**A METHODOLOGY FOR CONTROLLING
AIR POLLUTION EPISODES**

by

**T. D. Wolsko, M. T. Matthies,
and R. F. King**

ARGONNE NATIONAL LABORATORY

CENTER FOR ENVIRONMENTAL STUDIES

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ARGONNE NATIONAL LABORATORY
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Thomas D. Wolsko, Michael T. Matthies,**
and Richard F. King

Center for Environmental Studies

September 1972

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ABSTRACT

A methodology for developing effective, preplanned emission control strategies for urban air pollution episodes is presented. A steady-state Gaussian dispersion model is applied to known emission inventories for various sets of meteorological conditions that are liable to exist during episodes. Calculated pollution contours are plotted directly on 35 mm film for projection into a larger display format that is convenient for identifying episode problems and planning control strategies. A hypothetical episode is used to illustrate techniques. Although the procedures were designed to control sulfur dioxide and particulate matter, they are applicable for any non-reacting, airborne pollutant.

I. INTRODUCTION

Air pollution episodes come about when meteorological conditions reduce the volume of air in which the pollutants can be dispersed. If the conditions persist and sources continue to emit pollutants, the ambient air quality will deteriorate. Source emission reduction is the only means by which severe short-term air pollution problems can be resolved. However, emission reduction strategies are likely to involve more operational and economic disruption than the episode itself. Because control strategies affect the metabolism of an urban economy, they must be carefully selected to minimize disruption and yet effectively resolve the air pollution problem. Without an effective method for developing control strategies, the episode control planner will most likely over-control sources in the area.

This report describes a methodology for developing effective control strategies that minimize the constraints on the economy. The methodology is designed for large urban areas with short-term air pollution episodes and not for the abatement of long-term air pollution problems. Although the procedures were designed to control sulfur dioxide and particulate episodes, they are applicable for any non-reacting pollutant.

Episode control strategy development is considered as a preplanned task in this methodology. That is, the data necessary to determine the most effective control strategy is calculated and available before the episode actually develops. Preplanning for episodes leaves more time for implementing the control strategies.

The main thrust of the methodology is to precalculate pollution contours for episode-prone meteorological conditions so that a picture of the problem is available. Source emission data, pollutant dispersion, graphical

display, and strategy development are all a part of the methodology to control episodes. Any emission source inventory can be used, but the system is designed to use data in the Implementation Planning Program format (IPP). Recent source inventories in the IPP format are available for most major metropolitan areas in the United States. Computer programs that process the inventory data into a source file and preprocess it for the dispersion program are available.

The dispersion program (ASSM) that calculates pollution contours (isopleths) is based on a steady-state Gaussian diffusion model. That is, it is assumed that meteorological conditions do not change radically during the episode, and this is usually the case. A complete description of the dispersion model is included in this report.

Outputs from the dispersion model must be assembled in a format that is usable by the control strategist. Plotting programs that provide pollution contours on 35mm film directly from the computer have been developed. All programs are written for an IBM 50/75 computer, and film plotting is performed on the IBM 2280 film unit. The 35mm film format was chosen because, with the aid of projection equipment, the larger format is convenient in identifying episode problems and planning control strategies. Descriptions of the plotting programs and their links to the dispersion model are available.

In addition to describing all the techniques, computer programs, and data gathering, the report contains a section devoted to the use of these tools for planning an episode control strategy. A hypothetical episode is used to illustrate the development of a control strategy for a major metropolitan area using the methodology described in this report.

II. SOURCE EMISSION FILE

An essential part of any effective procedure for controlling air pollution episodes is a well-designed source emission file. The accuracy of the data is of course very important; but furthermore, because the response time for effective control procedures is short, the emission data must be assembled so that desired information can be located quickly. Convenient data files should be available for determining, applying, and analyzing episode control strategies.

Any emission inventory can be assembled to serve as the basis for a source emission file, but the procedures and programs described here are based upon the Implementation Planning Program (IPP) emission inventory format. This inventory format was chosen because the Federal Environmental Protection Agency has specified such a format for air quality planning programs. Two large computer programs were written to assist federal, state, and local agencies in their air quality planning activities. The first of these programs is a dispersion program (Air Quality Display Model: AQDM);¹ the second is designed to test air quality control strategies for cost-effectiveness (Air Quality Implementation Planning Program: IPP).² Both of these programs use the IPP emission inventory format as input. A sample format is shown in Figs. 1 and 2. Even though these two complex programs have received very little use because of their complexity, emission inventories for most major urban air-sheds have been collected by the Environmental Protection Agency using this format. The IPP emission inventory format has recently been modified to the IPP-2 format shown in Table I. Most changes in the format relate to data location and input format, while very few changes have been made with respect to the type of data.

NAME _____		IMPLEMENTATION PLANNING PROGRAM		PAGE _____ OF _____	
REGION _____		SOURCE FILE		KEYPUNCHED BY _____	
NO. OF CARDS _____		(point)		VERIFIED BY _____	
REGION	SOURCE ID	SOURCE DESCRIPTIVE NAME		LOCATION X (KM)	LOCATION Y (KM)
		0,0,1	0,0,2	0,0,3	0,0,4
REGION	SOURCE ID	POLITICAL JURISDICTION	OWNERSHIP	SOURCE TYPE	STACK HEIGHT (M)
		0,0,8	0,0,9	0,1,0	0,1,2
REGION	SOURCE ID	STACK DIAMETER (M)	EXIT VELOCITY (M/SEC)	EXIT TEMPERATURE (°K)	EXISTING CONTROL DEVICE
		0,1,3	0,1,4	0,1,5	0,1,6
REGION	SOURCE ID	EXISTING SO ₂ CONTROL EFFICIENCY (%)	EXISTING CO CONTROL EFFICIENCY (%)	EXISTING PARTICULATE CONTROL EFFICIENCY (%)	EXHAUST GAS VOLUME (ACFM)
		0,1,7	0,1,8	0,1,9	0,2,0
REGION	SOURCE ID	RATED CAPACITY (BTU/HR)	OPERATING TIME (HR/YR)	ANNUAL SHIFTS (SHIFTS/DAY)	ORIGINAL COAL COST (\$/TON)
		0,2,2	0,2,3	0,2,6	0,2,7
REGION	SOURCE ID	ORIGINAL OIL COST (\$/GAL)	ORIGINAL GAS COST (\$/CU. FT.)	ORIGINAL COAL HEAT CONTENT (BTU/TON)	ORIGINAL OIL HEAT CONTENT (BTU/GAL)
		0,2,8	0,2,9	0,3,0	0,3,1
REGION	SOURCE ID	ORIGINAL GAS HEAT CONTENT (BTU/CU. FT.)	ELECTRICITY COST (\$/KWHR)	DEVICE FUEL COST (\$/CU. FT.)	LIQUID COST (\$/GAL)
		0,3,2	0,3,6	0,3,7	0,3,8
REGION	SOURCE ID	DISPOSAL FACTOR SO ₂ (\$/TON)	DISPOSAL FACTOR CO (\$/TON)	DISPOSAL FACTOR PARTICULATE (\$/TON)	MANUFACTURING PROCESS UNITS
		0,3,9	0,4,0	0,4,1	0,4,3
REGION	SOURCE ID	COAL RATE ANNUAL (T/DAY)	OIL RATE ANNUAL (GAL/DAY)	GAS RATE ANNUAL (CU. FT./DAY)	PROCESS RATE ANNUAL (PROC. lb./hr)
		0,4,6	0,4,9	0,5,2	0,5,5
REGION	SOURCE ID	ORIGINAL GAS sulfur content (%)	EMISSION RATE SO ₂ SUMMER (T/DAY)	EMISSION RATE SO ₂ WINTER (T/DAY)	EMISSION RATE SO ₂ ANNUAL (T/DAY)
		0,5,5	0,5,6	0,5,7	0,5,8
REGION	SOURCE ID	EMISSION RATE CO SUMMER (T/DAY)	EMISSION RATE CO WINTER (T/DAY)	EMISSION RATE CO ANNUAL (T/DAY)	EMISSION RATE PART. SUMMER (T/DAY)
		0,5,9	0,6,0	0,6,1	0,6,2
REGION	SOURCE ID	EMISSION RATE PART. WINTER (T/DAY)	EMISSION RATE PART. ANNUAL (T/DAY)	ORIGINAL COAL sulfur content (%)	ORIGINAL OIL sulfur content (%)
		0,6,3	0,6,4	0,6,5	0,6,6

Fig. 1. IPP Input-data Form; Point Source

DATE _____		IMPLEMENTATION PLANNING PROGRAM		PAGE _____ OF _____	
NAME _____		SOURCE FILE		RETPUNCHED BY _____	
REGION _____		(area)		VERIFIED BY _____	
NO OF CARDS _____					
REGION	SOURCE ID	SOURCE DESCRIPTIVE NAME		LOCATION X (KM)	LOCATION Y (KM)
	0,0,1	0,0,2	0,0,3	0,0,4	
REGION	SOURCE ID	AREA (KM ²)	EMISSION RATE SO ₂ SUMMER (T/DAY)	EMISSION RATE SO ₂ WINTER (T/DAY)	EMISSION RATE SO ₂ ANNUAL (T/DAY)
	0,0,5	0,0,6	0,0,7	0,0,8	
REGION	SOURCE ID	EMISSION RATE CO SUMMER (T/DAY)	EMISSION RATE CO WINTER (T/DAY)	EMISSION RATE CO ANNUAL (T/DAY)	EMISSION RATE PART. SUMMER (T/DAY)
	0,0,9	0,0,0	0,0,1	0,0,2	
REGION	SOURCE ID	EMISSION RATE PART. WINTER (T/DAY)	EMISSION RATE PART. ANNUAL (T/DAY)	POLITICAL JURISDICTION	STACK HEIGHT (M)
	0,0,3	0,0,4	0,0,8	0,0,2	
REGION	SOURCE ID	SOURCE DESCRIPTIVE NAME		LOCATION X (KM)	LOCATION Y (KM)
	0,0,1	0,0,2	0,0,3	0,0,4	
REGION	SOURCE ID	AREA (KM ²)	EMISSION RATE SO ₂ SUMMER (T/DAY)	EMISSION RATE SO ₂ WINTER (T/DAY)	EMISSION RATE SO ₂ ANNUAL (T/DAY)
	0,0,5	0,0,6	0,0,7	0,0,8	
REGION	SOURCE ID	EMISSION RATE CO SUMMER (T/DAY)	EMISSION RATE CO WINTER (T/DAY)	EMISSION RATE CO ANNUAL (T/DAY)	EMISSION RATE PART. SUMMER (T/DAY)
	0,0,9	0,0,0	0,0,1	0,0,2	
REGION	SOURCE ID	EMISSION RATE PART. WINTER (T/DAY)	EMISSION RATE PART. ANNUAL (T/DAY)	POLITICAL JURISDICTION	STACK HEIGHT (M)
	0,0,3	0,0,4	0,0,8	0,0,2	
REGION	SOURCE ID	SOURCE DESCRIPTIVE NAME		LOCATION X (KM)	LOCATION Y (KM)
	0,0,1	0,0,2	0,0,3	0,0,4	
REGION	SOURCE ID	AREA (KM ²)	EMISSION RATE SO ₂ SUMMER (T/DAY)	EMISSION RATE SO ₂ WINTER (T/DAY)	EMISSION RATE SO ₂ ANNUAL (T/DAY)
	0,0,5	0,0,6	0,0,7	0,0,8	
REGION	SOURCE ID	EMISSION RATE CO SUMMER (T/DAY)	EMISSION RATE CO WINTER (T/DAY)	EMISSION RATE CO ANNUAL (T/DAY)	EMISSION RATE PART. SUMMER (T/DAY)
	0,0,9	0,0,0	0,0,1	0,0,2	
REGION	SOURCE ID	EMISSION RATE PART. WINTER (T/DAY)	EMISSION RATE PART. ANNUAL (T/DAY)	POLITICAL JURISDICTION	STACK HEIGHT (M)
	0,0,3	0,0,4	0,0,8	0,0,2	

Fig. 2. IPP Input-data Form; Area Source

TABLE I. IPP-2 Inventory Format

<u>Point Source Record</u>		
1-3	XXX	Region Number
4-7	XXXX	SIC Code
8-10	XXX	Site Number
11-12	XX	Process Code
13-35	X(23)	Descriptive Names
36-39	999V9	Location X, kilometers (UTM System)
40-44	9999V9	Location Y, kilometers (UTM System)
45-46	XX	Political Jurisdiction Code
47	A	Ownership Code P,L,S,F,U ⁽¹⁾
48	A	Source Type B,P,S ⁽²⁾
49-55	9(4)V999	SO ₂ Emission Rate, tons/day
56-62	9(4)V999	Particulate Emission Rate, tons/day
63-66	9999	Operating Time, hours/year
67-68	9V9	Shifts/Day
69-71	99V9	SO ₂ Control Efficiency (Existing), %
72-75	99V99	Part., Control Efficiency (Existing), %
76-78	XXX	Control Device ID (Existing)
79-90	+9.9(5)E+99	Rated Capacity, Btu/hour
91-100	+9.999E+99	Coal Heat Content, Btu/ton
101-111	+9.9(4)E+99	Residual Oil Heat Content, Btu/gal
112-122	+9.9(4)E+99	Distillate Oil Heat Content, Btu/gal
123-126	9999	Gas Heat Content, Btu/cu ft
127-131	9(5)	Coal Burned, tons/day
132-137	9(6)	Residual Oil Heat Burned, gals/day
138-143	9(6)	Distillate Oil Burned, gals/day
144-151	9(5)000	Gas Burned, cu ft/day
152-154	9V99	Coal Sulfur Content, %
155-157	9V99	Residual Oil Sulfur Content, %
158-160	9V99	Distillate Oil Sulfur Content, %
161-165	9V9999	Gas Sulfur Content, %
166-168	99V9	Coal Ash Content, %
169-175	9999V9(3)	Stack Height, meters
176-182	9999V9(3)	Stack Temperature, °K
183-189	9999V9(3)	Normalized Plume Rise, meters ² /sec
190-197	9(8)	Maximum Process Rate, lb/hour
198-204	9(5)00	Maximum Exhaust Gas Volume, ACFM
205-211	99V9(5)	Stack Diameter, meters
212-218	999V9(4)	Stack Velocity, meters/sec
219-221	9V99	Use Factor
<u>Dummy Record</u>		
1-3	XXX	Region Number
4-7	XXXX	"9999"
8-10	XXX	"000"
11-12	XX	"00"
12-331	Blank	-
<u>Area Source Record</u>		
1-3	XXX	Region Number
4-7	XXXX	SIC Code
8-10	XXX	Site Number
11-12	XX	Process Code
13-16	999V9	Location X, kilometers
17-21	9999V9	Location Y, kilometers
22-25	999V9	Area, square kilometers
26-27	XX	Political Jurisdiction Code
28-34	9999V9(3)	Effective Stack Height, meters
35-41	9(4)V999	SO ₂ Emission Rate, tons/day
42-48	9(4)V999	Part., Emission Rate, tons/day

(1)P: Private Ownership; L: Local Government; S: State Government; F: Federal Government; U: Utilities.

(2)B: Fuel Combustion; P: Industrial Process; S: Solid Waste Disposal.

A complete emission inventory of the pollutants that are considered of episode potential is necessary for the development of effective control strategies. And any survey technique, including Rapid Survey,³ can be used to develop a complete inventory. Even though most control strategies will probably only affect large point sources, a complete emission inventory is required in order to determine the effectiveness of a control strategy. For example, if space heating is causing 90 percent of the SO₂ problem in a residential area, controlling a fossil-fueled power plant will not materially ease the problem. The importance of having a complete inventory will become more obvious in discussions of the culpable source listings.

A. Emission Data Lists

There are many ways of assembling emission data for use in episode control planning. Included in this section are descriptions of five different emission data lists that are helpful in episode control activities. Listings of the computer programs that generate these data lists are contained in Appendix A. The programs are quite simple in design, utilizing a sorting and merging subroutine found in most IBM computer libraries (SORT). Other computer systems that do not have a SORT subroutine package probably have a similar software option. It is not the uniqueness of the computer coding that is important, but the arrangement of data. These programs could be rewritten for any computer with relative ease.

B. General Source Listing

A complete listing of the emission data for each source is a necessary part of any data file. Other listings will only be reorderings of the sources based upon a particular source parameter, and then the general file will contain all the data that may not be included in other lists. This is the purpose of the general source file (code name GSFILE). It includes a listing of all information in the IPP-2 inventory format that is useful in episode control. A sample General Source File is shown in Table II for the Chicago Metropolitan Air Quality Control Region. The GSFILE listing has been divided into three pages so that the information could be listed on standard 8 1/2 x 11" paper for easy handling. There is a great deal of other data in the IPP format that was either considered irrelevant for episode control or difficult to survey, and probably not reliable. Even some of the source parameters that are displayed in the general file are not available (e.g., fuel use data) or are unreliable (e.g., effluent exit velocity). The GSFILE is listed according to source number (assigned by user) on all three pages of data.

TABLE II. General Source File for Chicago Metropolitan Air Quality Region

SRCE	SOURCE NAME	PCLIT JURIS	X KM	Y KM	AREA	SU2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	STACK HT(M)
1	009340 CCRN PRODUCTS	3	57.2	68.9	0.0	0.0	4.75	33.6
2	014070 48-INSULATIONS	1	15.8	74.2	0.0	0.0	0.19	18.3
3	255070 UNIROVAL JOLETT	1	27.4	27.4	0.0	0.0	9.70	18.3
4	255070 UNIROVAL	1	27.4	27.4	0.0	23.30	0.0	22.9
5	354680 ABBOTT LABS N CGO	1	59.2	131.5	0.0	0.0	0.35	4.6
6	208420 STAFFER CHEMICAL	1	73.9	39.6	0.0	0.0	1.40	17.0
7	295420 AMER CYANAMID	1	35.2	39.1	0.0	4.20	0.0	33.5
8	035130 CFGC CL & CHEM	1	70.1	56.4	0.0	8.72	0.46	7.3
9	503340 AMOCO CHEMICAL	1	27.2	32.7	0.0	0.0	1.83	23.2
10	312370 PURE OIL CO	1	38.2	56.3	0.0	0.0	0.95	55.5
11	317050 TEXACO REFINERY	1	38.1	50.4	0.0	0.0	2.51	59.5
12	442620 GALLAGHER ASPHALT	1	74.5	45.7	0.0	0.0	0.19	11.6
13	502040 CROWN TRYGG JOLETT	1	28.7	39.2	0.0	0.0	0.06	19.2
14	312160 CROWN-TRYGG CORP	1	42.4	59.5	0.0	0.0	0.81	13.4
15	501480 GEC H HARTONG INC	5	54.6	69.6	0.0	0.0	0.03	12.2
16	281800 LIBERTY ASPHALT	1	40.4	131.2	0.0	0.0	0.07	9.1
17	453390 SKOKIE VAL ASPHALT	1	52.8	133.6	0.0	0.0	0.09	6.1
18	501960 STEFFAN BRGS INC	1	19.7	107.6	0.0	0.0	0.06	9.1
19	427840 MAYER ASPHALT CO	1	66.9	95.6	0.0	0.0	0.02	10.7
20	501760 MCNARCH ASPHALT	1	67.6	96.8	0.0	0.0	0.04	12.8
21	296230 CROWN TRYGG TROY	1	30.0	37.8	0.0	0.0	0.17	16.8
22	302710 GAF CORP 5	1	35.9	45.2	0.0	0.0	0.72	19.5
23	302710 GAF CORP 3	1	35.9	45.2	0.0	0.0	0.55	21.4
24	247120 GIERTZ-MELAHN CO	1	18.8	94.9	0.0	0.0	0.03	9.8
25	208960 WESTERNMETAL ABRSV	1	72.7	37.8	0.0	0.0	2.20	19.8
26	291760 VULCANMETALS HOOK	1	55.3	68.8	0.0	0.0	0.08	22.9
27	452460 JOHNS-MANVILLE WK	1	59.9	136.9	0.0	0.0	0.51	15.3
28	442710 MARBLEHEAD LIME	1	74.6	45.6	0.0	0.0	4.79	22.9
29	MCCOOK STANDARD LIME	5	55.3	71.0	0.0	0.0	25.50	16.3
30	297310 JOHNS MANVILLE J	1	29.4	38.0	0.0	0.0	0.07	12.0
31	302710 GAF CORP 4	1	35.9	45.2	0.0	0.0	0.59	18.0
32	206230 CALUMET STEEL	1	73.9	40.4	0.0	0.0	1.57	30.0
33	206620 COLUMBIA TGL STL	1	74.0	38.8	0.0	0.0	0.14	15.3
34	452220 GM CRP-CHEVROLET	1	60.2	134.5	0.0	3.00	0.33	76.3
35	206440 CFGC HTS GRY FE F	1	73.5	39.5	0.0	0.0	0.13	18.3
36	502700 GREENLEE FOUNDRY	1	64.7	78.4	0.0	0.0	0.08	18.3
37	431080 WELLS MANUFACTURN	1	61.7	96.5	0.0	0.0	0.05	12.2

TABLE II (Contd.)

