	1.5	3	1	1000	30	010	0	1986	4.81E00	4.45E-1	2.49E-1	5.87E-4	2.02E-2
2	399,	264	844,	263	1.5	3	1	1300	30	010	0	1986	7.40E00	6.86E-1	3.83E-1	9.01E-4	3.11E-2
3	842,	261	1057,	424	1.5	3	1	1300	20	010	0	1986	6.59E00	5.58E-1	2.06E-1	5.45E-4	1.85E-2
4	1056,	422	1102,	501	1.5	3	1	1300	5	010	0	1986	6.43E00	4.90E-1	7.69E-2	1.85E-4	6.37E-3
5	1099,	501	1065,	590	1.5	3	1	1300	5	010	0	1986	6.61E00	5.04E-1	7.81E-2	1.90E-4	6.54E-3
6	1071,	591	1005,	622	1.5	3	1	1300	5	010	0	1986	5.13E00	3.91E-1	6.06E-2	1.47E-4	5.07E-3
7	1005,	622	935,	594	1.5	3	1	1300	5	010	0	1986	5.11E00	3.89E-1	6.04E-2	1.46E-4	5.07E-3
8	936,	594	718,	460	1.5	3	1	1300	20	010	0	1986	6.29E00	5.33E-1	1.97E-1	5.20E-4	1.80E-2
9	718,	460	436,	450	1.5	3	1	1300	30	010	0	1986	4.69E00	4.34E-1	2.42E-1	5.71E-4	1.97E-2
10	422,	459	343,	445	1.5	3	1	1000	30	010	0	1986	1.15E00	1.07E-1	5.95E-2	1.40E-4	4.85E-3
11	343,	444	51,	474	1.5	3	1	1000	35	010	0	1986	3.25E00	3.13E-1	2.00E-1	4.57E-4	1.55E-2
12	53,	873	47,	0	1.5	3	1	3400	35	010	0	1986	3.28E01	3.16E00	2.02E00	4.60E-3	1.60E-1
13	453,	874	460,	0	1.5	3	1	100	30	010	0	1986	1.12E00	1.03E-1	5.77E-2	1.36E-4	4.69E-3
14	431,	458	350,	364	1.5	3	1	300	30	010	0	1986	4.75E-1	4.40E-2	2.46E-2	5.77E-5	2.00E-3
15	351,	363	399,	260	1.5	3	1	300	30	010	0	1986	4.35E-1	4.03E-2	2.25E-2	5.33E-5	1.84E-3
16	600,	460	635,	460	1.5	3	1	QUEUE	0	010	0	1986	3.33E00	2.43E-1	3.77E-2	8.75E-5	3.03E-3
												TOTAL	9.55E01	8.44E00	3.98E00	9.32E-3	3.23E-1

DISPERSION REPORT

INPUTS								OUTPUT				
DATE	HR	U (M/S)	WD (DEG)	P/G (A=1)	RECEPTOR NO.	X	Y	CONCENTRATION GM/M^3 CO	HC	NOX	SOX	PART
NOV- 7-86	16	1	240	4	1	1114	458	1.14E-2	8.90E-4	1.29E-4	4.64E-7	1.60E-5
NOV- 7-86	16	1	240	4	2	1102	543	2.00E-2	1.54E-3	2.82E-4	6.79E-7	2.35E-5
NOV- 7-86	16	1	240	4	3	1046	629	2.77E-2	2.16E-3	4.41E-4	1.08E-6	3.72E-5
NOV- 7-86	16	1	240	4	4	729	490	6.89E-3	6.19E-4	3.15E-4	7.37E-7	2.55E-5
NOV- 7-86	16	1	240	4	5	81	409	1.13E-2	1.07E-3	6.64E-4	1.52E-6	5.27E-5
NOV- 7-86	16	1	240	4	6	477	16	3.68E-4	3.41E-5	1.91E-5	4.49E-8	1.55E-6
NOV- 7-86	16	1	240	4	7	483	285	1.21E-3	1.15E-4	7.03E-5	1.62E-7	5.60E-6

APPENDIX B

GIMM PRINTOUTS FOR THE STAPLETON
INTERNATIONAL AIRPORT SCENARIO

Figures 6 through 21 were prepared from the printouts listed in this Appendix. These data include the following combinations of information:

1. 8-hour and 1-hour analysis
2. motor vehicles and airplanes
3. existing and future runways
4. north and east departures

The interrelationship of these combinations is shown in Figure B-1.

To facilitate Graphics Tablet use, the wind direction values listed in the printouts had to be referenced from the top of the page. This required rotating the maps of Figures 1 - 5 from a vertical north orientation. The user of Appendix B data must therefore subtract 90 degrees from all listed wind angles to establish the true wind angle.