SRCE	SIC CODE	VELOCITY (M/SEC)	STACK DIAM(M)	TEMP (K)	COAL (BTU/TN) HEAT CONTENT	OIL (BTU/GAL) HEAT CONTENT	ANNUAL COAL RATE TN/DAY	ANNUAL OIL RATE TN/DAY
1	2040	1.5	2.7	288.	0.0	0.0	0.0	0.0
2	2600	5.6	0.9	589.	0.0	0.0	0.0	0.0
3	2800	0.8	0.5	395.	0.0	0.0	0.0	0.0
4	2800	2.0	0.3	395.	0.0	0.0	0.0	0.0
5	2818	1.3	3.0	366.	0.0	0.0	0.0	0.0
6	2818	1.3	2.0	366.	0.0	0.0	0.0	0.0
7	2819	11.9	0.9	366.	0.0	0.0	0.0	0.0
8	2819	12.0	1.2	366.	0.0	0.0	0.0	0.0
9	2911	1.0	1.8	329.	0.0	0.0	0.0	0.0
10	2911	3.6	3.7	550.	0.0	0.0	0.0	0.0
11	2911	4.9	3.7	550.	0.0	0.0	0.0	0.0
12	2911	2.3	3.7	329.	0.0	0.0	0.0	0.0
13	2951	3.9	2.2	390.	0.0	0.0	0.0	0.0
14	2951	6.3	2.2	390.	0.0	0.0	0.0	0.0
15	2951	1.0	5.0	395.	0.0	0.0	0.0	0.0
16	2951	6.3	2.2	390.	0.0	0.0	0.0	0.0
17	2951	6.3	2.2	390.	0.0	0.0	0.0	0.0
18	2951	5.2	2.2	390.	0.0	0.0	0.0	0.0
19	2951	4.7	2.2	390.	0.0	0.0	0.0	0.0
20	2951	6.3	2.2	390.	0.0	0.0	0.0	0.0
21	2952	6.2	2.2	422.	C.30000E 00	0.0	0.0	0.0
22	2952	0.0	0.0	288.	0.0	0.0	0.0	0.0
23	2952	0.0	0.0	288.	0.0	0.0	0.0	0.0
24	2952	6.2	2.2	422.	0.0	0.0	0.0	0.0
25	3200	5.0	1.7	811.	0.0	0.0	0.0	0.0
26	3270	5.5	3.7	1005.	0.0	0.0	0.0	0.0
27	3270	7.0	1.6	330.	0.0	0.0	0.0	0.0
28	3274	2.4	5.9	505.	0.0	0.0	0.0	0.0
29	3274	8.0	1.6	480.	0.0	0.0	0.0	0.0
30	3295	12.6	0.3	372.	0.0	0.0	0.0	0.0
31	3295	1.0	1.9	288.	0.0	0.0	0.0	0.0
32	3312	7.2	6.7	408.	0.0	0.0	0.0	0.0
32	3312	3.9	3.3	408.	0.0	0.0	0.0	0.0
34	3312	5.8	1.8	300.	0.0	0.0	0.0	0.0
35	3321	9.2	0.9	1033.	0.0	0.0	0.0	0.0
36	3321	10.0	1.4	372.	0.0	0.0	0.0	0.0
37	3321	6.0	1.8	523.	0.0	0.0	0.0	0.0

TABLE II. General Source File for Chicago Metropolitan Air Quality Region

SORCE	PROCESS	PERCENT	PERCENT	EXHAUST	SOURCE	RATED B/HR	ANNUAL	GAS(B/FT3)
	RATE LB/HR	SULFUR CCAL	SULFUR OIL	GAS FT3/DA	TYPE	CAPACITY	FT3/DA	HEAT CONTENT
1	C.30300E C6	C.0	C.0	0.15400E 06	2	0.0	0.0	0.0
2	C.29000E 05	0.0	C.0	0.11200E 05	2	0.0	0.0	0.0
3	C.28C80E 05	0.0	0.0	0.84400E 05	2	0.0	0.0	0.0
4	C.710CC0E C5	0.0	0.0	0.25710E 06	2	0.0	0.0	0.0
5	C.60320E C5	0.0	C.0	0.50000E 05	2	0.0	0.0	0.0
6	C.24873E C6	C.0	C.0	0.20000E 05	2	0.0	0.0	0.0
7	C.14600E 05	0.0	0.0	0.17000E 05	2	0.0	0.0	0.0
8	C.35668E C5	0.0	C.0	0.49000E 05	2	0.0	0.0	0.0
9	C.36600E C5	0.0	C.0	0.25000E 04	2	0.0	0.0	0.0
10	C.26200E C6	C.0	0.0	0.80000E 05	2	0.0	0.0	0.0
11	C.28050E C7	C.0	C.0	0.10820E 07	2	0.0	0.0	0.0
12	C.16000E 07	C.0	C.0	0.10100E 06	2	0.0	0.0	0.0
13	C.18000E C6	0.0	C.0	0.29800E 05	2	0.0	0.0	0.0
14	C.24000E C6	0.0	C.0	0.40000E 05	2	0.0	0.0	0.0
15	C.20000E C6	0.0	C.0	0.27300E 05	2	0.0	0.0	0.0
16	C.48000E C6	0.0	C.0	0.80000E 05	2	0.0	0.0	0.0
17	C.47100E C6	C.0	C.0	0.80000E 05	2	0.0	0.0	0.0
18	C.20000E C6	0.0	C.0	0.33000E 05	2	0.0	0.0	0.0
19	C.36000E C6	C.0	C.0	0.60000E 05	2	0.0	0.0	0.0
20	C.24000E C6	C.0	C.0	0.40000E 05	2	0.0	0.0	0.0
21	C.30000E C6	0.0	C.0	0.47900E 05	2	0.0	0.0	0.0
22	C.36880E 05	C.0	0.0	0.15400E 05	2	0.0	0.0	0.0
23	C.47486E C6	0.0	C.0	0.12500E 06	2	0.0	0.0	0.0
24	C.30000E C6	0.0	C.0	0.47900E-01	2	0.0	0.0	0.0
25	C.30000E 05	C.0	C.0	0.27000E 05	2	0.0	0.0	0.0
26	C.80000E 05	0.0	C.0	0.12200E C6	2	0.0	0.0	0.0
27	C.46910E C5	0.0	0.0	0.11000E 06	2	0.0	0.0	0.0
28	C.23230E C6	0.0	C.0	0.40000E C6	2	0.0	0.0	0.0
29	C.80000E 05	0.0	C.0	0.50000E 05	2	0.0	0.0	0.0
30	C.56000E 04	0.0	0.0	0.22700E 04	2	0.0	0.0	0.0
31	C.14880E C5	C.0	C.0	0.60000E 04	2	0.0	0.0	0.0
32	C.25000E 05	0.0	C.0	0.32900E C6	2	0.0	0.0	0.0
33	C.50000E 04	0.0	C.0	0.22400E 05	2	0.0	0.0	0.0
34	C.25000E 05	0.5	C.0	0.60000E 05	2	0.0	0.0	0.0
35	C.12000E C4	0.0	0.0	0.19600E 05	2	0.0	0.0	0.0
36	C.18470E 05	0.0	C.0	0.22700E 05	2	0.0	0.0	0.0
37	C.18892E 05	C.0	C.0	0.17100E 05	2	0.0	0.0	0.0

C. Source Priority Listing

It is important for any control agency to know the largest pollution emitters in the control region. A list of such sources, ordered by the magnitude of their emissions for the control region, is useful in determining priorities for control strategies.

Tables III and IV show ordered listings of sources for sulfur dioxide and particulates, respectively. These ordered lists show only the pollutant emission level and source name. If additional source data is required, then, using the source number as a guide, the data can be located in the General Source File. A separate ordered list of polluters can be created for each pollutant.

TABLE III. SSFILE, Ordered List of SO₂ Emitters in Chicago Region

SRCE	SO ₂ (TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	PCLIT JURIS
157	570.00	18.50	500270 COM EDNEW JOLIET	1
330	375.00	1.14	CCM EDISON STATE LINE	6
162	316.50	12.32	502300 COM EDWILL CO 2	1
383	303.30	11.21	CRAWFORD PP	2
332	267.00	5.40	MITCHELL POWER PLANT	8
160	258.00	16.93	500380 COM ED WAUKEGAN	1
155	171.50	1.30	500260 CCM EDOLD JOLIET1	1
161	150.01	6.45	502300 CCM EDWILL CO 1	1
321	118.00	39.88	US STEEL COALFOR FUEL	8
382	116.70	3.89	FISK PP NEW	2
428	96.25	0.0	AMOCO WHIT ING	7
381	89.80	1.80	FISK PP OLD	2
156	89.50	39.00	500260 COM EDOLD JOLIET2	1
320	85.50	3.26	US STEEL OIL COMBUSTION	8
159	84.00	1.88	500200 COM ED RIDGELAND	1
280	68.00	1.53	ATLANTIC BOILERS	9
390	55.58	57.00	METROCSANTOI	2
289	51.70	10.40	INLAND STEEL PWR GEN 401	9
391	47.00	29.00	TAYLORHOMES	2
219	43.30	34.30	YNGSTWN S T STEEL PL	9
422	36.50	102.00	UNIV ATLAS CEMENT MILL 6	8
175	35.50	3.00	OC9340 CORN PRODUCTS	3
421	35.00	0.0	DUPONT SULF AC MFG	9
331	28.50	0.12	NIPSCO BURNSHARBOR	6
58	27.40	38.40	JOLIET ARMY AMMO PLANT	1
433	24.11	50.20	US STEEL ATLASHARBOR	8
419	23.70	0.01	STAUFFER CHEMICAL CO	10
4	23.30	0.0	255070 UNIRCYAL	1
268	22.52	3.20	UNION CARBIDE LINDE CCM	9
427	22.30	1.20	AMOCO WHIT FCC CAT REG	9
384	22.22	1.97	CALUMET PP	2
194	21.36	0.32	035220 CLARK REFINERY	1
190	21.20	35.50	255070 UNIRCYAL	1
282	20.02	0.16	CIT SER BOILERS	9
271	19.00	6.22	UNION CARBIDE WHITING CCM	7
164	18.04	12.58	GREAT LAKES TRAIN,CTR.	1
197	17.86	0.50	317050 TEXACO REFINERY	1
277	16.70	0.16	MCBIL CIL REFBILERS	9
270	15.43	6.17	UNION CARBIDE POLYETHYLEN	9
281	13.90	4.82	AMOCO WHIT BOILERS	9
291	13.60	0.0	INLAND STEEL COKE OVN 2	9
304	12.60	1.11	INLAND STEEL 80 STRIP ML	9
423	12.51	0.0	ATLANTIC FCC STRIP	9
293	11.74	0.0	INLAND STEEL OPN HRTH 2	9
274	11.40	0.0	ATLANTIC GAS DEA ABS	9
371	11.25	12.45	10625 CAMPBELLS	2
295	10.30	0.33	INLAND STEEL MILLS 2	9
424	10.00	0.0	AMOCO WHIT SULF REC	9
339	10.00	10.52	10725 CENTRAL SOYA	2
196	9.70	0.53	312370 PURE CIL CO	1
8	8.72	0.46	035130 CHGO CU & CHEM	1
377	8.70	3.39	31974 INTERNATHAR	2

TABLE IV. PSFILE, Ordered List of Particulate Emitters in Chicago Region

SRCE	SG2(TN/CA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	PCLIT JURIS
432	36.50	102.00	UNIV ATLAS CEMENT MILL 6	8
435	0.0	85.50	US STEEL OPENHEARTHS	8
449	0.0	64.40	US STEEL SINTERING PLANT	8
109	0.0	59.26	63857 USSTEEL	2
390	55.58	57.00	METRO SANTOI	2
433	24.11	50.20	US STEEL ATLAS HARBOR	8
321	118.00	39.88	US STEEL COAL FOR FUEL	8
156	89.50	39.00	500260 COM ED OLD JOLIET 2	1
58	27.40	38.40	JOLIET ARMY AMMO PLANT	1
190	21.20	35.50	255070 UNIROYAL	1
319	43.30	34.30	YNGSTWN S T STEEL PL	9
106	0.0	32.90	63857 USSTEEL	2
107	0.0	30.14	63857 USSTEEL	2
57	0.0	30.00	MCCOOK MATERIAL SERVICE	5
391	47.00	29.00	TAYLOR HCMES	2
29	0.0	25.50	MCCOOK STANDARD LINE	5
441	0.0	20.60	INLAND STEEL OP H PL 2	9
113	0.0	20.55	31975 WISCONSINST	2
414	0.0	19.70	OHARE AIRPORT JET PLANES	2
157	570.00	18.50	500270 COM ED NEW JOLIET	1
160	258.00	16.93	500380 COM ED WAUKEGAN	1
100	0.0	14.56	31735 INTERLAKE	2
103	0.0	12.60	52455 REPUBLIC ST	2
164	18.04	12.58	GREAT LAKES TRAIN, CTR.	1
371	11.25	12.45	10625 CAMPBELLS	2
162	316.50	12.32	502300 COM ED WILL CO 2	1
49	0.0	12.10	MCCOOK REYNOLDS METALS	5
105	0.0	11.64	52455 REPUBLIC ST	2
440	0.0	11.30	INLAND STEEL COKING PL	9
383	303.30	11.21	CRAWFORD PP	2
339	10.00	10.52	10725 CENTRAL SOYA	2
289	51.70	10.40	INLAND STEEL PWR GEN 401	9
443	0.0	10.40	US STEEL BLAST FURNACE I	8
3	0.0	9.70	255070 UNIROYAL JOLIET	1
104	0.0	8.91	52455 REPUBLIC ST	2
350	5.88	6.86	41140 MARBLEHEAD	2
111	0.0	6.58	31975 WISCONSINST	2
161	150.01	6.45	502300 COM ED WILL CO 1	1
57	0.0	6.40	500100 METRO SANI DIST	1
271	19.00	6.22	UNION CARBIDE WHITING COM	7
270	15.43	6.17	UNION CARBIDE POLYETHYLEN	9
110	0.0	5.92	31975 WISCONSINST	2
332	267.00	5.40	MITCHELL POWER PLANT	8
338	4.68	4.97	17320 DARLIG & CO	2
281	13.90	4.82	ANGCO WHIT BOILERS	9
28	0.0	4.79	442710 MARBLEHEAD LIME	1
1	0.0	4.75	009340 CORN PRODUCTS	3
102	0.0	4.66	52455 REPUBLIC ST	2
95	0.0	4.38	41140 MARBLEHEAD	2
98	0.0	4.33	31735 INTERLAKE	2
69	0.0	4.25	10666 CARGILL	2
372	2.57	4.00	60057 GLIDDEN CO	2

D. Jurisdictional Ordering

The previously described listing orders sources by emission rate for the entire air quality control region. However, most air quality control regions have several local governing structures that have separate air pollution control agencies. An example would be the Chicago Metropolitan Air Quality Control Region, which has at least eleven jurisdictions in the Chicago Region with control agencies. The U. S. Environmental Protection Agency would, of course, want to know the largest problems in each of the jurisdictions for effective control. States and counties would also want to know the largest sources within their aggregated jurisdiction.

For this reason an ordered list of source emissions using a breakdown by jurisdiction and pollutant has been formed. Tables V and VI show jurisdictional listings for sulfur dioxide and particulates for the Chicago Region. The jurisdiction number is keyed to the number found in Table VII.

TABLE V. SJFILE, Ordered List of SO₂ Emitters
in Chicago Region, according to Jurisdiction

SCRCE	SO2(TN/CA) EMISSIONS	PART(TN/CA) EMISSIONS	SOURCE NAME	PCLIT JURIS
157	570.00	18.50	500270 COM EDNEW JOLIET	1
162	316.50	12.32	502300 COM EDWILL CO 2	1
160	258.00	16.93	500380 COM ED WAUKEGAN	1
155	171.50	1.30	500260 COM EDOLD JOLIET1	1
161	150.01	6.45	502300 CCM EDWILL CO 1	1
156	89.50	39.00	500260 CCM EDOLD JOLIET2	1
155	84.00	1.88	500200 COM ED RIDGELAND	1
58	27.40	38.40	JOLIET ARMY AMMO PLANT	1
4	23.30	0.0	255070 UNIRCYAL	1
194	21.36	0.32	035220 CLARK REFINERY	1
190	21.20	35.50	255070 UNIRCYAL	1
164	18.04	12.58	GREAT LAKES TRAIN,CTR.	1
197	17.86	0.50	317050 TEXACO REFINERY	1
196	9.70	0.53	312370 PURE GIL CO	1
8	8.72	0.46	035130 CHGO CU & CHEM	1
184	6.51	0.85	354880 ABBOTT LABS N CGO	1
150	5.92	0.34	312170 ARGONNE NATL LABS	1
208	5.80	0.92	286030 WYMAN-GORDEN CO	1
136	5.56	0.45	295900 CATERPILLAR	1
202	5.25	3.19	302710 GAF CORP 1 COAL	1
169	4.56	1.56	508940 ELGIN STATE HOSP	1
7	4.20	0.0	295420 AMER CYANAMID	1
132	3.85	1.23	453570 U.S. STEEL CORP	1
34	3.00	0.33	452220 GM CRP-CHEVROLET	1
170	2.88	0.88	507980 STATE-VILLE PEN.	1
143	2.75	0.02	206950 FGRD MOTOR CO	1
165	2.46	0.31	FT.SHERIDAN	1
200	1.89	2.13	452460 JOHNS-MANVILLE WK	1
182	1.82	0.25	208420 STAUFFER CHEMICAL	1
172	1.69	1.05	247630 KERBER PACKING CO	1
173	1.45	0.02	448530 OVALTINE FOOD PRO	1
158	1.41	0.46	507900 WINNETKA MUN ELEC	1
140	1.37	0.97	461970 WOODSTOCK DIECAST	1
191	1.30	0.01	303220 US STEEL	1
204	1.00	0.32	416170 MOLINE-MALLEABLE	1
145	0.96	0.30	298090 LENNENWALL PAPER	1
128	0.82	0.30	452280 GRISS-PFLEGER TAN	1
177	0.77	0.06	012420 AURORA PAPERBOARD	1
142	0.66	0.12	458850 GM FISHER BODY	1
127	0.60	0.03	026940 STANDARD SCREW CO	1
207	0.56	0.05	430600 TELE TYPE CORP	1
166	0.55	0.38	037710 ROSSI & SONS	1
185	0.43	0.04	429940 SEARLE & CO	1
199	0.38	0.02	206350 CERTAIN-TEED	1
149	0.37	0.03	285790 SINCLAIR RESEARCH	1
198	0.35	0.02	505160 TRUMBUL ASPHALT	1
181	0.35	0.05	321700 SMITH CHEMICAL WK	1
133	0.35	0.04	452490 JOHNSON MOTORS	1
130	0.33	0.35	355240 FANSTEEL MTL CORP	1
205	0.32	0.05	206620 COLUMBIA TOOL STL	1
183	0.30	0.21	454380 AMER PCTASH CORP	1
129	0.29	0.03	245710 CHICAGO RAWHIDE	1

TABLE VI. PJFILE, Ordered List of Particulate Emitters
in Chicago Region, according to Jurisdiction

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
156	89.50	39.00	500260 COM EDOLD JOLIET2	1
58	27.40	38.40	JOLIET ARMY AMMO PLANT	1
190	21.20	35.50	255070 UNIROYAL	1
157	570.00	18.50	500270 COM EDNEW JOLIET	1
160	258.00	16.93	500380 COM ED WAUKEGAN	1
164	18.04	12.58	GREAT LAKES TRAIN,CTR.	1
162	316.50	12.32	502300 COM EDWILL CO 2	1
3	0.0	9.70	255070 UNIROYAL JOLIET	1
161	150.01	6.45	502300 COM EDWILL CO 1	1
57	0.0	6.40	500100 METRO SANI DIST	1
28	0.0	4.79	442710 MARBLEHEAD LIME	1
202	5.25	3.19	302710 GAF CORP 1 COAL	1
141	0.0	3.01	502900 WESTRN ELECTRIC	1
11	0.0	2.51	317050 TEXACO REFINERY	1
25	0.0	2.20	208960 WESTRNMETAL ABRSV	1
200	1.89	2.13	452460 JOHNS-MANVILLE WK	1
159	84.00	1.88	500200 COM ED RIDGELAND	1
9	0.0	1.83	503340 AMOCO CHEMICAL	1
44	0.0	1.66	205870 ABEX CORP	1
32	0.0	1.57	206230 CALUMET STEEL	1
169	4.56	1.56	508940 ELGIN STATE HOSP	1
6	0.0	1.40	208420 STAUFFER CHEMICAL	1
50	0.10	1.39	207220 BENJ HARRIS CO	1
155	171.50	1.30	500260 COM EDOLD JOLIET1	1
132	3.85	1.23	453570 U.S. STEEL CORP	1
172	1.69	1.05	247630 KERBER PACKING CO	1
140	1.37	0.97	461970 WOODSTOCK DIECAST	1
10	0.0	0.95	312370 PURE OIL CO	1
208	5.80	0.92	286030 WYMAN-GORDON CO	1
38	0.0	0.91	028770 CLOW & SONS INC	1
170	2.88	0.88	507980 STATE-VILLE PEN.	1
184	6.91	0.85	354880 ABBOTT LABS N CGO	1
14	0.0	0.81	312160 CROWN-TRYGG CORP	1
22	0.0	0.72	302710 GAF CORP 5	1
171	0.10	0.71	508000 JOLIETSTATE PEN.	1
54	0.0	0.68	452490 JOHNSON MOTORS	1
48	0.0	0.60	014880 W F JOBBINS CO	1
31	0.0	0.59	302710 GAF CORP 4	1
23	0.0	0.55	302710 GAF CORP 3	1
196	9.70	0.53	312370 PURE OIL CO	1
27	0.0	0.51	452460 JOHNS-MANVILLE WK	1
43	0.0	0.50	416170 MOLINE-MALLEABLE	1
197	17.86	0.50	317050 TEXACO REFINERY	1
158	1.41	0.46	507900 WINNETKA MUN ELEC	1
8	8.72	0.46	035130 CHGO CU & CHEM	1
136	5.56	0.45	295900 CATERPILLAR	1
168	0.55	0.38	037710 ROSSI & SONS	1
94	0.0	0.36	208000 OWENS ILLINOIS	1
5	0.0	0.35	354880 ABBOTT LABS N CGO	1
130	0.33	0.35	355240 FANSTEEL MTL CORP	1
150	5.92	0.34	312170 ARGONNE NATL LABS	1
34	3.00	0.33	452220 GM CRP-CHEVROLET	1

TABLE VII. Political Jurisdiction
Key for Chicago Metropolitan Air
Quality Control Region

-
1. State of Illinois
 2. Chicago, Illinois
 3. Bedford Park, Illinois
 4. Morton Grove, Illinois
 5. McCook, Illinois
 6. State of Indiana
 7. Lake County, Indiana
 8. Gary, Indiana
 9. East Chicago, Indiana
 10. Hammond, Indiana
 11. Cook County, Illinois
-

E. Single Source Tables Listing

In planning emergency control strategies, the individual effects of single sources must be identified. A convenient method for determining the effects of singular sources is use of the Isopleth Area Tables.⁴

These tables represent a single-source dispersion model in tabular form.

A source listing (ordered by source number) provides information for using the Isopleth Area Tables. Table VIII is a sample listing for the Chicago Region. In this table the emissions are given in lb/hr because this is the dimension used in the Isopleth Area Tables. The physical stack height and heat output are also given, so that the "effective stack height" can be calculated for any source.

TABLE VIII. TFILE, Source Log for Isopleth-area Tables; Chicago Region

SOURCE	SC2 EMISSION (LB/HR)	PART EMISSION (LB/HR)	STACK HEIGHT (FT)	HEAT OUTPUT (B/HR)	SQRT HEAT OUTPUT	SOURCE NAME	X KM	Y KM
1	C.	396.	110.	0.0	0.0	009340 CORN PRODUCTS	57.2	68.9
2	C.	16.	60.	0.0	0.0	014070 48-INSULATIONS	15.8	74.2
3	C.	808.	60.	0.0	0.0	255070 UNIROYAL JOLIET	27.4	27.4
4	1942.	0.	75.	0.0	0.0	255070 UNIROYAL	27.4	27.4
5	C.	29.	15.	0.0	0.0	354880 ABBOTT LABS N CGO	59.2	131.5
6	0.	117.	56.	0.0	0.0	208420 STAUFFER CHEMICAL	73.9	39.6
7	350.	0.	110.	0.0	0.0	295420 AMER CYANAMID	35.2	39.1
8	727.	38.	24.	0.0	0.0	035130 CHGO CU & CHEM	70.1	56.4
9	C.	152.	76.	0.0	0.0	503340 AMOCO CHEMICAL	27.2	32.7
10	0.	79.	182.	0.0	0.0	312370 PURE OIL CO	38.2	56.3
11	C.	209.	195.	0.0	0.0	317050 TEXACO REFINERY	38.1	50.4
12	C.	16.	38.	0.0	0.0	442620 GALLAGHER ASPHALT	74.5	45.7
13	C.	5.	62.	0.0	0.0	502040 CROWN TRYGG JOLET	28.7	39.2
14	C.	67.	44.	0.0	0.0	312160 CROWN-TRYGG CORP	42.4	59.5
15	C.	2.	40.	0.0	0.0	501480 GEO H HARTONG INC	54.6	69.6
16	C.	6.	30.	0.0	0.0	281800 LIBERTY ASPHALT	40.4	131.2
17	0.	7.	20.	0.0	0.0	453390 SKOKIE VAL ASPHAL	52.8	133.6
18	C.	5.	30.	0.0	0.0	501960 STEFFAN BROS INC	19.7	107.6
19	C.	2.	35.	0.0	0.0	427840 MAYER ASPHALT CO	66.9	95.6
20	0.	3.	42.	0.0	0.0	501760 MONARCH ASPHALT	67.6	96.8
21	C.	14.	55.	0.0	0.0	296230 CROWN TRYGG TROY	30.0	37.8
22	0.	60.	64.	0.0	0.0	302710 GAF CORP 5	35.9	45.2
23	C.	46.	70.	0.0	0.0	302710 GAF CORP 3	35.9	45.2
24	C.	2.	32.	0.0	0.0	247120 GIERTZ-MELAHN CO	18.8	94.9
25	C.	183.	65.	0.0	0.0	208960 WESTERNMETAL ABRSV	72.7	37.8
26	0.	7.	75.	0.0	0.0	291760 VULCANMTRLS HODK	55.3	68.8
27	0.	42.	50.	0.0	0.0	452460 JOHNS-MANVILLE WK	59.9	136.9
28	C.	355.	75.	0.0	0.0	442710 MARBLEHEAD LIME	74.6	45.6
29	C.	2125.	53.	0.0	0.0	MCCOOK STANDARD LINE	55.3	71.0
30	C.	6.	39.	0.0	0.0	297310 JOHNS MANVILLE J	29.4	38.0
31	0.	49.	59.	0.0	0.0	302710 GAF CORP 4	35.9	45.2
32	C.	131.	58.	0.0	0.0	206230 CALUMET STEEL	73.9	40.4
33	0.	12.	50.	0.0	0.0	206620 COLUMBIA TOOL STL	74.0	38.8
34	250.	27.	250.	0.0	0.0	452220 GM CRP-CHEVROLET	60.2	134.5
35	C.	11.	60.	0.0	0.0	206440 CHGO HTS GRY FE F	73.5	39.5
36	C.	7.	60.	0.0	0.0	502700 GREENLEE FOUNDRY	64.7	78.4
37	0.	4.	40.	0.0	0.0	431080 WELLS MANUFACTURN	61.7	96.5

F. Area Source Locations

When certain areas within an air quality control region produce high pollutant levels and it does not appear obvious that a singular large source, or sources upwind from the receptor, are causing the problem, then the strategist should probably look at the sources in the immediate vicinity of the receptor. A grouping of sources by their location (X,Y coordinates) may be performed by a simple primary and secondary search on the X and Y coordinates.

III. DISPERSION ANALYSIS

An important part of episode control is predicting the dispersion of pollutants when poor meteorological conditions prevail. Since almost all episodes occur when non-typical meteorological conditions dominate an urban region, episode strategies or planning methodologies should be oriented to these abnormal meteorological conditions. A dispersion model is utilized in this episode planning methodology to precalculate pollutant distributions for probable episode meteorological conditions. These preplanned contours are then used to develop effective and efficient emergency control strategies.

The dispersion model recommended by the U.S. Environmental Protection Agency is the Air Quality Display Model (AQDM) developed by TRW Systems for the EPA, Office of Air Programs (OAP). This model was developed so that state and local agencies would have a dispersion modeling tool available when they assembled their implementation plans. Therefore, AQDM is oriented toward annual emissions and annual air quality averages and can only calculate shorter-time air quality levels utilizing statistical techniques. This type of dispersion modeling as it stands is totally inadequate for episode control planning.

The "ideal" dispersion model for episode control is the integrated PUFF model.⁵ This model utilizes a Lagrangian view of plumes, and therefore allows the observer to follow the "puff" of pollutant through changes in wind direction and wind speed. However, this model has two disadvantages for pre-planning episode control. First, there are so many possible episode conditions and changes in conditions that it would be extremely costly in terms of computer time and manpower spent on input setup. Second, and probably more important, is the fact that the program is not oriented toward episode strategy development,

and a great deal of program modification would be required to overcome this disadvantage. The capabilities of the integrated PUFF model are best utilized as an episode evaluation tool or for accidents and spills, both of which take advantage of the ability of the PUFF system to follow the dynamics of a plume.

A simple model, both computationally and operationally, is a steady-state Gaussian plume model developed for episode strategy planning. Although the steady-state Gaussian formulation is not applicable to all situations, it has proven to be as accurate as the PUFF model under certain conditions. It of course must be understood by the user that the steady-state formulation assumes infinite time, and this is unrealistic. Therefore the outputs must be examined very carefully.

There are many steady-state Gaussian plume models available, including several at Argonne National Laboratory. However, the AQDM program is the federally accepted dispersion program and it has a basic Gaussian plume algorithm; hence, it was decided that this model would be the starting point for developing an episode strategy dispersion model. The AQDM model has two other features that make it a more universally useful tool for episode planning. First, the input format for source emissions is the IPP standard inventory format, and second, the coordinate system used is the Universal Transverse Mercator (UTM) system; both of these are used throughout the country.

In the process of developing a useful dispersion program for episode control planning, it became evident that there were many parts of the AQDM program that, while presenting no difficulty when used in the context of annual statistics and calibration, showed serious drawbacks for individual sets of meteorological conditions. It is popularly known from past experience that the AQDM model overpredicts air pollution levels by a factor of two to three. When

calibration is used in the case of the annual average operation of the AQDM program, the overprediction of air pollution can be regressed to quasirealistic values. Several changes were made to the AQDM dispersion program to produce more accurate air quality predictions in the absence of its regression bias of calculated air quality. The major changes and their effect on air quality calculations are described in greater detail in this chapter. A more complete discussion of the AQDM steady-state Gaussian formulation can be found in the program writeup¹ or D.B. Turner's handbook⁶ on atmospheric dispersion.

A. Argonne Steady State Model (ASSM)

This model is a Gaussian plume dispersion model that calculates air quality levels for single sets of meteorological conditions. The chief outputs are: regional air quality contours; receptor air quality levels; and source culpability lists. The outputs from this model are discussed in Chapter V with the entire methodology for episode strategy analysis. Sulfur dioxide and particulates are the two pollutants handled by ASSM, but air quality levels for any non-reacting pollutant could be calculated using this model.

The ASSM program, as stated previously, utilizes most of the AQDM dispersion model; however, several significant changes were made to the program. These changes are described in the following sections.

B. Plume Rise

Estimates of plume rise are required to predict the dispersion of pollutants from sources having a large buoyancy or a high stack exit velocity. The use of emissions above their stack height can account for a sizeable reduction in the pollutant concentrations calculated at the ground. A recent analysis of plume rise observations by G. A. Briggs⁷ suggests a formulation that predicts plume rise very well. This work was recently presented in a critical review⁸ he performed for the Atomic Energy Commission. The expression for plume rise, Δh , is given by

$$\Delta h = 1.6 F^{1/3} u^{-1} x^{2/3} \quad (1)$$

$$F = g(1 m_o/m) (T/T_o) w_o r_o^2 + g Q_h / (\pi C_p \rho T) \quad (2)$$

where u is the mean wind speed, x is the downwind distance, g is the acceleration of gravity, m is the mean ambient molecular weight, m_o is the efflux molecular weight, T is the ambient absolute temperature, T_o is the efflux absolute temperature, w_o is the mean efflux velocity, r_o is the stack radius, Q_h is the heat emission rate, and C_p is the specific heat capacity of air ($0.24 \text{ cal/gm}^\circ\text{K}$). The quantity $g/(\pi C_p \rho T)$ is a constant, $3.7 \times 10^{-5} \text{ (m}^4/\text{cal-sec}^2\text{)}$, times the ratio of standard sea level pressure to the ambient pressure.

The first term in equation (2) accounts for the plume rise due to initial effluent momentum, and the second term is the buoyancy contribution. The plume rise due to initial effluent momentum is neglected in the ASSM program for two reasons. First, the plume rise due to initial momentum is usually small compared to the buoyancy effect for most sources; second, and more important, the stack exit velocity data for most sources is unreliable unless a good stack sampling study has been performed.

The heat emission rate is the only source emission data required to calculate the plume rise due to buoyancy. For combustion sources the stack heat emission rate is a fraction of the total produced in the combustion

$$Q_{HJ} = B_J \sum_{i=1}^N U_{iJ} H_i \quad (3)$$

where Q_{HJ} is the stack heat emission rate for combustion source type J, B_J is the fraction of the combustion heat lost to the stack from boiler type J, U_{iJ} is the use of fuel i by source J, and H_i is the heat content of fuel i. Typical values of B_J might be .1 for large steam-electric power plants and .2 for smaller space-heating units. Fuel use data on emission sources is available in the IPP inventory or from fuel suppliers, and therefore Q_H for combustion sources can be readily calculated.

C. Seasonal Variations

The primary use of the ASSM program is to calculate air quality levels for "episode-prone" meteorological conditions. Although episodes are usually caused by poor meteorology, variations in emission levels will usually determine the severity of the episode. Therefore seasonal emission data is required by ASSM in order to precalculate the episode potentials during different seasons. Some sources have operating schedules that do not correspond to any climatic season but operate on an economic schedule. These emission variations must also be included in the preplanning of episodes using ASSM. Both types of emission variations (climatic and economic) can be handled within the framework of the ASSM program. Changes in the source emission data can be made by modifying an entire class of sources (e.g., residential, commercial, and industrial space heating) or by modifying the emission pattern of an individual source (e.g., power plant). The Standard Industrial Classification (SIC) is used as the source classification code. Modification of individual sources is performed using an input array of modification factors.

D. Space Heating

Residential and commercial (R/C) and industrial heating plants have seasonal variations in most areas of the country. Most residential and commercial emissions are aggregated into area sources in an emission inventory. This, of course, might exclude some large residential or commercial structures with large enough heating plants, and emissions, to be considered point sources. Fuel suppliers usually have data on the seasonal utilization of fuels by residential, commercial, and industrial sources for space heating.

Once the fraction of emissions that originate from space heating sources is determined, the next step is to determine the seasonal variation. If fuel suppliers do not have this data, space heating seasonal variations can be determined from the degree-day heating in a region. Degree-day heating is the number of degrees the average temperature on a given day is below the critical temperature. The critical temperature is defined as the temperature above which there is no heating, and below which there is heating. For example, if the average temperature for a day in March was 55°F, and the critical temperature was 65°F, then that day would have 10 degree-days of heating. This technique assumes a linear relationship between fuel use and ambient temperature; although not exact, the linear assumption represents a good approximation to the fuel use pattern unless temperatures are quite extreme.

Equation (4) shows the method used in calculating the seasonal variation in emissions from space heating. A critical temperature of 65°F is assumed.

$$F_J = \frac{S_J}{D_J} = \frac{\sum_{i=1}^{N_J} g_i}{D_J}, \quad \text{where } g_i = \begin{cases} 65 - T_i & \text{for } T < 65 \\ 0 & \text{for } T_i \geq 65 \end{cases} \quad (4)$$

$$D_J = \left(\sum_{J=1}^N S_J \right) \frac{N_J}{365} \quad (5)$$

where F_J is the emission factor which when multiplied by the annual average emission rate gives the seasonal emission rate, T_i is the average daily temperature, S_J is the number of degree-days of heating occurring in season J , N_J is the number of days in season S_J , D_J is the annual average number of degree days that occur in a season S_J , and N is the number of seasons selected in the year. Seasons can be of any length, and the ASSM program is capable of handling four different seasons. Equations (4) and (5) need not be used for each day in the year but could be modified using average weekly or monthly temperatures. This depends entirely upon the seasonal temperature variations and the availability of data on the region.

E. Mixing Height

Another seasonal variable is the mixing depth or lid height. The ASSM program uses seasonal mixing heights; if only one mixing height is used however, then it is assumed for all seasons. Since the vertical mixing depth is an important parameter for diffusion and since wide variations in mixing heights exist for different seasons, it is important to utilize this option. Seasonal mixing height data can be obtained from the local Environmental Meteorological Support Unit (EMSU) station or from a local airport that performs soundings. A regional meteorologist would probably have historical mixing heights already tabulated for the control region. The precalculation of the effects of a non-typical mixing height (inversion) can be performed by running a season with an assumed inversion lid height.

F. Vertical Diffusion

In the process of developing the ASSM program from AQDM, individual meteorological conditions were run to determine the accuracy of the AQDM plume model in calculating individual uncalibrated conditions. Separate problems were run for a variety of wind speeds and stability classes. Since the low wind speed cases consistently produced very high pollutant levels, some of them were checked with the PUFF model, which has been validated with monitored air quality data. This check showed the AQDM model to be overcalculating by an order of magnitude for some of these very low wind speed cases.

A recent study performed by D. Rote⁵ suggests a possible reason for the overcalculation of the AQDM program. Rote shows that the steady-state plume formulation suffers from its $1/u$ (u is wind velocity) dependence at low wind speeds when downwind-distance-dependent vertical diffusion coefficients are used in the steady-state formulation. Concentrations (X/Q) are proportional to $1/u$ and calculate unrealistically high concentrations even in the 4 to 6-knot wind speed class used by AQDM. When the travel-time-dependent vertical diffusion coefficients are used, the high values calculated by the AQDM steady-state plume are reduced to realistic levels. As stated by Rote, even though the use of the travel-time-dependent coefficients has not been rigorously justified, their functional dependence upon u is much more satisfactory than the downwind-distance-dependent coefficients at low wind speeds. Using the travel-time-dependent coefficients produces more realistic values down to a wind speed of 1 mph, and since the lowest wind speed classification in the ASSM program uses an average speed of about 1.5 knots, it seems reasonable to use the travel-time-dependent coefficients for all wind speed classes. Using the travel-time-dependent coefficients shows improvements in

the air quality calculations even in the 7-10 wind speed class for some cases. The travel-time-dependent coefficients are those of D. B. Turner.⁶ A one-hour measuring time is assumed for the vertical diffusion coefficients.

G. Horizontal Dispersion

ASSM uses uniform pollutant dispersion in the horizontal direction within a $22\frac{1}{2}$ -degree angle centered in the downwind direction from the source. This assumes that the plume is entrained in a $22\frac{1}{2}$ -degree "channel" and spreads uniformly within the "channel" This assumption is reasonable for the steady state formulation used by ASSM and problems that include many sources.

IV. ISOPLETH PLOTTING

A. Isopleth Plotting System

One of the options available from the dispersion program is the creation of a data file containing the location and pollutant concentrations at specified receptors in a given region. Based upon this data file, an isopleth plotting system has been designed and implemented to display the air quality for that region.

The plotting system produces isopleths on both a line printer and 35mm film. Figures C-4 and C-5 represent the isopleth displays on printer and film respectively for a sample case. Both outputs are produced from a version of the SYMAP (Synagraphic Computer Mapping Program*) system that has been extended to include film output. In the remainder of this section we will discuss the general characteristics of that extended SYMAP system.^{9,10} Sec. B below considers the film-plotting portion of that system in greater detail.

The dispersion analysis system was designed to display the isopleths and geographic characteristics of a particular region on 35mm film. In order to produce "smooth" isopleths, it is necessary to have pollutant concentrations for a fine regular grid system. However, the cost of computing the concentrations with the dispersion program for a suitable mesh is prohibitive. The obvious alternative is to interpolate from the course grid in the data file to a fine grid with values suitable for contouring. Since nongrid receptors are also included in the data file, the interpolation must include these data points when generating the regular grid.

The SYMAP program was selected because of its capability of accepting data on a nonregular grid and producing a fine mesh of regularly spaced data.

*SYMAP program may be obtained from the Harvard University Laboratory for Computer Graphics and Spatial Analysis, Cambridge, Massachusetts.

Additionally, since SYMAP is a contouring package, its output was designed to produce smooth contours.

In the contour map displayed in Figure C-4, SYMAP assigned a value to each print position. These values were output to a scratch file ("Tape 8"), and subsequently input and contoured on 35mm film, Figure C-5. For the sample problem described in Appendices B and C, SYMAP started with a non-regular receptor grid of 268 points (average mesh size is 7.5 kilometers) and produced a regular grid of approximately 9200 points (mesh size is 0.1 kilometer).

B. Film-Plotting Subsystem

The isopleth plotting system described in Sec. A above produces isopleths and regional characteristics on 35mm film. The device used is the IBM 2280 Film Recorder. The recording area on film is 1.17 inches by 1.17 inches and is divided into 4096 by 4096 points. The distance between adjacent horizontal or adjacent vertical points is called a raster unit (r.u.). Some of the features of the 2280 will be described here. For a more detailed description, consult Reference 11.

Images (characters and lines) are composed of vectors. When plotting vectors the beam is moved from its current position to the specified new position. The beam can either be blank (film not exposed) or unblank (film exposed). Characters may be plotted in two different sizes: basic and large. Figure C-5 contains both sizes for comparison. Characters must always be plotted parallel to the horizontal axis, and any standard IBM character can be plotted.

Since direct use of film orders requires assembly language, an interface package has been developed so that FORTRAN programs can more easily use the 2280. This film-plotting subroutine package (FSP) is an assembly language routine, callable from FORTRAN; utilizing user-supplied or default parameters, it converts the user's data into film orders and data usable by the IBM 2280 Film Recorder.

The actual contouring is done by a set of FORTRAN subroutines, namely, GRAPH, SECDRV, and DECIDE,* which access the FSP. The routines used by the isopleth plotting system for producing film output will be described in Sec. C below. For a more complete description, consult Reference 13.

*Listed in Appendix C and described in Reference 12.

C. Film-Plotting Subroutine Package Routines

In this section we will describe the set of routines that are contained in the Film-Plotting Subroutine Package for the IBM 2280 Film Recorder,^{11,13} and are used in the isopleth plotting system.

- 1) FINIT Initializes FSP - This routine sets the calling sequence type for FORTRAN programs. It must be the following:

CALL FINIT (1, 2)

- 2) FDATM Define Input Argument Mode - This routine sets the data mode to be floating point in units defined by the user's coordinate system. It must be the following:

CALL FDATM (2)

- 3) FLIND Set Line Density - This routine sets the film line density. It must be the following:

CALL FLIND (1)

- 4) FLINW Set Line Width - This routine sets the film line width. It must be the following:

CALL FLINW (1)

- 5) FXYLIM Define Data Mapping Units - This routine is called to set the maximum and minimum values of the user's coordinate system.

It has the following form:

CALL FXYLIM (XMIN, YMIN, XMAX, YMAX)

XMIN, YMIN define the minimal x, y values in the user's coordinate system (lower left-hand corner of the plotting area).

XMAX, YMAX define the maximal x, y values in the user's coordinate system (upper right hand corner of the plotting area).

The four values are in the same units as the receptor grid.

- 6) FCHSZ Set Character Size - This routine sets the character size of the characters to be generated. It has the following form:

CALL FCHSZ (I)

I is 2 for basic characters, that is, each character occupies 28 x 28 r.u., there are 74 characters per line, and 52 lines per frame.

I is 3 for large characters, that is, each character occupies 56 x 56 r.u., there are 49 characters per line, and 35 lines per frame.

- 7) FCHAR Plot a Single Character - This routine plots a single character at a specified location. It has the following form:

CALL FCHAR (CHAR, X, Y)

The character specified by CHAR is plotted at the point whose coordinates are X, Y.