The graphics tablet relates all coordinates to a (0,0) map origin. Since the origin of the large scale map (Figure 1) is (0,0), and aircraft coordinates are entered from this map, these sources do not have to be corrected. However, the coordinate printouts for motor vehicles have to be corrected because they are entered into the Graphics Tablet from the small scale map (Figure 5) which has a non-zero origin of (200,2800).

COMPUTER PRINTOUT SUMMARY

8 Hour Analyses

MOTOR VEHICLES	AIRPLANES	
Existing and Future Runways	Existing Runways	Future Runways
East Departure Run #5	Run #1	
		Run #2
North Departure Run #5	Run #3	
		Run #4

1 Hour Worst Cast Analsyis

MOTOR VEHICLES	AIRPLANES	
Existing and Future Runways	Existing Runways	Future Runways
East Departure Run #10	Run #6	
		Run #7
North Departure Run #10	Run #8	
		Run #9

Figure B-1

RUN# 1

TYPICAL PRINTOUT (THERE ARE OVER 100 OF THEM IN THE COMPLETE APPENDIX)

EMISSION REPORT
DEC- 9-84 (1700 HR.)

INPUTS: COORDINATES OF SOURCES (M) ORIGIN AT (0, 0)					INITIAL PARAMETERS (M)			(AP-42)		OUTPUTS: EMISSION RATES GM/SEC				
REC #	X1	Y1	X2	Y2	SIG Y	PLUME HT.	SIG Z	ACFT/HR	AIRCRAFT TYPE	CO	HC	NOX	SOX	PART
1	612	2827	612	750	16	15	10	14	B737-200/JT8D-17	2.08E-1	2.06E-2	8.34E00	4.11E-1	1.54E-1
1	740	3030	612	2827	16	15	10	14	B737-200/JT8D-17	3.45E01	8.91E00	3.44E00	1.01E00	3.11E-1
2	612	2827	612	750	16	15	10	4	DH6/PT6A-27	3.61E-3	0.00E00	2.00E00	3.52E-3	0.00E00
2	740	3030	612	2827	16	15	10	4	DH6/PT6A-27	1.84E00	1.44E00	7.06E-2	2.70E-2	0.00E00
3	612	2827	612	750	16	15	10	2	CV580/501D22A	2.04E-2	2.01E-3	8.86E-2	1.00E-2	0.00E00
3	740	3030	612	2827	16	15	10	2	CV580/501D22A	3.35E00	1.35E00	2.71E-1	7.70E-2	0.00E00
4	612	2827	612	750	16	15	10	1	B99/PT6A-27	9.83E-4	0.00E00	6.99E-1	8.00E-4	0.00E00
4	740	3030	612	2827	16	15	10	1	B99/PT6A-27	4.64E-1	3.64E-1	1.76E-2	6.94E-3	0.00E00
5	612	2827	612	750	16	15	10	19	NAVAJO/T10-540	8.96E00	7.71E-2	2.27E-3	1.06E-3	0.00E00
5	740	3030	612	2827	16	15	10	19	NAVAJO/T10-540	3.08E01	2.04E00	1.17E-2	1.32E-2	0.00E00
6	338	3306	337	313	16	15	10	3	B747-200B/JT9D-70	6.04E-2	5.13E-2	1.06E01	3.42E-1	6.61E-2
6	453	2605	338	3306	16	15	10	3	B747-200B/JT9D-70	2.31E01	4.58E-1	1.00E00	6.03E-1	8.33E-1
7	338	3306	337	313	16	15	10	1	DC-10-30/CF6-50C	1.67E-3	8.36E-4	2.96E00	8.33E-2	2.33E-3
7	453	2605	338	3306	16	15	10	1	DC-10-30/CF6-50C	8.32E00	3.42E00	2.05E-1	1.15E-1	4.17E-3
8	338	3306	337	313	16	15	10	1	B767/CF6-80A	5.00E-2	1.45E-2	1.49E00	5.00E-2	0.00E00
8	453	2605	338	3306	16	15	10	1	B767/CF6-80A	2.11E00	4.71E-1	2.54E-1	7.50E-2	0.00E00
9	338	3306	337	313	16	15	10	19	B727-200*/JT8D-17	5.06E-1	4.19E-2	1.70E01	8.37E-1	3.14E-1
9	453	2605	338	3306	16	15	10	19	B727-200*/JT8D-17	7.02E01	1.81E01	7.01E00	2.06E00	6.33E-1
10	338	3306	337	313	16	15	10	17	B737-200/JT8D-17	3.49E-1	2.50E-2	1.01E01	4.99E-1	1.87E-1
10	453	2605	338	3306	16	15	10	17	B737-200/JT8D-17	4.19E01	1.08E01	4.18E00	1.23E00	3.78E-1
									TOTAL	2.35E02	4.76E01	7.14E01	7.54E00	2.08E00