- 8) FTEXT Plot a String of Characters - This routine plots a string of characters either horizontally or vertically. It has the following form:

CALL FTEXT (TEXT, ICNT, IOR, X, Y)

TEXT is an array containing the string of characters.

ICNT is the number of characters to be plotted.

IOR is 1 for horizontal text and 2 for vertical text.

X, Y represent the coordinates of the starting point of the first character in the string.

- 9) FLNSG Draw a Line Segment - This routine draws a line segment between two specified points. It has the following form.

CALL FLNSG (X1, Y1, X2, Y2)

X1, Y1 specify one end point of the line to be drawn. X2, Y2 specify the other end point.

- 10) FERROR Interrogate Error Code - This routine obtains the value of the error code. It has the

following form:

CALL FERROR (K)

K is an integer representing the latest error code. If K is 0 no error has occurred. There are 16 additional values representing various errors. They are not listed here but can be found in Reference 13.

- 11) FADV Advance the Film - This routine advances the film for the start of the next frame. It must be of the following form:

CALL FADV (4)

After one complete plot has been made and before the start of plotting on the next frame, FADV must be called. The separation between frames is two inches.

This completes the description of the FSP routines used in the isopleth plotting system. It is important to remember that all coordinate references to the film plotting area must be in the same units as the receptor grid in the dispersion program.

Various examples of the use of these routines are found in the source listings of subroutines FLEXIN and GRAPH in Appendix C. It would be advantageous to consult the sample isopleth plot in Figure C-5 when considering the various FSP routines.

V. EPISODE CONTROL METHODOLOGY

Stepwise procedures for pre-planning and using the episode control methodology are described in this chapter. Episode pre-planning refers to the effort required to collect and process data for an air quality region before the occurrence of an episode. This procedure involves:

- 1) An assessment of the meteorological and geographical characteristics of possible episodes in an air quality region;
- 2) Gathering of a complete data base containing source emission levels, operating characteristics, and geographical distribution;
- 3) The pre-calculation of pollution contours predicting the possible air quality levels expected in the event episode-prone meteorological conditions develop.

Pre-calculating information before the occurrence of episodes not only is useful for developing effective control strategies quickly but provides insight into the air pollution problems characteristic of a particular air quality region. For example, certain regions may have episode problems that are caused by basically uncontrollable sources such as residential space heating.

A procedure to develop an effective control plan must be technically sound so as to eliminate not only undercontrol strategies, but, and more importantly, over-control strategies. Pre-calculating data for a region is the first step toward creating a technically sound control strategy.

The second part of this chapter describes the procedure for developing an effective control plan using the pre-planned data technique. This procedure does not include any discussion of the controllability or uncontrollability of different sources, either for technical or political reasons. A sample region

(Chicago) will be used in the stepwise procedure; it will be followed through development of the necessary data and creation of an effective full strategy for a hypothetical episode. Since every region has different air quality problems, the procedures will be general and will not directly follow the problems existing in Chicago. Of course the air quality problems characteristic of the Chicago Region will probably emerge from the analysis.

A. Episode Control Data Base Development

A data base necessary for creating effective control strategies should be developed in the order occurring in this section. Each step in the development of a data base guides the preparation of the next set of data.

1. Source Emission Inventory

The starting point for the development of any air pollution control program is a complete source emission inventory. The effectiveness of the control program is determined to a large extent by the accuracy and the completeness of this inventory. Chapter II describes the type and format of inventory required for effective episode planning.

a. Establishment of Data Base

Inventory lists like those described in Chapter II should be prepared for the region. Computer programs can be used to order and print the lists of sources for large inventories. For smaller inventories, it may be more convenient to have typed lists. For the Chicago Region, which is in an area of acute air quality problems, an emission inventory was prepared by the U.S. Environmental Protection Agency in the IPP inventory format. This inventory format was processed using computer programs listed in Appendix A, and a regional source file was created. Parts of this source file are shown in Chapter II. There are 459 large point sources and 169 area sources in the inventory. The Chicago Department of Environmental Control (the major local control agency) was then contacted to determine whether any changes had been made in these source emissions. This procedure should be followed in developing every inventory. That is, the data base should be updated using local information, either from local control agencies or from fuel suppliers or other groups who have data about emissions in the area. Included would be private, industrial

organizations such as coal users. In the case of the Chicago inventory, several fuel conversions were discovered for large point sources. Therefore the regional source file was updated to reflect these changes. The computer programs used to print the regional lists are quite simple and could be combined into one program that just prints out a general regional file. In summary, the basic procedure here was (1) to find a good emission inventory (preferably in an IPP format), (2) to update this inventory with data from local control agencies, and (3) to develop a regional source file.

Next, a cursory examination of the regional source file should be carried out to determine the nature of the problems in the region. A brief examination of the Chicago file indicates that the major sulfur dioxide emissions are from large, fossil-fueled electrical generating stations and the major particulate emitters are the primary metals industry located in the region. One way of identifying these large sources is by means of source location maps; such maps may in turn be useful in episode control planning. Figures 3 and 4 show source location maps (sulfur dioxide and suspended particulates) for the Chicago Metropolitan Air Quality Region. These source location maps show the relative location of large point sources within the jurisdictional boundaries of the region. Source location maps should be drawn on a large format (standard E-size drawing) and duplicated (ozalid) so that they can be used for strategy planning. A Universal Transverse Mercator (UTM) coordinate system should be used in the margins for planning purposes. The origin of the coordinate system is located at the lower left of Figs. 3 and 4. Source numbers on the location maps should correspond to the numbers used in the regional source file, or supplementary source guides can be used to relate source lists to the location maps. This

Fig. 3. Largest Sulfur Dioxide Point Sources in the Chicago Metropolitan Air Quality Control Region. ANL Neg. No. 190-30.

Fig. 4. Largest Suspended-particulate Point Sources in the Chicago Metropolitan Air Quality Control Region. ANL Neg. No. 190-31.

latter technique is particularly useful for avoiding congestive maps when there are many sources in a small area. Tables IX and X represent a supplementary source guide for the sources on this location map (Figs. 3 and 4). Source location maps should be made for every major pollutant, including hazardous materials. These maps can be easily prepared by tracing the jurisdictional boundaries and coordinate system from a large-scale (two-degree) U.S. Geological Survey Map. The local, regional land-use planner will also have maps that could be used.

Another important part of the regional source file is information on the controllability of sources in the region. For one developing an episode control strategy it is essential to be able to determine which sources are controllable. Simple listings containing names and types of sources (e.g., combustion, process) is one method of categorizing source control. TABLE XI shows a listing of large controllable combustion sources in the Chicago Region, along with their fuel types. Table XII shows another controllable source list (for power plants in the Chicago Region). For each plant, in addition to its emission rate, the control benefit per unit cost is also listed (emission/MWe). If the file of the episode "action plans" is available for a region, then source control is well known at every stage of an episode. This is usually not the case, however; therefore information on controllability of controllable sources should be prepared separately. These lists can be generated either from information provided by a local air pollution planning agency or by simply categorizing the sources by types and recognizing the operational constraints of each source type.

b. Regional Monitoring Network

Regional air quality data will always be important information in episode control strategy. Even the best air quality dispersion models do not

TABLE IX. Sulfur Dioxide Emissions in the Chicago Region

	Source Number	Source Name	SO ₂ , tons/day	Polit. Juris.	X mi	Y mi
1	155, 156, 157	Commonwealth Edison Joliet PP	831.00	1	20.5	24.0
2	161, 162	Commonwealth Edison Will Cty. PP	466.51	1	23.4	33.6
3	330	Commonwealth Edison Stateline PP	375.00	6	51.2	38.4
4	159	Commonwealth Edison Ridgeland PP	308.00	1, 2	38.0	45.2
5	383	Commonwealth Edison Crawford PP	303.00	2	41.3	46.7
6	332	Commonwealth Edison Mitchell PP	267.00	8	57.2	33.5
7	160	Commonwealth Edison Waukegan PP	258.00	1	37.8	85.1
8	381, 382	Commonwealth Edison Fisk PP	206.50	2	44.8	48.3
9	320, 321	U.S. Steel	203.50	8	60.3	32.1
10	427, 276, 281, 428, 424	Amoco	149.22	9	53.5	35.6
11	-	Inland Steel*	145.37	9	55.3	34.8
12	425, 423, 274, 280	Atlantic	97.78	9	53.5	34.1
13	4, 58, 190	Joliet Army Ammunition Plant	71.90	1	17.1	17.1
14	-	Youngstown Steel**	59.61	9	55.0	35.2
15	390	Metropolitan Sanitary District	47.00	2	38.8	46.2
16	175	Corn Products	45.40	3	35.6	43.1
17	431, 426, 430 275, 282, 279	Cities Service	42.98	9	55.9	32.3
18	420, 270, 268	Union Carbide	38.09	9	54.5	33.3
19	432	Universal Atlas Cement Mill 6	36.50	8	56.6	33.4
20	421	Du Pont	35.00	9	54.9	32.0
21	380	Commonwealth Edison Northwest PP	28.95	2	42.7	54.4
22	331	Northern Ind. Power Supply Co. NIPSCO (Burns Harbor)	28.50	6	71.8	33.6
23	433	U.S. Steel Atlas Harbor	24.11	8	57.0	33.5
24	269, 419	Stauffer Chemical Co.	23.81	10	53.6	30.3
25	194	Clark Refinery	21.36	1	41.9	34.8
26	370, 141	Western Electric	19.50	1, 2	40.3	48.1
27	271	Union Carbide	19.00	7	54.1	35.6
28	429, 277, 273	Mobil Oil	18.05	9	53.7	33.8
29	164	Great Lakes Training Center	18.04	1	35.4	79.9
30	197	Texaco Refinery	17.86	1	23.8	31.5
31	371	Campbell's	11.25	2	42.9	46.8
32	339	Central Soya	10.00	2	39.4	52.7
33	196	Pure Oil	9.70	1	23.8	35.1
34	193	Armour-Dial Co.	9.01	1	7.7	40.9
35	8, 187	Chicago Copper & Chemical	8.86	1	43.7	35.2
36	377	International Harvester	8.70	2	43.0	47.9
37	347	Proctor & Gamble	8.30	2	44.7	52.2

TABLE IX (Contd.)

	Source Number	Source Name	SO ₂ , tons/day	Polit. Juris.	X mi	Y mi
38	337, 338	Darling & Co.	8.12	2	44.2	45.8
39	351	Interlake	7.30	2	46.0	34.1
40	184	Abbott Labs No. Chicago	6.91	1	36.9	81.4
41	150	Argonne National Laboratory	5.92	1	27.2	38.8
42	350	Marblehead Lime	5.88	2	50.4	38.3
43	348	Sherwin-Williams	5.80	2	46.9	36.6
44	208	Wyman-Gordon Co.	5.77	1	44.1	32.8
45	148	G.M. Corp. La Grange	5.60	5	34.5	44.4
46	136	Caterpillar	5.56	1	19.5	23.7
47	410	The University of Chicago	5.38	2	47.7	43.8
48	202, 203	GAF Corp.	5.32	1	22.3	28.2
49	135	International Harvester	5.28	1	33.0	52.5
50	411	University of Illinois	5.00	2	45.2	49.9
51	322	Bethlehem Steel	4.57	6	69.5	33.3
52	169	Elgin State Hospital	4.56	1	12.3	60.4
53	7	American Cyanamid	4.20	1	22.0	24.4
54	142	G.M. Fisher Body	4.00	1	32.8	42.1
55	177	Aurora Paperboard	3.99	1	11.7	43.3
56	408	Sears Roebuck & Co.	3.94	2	46.2	50.0
57	132	U.S. Steel	3.85	1	36.4	82.4
58	201	McCook Standard Lime	3.84	5	34.5	44.3
59	375	Container Corp.	3.75	2	46.7	50.7
60	352	Interlake	3.72	2	49.9	37.4
61	353	Republic Steel	3.67	2	49.9	36.4
62	183	Americal Potash Corp.	3.50	1	16.2	50.9
63	386	Mayfair Pumping Station	3.44	2	40.2	56.2
64	376	Container Corp.	3.37	2	45.0	51.3
65	385	Central Park Pumping Station	3.32	2	39.2	49.9
66	34, 206	G.M. Corp. Chevrolet	3.26	1	37.6	83.9
67	378	International Harvester	3.03	2	49.7	37.8

*Here Inland Steel is treated as an area source. Thirty (30) point sources are located within a 1.44 square mile area, with center (55.3, 34.8), twenty-two (22) of which contribute to the total SO₂ emission.

**Here Youngstown Steel is treated as an area source. Eighteen (18) point sources are located within a 1.44 square mile area with center (55.0, 35.2), fourteen (14) of which contribute to the total SO₂ emission.

TABLE X. Particulate Emissions in the Chicago Region

	Source Number	Source Name	Part. tons/day	Polit. Juris.	X mi	Y mi
1	-	U.S. Steel*	204.67	8	60.9	31.9
2	432	Univ. Atlas Cement Mill G	102.00	8	56.6	33.4
3	190, 58, 3, 4	Joliet Army Ammunition Plant	83.60	1	17.1	17.1
4	155, 156, 157	Commonwealth Edison Joliet PP	58.80	1	20.5	24.0
5	-	Inland Steel**	50.81	9	55.3	34.8
6	433	U.S. Steel	50.20	8	57.0	33.5
7	-	Youngstown Steel [†]	39.12	9	55.0	35.2
8	112, 113, 110, 111	Wisconsin Steel	33.37	2	49.6	37.6
9	97	McCook Material Service	30.00	5	34.6	45.0
10	390	Metropolitan Sanitary District	29.00	2	38.8	46.2
11	29	McCook Standard Lime	26.29	5	34.5	44.3
12	352, 98, 99, 100, 101	Interlake	24.15	2	49.9	37.4
13	353, 105, 104 103, 102	Republic Steel	23.28	2	49.9	36.4
14	415, 416, 414	O'Hare Airport	20.51	2	31.8	57.4
15	161, 162	Commonwealth Edison Will County PP	18.77	1	23.4	33.6
16	160	Commonwealth Edison Waukegan PP	16.93	1	37.8	85.1
17	159	Commonwealth Edison Ridgeland PP	16.50	1	38.0	45.2
18	1, 175	Corn Products	15.87	3	35.7	43.0
19	371, 71	Campbell's	14.70	2	42.9	46.8
20	164	Great Lakes Training Center	12.58	1	35.4	79.9
21	49	McCook Reynolds Metals	12.10	5	35.1	44.8
22	370	Western Electric Co.	11.62	2	40.4	48.2
23	95, 350	Marblehead Lime Co.	11.24	2	50.4	38.3
24	339, 70	Central Soya	11.23	2	39.4	52.7
25	383	Commonwealth Edison Crawford PP	11.21	2	41.3	46.7
26	420, 270, 268	Union Carbide	9.59	9	54.4	33.3
27	337, 338	Darling & Co.	8.50	2	44.2	45.8
28	26	Vulcan Materials	8.07	1	34.5	42.9
29	51	Lemont Mfg.	6.71	1	25.0	35.6
30	422, 271	Union Carbide	6.47	7	54.1	35.6
31	57	Metropolitan Sanitary Dist.	6.40	1	38.7	45.7
32	276, 281, 427, 424	Amoco	6.02	9	53.9	35.3
33	208	Wyman-Gordon Co.	5.85	1	44.1	32.8
34	381, 382	Commonwealth Edison Fisk PP	5.69	2	44.8	48.3
35	332	Commonwealth Edison Mitchell PP	5.40	8	57.2	33.5
36	23, 22, 31 202, 203	GAF Corp.	5.07	1	22.4	28.2

TABLE X (Contd.)

	Source Number	Source Name	Part. tons/day	Polit. Juris.	X mi	Y mi
37	425, 423, 274 280	Atlantic	4.83	9	53.5	34.1
38	28	Marblehead Lime	4.79	1	46.6	28.5
39	177	Aurora Paperboard	4.70	1	11.7	43.3
40	69	Cargill	4.25	2	49.4	35.8
41	372	Glidden Co.	4.00	2	43.3	53.5
42	125	Sw. Mun. Inc.	3.74	2	44.5	46.3
43	347	Proctor & Gamble	3.64	2	44.7	52.2
44	2	Forty-eight Insulations	3.55	1	9.9	46.3
45	377	International Harvester	3.39	2	43.0	47.0
46	351	Interlake	3.33	2	46.0	34.1
47	348, 89	Sherwin-Williams	3.33	2	46.9	36.6
48	141, 53	Western Electric Co.	3.09	1	40.3	48.1
49	197, 11	Texaco Refinery	3.01	1	23.8	31.5
50	126	Calumet M. Inc.	2.76	2	48.0	38.3
51	200, 27	Johns-Manville	2.64	1	37.4	85.4
52	411	The University of Chicago	2.55	2	47.7	43.8
53	124	Medillm. Inc.	2.52	2	44.1	53.0
54	93, 343	Bird & Sons	2.22	2	50.0	35.3
55	341	Joanna Western	2.16	2	45.3	48.3
56	61	Continental Elevator B	2.15	2	49.4	36.4
57	375	Container Corp.	2.03	2	46.7	50.7

*Here U.S. Steel is treated as an area source. Six (6) point sources are located within a 1.44 square mile area with center (60.9, 31.9).

**Here Inland Steel is treated as an area source. Thirty (30) point sources are located within a 1.44 square mile area with center (55.3, 34.8), twenty-four (24) of which contribute to the total particulate emissions.

†Here Youngstown Steel is treated as an area source. Eighteen (18) point sources are located within a 1.44 square mile area with center (55.0, 35.2), seventeen (17) of which contribute to the total particulate emission.

TABLE XI. Controllable Industrial Plants
with Large Sulfur Dioxide Emissions

Source No.	Name	Fuel Types
165	Great Lakes Training Center	Coal, Oil
294	Inland Steel Open Hearth*	Coal, Oil, Gas
269	Union Carbide	Coal, Oil
281	Atlantic Boilers	Oil, Gas
282	Amoco Whit Boilers	Oil, Gas
283	Cities Service Boilers	Oil, Gas
290	Inland Steel Power Gen. 401	Coal, Gas
321	U.S. Steel Oil Combustion	Oil, Gas
392	Metropolitan Sanitary District	Coal, Oil
278	Mobil Oil Ref. Boilers	Oil, Gas
323	Bethlehem Steel Boilers	Oil, Gas
338	Darling & Co.	Coal, Oil
353	Interlake	Coal, Oil

*Here Inland Steel has seven (7) plants with dual fuel capability and located within a 1 square mile area.

TABLE XII. Commonwealth Edison (Power) Plants in the Chicago Region

Plant	MWe	SO ₂ , tons/day	Part., tons/day	SO ₂ / MWe	Part./ MWe
Joliet (new)	1242	570	18.5	0.458	0.0149
Stateline (total)	944	375	1.14	0.37	0.0121
Will Cty. No. 2	844	316.5	12.32	0.375	0.0146
Crawford	675	303.3	11.21	0.455	0.0168
Waukegan	1047	258	16.93	0.246	0.162
Joliet-Old-1	117	171.5	1.30	1.465	0.11
Will Cty. No. 1	328	150	6.45	0.457	0.196
Fisk (new)	341	116.7	3.89	0.34	0.114
Fisk (old)	168	89.8	1.8	0.534	0.17
Joliet-Old-2	344	89.5	39.0	0.259	0.113
Ridgeland	647	84	1.88	0.130	0.0029
Calumet	121	22.22	1.97	0.184	0.0163
Total		2171.52	115.25		

calculate air quality with the level of accuracy needed to control an episode. Therefore, it is important that episode control strategists know exactly what type of air quality is being monitored, where it is being monitored, and who can supply the data.

The first step is to survey all federal and local control agencies to determine what monitoring stations are operated in the region. Table XIII lists the sites that have SO₂ monitoring stations in the Chicago Region. The tables should show the types of monitors available at each site (Table XIV).

The next step is to prepare a monitor location map to show the relative location of air quality sampling stations within the region. Figure V-3 shows air quality monitoring stations for SO₂ in the Chicago Region. This map is similar to the source location map and could have been combined with it if the merged map would not have been overcongested. Accompanying the monitor location map should be a table that lists the stations and the air quality monitoring instruments available at the different locations. A typical (imaginary) tabulated list is shown by Table XIV for some of the monitoring stations in the Chicago Region that are located in Fig. 5. Since there are a large variety of monitoring instruments used, the accuracy and sampling times of these instruments vary quite widely. A checklist is also included in Table XIV to indicate the types of instruments available and therefore the types of data that could be obtained from the monitoring network. An instrument key is used to simplify the checklist (Table XV).

c. Regional Meteorological Data

Local meteorological data can usually be obtained either from the local weather station or from a regional meteorologist. Chicago data was obtained from a climatological study performed by H. Moses.¹⁴ Seasonal lid heights and temperatures for Chicago are shown in Table XVI. The average daily temperatures were also obtained for the Chicago Region for purposes of calculating seasonal

TABLE XIII. Sulfur Dioxide Monitoring Stations in the Chicago Region

Station	X mi	Y mi
1. Chicago No. 1	37.70	57.20
2. Chicago No. 2	44.00	55.20
3. Chicago No. 3	37.90	53.85
4. Chicago No. 4	45.40	51.70
5. Chicago No. 6	45.90	49.45
6. Chicago No. 7	43.10	49.75
7. Chicago No. 8	39.00	50.40
8. Chicago No. 9	46.20	46.85
9. Chicago No. 10	42.30	45.65
10. Chicago No. 11	43.55	43.15
11. Chicago No. 12	47.80	43.10
12. Chicago No. 13	40.30	40.85
13. Chicago No. 14	44.55	40.65
14. Chicago No. 15	48.47	40.14
15. Chicago No. 16	45.20	37.00
16. Chicago No. 17	47.00	34.40
17. Chicago No. 18	49.80	34.35
18. Chicago No. 20	44.00	58.30
19. Camp Station	46.00	49.70
20. Bedford Park No. 1	39.00	42.80
21. Bedford Park No. 2	39.00	42.50
22. Cook County No. 3	42.30	64.30
23. Cook County No. 6	31.75	50.00
24. Cook County No. 7	39.70	48.95
25. Cook County No. 8	36.75	42.80
26. Cook County No. 12	44.40	31.70
27. Cook County No. 13	50.00	31.50
28. Cook County No. 15	44.55	24.75
29. Elgin	13.00	62.50
30. Wheaton	21.45	49.25
31. North Chicago	35.50	80.80
32. Waukegan	35.75	83.25
33. Chicago Heights	45.85	25.25
34. Gary: No. 1 Fire Station	60.70	30.50
35. Gary: Airport	56.90	31.80
36. Gary: Kuny School	61.40	25.30
37. Lake County: Taft School	59.30	17.70
38. Whiting: So. Side School	52.95	35.25
39. Hammond: City Hall	51.85	30.90
40. E. Chicago: Fire Station	54.10	33.20
41. E. Chicago: Roxanna School	54.60	31.30
42. E. Chicago: NASN	56.50	33.20
43. Porter County: So. Haven	75.70	18.40
44. Porter County: Ogden Dunes	68.00	32.90
45. Porter County: Chesterton	75.20	32.20
46. Porter County: Flint Lake	75.60	24.60

TABLE XIV. Typical List of Monitoring Stations and Their Instruments
(Chicago Metropolitan Air Quality Control Region)

Station	WS	WD	SO ₂	Part.	CO	HC	NO ₂	O ₃
Chicago No. 1	X	X	01	12				
Chicago No. 7	X	X	04	12				
Camp Station	X	X	01	11	22	31	41	51
Bedford Park No. 1	X	X	02	12				
Elgin			01	12				
Wheaton			01	12				
Gary Airport	X	X	01	12				
Cook County No. 3			01	12				
Ill. EPA No. 1	X	X	01	11	22	32	42	51

Fig. 5. Sulfur Dioxide Monitoring Sites in the Chicago Metropolitan Air Quality Control Region. ANL Neg. No. 190-33.

TABLE XV. Sampling-method Key for Monitoring Stations

<u>Sulfur Dioxide</u>		<u>Hydrocarbons</u>	
01	Bubbler	31	Total Hydrocarbon Analyzer
02	Titrimetric	32	Gas Chromatography
03	Flame Photometric		
04	Turbidimetric (PbO ₂ candle)	<u>Nitrogen Dioxide</u>	
05	Turbidimetric (K ₂ CO ₃ alkaline plate)	41	Bubbler
		42	Electrochemical
		43	Chemiluminescent
<u>Suspended Particulates</u>			
11	Tape Sampler		
12	Hi Volume Sampler	<u>Oxidant & Ozone</u>	
13	Crystal Sampler	51	Bubbler
14	Beta Gauge	52	Amperometric
		53	Potentiometric
		54	Chemiluminescent
		55	UV Absorption
<u>Carbon Monoxide</u>			
21	Gas Chromatography		
22	Non-Dispersive Infrared		

TABLE XVI. Average Chicago Seasonal Mixing Heights and Temperatures

	Mixing Height (meters)	Temperature (°F)
Dec-Feb (Winter)	600	30
Mar-May (Spring)	850	50
Jun-Aug (Summer)	1100	75
Sept-Nov (Fall)	850	50

heating emissions. One method of finding out about local meteorology is to talk to the local meteorologist, who is familiar with the area. Another method is to obtain weather tapes from the National Weather Center for the region and use the PERSIST code to determine the relative persistence of weather conditions. PERSIST was used for Chicago, and the result showed:

- 1) Chicago winds are mostly from the west,
- 2) Summer winds are usually southwest,
- 3) Winter winds are generally northwest and westerly,
- 4) Easterly winds usually do not persist for any length of time.

d. Precalculated Pollution Contours

A major portion of the effort to preplan episode control is devoted to the calculation of pollution contours for episode-prone meteorological situations. The steady-state diffusion model described in Chapter III and Appendix D is used to calculate these contours. However, much of the input required by the ASSM program must be determined by the user. The most probable meteorological and source operating conditions must be examined to determine their episode potential. The question that must be asked is: "What meteorological conditions (lid heights, wind speeds, wind directions, stability conditions) could exist in that area?" It is of course possible to calculate pollution contours for every conceivable set of meteorological conditions. This would be expensive and cumbersome. Instead, the local meteorological conditions should be parameterized and grouped so that pollution contours can be calculated for a characteristic set of conditions. The following seasonal patterns characterize a region and must be supplied as input for using the steady-state diffusion algorithm in calculating pollution contours.

- 1) Seasonal mixing height,
- 2) Wind speeds,
- 3) Wind directions,

- 4) Stability conditions,
- 5) Seasonal temperatures.

Source emission characteristics depend upon the types of sources that exist in a region, and therefore must be identified before contours can be developed. Space heating, which is dependent upon temperature, is only one type of emission source that is seasonally dependent. Some process industries operate on an economic season that is dependent upon the meteorological season (e.g., asphalt plants, power plants). The region has sources that have an operating schedule with seasonal dependence and must be identified so that the seasonal pollution contours can include emission variations. Most of these seasonally operating sources will be combustion sources that are tied to the seasonal temperature variations.

Space heating is one source that will almost always be seasonally dependent. The degree-day heating method described in Chapter III was used for Chicago; seasonal degree-day factors are listed below:

Winter	2.16
Spring	1.0
Summer	.04
Fall	.8

It was assumed that 60% of the emissions from area sources were due to seasonal space heating, and therefore would use seasonal degree-day factors for determining their seasonal source emissions. The other two major types of sources in the Chicago area, power plants and primary metals industries, do not have any climatological seasonal operating patterns. There is no significant seasonal variation in the load of power plants because the Chicago Region has both an air conditioning and an electrical heating load. Primary metals industries, of course, do not have any climatological seasonal operational pattern;

therefore, no seasonal emission variation would be assumed for any large point sources in the Chicago Region.

After establishing the seasonal emission variations, episode-prone meteorological conditions (MET SETS) must be identified so that pollution contours can be calculated. Many of these MET SETS are unlikely to occur and others would not create episode problems. Therefore, pollution contour calculations should be limited to those MET SETS that could cause an episode and those conditions that are possible. For the Chicago Region, only the lower three wind speed classes (0 to 3, 4 to 6, 7 to 10 knots) in the ASSM program were considered episode-prone. The other higher wind speed classes were considered to have too much horizontal ventilation to cause episode problems. Eight wind directions (N, S, W, E, NW, NE, SW, SE) were considered adequate to identify episode problems in the Chicago Region and three stability classes (slightly unstable, neutral, unstable) were considered episode-prone situations. Three seasons were used for the Chicago Region: winter, summer, and spring. Since spring and fall have about the same mixing depth and have similar temperatures, there would be relatively little difference in their emissions.

B. Episode Control Strategy Development

The first part of this chapter describes a preplanning procedure for episode control. This involves the development of a data bank of information that can be used to prepare control strategies during episodes. The remaining part of the chapter is concerned with the use of this data base for developing episode control strategies. A stepwise procedure will be given for a sample episode in the Chicago Region; the procedure illustrates the development of a control strategy using the precalculated data base.

1. Define Episode Potential

Conditions of the episode problem should be determined exactly before an episode control strategy is developed. The expected episode length and local wind direction should be known, along with local air quality levels.

For purposes of illustration an episode will be assumed in the Chicago Region. It is winter, a weak high pressure air mass has settled over the Chicago Region, and an air stagnation advisory has been issued for the area. The Whiting monitoring station reports .45 ppm SO₂ for the past 24 hours. Furthermore, the weak high pressure system is expected to remain in the area.

2. Examine Pollution Contours for the Particular Meteorological Conditions

The next step is to locate the pollution contours for the "met-set" that most closely fits the conditions existing in the area. Then, with the aid of the corresponding culpability lists, determine those sources contributing most to the acute air quality problems.

For the example case, the wind is assumed to be out of the southwest at around 2 mph. The SO₂ pollution contour for the Chicago Region for the winter (H), with neutral stability (NT), and a wind from the southwest (SW) at 0-3 knots (3) is shown in Fig. 6. The problem areas are shown to be around the near north side of Chicago and northern Lake County, Indiana. The highest receptor shown in the culpability list (Table XVII) is very close to the Whiting

Fig. 6. Pollution Contours for the Chicago Region Sample Episode

TABLE XVII. Culpability List

CHICAGO REGION SO2-H-NT-SW - 3 1

CULPABILITY LIST

PART 1

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB

STABILITY CLASS 4

WIND DIRECTION SW

WIND SPEED 0 - 3 KNOTS

SO2

FOR HIGHEST RECEPTORS (MICROGRAMS PER CUBIC METER)

		RECEPTOR 266				RECEPTOR 182				RECEPTOR 183				RECEPTOR 154				RECEPTOR 259		
	1	69	362.92 23.49 %	60.0	69	292.36 26.83 %	60.0	107	380.78 47.97 %	54.9	494*	65.22 9.48 %	39.9	465*	66.26 9.80 %	39.9				
	2	101	296.09 19.17 %	21.3	101	170.60 15.66 %	21.3	105	112.17 14.13 %	64.9	461*	46.18 6.71 %	39.9	362	52.85 7.82 %	49.7				
	3	111	247.42 16.02 %	27.1	111	142.65 13.09 %	27.1	98	50.30 6.34 %	61.9	465*	41.77 6.07 %	39.9	470*	48.33 7.15 %	39.9				
	4	108	245.31 15.88 %	57.3	108	142.27 13.06 %	57.3	97	42.23 5.32 %	39.9	460*	39.02 5.67 %	39.9	471*	46.93 6.54 %	39.9				
	5	67	116.67 7.55 %	89.9	67	101.01 9.27 %	89.9	99	38.49 4.85 %	29.9	466*	37.45 5.44 %	39.9	472*	42.09 6.23 %	39.9				
	6	591*	36.93 2.39 %	10.1	591*	32.40 2.57 %	10.1	100	34.05 4.29 %	39.9	500*	34.62 5.03 %	10.1	498*	37.60 5.56 %	10.1				
	7	103	22.94 1.49 %	22.6	573*	17.57 1.61 %	10.1	102	19.82 2.50 %	41.1	471*	26.50 3.85 %	39.9	477*	35.98 5.32 %	39.9				
	8	113	21.67 1.40 %	54.9	574*	17.56 1.61 %	10.1	544*	13.42 1.69 %	10.1	362	26.06 3.79 %	49.7	473*	31.37 4.64 %	39.9				
	9	574*	18.41 1.19 %	10.1	583*	13.53 1.24 %	10.1	573*	7.71 0.97 %	10.1	467*	23.77 3.45 %	39.9	475*	30.11 4.45 %	39.9				
	10	573*	17.98 1.16 %	10.1	103	13.22 1.21 %	22.6	574*	6.85 0.86 %	10.1	462*	22.80 3.31 %	39.9	481*	27.32 4.04 %	39.9				
TOT			1386.35 89.74 %			943.13 86.57 %			705.83 88.92 %			363.40 52.81 %			418.84 61.97 %					

*Area source.

TABLE XVII (Contd.)

CULPABILITY LIST

PART 2

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB

STABILITY CLASS 4

WIND DIRECTION SW

WIND SPEED 0 - 3 KNOTS

S02

FOR HIGHEST RECEPTORS (MICROGRAMS PER CUBIC METER)

	RECEPTOR 138			RECEPTOR 137			RECEPTOR 258			RECEPTOR 155			RECEPTOR 153		
1	362	61.83 12.94 %	49.7	362	179.70 42.71 %	49.7	494*	66.53 15.92 %	39.9	491*	48.20 12.59 %	10.1	500*	62.89 16.60 %	10.1
2	463*	56.02 11.73 %	39.9	498*	56.86 13.51 %	10.1	491*	53.49 12.80 %	10.1	494*	40.76 10.65 %	39.9	505*	43.32 11.43 %	10.1
3	494*	54.13 11.33 %	39.9	502*	27.85 6.62 %	10.1	492*	38.86 9.30 %	10.1	492*	23.81 6.22 %	10.1	486*	34.12 9.01 %	39.9
4	496*	41.22 8.63 %	10.1	484*	20.82 4.95 %	39.9	495*	36.68 8.78 %	10.1	529*	23.49 6.14 %	10.1	481*	29.11 7.68 %	39.9
5	498*	40.84 8.55 %	10.1	483*	19.59 4.66 %	39.9	496*	28.85 6.90 %	10.1	495*	18.63 4.87 %	10.1	480*	26.10 6.89 %	39.9
6	495*	33.20 6.95 %	10.1	499*	15.80 3.75 %	39.9	362	27.75 6.64 %	49.7	461*	17.45 4.56 %	39.9	488*	23.37 6.17 %	39.9
7	469*	30.66 6.42 %	10.1	490*	15.75 3.74 %	10.1	493*	26.47 6.33 %	10.1	460*	16.43 4.29 %	39.9	506*	19.34 5.10 %	10.1
8	474*	27.95 5.85 %	10.1	503*	14.47 3.44 %	10.1	463*	22.22 5.32 %	39.9	466*	14.34 3.75 %	39.9	501*	18.74 4.95 %	10.1
9	497*	27.93 5.85 %	10.1	507*	13.75 3.27 %	10.1	498*	20.78 4.97 %	10.1	493*	13.45 3.51 %	10.1	487*	16.29 4.30 %	39.9
10	464*	25.70 5.38 %	10.1	537*	13.35 3.17 %	10.1	497*	16.43 3.93 %	10.1	496*	12.86 3.36 %	10.1	502*	16.25 4.29 %	10.1
TOT		399.48 83.61 %			377.95 85.62 %			338.07 80.88 %			229.43 59.94 %			289.54 76.41 %	

monitoring station, which has already shown a 24-hour SO₂ reading of .45 ppm.

The source culpability lists of Table XVII are explained in Fig. 7. They show the sulfur dioxide contributions (pollutant value and percent) of the 10 highest point sources for the 5 highest receptor values in the region. For each source the source number, pollutant contribution, and effective stack height in meters are shown as indicated in Fig. 7.

3. Check Pollution Contours against Monitored Air Quality

Because the pollution contours are calculated using an uncalibrated steady-state diffusion model, the absolute value of the calculated data is open to question. In addition, plume behavior in an urban area does not always follow the "cook book." Therefore monitored air quality should be used to "field-calibrate" the calculated data to the existing situation. If no air quality data is available in the critical areas, then mobile monitoring equipment should be sited to assess the problem.

For this hypothetical episode the Whiting monitoring station would be checked to see if the levels calculated at receptor 266 were reached, and monitoring stations on the north side of Chicago (4, 5, and 19 in Fig. 5 should be checked to see if the levels calculated at receptor 259 (5th highest receptor figure) were reached.

4. Identify Culpable Sources

Culpability lists that correspond to high pollution contours should be examined to identify controllable sources that can help the air quality by modifying their emissions. This should be done for every problem area in the region (high receptors in the culpability list).

In the case of the Chicago episode, the highest receptor (#266) has a calculated value of approximately .54 ppm, of which 82% is due to 5 point sources

CHICAGO REGION SO₂-H-NT-SW - 3 1

CULPABILITY LIST

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB STABILITY CLASS 4 WIND DIRECTION SW

SO₂ FOR HIGHEST RECEPTORS (MICROGRAMS PER CUBIC METER)NUMBER REFERS
TO GRID POINTHIGHEST
CONTRIBUTORNUMBER OF SOURCE
(FROM REGIONAL
SOURCE FILE)SO₂ CONCENTRATION IN $\mu\text{g}/\text{m}^3$
AT RECEPTOR 266
DUE TO SOURCE 111STACK HEIGHT
(METERS)PERCENT OF ALL SO₂
AT RECEPTOR 266
FROM SOURCE 111

		RECEPTOR 266			RECEPTOR 182		
1	69	362.92	60.0	69	292.36	60.0	
		23.49%			26.83%		
2	101	296.09	21.3	101	170.60	21.3	
		19.17%			15.66%		
3	111	247.42	27.1	111	142.65	27.1	
		16.02%					

EACH AREA SOURCE IS DENOTED BY AN ASTERISK (*)

Fig. 7. Explanation of Source Culpability List

(#'s 69, 101, 111, 108, 67). These five sources combined emit over 80 tons of SO_2 per day. Each of the other high receptors could be examined to determine the major cause of the problem. In the case of receptor #138 (6th highest receptor), 70% of the problem is caused by area sources, which are probably space heating sources, and the only control strategy possible would be indoor temperature reductions.

5. Determine Control Strategy

After the nature and cause of the region's poor air quality has been determined, an episode control strategy will be instituted if necessary. The control strategy, both in severity and scope, is still basically at the discretion of the strategist, but identification of the problem has directed him to its causes.

In the case of the hypothetical episode, the 5 culpable sources could be controlled if it was determined that SO_2 levels would soon exceed the 1.0 ppm safety limit. This decision is then based upon the meteorological forecast and the reported air quality. This procedure could then be followed for each of the 10 highest receptors listed in the culpability list.

Planning episode control strategies can be performed on hard copies of the film pollution contours or shown on the display unit described in Appendix D.

VI. EPILOGUE

At the conclusion of every system design effort the engineer, in retrospect, always has thoughts on how the system could be improved. This system is no exception and the epilogue represents a discussion of ways of improving the methodology for controlling air pollution episodes presented in this report.

The heart of the methodology is the steady-state dispersion model (ASSM), which was developed specifically for this system. It was not the intention to develop a model that predicts air quality levels closer to monitored values than other dispersion models, but to create a tool that would facilitate the need to identify the causes (sources) of the episode. That does not mean to say that ASSM was developed without any thought as to predictability, because a great deal of time was spent on improving the calculational ability of the model, but rather that the main thrust was directed at providing the information necessary to develop effective control strategies. Now that ASSM is a usable working model, more attention should be paid to the accuracy of the model in predicting air quality concentrations during poor meteorological conditions. At least a cursory validation effort should be performed using monitored air quality data. Because ASSM is driven by a steady-state diffusion algorithm the validation should be performed for cases and data approximating steady-state meteorological conditions. Attention should be given to the source emissions for the validation period to assure that they resemble the source inventory, which is based on an annual average.

One area in the diffusion algorithm where the authors feel ASSM could be deficient is the simulation of area sources. The fixed angle (22.5 degrees)

that is used to calculate the vertical point source and subsequent source contributions may not always correctly simulate the effects of area sources. The PUFF program uses a different area source simulation technique that seems to work very well. It should probably be incorporated into the ASSM program in place of the present area source simulation model, which was originally designed to predict concentrations for averages and for single meteorological conditions.

The methodology presented in this report, although including several computer programs, is still a manual technique. With the aid of a remote graphical display computer terminal and some program modifications, the entire procedure could be automated. An IBM 2250 or similar graphical display terminal could be used; or, if access to a central computer were more difficult, then a unit with a viewing screen that retains an image could be utilized.

The basic idea would be to implement ASSM on a main computer and then access the program from a remote terminal. Pollution contours could be developed "on-line" and plotted on the viewing screen of the terminal. The advantage of having the model "on-line" rather than precalculated is that pollution contours could be derived for the "exact" meteorological conditions rather than for values based on historical data. This would be particularly useful in the case of the mixing height.

Once ASSM is implemented and available by remote terminal, several changes to the main program could automate the entire episode control strategy process. A calibration algorithm could be used to "rollback" the pollution contour levels using measured air quality. This would certainly give a better picture of the true air quality episode problems. One aid for developing control strategies would be a capability for removing culpable source contributions

from the pollution contours and viewing the effect at the terminal. Control strategies would be developed by removing culpable sources, one by one, until the episode problems appear to be resolved. The results would certainly be more accurate and the control strategy development would be much quicker.