DISPERSION REPORT

INPUTS: DATE	HR	W/S M/S	WD DEG	P/G A=1	RECEPTOR NO.	X	Y	OUTPUT: CONCENTRATION GM/M^3 CO	HC	NOX	SOX	PART
DEC- 9-84	17	2.6	230	4	1	1070	2990	1.37E-4	8.77E-6	2.80E-4	1.19E-5	4.07E-6
DEC- 9-84	17	2.6	230	4	2	1197	3009	8.19E-5	1.76E-6	2.27E-4	9.10E-6	3.03E-6
DEC- 9-84	17	2.6	230	4	3	1241	3085	1.00E-4	5.31E-6	2.31E-4	9.64E-6	3.27E-6
DEC- 9-84	17	2.6	230	4	4	1114	3335	0.77E-3	1.67E-3	7.44E-4	1.65E-4	5.58E-5
DEC- 9-84	17	2.6	230	4	5	1126	3877	1.75E-3	3.98E-4	6.41E-4	7.03E-5	2.85E-5
DEC- 9-84	17	2.6	230	4	6	1011	4013	9.86E-5	2.23E-5	8.16E-5	5.89E-6	2.21E-6
DEC- 9-84	17	2.6	230	4	7	923	3545	2.41E-3	5.49E-4	5.46E-4	8.25E-5	3.48E-5

APPENDIX C

AIRCRAFT CAPACITY/DEMAND ANALYSIS

1. Introduction

The aircraft pollution burden is determined by modeling aircraft queuing emissions. A capacity/demand analysis is required to estimate this burden. The demand portion of this analysis is described in section 3.3.1 of the main report. The capacity analysis is made by selecting north-south and east-west runway configurations from Reference 6 that were determined to be "worst case" with respect to air quality and therefore appropriate for air quality analysis.

2. Runway Usage Selection for Air Quality Analysis

Departures to the east or to the north were selected as the appropriate runway geometries to use in this air quality analysis. These two geometries, which were part of the seven geometries listed in Reference 6, were selected because they place aircraft emissions closest to the pollution receptors at the terminal and, therefore, would record the highest possible pollution values.

For each of the runway geometries listed above, two capacity values are listed in Reference 6; one during flight under Visual Flight Rules (VFR), and the other during flight under Instrument Flight Rules (IFR). The values listed under VFR were selected for this analysis because they predominate under the "worst case" meteorological conditions provided by the CDPH.

3. Delay calculations

As was mentioned in the main text of this report (section 3.3.1), 81 aircraft were estimated to depart from the airport during the peak hour. For the existing configuration, these aircraft are assumed to depart on two parallel runways either to the east or to the north. Departures would therefore consist of 40 airplanes on one runway and 41 on the other.

During the peak hour there would be pressure to disperse these aircraft to the third proposed runway. Assuming an even split over the three runways, the departure rates would be 27 aircraft per hour on each runway.

The total VFR capacity from Reference 6 is 150 aircraft per hour. Assuming the takeoff portion of this capacity is 88 aircraft per hour or slightly greater than one half, the following equation from Reference 7 can be used to calculate delays prior to takeoff:

$$T = \frac{q(60 \text{ min.})}{Q(Q-q)}$$

q = demand (airc./hr)
Q = capacity (airc/hr)
T = queue time (min.)

DELAY CALCULATIONS FOR EXISTING RUNWAY SYSTEM

Assuming a Poisson distribution of aircraft arriving at each of the two takeoff queue areas:

$$T = \frac{40\,(60\text{ min.})}{44\,(44-40)} = 14\text{ min/AIRC.} \quad \text{(runway 1)}$$

$$T = \frac{41\,(60\text{ min.})}{44\,(44-41)} = 19\text{ min./AIRC.} \quad \text{(runway 2)}$$

For conservatism a 15 minute queue time was selected. With a departure rate of 1 1/2 airplanes per minute the peak queue length would be 10 airplanes. This value is consistant with queue lengths reported by tower personnel during peak hours. It is now possible to use this takeoff capacity estimate to calculate the decrease in queue time with the additional runways.

DELAY CALCULATIONS FOR EXISTING + PROPOSED RUNWAYS

Assume that the proposed east-west or north-south runways are in place and that during peak hours scheduled departures will be evenly directed to these three runways (27-27-27). Assume that each runway has a takeoff capacity of 44 (1/2 of 88) departures per hour.

Under these conditions:

$$T = \frac{27\,(60\text{ min.})}{44\,(44-27)} = 2.16\text{ MINUTES} \quad \text{(all 3 runways)}$$

To be conservative 3 minutes was selected

Therefore, aircraft queues at each runway will be:

PRESENT CONFIGURATION ---- 15 minutes

PROPOSED CONFIGURATION --- 3 minutes

END
12-87
DTIC