APPENDIX A

Sample Lists and Computer Program Listings
for the Regional Source File

1. Ordered List of SO₂ Emitters in Chicago Region according to
Jurisdiction Together with Its Program Listing

SOURCE	SO ₂ (TN/CA) EMISSIONS	PART(TN/CA) EMISSIONS	SOURCE NAME	POLIT JURIS
157	570.00	18.50	500270 COM EDNEW JOLIET	1
162	316.50	12.32	502300 COM EDWILL CO 2	1
160	258.00	16.93	500380 COM ED WAUKEGAN	1
155	171.50	1.30	500260 COM EDOLD JOLIET1	1
161	150.01	6.45	502300 COM EDWILL CO 1	1
156	89.50	39.00	500260 COM EDOLD JOLIET2	1
159	84.00	1.88	500200 COM ED RIDGELAND	1
58	27.40	38.40	JOLIET ARMY AMMO PLANT	1
4	23.30	0.0	255070 UNIRGYAL	1
194	21.36	0.32	035220 CLARK REFINERY	1
190	21.20	35.50	255070 UNIRGYAL	1
164	18.04	12.58	GREAT LAKES TRAIN,CTR.	1
197	17.86	0.50	317050 TEXACO REFINERY	1
196	9.70	0.53	312370 PURE OIL CO	1
8	8.72	0.46	035130 CHGO CU & CHEM	1
184	6.91	0.85	354880 ABBOTT LABS N CGO	1
150	5.92	0.34	312170 ARGONNE NATL LABS	1
208	5.80	0.92	286030 WYMAN-GORDEN CO	1
136	5.56	0.45	295900 CATERPILLAR	1
202	5.25	3.19	302710 GAF CORP 1 COAL	1
169	4.56	1.56	508940 ELGIN STATE HOSP	1
7	4.20	0.0	295420 AMER CYANAMID	1
122	3.85	1.23	453570 U.S. STEEL CORP	1
34	3.00	0.33	452220 GM CRP-CHEVROLET	1
170	2.88	0.88	507980 STATE-VILLE PEN.	1
142	2.75	0.02	206950 FORD MOTOR CO	1
165	2.46	0.31	FT.SHERIDAN	1
200	1.89	2.13	452460 JOHNS-MANVILLE WK	1
182	1.82	0.25	208420 STAUFFER CHEMICAL	1
172	1.69	1.05	247630 KERBER PACKING CO	1
173	1.45	0.02	448530 OVALTINE FOOD PRO	1
158	1.41	0.46	507900 WINNETKA MUN ELEC	1
140	1.37	0.97	461970 WOODSTOCK DIECAST	1
131	1.30	0.01	303220 US STEEL	1
204	1.00	0.32	416170 MOLINE-MALLEABLE	1
145	0.96	0.30	298090 LENNONWALL PAPER	1
128	0.82	0.30	452280 GRISS-PFLEGER TAN	1
177	0.77	0.06	012420 AURORA PAPERBOARD	1
142	0.66	0.12	458850 GM FISHER BODY	1
127	0.60	0.03	026940 STANDARD SCREW CO	1
207	0.56	0.05	430600 TELETYPE CORP	1
166	0.55	0.38	037710 ROSSI & SONS	1
185	0.43	0.04	429940 SEARLE & CO	1
199	0.38	0.02	206350 CERTAIN-TEED	1
149	0.37	0.03	285790 SINCLAIR RESEARCH	1
198	0.35	0.02	505160 TRUMBUL ASPHALT	1
181	0.35	0.05	321700 SMITH CHEMICAL WK	1
133	0.35	0.04	452490 JOHNSON MOTORS	1
130	0.33	0.35	355240 FANSTEEL MTL CORP	1
205	0.32	0.05	206620 COLUMBIA TCOL STL	1
183	0.30	0.21	454380 AMER PCTASH CORP	1
129	0.29	0.03	245710 CHICAGO RAWHIDE	1

SCRCE	SO2 (TN/DAY EMISSIONS	PART (TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
206	0.26	0.31	452220 GM CRP-CHEVROLET	1
151	0.25	0.11	013590 DAVIS-AURORA CO	1
192	0.22	0.01	355330 GOODYEAR RUBBER	1
211	0.21	0.01	357910 BLISS-LAUGHLIN IN	1
186	0.19	0.02	500920 ABBOTT PARK	1
137	0.19	0.05	012870 BARBER-GREENE CO	1
144	0.18	0.01	255940 AMER PHOTO COPY	1
139	0.16	0.01	313300 HUGH DIV INT HAR	1
174	0.16	0.02	454680 GENERAL MILLS INC	1
176	0.16	0.01	285340 HARRIS HUB CO	1
187	0.14	0.19	035130 CHGO CU & CHEM	1
195	0.14	0.01	365170 UNION OIL PALATIN	1
171	0.10	0.71	508000 JOLIETSTATE PEN.	1
50	0.10	1.39	207220 BENJ HARRIS CO	1
203	0.07	0.02	302710 GAF CORP 2 OIL	1
134	0.07	0.01	505420 G M C BOATS	1
135	0.06	0.01	321600 INTRN HARVESTER	1
178	0.03	0.01	415960 HAWLEY PRODUCTS	1
163	0.01	0.10	502320 COM ED N DIV HQ	1
146	0.0	0.27	310720 VULCANMOLD & IRON	1
147	0.0	0.0	506160 C B Q RAILROAD	1
193	0.0	0.0	345820 ARMOUR-DIAL CO	1
210	0.0	0.10	506700 TAYLORFORGE	1
141	0.0	3.01	502900 WESTRN ELECTRIC	1
138	0.0	0.02	012780 AUSTIN-WESTERN CO	1
188	0.0	0.0	042690 COSDEM OIL CO	1
51	0.0	0.07	312250 LEMONT MFG CORP	1
57	0.0	6.40	500100 METRC SANI DIST	1
56	0.0	0.07	310720 VULCANMOLD & IRON	1
54	0.0	0.68	452490 JOHNSON MOTORS	1
53	0.0	0.08	502900 WESTRN ELECTRIC	1
48	0.0	0.60	014880 W F JOBBINS CO	1
47	0.0	0.11	207130 HALL ALUMINUM	1
36	0.0	0.08	502700 GREENLEE FOUNDRY	1
35	0.0	0.13	206440 CHGO HTS GRY- FE F	1
33	0.0	0.14	206620 COLUMBIA TOOL STL	1
44	0.0	1.66	205870 ABEX CORP	1
43	0.0	0.50	416170 MOLINE-MALLEABLE	1
92	0.0	0.06	028980 DU-KANE ASPHALT C	1
42	0.0	0.03	386410 RICHMOND FOUNDRY	1
94	0.0	0.36	208000 OWENS ILLINOIS	1
41	0.0	0.09	322000 MARENGO FOUNDRY	1
40	0.0	0.01	453060 NORTH SHORE FNDY	1
38	0.0	0.91	028770 CLOW & SONS INC	1
37	0.0	0.05	431080 WELLS MANUFACTURN	1
32	0.0	1.57	206230 CALUMET STEEL	1
31	0.0	0.59	302710 GAF CORP 4	1
30	0.0	0.07	297310 JOHNS MANVILLE J	1
6	0.0	1.40	208420 STAUFFER CHEMICAL	1
5	0.0	0.35	354880 ABBOTT LABS N CGO	1
3	0.0	9.70	255070 UNIROYAL JOLIET	1
2	0.0	0.19	014070 48-INSULATIONS	1
12	0.0	0.19	442620 GALLAGHER ASPHALT	1

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
11	0.0	2.51	317050 TEXACO REFINERY	1
10	0.0	0.95	312370 PURE OIL CO	1
9	0.0	1.83	503340 AMOCO CHEMICAL	1
28	0.0	4.79	442710 MARBLEHEAD LIME	1
27	0.0	0.51	452460 JOHNS-MANVILLE WK	1
26	0.0	0.08	291760 VULCANMTRLS HODK	1
25	0.0	2.20	208960 WESTRNMETAL ABRSV	1
24	0.0	0.03	247120 GIERTZ-MELAHN CO	1
23	0.0	0.55	302710 GAF CORP 3	1
22	0.0	0.72	302710 GAF CORP 5	1
21	0.0	0.17	296230 CROWN TRYGG TROY	1
20	0.0	0.04	501760 MCNARCH ASPHALT	1
19	0.0	0.02	427840 MAYER ASPHALT CO	1
18	0.0	0.06	501960 STEFFAN BROS INC	1
17	0.0	0.09	453390 SKOKIE VAL ASPHAL	1
16	0.0	0.07	281800 LIBERTY ASPHALT	1
14	0.0	0.81	312160 CROWN-TRYGG CORP	1
13	0.0	0.06	502040 CROWN TRYGG JOLET	1
383	303.30	11.21	CRAWFORD PP	2
382	116.70	3.89	FISK PP NEW	2
381	89.80	1.80	FISK PP OLD	2
390	55.58	57.00	METRCSANTOI	2
391	47.00	29.00	TAYLORHOMES	2
384	22.22	1.97	CALUMET PP	2
371	11.25	12.45	10625 CAMPBELLS	2
339	10.00	10.52	10725 CENTRALSOYA	2
377	8.70	3.39	31974 INTERNATHAR	2
347	8.30	3.64	49915 PROCTER&GAM	2
351	7.30	3.33	31735 INTER6AKE	2
350	5.88	6.86	41140 MARBL)HEAD	2
346	5.80	2.47	61295 SHERW2N-WMS	2
410	5.38	2.55	UNIVCHICAGO	2
411	5.00	1.85	UNIV.ILL.	2
354	5.00	0.80	63857 USSTEEL	2
338	4.68	4.97	17320 DARLING & CO	2
408	3.94	1.50	SEARSR0EBUC	2
375	3.75	2.03	12195 CONTAINERCO	2
352	3.72	1.26	31735 INTERLAKFIB	2
353	3.67	0.47	52455 REPUBLIC ST	2
386	3.44	1.85	MAYFAIR PS	2
337	3.44	3.53	17322 DARLING & CO	2
376	3.37	1.46	12185 CONTAINERCO	2
385	3.32	1.75	CENT PARKPS	2
378	3.03	0.29	31975 INTERNATHAR	2
387	2.97	1.60	ROSELAND PS	2
372	2.97	4.00	60057 GLIDDEN CO	2
412	2.92	1.28	NORTHWESTER	2
388	2.87	1.54	SPRFIELD PS	2
409	2.80	0.20	GOLDBLATTS	2
389	2.68	1.45	WESTERN PS	2
355	2.26	0.92	04095 AMERICAN CA	2
379	2.00	0.99	31976 INTERNATHAR	2
392	1.94	0.11	ALBA APTS	2

SRCR	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
394	1.90	0.13	TRUMBULLAPT	2
341	1.83	2.16	34160 JOANNA WEST	2
343	1.64	2.02	09025 BIRD & SON	2
368	1.61	0.48	48540 PETTIBONE-M	2
373	1.60	0.68	19500 EJBACH&SON	2
357	1.32	0.60	57715 STD. BRANDS	2
167	1.27	1.86	OHARE AIRPORT	2
365	1.14	0.10	INGERSOLL P	2
336	1.09	1.29	31071 ILLINOIS OF	2
393	1.02	0.06	CABRINIHOME	2
404	0.99	0.08	COCKCOHOSP	2
346	0.77	0.06	26885 G.LAKIS CARE	2
125	0.71	3.74	SW MUN. INC.	2
405	0.68	0.05	ILLINSTECH	2
412	0.65	0.24	CHI.VOCATIO	2
295	0.65	0.04	STATEWAYAPT	2
359	0.64	0.05	44895 NAT BISCUIT	2
396	0.63	0.04	ICKES HOMES	2
406	0.59	0.50	MERCH. MART	2
356	0.58	0.04	66650 WESTERN FEL	2
342	0.55	0.30	53281 ROCK-OLA	2
363	0.53	0.15	30000 HURWEEN LTH	2
344	0.53	0.04	65190 WFHALLPRNTG	2
126	0.52	2.76	CALUMETMNC	2
124	0.48	2.52	MEDILLM. INC	2
345	0.48	0.03	62260 CUNEO PRESS	2
397	0.47	0.22	WENTWORTH A	2
366	0.43	0.03	52705 RHEEM MFG	2
335	0.43	0.03	25140 GNL RENDERI	2
166	0.42	0.58	FEDERAL BLDG	2
398	0.38	0.30	LATHROPHOME	2
213	0.34	0.03	53440 STEWARTWARN	2
367	0.32	0.36	28460 HANDY BUTTO	2
402	0.31	0.12	GLDTONAPTS	2
361	0.31	0.22	06512 ARVEY CORP.	2
403	0.31	0.04	SANDBURGVIL	2
364	0.31	0.37	14650 CHI. RAWHIDE	2
362	0.30	0.58	59100 SUPER. TANNI	2
360	0.29	0.04	60313 GORDEN BAKI	2
374	0.29	0.02	67590 WMRIGLEYCO	2
214	0.29	0.02	02750 BELDEN MFG	2
215	0.28	0.03	10550 CCRN PRODC	2
399	0.28	0.02	ROCKWELLAPT	2
349	0.26	0.01	05040 AMERICAN OF	2
217	0.26	0.02	50350 PURE ASPHAL	2
216	0.26	0.02	34545 BELL FIBRE	2
220	0.25	0.03	09431 BERG-WARNER	2
221	0.25	0.01	06091 ARMSTRONG P	2
218	0.25	0.10	08455 BELL FIBRE	2
219	0.25	0.02	66036 WARD BAKING	2
222	0.24	0.01	31715 INTER CHEM	2
358	0.24	0.03	66515 WESSON OIL	2
340	0.23	0.28	57635 SQUIR) DING	2

SCRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
369	C.23	0.11	LINK BELT	2
224	C.22	0.06	29374 HEWITT-ROBI	2
223	C.22	0.08	04320 AM LICORICE	2
225	C.22	0.01	52560 REVERE COPR	2
228	C.21	0.01	16030 CHICAGO CAR	2
230	C.21	0.03	38471 LIBBY,MCN,L	2
227	C.21	0.01	26300 GOLDBLATT	2
226	C.21	0.03	03901 ALLIED CHEM	2
229	C.21	0.01	43300 MIEHLE-GOSS	2
233	C.20	0.01	11965 CONT.CAN	2
232	C.20	0.01	58495 STONE CONTA	2
231	C.20	0.03	37520 LANZIT BOX	2
401	C.20	0.02	HORNERHOMES	2
400	C.19	0.14	MURRAYHOMES	2
407	C.19	0.01	PRUDENTIAL	2
234	C.19	0.04	18451 RR DONNELLY	2
237	C.18	0.01	59840 TEE-PAK	2
239	C.18	0.01	20710 LRGO PRGD.	2
238	C.18	0.05	09490 BOWEYS	2
236	C.18	0.01	36355 KRAFT FOODS	2
235	C.18	0.01	30820 ILL.PACKING	2
243	0.17	0.02	46145 NOVO IND.	2
245	0.17	0.11	44976 NATL LEAD	2
242	0.17	0.01	60070 GRIFFITH LP	2
244	0.17	0.03	64740 VICTOR MFG.	2
241	0.17	0.01	53540 ROSENBAKER	2
240	0.17	0.02	11270 CHICURLEOHA	2
249	0.16	0.01	52110 RELIABLEPCK	2
248	0.16	0.01	44195 MOTOROLA	2
250	0.16	0.01	61350 PYLENATIONA	2
246	0.16	0.01	30860 ILLMCULCING	2
247	0.16	0.02	05770 APPLETON EL	2
334	0.16	0.02	28335 HAMMOND WHS	2
251	0.15	0.01	78480 PETER HAND	2
252	0.15	0.01	50260 PULLMAN	2
254	0.15	0.01	68140 ZENITHRADIO	2
253	0.15	0.35	60910 HUCH LEATHE	2
257	0.14	0.12	14550 CHIMCLODEPE	2
255	0.14	0.01	23495 FORD MOTOR	2
258	0.14	0.01	44978 NATL LEAD	2
256	0.14	0.01	28890 HAW-MELCODY	2
261	0.14	0.01	61240 MARTINSENOD	2
259	0.14	0.01	60265 BORDEN	2
260	0.14	0.01	48650 PHOENIX CAP	2
263	0.13	0.17	66470 WENDNAGEL	2
262	0.12	0.18	63640 UNITED SCRE	2
265	0.09	0.16	66340 WEIL&EISEND	2
266	0.09	0.14	14700 CHI-ALLIS	2
264	0.07	0.17	07920 BARNESMETAL	2
416	0.0	0.37	OHARE AIRPORTPISTONS	2
418	0.0	1.07	MIDWAYAIRPORTPISTONS	2
415	0.0	0.44	OHARE AIRPORTTURBOPROPS	2
414	0.0	19.70	OHARE AIRPORTJET PLANES	2

SRCR	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
417	0.0	0.71	MIDWAYAIRPORTJET PLANES	2
370	0.0	0.01	WEST.ELECTR	2
380	0.0	0.0	NORTHWESTPP	2
123	0.0	0.53	52705 RHEEM MFG	2
122	0.0	0.31	45300 NATL CAN	2
121	0.0	1.73	44978 NATL LEAD	2
120	0.0	0.24	05650 APEX SMELT	2
119	0.0	0.19	28750 HARCO ALUM	2
118	0.0	0.16	8711 BERKSCN&SON	2
117	0.0	0.27	49250 PORTEC	2
116	0.0	0.22	16640 CLARK EQPT	2
115	0.0	0.14	43440 MILLES EQPT	2
114	0.0	0.40	22800 FERGUSCNFDY	2
113	0.0	20.55	31975 WISCONSINST	2
112	0.0	0.82	31975 WISCONSINST	2
111	0.0	6.58	31975 WISCONSINST	2
110	0.0	5.92	31975 WISCONSINST	2
109	0.0	59.26	63857 USSTEEL	2
108	0.0	2.22	63857 USSTEEL	2
107	0.0	30.14	63857 USSTEEL	2
106	0.0	32.90	63857 USSTEEL	2
105	0.0	11.64	52455 REPUBLIC ST	2
76	0.0	0.27	26140 GLOBECABINE	2
104	0.0	8.91	52455 REPUBLIC ST	2
103	0.0	12.60	52455 REPUBLIC ST	2
78	0.0	0.44	22950 FIELDENTERP	2
77	0.0	0.19	45700 BONNETT	2
74	0.0	0.34	66415 ZANGERLIE	2
73	0.0	0.55	26530 GRANDWOODWK	2
72	0.0	0.57	22890 UNCARBIDE	2
71	0.0	2.25	10625 CAMPBELLS	2
70	0.0	0.71	10725 CENTRALSOYA	2
69	0.0	4.25	10666 CARGILL	2
68	0.0	0.38	22466 FALSTAFF	2
67	0.0	0.14	42802 NEWCENTURY	2
66	0.0	1.64	52722 CONT ELEV C	2
65	0.0	0.21	55015 SANTEFEELEV	2
64	0.0	0.60	52706 RIALTO ELEV	2
63	0.0	0.99	31015 INDIANAGRAI	2
62	0.0	0.63	24895 GARVEYGRAIN	2
61	0.0	2.15	16125 CONT ELEV B	2
102	0.0	4.66	52455 REPUBLIC ST	2
101	0.0	1.53	31735 INTERLAKE	2
100	0.0	14.56	31735 INTERLAKE	2
99	0.0	2.47	31735 INTERLAKE	2
98	0.0	4.33	31735 INTERLAKE	2
96	0.0	0.14	66558 MISS. LIME	2
95	0.0	4.38	41140 MARBLEHEAD	2
93	0.0	0.20	09025 BIRD & SCN	2
91	0.0	0.35	49370 PGZZGLANPRO	2
90	0.0	0.73	32935 JM CCRBETT	2
89	0.0	0.86	61295 FUMESSFERWIN-WMS	2
88	0.0	0.88	58665 STUART OIL	2

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
75	0.0	0.29	65190 WFHALLPRNT6	2
87	0.0	0.15	58400 STEREOTYPE	2
86	0.0	0.25	58165 MIXSTAUFFERCHE	2
45	0.0	0.35	30085 HOWARD FDY	2
85	0.0	0.14	58165 MILLSSTAUFFERCHE	2
84	0.0	0.31	58100 STDPASTE&GL	2
83	0.0	0.65	44170 MORTON SALT	2
82	0.0	0.46	09120 BLACK PROD	2
75	0.0	0.16	63260 TURNER MFG	2
60	0.0	0.27	16116 CONT ELEV A	2
59	0.0	0.61	20050 DIXIEMILLS	2
81	0.0	0.46	28390 HANDSCHYCHE	2
80	0.0	0.23	06230 ARRC CARD	2
175	35.50	3.00	009340 CORN PRODUCTS	3
154	0.89	0.01	BFD PK JOHNSON & JOHNSON	3
189	0.82	0.05	BFD PK NALCO CHEMICAL CO	3
191	0.44	0.07	BFD PK UNION CARBIDE	3
212	0.43	0.40	BFD PK CCNTNL CAN CO	3
152	0.35	0.02	BFD PK MILES LABS	3
179	0.28	0.04	BFD PK M M M CO	3
153	0.26	0.01	BFD PK BORG & BECK DIV	3
205	0.23	0.02	BFD PK CCMRL STAMPING	3
180	0.18	0.01	BFD PK H P SMITH PAPER	3
1	0.0	4.75	009340 CORN PRODUCTS	3
52	0.0	0.01	336370 HARPER CO	4
148	5.60	0.66	307690 GM CORP LAGRANGE	5
201	3.84	0.75	MCCOOK STANDARD LIME	5
49	0.0	12.10	MCCOOK REYNOLDS METALS	5
46	0.0	0.69	MCCOOK PILET BROS	5
55	0.0	0.23	MCCOOK MCCOOK DRUM & BBL	5
97	0.0	30.00	MCCOOK MATERIAL SERVICE	5
29	0.0	25.50	MCCOOK STANDARD LINE	5
15	0.0	0.03	501480 GEO H HARTONG INC	5
330	375.00	1.14	CCM EDISON STATE LINE	6
331	28.50	0.12	NIPSCO BURNSHARBOR	6
322	4.57	0.61	BETHLEHEM STEEL BOILERS	6
333	0.99	0.02	PORTER MEM HOSPITAL	6
223	0.96	0.20	MIDWESTSTEEL	6
428	96.25	0.0	AMCCO WHIT ING	7
271	19.00	6.22	UNION CARBIDEWHITING COM	7
451	0.0	0.54	KEEN FNDRY GRAY IRON	7
457	0.0	0.33	AMER SMELTINGAND REFIN	7
422	0.0	0.25	UNION CARBIDE WHITING	7
332	267.00	5.40	MITCHELL POWER PLANT	8
321	118.00	39.88	US STEEL COALFOR FUEL	8
320	85.50	3.26	US STEEL CIL COMBUSTION	8
422	36.50	102.00	UNIV ATLAS CEMENT MILL 6	8
433	24.11	50.20	US STEEL ATLASHARBOR	8
328	0.55	0.21	SCREW BOLT CORP OF AM	8
435	0.0	85.50	US STEEL CPENHEARTHS	8
449	0.0	64.40	US STEEL SINTERING PLANT	8
443	0.0	10.40	US STEEL BLAST FURNACE I	8
444	0.0	1.23	US STEEL BOF	8

SORCE	SO2(TN/DA) EMISSIONS	PART.(TN/DA) EMISSIONS	SOURCE NAME	PCLIT JURIS
280	68.00	1.53	ATLANTIC BOILERS	9
289	51.70	10.40	INLAND STEEL PWR GEN 401	9
319	43.30	34.30	YNGSTWN S T STEEL PL	9
421	35.00	0.0	DUPONT SULF AC MFG	9
268	22.52	3.20	UNION CARBIDE LINDE CCMB	9
427	22.30	1.20	AMOCO WHIT FCC CAT REG	9
282	20.02	0.16	CIT SER BOILERS	9
277	16.70	0.16	MCBIL CIL REFBUILDERS	9
270	15.43	6.17	UNION CARBIDE POLYETHYLEN	9
281	13.90	4.82	AMOCO WHIT BOILERS	9
291	13.60	0.0	INLAND STEEL COKE OVN 2	9
304	12.60	1.11	INLAND STEEL 80 STRIP ML	9
423	12.51	0.0	ATLANTIC FCC STRIP	9
293	11.74	0.0	INLAND STEEL OPN HRTN 2	9
274	11.40	0.0	ATLANTIC GAS DEA ABS	9
295	10.30	0.33	INLAND STEEL MILLS 2	9
424	10.00	0.0	AMOCO WHIT SULF REC	9
275	8.13	0.0	CIT SER SOUR STRIP	9
279	6.80	0.0	CITIES SERVICE 25 SCRUBBE	9
430	6.80	0.0	CIT SER GIBBETL	9
276	6.77	0.0	AMOCO WHIT SOUR STRIP	9
299	6.64	0.50	INLAND STEEL 76 STRIP ML	9
425	5.87	3.30	ATLANTIC FCC RESEN	9
290	5.80	0.0	INLAND STEEL COKE OVN 3	9
296	5.77	0.14	INLAND STEEL BLM MILL 3	9
316	5.23	0.19	YNGSTWN S T COKE PLANT	9
207	4.90	0.06	INLAND STEEL PWR GEN 301	9
298	4.87	0.32	INLAND STEEL 44 STRIP ML	9
208	4.20	0.68	YNGST STEEL POW ST PT	9
294	3.55	0.09	INLAND STEEL MILLS 1	9
303	2.48	0.06	INLAND STEEL 14 IN MILL	9
292	2.14	0.01	INLAND STEEL OPH HRTN 3	9
301	2.03	0.04	INLAND STEEL COLD STRIP	9
285	1.68	0.13	INLAND STEEL PLATE MILL	9
315	1.63	0.34	YNGSTWN S T OPEN HERTH1	9
297	1.51	0.0	INLAND STEEL SLAB MILL 4	9
288	1.41	0.02	INLAND STEEL PWR GEN 305	9
313	1.14	0.10	YNGSTWN S T BLMG MILL 2	9
286	1.07	0.03	INLAND STEEL 10 IN MILL	9
429	0.90	0.73	MCBIL CIL CAT REGEN	9
314	0.77	0.0	YNGSTWN S T OPEN HTH 2	9
305	0.70	0.07	YNGSTWN S T UTIL BUIL 3	9
300	0.68	0.01	INLAND STEEL TIN MILL	9
207	0.63	0.02	YNGSTWN S T SHT MILL 2	9
426	0.63	1.29	CIT SER FCC REGEN	9
431	0.60	0.0	CIT SER CAUS REGEN	9
284	0.54	0.08	INLAND STEEL PWR GEN 211	9
312	0.46	0.06	YNGSTWN S T BLCCM NG 1	9
305	0.45	0.09	YNGSTWN S T 84 IN STRIP	9
273	0.45	0.0	MCBIL OIL FLARE	9
310	0.42	0.03	YNGSTWN S T SMLSS PIPE	9
283	0.36	0.0	INLAND STEEL BLKSMTH SHP	9
311	0.33	0.04	YNGSTWN S T MEP MILL	9

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
217	0.31	0.09	YNGSTWN S T SHEET MILL2	9
454	0.30	0.0	US LEAD REFINERY	9
327	0.22	0.02	STAND FORGE BOILERS OIL	9
202	0.14	0.0	INLAND STEEL SPIKE MILL	9
420	0.14	0.22	UNION CARBIDE PROCESS	9
325	0.13	0.0	US LEAD REFINERY INC	9
306	0.04	0.01	YNGSTWN S T TIN MILL 1	9
318	0.0	0.68	YNGSTWN S T POWER PT	9
448	0.0	1.54	INLAND STEEL SCARANG	9
442	0.0	0.08	YNGST S T SCARFING 2	9
445	0.0	0.80	INLAND STEEL SINTERING	9
452	0.0	0.20	AMER STEEL FOUNDRIES IHW	9
439	0.0	1.00	INLAND STEEL SINTERING D	9
447	0.0	0.40	INLAND STEEL OP HE PL 3	9
436	0.0	1.15	YNGSTN S T SCARFING 1	9
458	0.0	0.98	STAND FORGE PUSHER FCE	9
455	0.0	0.90	US RED CHLOR	9
438	0.0	1.13	INLAND STEEL BOFS	9
440	0.0	11.30	INLAND STEEL COKING PL	9
459	0.0	0.80	STAND FORGE ROTARY FCE	9
456	0.0	0.12	US RED SECCN AL	9
453	0.0	0.14	AMER STEEL FOUNDRY IHW	9
434	0.0	1.19	YNGSTWN ST SINTERING	9
446	0.0	0.66	US STEEL CCKE PLANT	9
437	0.0	0.71	INLAND STEEL BLAST FURN	9
441	0.0	20.60	INLAND STEEL OP H PL 2	9
419	23.70	0.01	STAUFFER CHEMICAL CO	10
324	1.46	0.36	AMERICAN STEEL FOUNDRIES	10
272	1.33	0.93	LEVER BROTHERS	10
329	0.44	0.02	UN TANK CAR	10
267	0.14	0.01	SWIFT CO FUEL	10
326	0.12	0.01	TAYLOR CHAIN	10
265	0.11	0.0	STAUFFER CHEMCO. FUEL	10
278	0.11	0.01	WITCO CHEMIC AL FUEL	10
450	0.0	0.76	HARBISON WN KER REFRACT	10
39	0.0	0.58	249040 WOODRUFF-EDWARDS	10

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X/CHIP7 JOB (F12844,45,9,1), 'MARY SNIDER', MSGLEVEL=1,
// REGION=300K, CLASS=B
CROKE E 12383 05782-00190
/*SETUP DDNAME=DUM1, DEVICE=2314, ID=DISK59
/*PROCESS MAIN
/*PROCESS PRINT
/*FORMAT PR, DDNAME=FT06F001, COPIES=5
//STEP2 EXEC SORTD
//SORTIN DD DSN=INSORC09, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
//SORTOUT DD DSN=INSORC10, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
//SORTWK01 DD UNIT=DISK, SPACE=(TRK, (200), , CONTIG)
//SORTWK02 DD UNIT=(DISK, , SEP=SORTWK01), SPACE=(TRK, (200), , CONTIG)
//SORTWK03 DD UNIT=(DISK, , SEP=(SORTWK01, SORTWK02)),
// SPACE=(TRK, (200), , CONTIG)
//SORTWK04 DD UNIT=(DISK, , SEP=(SORTWK01, SORTWK02, SORTWK03)),
// SPACE=(TRK, (200), , CONTIG)
//SYSIN DD *
SORT FIELDS=(155,0,6,0,F1,A,25,0,8,0,F1,D), SIZE=E1000
END
/*
//STEP3 EXEC FTGCLG
//FTG.SYSIN DD *
    DIMENSION SORCE(7,1000), PLUME(3,1000), CSORCE(14,1000)
    DIMENSION SORCNO(1000), SRCNM(8,1000)
    100 FORMAT(F6,0,3F6,1,2F8,2,F6,1,F6,0,8E12,5,2F6,0,2F6,2,2E12,5,3F6,1)
    I=0
    1 I=I+1
    READ(10,100,END=2) SORCNO(I), (SORCE(J,I), J=1,7), (CSORCE(J,I),
    1 J=1,14), (PLUME(J,I), J=1,3)
    IF(SORCE(7,I).EQ.9999.0) I=I-1
    GO TO 1
    2 CONTINUE
    NSORCE=I-1
    READ(11,12,END=110) ((SRCNM(I,J), I=1,8), J=1, NSORCE)
    12 FORMAT(3A4,A1)
    110 LINE=0
    WRITE(6,1000)
    DO 1100 I=1, NSORCE
    LINE=LINE+1
    IF(LINE.LT.53) GO TO 1101
    WRITE(6,1000)
    LINE=0
    1101 CONTINUE
    SORCE(1,I)=SORCE(1,I)*.6241
    SORCE(2,I)=SORCE(2,I)*.6241
    ISORCE=SORCNO(I)
    WRITE(6,1001) SORCNO(I), SORCE(4,I), SORCE(5,I), CSORCE(10,I),
    1 SORCE(7,I), CSORCE(3,I), CSORCE(4,I), CSORCE(14,I), (SRCNM(J, ISORCE)
    2 , J=1,8)
    1100 CONTINUE
    1000 FORMAT(1H1,5HSORCE,3X,16H,502 EMISSION
    1 21HPART EMISSION POLIT,7H SIC,4X,11HANNUAL COAL,
    2 15H ANNUAL OIL,15H ANNUAL GAS,
    3 /10X,16H RATE TN/DAY,20H RATE TN/DAY JURIS,
    4 7H CODE,15H RATE TN/DAY,15H RATE GAL/DA,
    5 15H RATE FT3/DA/)
    1001 FORMAT(1H ,F6,0,2(3X,E12,5),2(3X,F5,0),3(3X,E12,5),
    1 5X,2(3A4,A1))
    STOP
    END
/*
//GO.FT10F001 DD DSN=INSORC10, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
//GO.FT11F001 DD DSN=NAMEDATA, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
/*

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2. Ordered List of SO₂ Emitters in Chicago Region Together with Its Program Listing

SOURCE	SO ₂ (TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	PCLIT JURIS
157	570.00	18.50	500270 COM EDNEW JOLIET	1
330	375.00	1.14	CCM EDISON STATE LINE	6
162	316.50	12.32	502300 COM EDWILL CO 2	1
283	303.30	11.21	CRAWFORD PP	2
232	267.00	5.40	MITCHELL POWER PLANT	8
160	258.00	16.93	500380 COM ED WAUKEGAN	1
155	171.50	1.30	500260 CCM EDOLD JOLIET1	1
161	150.01	6.45	502300 CCM EDWILL CO 1	1
321	118.00	39.88	US STEEL COALFOR FUEL	8
282	116.70	3.89	FISK PP NEW	2
428	96.25	0.0	AMOCO WHIT ING	7
381	89.80	1.80	FISK PP OLD	2
156	89.50	39.00	500260 CCM EDOLD JOLIET2	1
320	85.50	3.26	US STEEL OIL COMBUSTION	8
159	84.00	1.88	500200 COM ED RIDGELAND	1
280	68.00	1.53	ATLANTIC BOILERS	9
290	55.58	57.00	METROSAINTO	2
289	51.70	10.40	INLAND STEEL PWR GEN 401	9
291	47.00	29.00	TAYLORHOMES	2
219	43.30	34.30	YNGSTWN S T STEEL PL	9
422	36.50	102.00	UNIV ATLAS CEMENT MILL 6	8
175	35.50	3.00	OC9340 CORN PRODUCTS	3
421	35.00	0.0	DUPONT SULF AC MFG	9
331	28.50	0.12	NIPSCO BURNSHARBOR	6
58	27.40	38.40	JOLIET ARMY AMMO PLANT	1
433	24.11	50.20	US STEEL ATLASHARBOR	8
419	23.70	0.01	STAUFFER CHEMICAL CO	10
4	23.30	0.0	255070 UNIRCYAL	1
268	22.52	3.20	UNION CARBIDE LINDE CCMB	9
427	22.30	1.20	AMOCO WHIT FCC CAT REG	9
384	22.22	1.97	CALUMET PP	2
194	21.36	0.32	035220 CLARK REFINERY	1
190	21.20	35.50	255070 UNIRCYAL	1
282	20.02	0.16	CIT SER BOILERS	9
271	19.00	6.22	UNION CARBIDE WHITING CCM	7
164	18.04	12.58	GREAT LAKES TRAIN,CTR.	1
197	17.86	0.50	317050 TEXACO REFINERY	1
277	16.70	0.16	MOBIL OIL REFBOILERS	9
270	15.43	6.17	UNION CARBIDE POLYETHYLEN	9
281	13.90	4.82	AMOCO WHIT BOILERS	9
291	13.60	0.0	INLAND STEEL COKE OVN 2	9
304	12.60	1.11	INLAND STEEL 80 STRIP ML	9
423	12.51	0.0	ATLANTIC FCC STRIP	9
293	11.74	0.0	INLAND STEEL OPN HRTH 2	9
274	11.40	0.0	ATLANTIC GAS DEA ABS	9
371	11.25	12.45	10625 CAMPBELLS	2
295	10.30	0.33	INLAND STEEL MILLS 2	9
424	10.00	0.0	AMOCO WHIT SULF REC	9
339	10.00	10.52	10725 CENTRAL SOYA	2
196	5.70	0.53	312370 PURE OIL CO	1
8	6.72	0.46	035130 CHGO CU & CHEM	1
377	6.70	3.39	31974 INTERNATHAR	2

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME		POLLUT JURIS
347	8.30	3.64	49915	PRCCTER&GAM	2
275	8.13	0.0	CIT SER	SGUR STRIP	9
351	7.30	3.33	31735	INTER6AKE	2
184	6.91	0.85	354880	ABBOTT LABS N CGO	1
279	6.80	0.0	CITIES SERVICH2S	SCRUBBE	9
430	6.80	0.0	CIT SER	GIRBOTCL	9
276	6.77	0.0	AMOCO WAIT	SGUR STRIP	9
299	6.64	0.50	INLAND STEEL 76	STRIP ML	9
150	5.92	0.34	312170	ARGONNE NATL LABS	1
350	5.88	6.86	41140	MARBLHEAD	2
425	5.87	3.30	ATLANTIC	FCC RESEN	9
290	5.80	0.0	INLAND STEEL	CKE QVN 3	9
348	5.80	2.47	61295	SHERW2N-WMS	2
208	5.80	0.92	286030	WYMAN-GURDUN CO	1
296	5.77	0.14	INLAND STEEL	BLM MILL 3	9
148	5.60	0.66	307690	GM CORP LAGRANGE	5
136	5.56	0.45	295900	CATERPILLAR	1
410	5.38	2.55		UNIVCHICAGO	2
202	5.25	3.19	302710	GAF CORP 1 COAL	1
316	5.23	0.19	YNGSTWN S T	CKE PLANT	9
411	5.00	1.85		UNIV.ILL.	2
354	5.00	0.80	63857	USSTEEL	2
287	4.90	0.06	INLAND STEEL	PWR GEN 301	9
298	4.87	0.32	INLAND STEEL	44 STRIP ML	9
338	4.68	4.97	17320	DARLIG & CO	2
322	4.57	0.61	BETHLEHEM ST	EEL BOILERS	6
169	4.56	1.56	508940	ELGIN STATE HOSP	1
308	4.20	0.68	YNGST STEEL	POW ST PT	9
7	4.20	0.0	295420	AMER CYANAMID	1
408	3.94	1.50		SEARSROEBUC	2
132	3.85	1.23	453570	U.S. STEEL CORP	1
201	3.84	0.79	MCCOOK	STANDARD LIME	5
375	3.75	2.03	12195	CONTAINERCO	2
352	3.72	1.26	31735	INTERLAKFIB	2
353	3.67	0.47	52455	REPUBLIC ST	2
294	3.55	0.09	INLAND STEEL	MILLS 1	9
337	3.44	3.53	17322	DARLIG & CO	2
386	3.44	1.85		MAYFAIR PS	2
376	3.37	1.46	12185	CONTAINERCO	2
385	3.32	1.75		CENT PARKPS	2
378	3.03	0.29	31975	INTERNATHAR	2
34	3.00	0.33	452220	GM CRP-CHEVROLET	1
387	2.97	1.60		ROSELAND PS	2
372	2.97	4.00	60057	GLIDDEN CO	2
412	2.92	1.28		NORTHWESTER	2
170	2.88	0.88	507980	STATE-VILLE PEN.	1
388	2.87	1.54		SPRFIELD PS	2
409	2.80	0.20		GOLDBLATTS	2
143	2.75	0.02	206950	FORD MCTOR CG	1
389	2.68	1.45		WESTERN PS	2
303	2.48	0.06	INLAND STEEL	14 IN MILL	9
165	2.46	0.31	FT. SHERIDAN		1
355	2.26	0.92	04095	AMERICAN CA	2

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLL JURIS
292	2.14	0.01	INLAND STEEL GPH HRTH 3	9
301	2.03	0.04	INLAND STEEL COLD STRIP	9
379	2.00	0.99	31976 INTERNATHAR	2
292	1.94	0.11	ALBA APTS	2
394	1.90	0.13	TRUMBULLAPT	2
200	1.89	2.13	452460 JCHNS-MANVILLE WK	1
341	1.83	2.16	34160 JCANNA WEST	2
182	1.82	0.25	208420 STAUFFER CHEMICAL	1
172	1.69	1.05	247630 KERBER PACKING CO	1
285	1.68	0.13	INLAND STEEL PLATE MILL	9
343	1.64	2.02	09025 BIRD & SON	2
215	1.63	0.34	YNGSTWN S T OPEN HERTH1	9
368	1.61	0.48	48540 PETTIBONE-M	2
273	1.60	0.68	19500 EJBRACH&SON	2
297	1.51	0.0	INLAND STEEL SLAB MILL 4	9
324	1.46	0.36	AMERICAN STEEL FOUNDRIES	10
173	1.45	0.02	448530 OVALTINE FOOD PRO	1
158	1.41	0.46	507900 WINNETKA MUN. ELEC	1
288	1.41	0.02	INLAND STEEL PWR GEN 305	9
140	1.37	0.97	461970 WOODSTOCK DIECAST	1
272	1.33	0.93	LEVER BROTHERS	10
357	1.32	0.60	57715 STD. BRANDS	2
131	1.30	0.01	303220 US STEEL	1
167	1.27	1.86	CHARE AIRPORT	2
365	1.14	0.10	INGERSOLL P	2
313	1.14	0.10	YNGSTWN S T BLMG MILL 2	9
336	1.09	1.29	31071 ILLINIS OI	2
286	1.07	0.03	INLAND STEEL 10 IN MILL	9
353	1.02	0.06	CABRINTHOME	2
204	1.00	0.32	416170 MOLINE-MALLEABLE	1
404	0.99	0.08	CCCKCOHOSP	2
333	0.99	0.02	PORTER MEM HOSPITAL	6
323	0.96	0.20	MIDWESTSTEEL	6
145	0.96	0.30	258090 LENNONWALL PAPER	1
429	0.90	0.73	MCBIL OIL CAT REGEN	9
154	0.89	0.01	BFD PK JOHNSON & JOHNSON	3
189	0.82	0.05	BFD PK NALCO CHEMICAL CO	3
128	0.82	0.30	452280 GRISS-PFLEGER TAN	1
177	0.77	0.06	012420 AURORA PAPERBOARD	1
346	0.77	0.06	26885 G.LAK)SCARE	2
314	0.77	0.0	YNGSTWN S T OPEN HTH 2	9
125	0.71	3.74	SW MUN. INC.	2
309	0.70	0.07	YNGSTWN S T UTIL BCIL 3	9
300	0.68	0.01	INLAND STEEL TIN MILL	9
405	0.68	0.05	ILLINSTTECH	2
142	0.66	0.12	458850 GM FISHER BODY	1
413	0.65	0.24	CHI. VOCATIO	2
395	0.65	0.04	STATEWAYAPT	2
359	0.64	0.05	44895 NAT BISCUIT	2
307	0.63	0.02	YNGSTWN S T SFT MILL 2	9
426	0.63	1.29	CIT SER FCC REGEN	9
356	0.63	0.04	ICKES HOMES	2
431	0.60	0.0	CIT SER CAUS REGEN	9

SCRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
127	C.60	0.03	026940 STANDARD SCREW CO	1
406	C.59	0.50	MERCH. MART	2
356	C.58	0.04	66650 WESTERN FEL	2
207	C.56	0.05	430600 TELE TYPE CORP	1
168	C.55	0.38	037710 RCSST & SCNS	1
328	C.55	0.21	SCREW BOLT CORP OF AM	8
342	C.55	0.30	53281 ROCK-OLA	2
284	C.54	0.08	INLAND STEEL PWR GEN 211	9
344	C.53	0.04	65190 WFHALLPRNTG	2
363	C.53	C.15	30000 HCRWEEN LTH	2
126	C.52	2.76	CALUMETMINC	2
124	C.48	2.52	MEDILLM. INC	2
345	C.48	0.03	62260 CUNEC PRESS	2
397	C.47	0.22	WENTWORTH A	2
312	C.46	0.06	YNGSTWN S I BLOCM NO 1	9
273	C.45	C.0	MCBIL GIL FLARE	9
305	C.45	C.09	YNGSTWN S T 84 IN STRIP	9
329	C.44	0.02	UN TANK CAR	10
191	C.44	C.07	BFD PK UNION CARBIDE	3
212	C.43	0.40	BFD PK CENTNL CAN CO	3
185	C.43	0.04	429940 SEARLE & CC	1
166	C.43	0.58	FEDERAL BLDG	2
366	C.43	0.03	52705 RHEEM MFG	2
335	C.43	0.03	25140 GNL RENDERI	2
310	C.42	0.03	YNGSTWN S T SMLESS PIPE	9
298	C.38	0.30	LATHROPHOME	2
199	C.38	0.02	206350 CERTAIN-TEED	1
149	0.37	0.03	285790 SINCLAIR RESEARCH	1
283	C.36	0.0	INLAND STEEL BLKSMTH SHP	9
152	C.35	0.02	BFD PK MILES LABS	3
198	0.35	0.02	505160 TRUMBUL ASPHALT	1
181	C.35	0.05	321700 SMITH CHEMICAL WK	1
133	C.35	0.04	452490 JOHNSON MOTORS	1
213	0.34	0.03	53440 STEWARTWARN	2
130	C.33	0.35	355240 FANSTEEL MTL CORP	1
311	0.33	0.04	YNGSTN S T MEP MILL	9
267	C.32	C.36	28460 HANDY BUTTO	2
205	0.32	0.05	206620 COLUMBIA TCOL STL	1
317	C.31	C.09	YNGSTWN S T SHEET MILL2	9
402	0.31	0.12	OLDTOWNAPTS	2
403	C.31	0.04	SANCBURGVIL	2
361	0.31	0.22	06512 ARVEY CORP.	2
364	C.31	0.37	14650 CHI. RAWHIDE	2
362	C.30	0.58	59100 SUPER. TANNI	2
454	C.30	C.0	US LEAD REFINERY	9
183	C.30	0.21	454380 AMER PCTASH CORP	1
214	C.29	0.02	02750 BELDEN MFG	2
129	C.29	0.03	245710 CHICAGO RAWHIDE	1
360	C.29	0.04	60313 GORDEN BAKI	2
374	C.29	0.02	67590 WMWRIGLEYCO	2
399	C.28	0.02	ROCKWELLAPT	2
215	C.28	0.03	10550 CORN PRODCUC	2
179	C.28	0.04	BFD PK M M M CC	3

SRCR	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME		POLIT JURIS
216	0.26	0.02	34545	BELL FIBRE	2
217	0.26	0.02	50350	PURE ASPHAL	2
153	0.26	0.01	BFD PK BORG &	BECK DIV	3
206	0.26	0.31	452220	GM CRP-CHEVROLET	1
249	0.26	0.01	05040	AMERICAN OI	2
151	0.25	0.11	013590	DAVIS-AURORA CO	1
220	0.25	0.03	09431	BORG-WARNER	2
218	0.25	0.10	08455	BELL FIBRE	2
219	0.25	0.02	66036	WARD BAKING	2
221	0.25	0.01	06091	ARMSTRONG P	2
222	0.24	0.01	31715	INTER CHEM	2
258	0.24	0.03	66515	WESSON OIL	2
340	0.23	0.28	57635	SQUIR DING	2
269	0.23	0.11		LINK BELT	2
209	0.23	0.02	BFD PK COMRL	STAMPING	3
225	0.22	0.01	52560	REVERE COPR	2
192	0.22	0.01	355330	GOODYEAR RUBBER	1
224	0.22	0.06	29374	HEWITT-ROBI	2
223	0.22	0.08	04320	AM LICORICE	2
227	0.22	0.02	STAND FORCE	BOILERS OIL	9
226	0.21	0.03	03901	ALLIED CHEM	2
227	0.21	0.01	26300	GOLDBLATT	2
228	0.21	0.01	16030	CHICAGO CAR	2
230	0.21	0.03	38471	LIBBY,MCN,L	2
211	0.21	0.01	357910	BLISS-LAUGHLIN IN	1
229	0.21	0.01	42300	MEHLE-GCSS	2
222	0.20	0.01	58495	STONE CONTA	2
233	0.20	0.01	11965	CONT.CAN	2
231	0.20	0.03	37520	LANZIT BOX	2
401	0.20	0.02		HORNERHOMES	2
407	0.19	0.01		PRUDENTIAL	2
400	0.19	0.14		MURRAYHOMES	2
234	0.19	0.04	18451	RR CONNELLY	2
186	0.19	0.02	500920	ABBOTT PARK	1
137	0.19	0.05	012870	BARBER-GREENE CO	1
226	0.18	0.01	36355	KRAFT FOODS	2
237	0.18	0.01	59840	TEE-PAK	2
180	0.18	0.01	BFD PK H P	SMITH PAPER	3
238	0.18	0.05	09490	BCWEYS	2
239	0.18	0.01	20710	LRCC PRCD.	2
144	0.18	0.01	255940	AMER PHOTO COPY	1
235	0.18	0.01	30820	ILL.PACKING	2
240	0.17	0.02	11270	CHICURLECHA	2
241	0.17	0.01	53540	ROSENSBAKER	2
242	0.17	0.01	60070	GRIFFITH LP	2
244	0.17	0.03	64740	VICTOR MFG.	2
243	0.17	0.02	46145	NOVO IND.	2
245	0.17	0.11	44976	NATL LEAD	2
250	0.16	0.01	61350	PLYENATIONA	2
247	0.16	0.02	05770	APPLETON EL	2
139	0.16	0.01	313300	HOUGH DIV INT HAR	1
176	0.16	0.01	285340	HARRIS HUB CO	1
174	0.16	0.02	454680	GENERAL MILLS INC	1

SRCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME		POLLIT JURIS.
249	0.16	0.01	52110	RELIABLEPCK	2
248	0.16	0.01	44195	MOTOROLA	2
246	0.16	0.01	30860	ILLMOULDING	2
334	0.16	0.02	28335	HAMMOND WHS	2
253	0.15	0.35	60910	HUGH LEATHE	2
254	0.15	0.01	68140	ZENITHRADIO	2
251	0.15	0.01	78480	PETER HAND	2
252	0.15	0.01	50260	PULLEMAN	2
259	0.14	0.01	60265	BORDEN	2
256	0.14	0.01	28890	HAW-MELODY	2
195	0.14	0.01	365170	UNION OIL PALATIN	1
267	0.14	0.01	SWIFT CO FUEL		10
261	0.14	0.01	61240	MARTINSENDO	2
187	0.14	0.19	035130	CHGO CO & CHEM	1
260	0.14	0.01	48650	PHOENIX CAP	2
255	0.14	0.01	23495	FCRD MOTOR	2
302	0.14	0.0	INLAND STEEL	SPIKE MILL	9
258	0.14	0.01	44978	NATL LEAD	2
257	0.14	0.12	14550	CHIMCLODEPE	2
420	0.14	0.22	UNION CARBIDE	PROCESS	9
325	0.13	0.0	US LEAD REFINERY INC		9
263	0.13	0.17	66470	WENDNAGEL	2
326	0.12	0.01	TAYLOR CHAIN		10
262	0.12	0.18	63640	UNITED SCRE	2
269	0.11	0.0	STAUFFER CHEMCO. FUEL		10
278	0.11	0.01	WITCO CHEMIC AL FUEL		10
171	0.10	0.71	508000	JOLIETSTATE PEN.	1
50	0.10	1.39	207220	BENJ HARRIS CO	1
265	0.09	0.16	66340	WEIL&EISEND	2
266	0.09	0.14	14700	CHT-ALLIS	2
264	0.07	0.17	07920	BARNESMETAL	2
203	0.07	0.02	302710	GAF CORP 2 CIL	1
134	0.07	0.01	505420	O M C BOATS	1
135	0.06	0.01	331600	INTRN HARVESTER	1
306	0.04	0.01	YNGSTWN S T	TIN MILL 1	9
178	0.03	0.01	415960	HAWLEY PRODUCTS	1
163	0.01	0.10	502320	COM ED N DIV HQ	1
318	0.0	0.68	YNGSTWN S T	POWER PT	9
146	0.0	0.27	310720	VULCANMOLD & IREN	1
210	0.0	0.10	506700	TAYLORFORGE	1
83	0.0	0.65	44170	MORTON SALT	2
84	0.0	0.31	58100	STUPASTE&GL	2
85	0.0	0.14	58165	MILLSSTAUFFERCHE	2
86	0.0	0.25	58165	MIXSTAUFFERCHE	2
87	0.0	0.15	58400	STEREOTYPE	2
88	0.0	0.88	58665	STUART OIL	2
89	0.0	0.86	61295	FUMESSHERWIN-WMS	2
90	0.0	0.73	32935	JM CORBETT	2
91	0.0	0.35	49370	POZZCLANPRO	2
92	0.0	0.06	028980	DU-KANE ASPHALT C	1
93	0.0	0.20	09025	BIRD & SON	2
94	0.0	0.36	208000	OWENS ILLINOIS	1
95	0.0	4.38	41140	MARBLEHEAD	2

SRCR	SO2(TN/CA) EMISSIONS	PART(TN/CA) EMISSIONS	SOURCE NAME		POLLUT JURIS
96	C.O	0.14	68558	MISS. LIME	2
97	C.O	30.00	MCCOCK	MATERIAL SERVICE	5
98	C.O	4.33	31735	INTERLAKE	2
99	C.O	2.47	31735	INTERLAKE	2
100	C.O	14.56	31735	INTERLAKE	2
101	C.C	1.53	31735	INTERLAKE	2
102	C.O	4.66	52455	REPUBLIC ST	2
103	C.O	12.60	52455	REPUBLIC ST	2
104	C.O	8.91	52455	REPUBLIC ST	2
105	C.O	11.64	52455	REPUBLIC ST	2
106	C.O	32.90	63857	USSTEEL	2
107	C.C	30.14	63857	USSTEEL	2
108	C.C	2.22	63857	USSTEEL	2
109	C.O	59.26	63857	USSTEEL	2
110	C.O	5.92	31975	WISCONSINST	2
111	C.O	6.58	31975	WISCONSINST	2
112	C.O	0.82	31975	WISCONSINST	2
113	C.O	20.55	31975	WISCONSINST	2
114	C.O	0.40	22800	FERGUSONFDY	2
115	C.C	0.14	43440	MILLES EQPT	2
116	O.O	0.22	16640	CLARK EQPT	2
117	C.O	0.27	45250	PORTEC	2
118	C.O	0.16	8711	BERKSON&SON	2
119	O.O	0.19	28750	HARCO ALUM	2
120	C.O	0.24	05650	APEX SMELT	2
121	C.C	1.73	44978	NATL LEAD	2
122	C.C	0.31	45300	NATL CAN	2
123	C.C	0.53	52705	RHEEM MFG	2
51	C.C	0.07	312250	LEMCNT MFG CORP	1
49	C.O	12.10	MCCOCK	REYNOLDS METALS	5
48	C.C	0.60	014880	W F JOBBINS CO	1
78	C.C	0.44	22950	FIELDENTERP	2
59	C.O	0.61	20050	DIXIEMILLS	2
57	C.O	6.40	500100	METRO SANI DIST	1
56	C.O	0.07	310720	VULCANMOLD & IRON	1
55	C.O	0.23	MCCOCK	MCCOCK DRUM & BBL	5
54	C.O	0.68	452450	JOHNSON MOTORS	1
53	C.C	C.O8	502900	WESTRN ELECTRIC	1
52	C.O	0.01	336370	HARPER CO	4
47	C.O	0.11	207130	HALL ALUMINUM	1
46	C.O	0.69	MCCOCK	PIELET BROS	5
45	C.O	0.35	30065	HOWARD FDY	2
138	C.C	0.02	012780	AUSTIN-WESTERN CO	1
44	C.O	1.66	205870	ABEX CORP	1
82	C.C	0.46	09120	BLACK PROD	2
141	O.O	3.01	502900	WESTRN ELECTRIC	1
35	C.O	C.13	206440	CHGO HTS GRY FE F	1
33	C.O	0.14	206620	COLUMBIA TOOL STL	1
32	C.O	1.57	206230	CALUMET STEEL	1
43	O.O	C.50	416170	MOLINE-MALLEABLE	1
42	C.O	C.O2	386410	RICHMOND FOUNDRY	1
147	C.O	C.O	506160	C B Q RAILROAD	1
41	C.C	C.C9	322000	MARENGO FOUNDRY	1

SORCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
40	C.O	C.O1	453060 NORTH SHORE FNDY	1
39	C.O	C.58	249040 WOODRUFF-EDWARDS	10
38	C.O	C.91	028770 CLOW & SONS INC	1
37	C.O	C.O5	431080 WELLS MANUFACTURN	1
36	C.C	C.O8	502700 GREENLEE FOUNDRY	1
31	C.O	C.55	302710 GAF CORP 4	1
30	C.O	C.O7	297310 JOHNS MANVILLE J	1
29	C.O	25.50	MCCOCK STANDARD LINE	5
28	C.C	4.79	442710 MARBLEHEAD LIME	1
81	C.O	0.46	28390 HANDSCHYCHE	2
79	C.O	0.29	65190 WFHALLPRNT6	2
6	C.O	1.40	208420 STAUFFER CHEMICAL	1
5	O.O	0.35	354880 ABBOTT LABS N CGO	1
80	C.O	0.23	06230 ARRCO CARD	2
11	C.C	2.51	317050 TEXACO REFINERY	1
10	C.C	C.95	312370 PURE OIL CO	1
9	C.O	1.83	503340 AMOCO CHEMICAL	1
77	O.O	0.19	45700 BONNETT	2
76	C.O	C.27	26140 GLCBECABINE	2
3	C.O	9.70	255070 UNIROVAL JOLLET	1
2	C.C	C.15	014070 48-INSULATIONS	1
1	C.O	4.75	009340 CORN PRODUCTS	3
75	C.O	C.16	63260 TURNER MFG	2
74	C.O	0.34	66415 ZANGERLIE	2
73	C.C	C.55	26530 GRANDWOODWK	2
72	C.O	C.57	22890 UNCARBIDE	2
71	C.O	2.25	10625 CAMPBELLS	2
70	C.O	0.71	10725 CENTRALSOYA	2
69	C.O	4.25	10666 CARGILL	2
68	C.C	C.38	22466 FALSTAFF	2
67	C.O	0.14	42802 NEWCENTURY	2
66	C.C	1.64	52722 CONT ELEV C	2
65	C.O	0.21	55015 SANTEFEELEV	2
64	C.C	0.60	52706 RIALTO ELEV	2
63	O.O	C.59	31015 INDIANAGRAT	2
62	C.C	C.63	24895 GARVEYGRAIN	2
61	C.C	2.15	16125 CONT ELEV B	2
60	C.C	0.27	16116 CONT ELEV A	2
27	C.C	C.51	452460 JOHNS-MANVILLE WK	1
188	C.C	0.0	042690 COSDEM OIL CO	1
26	C.O	C.O8	251760 VULCANMIRLS HOCK	1
25	O.O	2.20	208960 WESTERNMETAL ABRSV	1
24	C.C	0.03	247120 GIERTZ-MELAHN CO	1
23	C.C	0.55	302710 GAF CORP 3	1
193	C.C	0.0	345820 ARMOUR-DIAL CO	1
22	C.C	C.72	302710 GAF CORP 5	1
21	C.O	C.17	256230 CROWN TRYGG TRCY	1
20	C.C	C.O4	501760 MCNARCH ASPHALT	1
19	C.O	0.02	427840 MAYER ASPHALT CO	1
18	C.C	C.O6	501960 STEFFAN BRCS INC	1
17	O.O	C.O9	453390 SKOKIE VAL ASPHAL	1
16	C.C	C.O7	281800 LIBERTY ASPHALT	1
15	C.O	0.03	501480 GEC H HARTONG INC	5

SORCE	SO2(TN/DA) EMISSIONS	PART(TN/DA) EMISSIONS	SOURCE NAME	POLIT JURIS
14	0.0	0.81	312160 CROWN-TRYGG CORP	1
13	0.0	0.06	502040 CROWN TRYGG JOLET	1
12	0.0	0.19	442620 GALLAGHER ASPHALT	1
439	0.0	1.00	INLAND STEEL SINTERING D	9
422	0.0	0.25	UNION CARBIDE WHITING	7
446	0.0	0.66	US STEEL CCKE PLANT	9
370	0.0	0.01	WEST.ELECTR	2
453	0.0	0.14	AMER STEEL FOUNDRY IHW	9
442	0.0	0.08	YNGST S T SCARFING 2	9
436	0.0	1.15	YNGSTN S T SCARFING 1	9
452	0.0	0.20	AMER STEEL FOUNDRIES IHW	9
417	0.0	0.71	MIDWAYAIRPORTJET PLANES	2
380	0.0	0.0	NORTHWESTPP	2
438	0.0	1.13	INLAND STEEL BOFS	9
437	0.0	0.71	INLAND STEEL BLAST FURN	9
447	0.0	0.40	INLAND STEEL OP HE PL 3	9
445	0.0	0.80	INLAND STEEL SINTERING	9
458	0.0	0.98	STAND FORGE PUSHER FCE	9
455	0.0	0.90	US RED CHLOR	9
449	0.0	64.40	US STEEL SINTERING PLANT	8
444	0.0	1.23	US STEEL BOF	8
415	0.0	0.44	OHARE AIRPORTTURBOPROPS	2
448	0.0	1.54	INLAND STEEL SCARANG	9
414	0.0	19.70	OHARE AIRPORTJET PLANES	2
451	0.0	0.54	KEEN FNDRY GRAY IRON	7
435	0.0	85.50	US STEEL OPENHEARTHS	8
418	0.0	1.07	MIDWAYAIRPORTPISTONS	2
450	0.0	0.76	HARBISON WN KER REFRACT	10
441	0.0	20.60	INLAND STEEL OP H PL 2	9
459	0.0	0.80	STAND FORGE ROTARY FCE	9
440	0.0	11.30	INLAND STEEL CCKING PL	9
434	0.0	1.19	YNGSTWN ST SINTERING	9
416	0.0	0.37	OHARE AIRPORTPISTONS	2
457	0.0	0.33	AMER SMELTINGAND REFIN	7
443	0.0	10.40	US STEEL BLAST FURNACE 1	8
456	0.0	0.12	US RED SECCN AL	9

```

//CHIP3 JOB (F12844,45,9,1), 'MARY SNIDER', MSGLEVEL=1,
CROKE E      12383      05782-00190
//      REGION=300K, CLASS=B
/*SETUP DDNAME=DUM1, DEVICE=2314, ID=DISK59
/*FORMAT PR, DDNAME=FT06F001, COPIES=5
//STEP2 EXEC SORTD
//SORTIN DD DSN=STLSORC9, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
//SORTOUT DD DSN=INSORC10, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59,
//      SPACE=(TRK, (10, 10)), DCB=(RECFM=FB, LRECL=250, BLKSIZE=7000)
//      0      4      5- 3      -      0 8, - 3 5
//SORTWK03 DD UNIT=(DISK, , SEP=(SORTWK01, SORTWK02)),
//      SPACE=(TRK, (200), , CONTIG),
//SORTWK04 DD UNIT=(DISK, , SEP=(SORTWK01, SORTWK02, SORTWK03)),
//      SPACE=(TRK, (200), , CONTIG)
//SYSIN DD *
      SORT FIELDS=(25,0,8,0,FI,D), SIZE=E1000
      END
/*
//STEP3 EXEC FTGCLG
//FTG.SYSIN DD *
      DIMENSION SORCE(7,1000), PLUME(3,1000), CSORCE(14,1000)
      DIMENSION SORCNO(1000), SRCNM(8,1000)
100  FORMAT(F6,0,3F6.1,2F8.2,F6.1,F6,0,8E12.5,2F6,0,2F6.2,2E12.5,3F6.1)
      I=0
1  I=I+1
      READ(10,100,END=2)SORCNO(I), (SORCE(J,I),J=1,7), (CSORCE(J,I),
1  J=1,14), (PLUME(J,I),J=1,3)
      IF(SORCE(7,I).EQ.9999.0)I=I-1
      GO TO 1
2  CONTINUE
      NSORCE=I-1
      READ(11,12,END=110)((SRCNM(I,J),I=1,8),J=1,NSORCE)
12  FORMAT(3A4,A1)
110  LINE=0
      WRITE(6,1000)
      DO 1100 I=1,NSORCE
      LINE=LINE+1
      IF(LINE.LT.53)GO TO 1101
      WRITE(6,1000)
      LINE=0
1101  CONTINUE
      SORCE(1,I)=SORCE(1,I)*.6241
      SORCE(2,I)=SORCE(2,I)*.6241
      ISORCE=SORCNO(I)
      WRITE(6,1001)SORCNO(I), SORCE(4,I), SORCE(5,I), CSORCE(10,I),
1  SORCE(1,I), SORCE(2,I), (SRCNM(J,ISORCE),J=1,8)
1100  CONTINUE
1000  FORMAT(1H1,5HSORCE,3X,16H S02 EMISSION
1  21HPART EMISSION  POLIT,5X,1HX,8X,1HY,
2  /10X,16H RATE TN/DAY      ,20H RATE TN/DAY  JURIS,
3  6X,10H MILES  /)
1001  FORMAT(1H ,F6,0,2(3X,E12.5),3X,F5,0,3X,F6.1,3X,F6.1,
1  5X,2(3A4,A1))
      STOP
      END
/*
//GO.FT10F001 DD DSN=INSORC10, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
//GO.FT11F001 DD DSN=STLNAME, UNIT=DISK, DISP=(OLD, KEEP), VOL=SER=DISK59
/*

```


APPENDIX B
ASSM Program

1. ASSM Program Listing and Subroutine Description (see Fig. B-1)

LIST OF SUBROUTINES

<u>Subroutine</u>	<u>Description</u>	<u>Page</u>
BLOCK DATA	Initializes variables in labeled common	102
CULPLT	Generates culpability lists	103
IOCONV	Converts machine representation to EBCDIC	106
LINSRT	Sorts source contributions for a given receptor into descending order	114
MAIN	Inputs all data; adjusts calculation parameters; drives basic subroutines	115
POLUT	Computes ground-level concentration and source contributions for selected receptors; outputs receptor concentration data	121
SELECT	Selects receptors for output in the culpability list	126

Fig. B-1. ASSM Program Structure

a. BLOCK DATADescription: Initializes variables in labeled common

	BLOCK DATA	BLKD 0
C	COMMON/CULP/IAPERT, NCSORC	BLKD 10
	DATA IAPERT/ 0 /	BLKD 20
C	COMMON/POLYTP/IPOLU1, IPOLU2	BLKD 30
	DATA IPOLU1, IPOLU2/1, 2/	BLKD 40
C	COMMON/RECPTR/DM, ISTAB, IND, IWS, LINCT, NSORCE, S, BACKGR(2),	BLKD 50
	* QSORCE(1000), RECEPT(2, 340), SORCE(7, 1000)	BLKD 60
	DATA NSORCE, BACKGR/0, 2*1.0/	BLKD 70
C	COMMON/SELCT/NSELC, ISELC(2, 10), POLUTC(2, 10)	BLKD 80
	DATA NSELC/ 0 /	BLKD 90
C	REAL*8 LABEL(5), TITLE1(12)	BLKD 100
	COMMON/TITLES/LABEL, TITLE1, REGION(18)	BLKD 110
	DATA LABEL/2*8H .8H - - .8H- - .8H /	BLKD 120
	DATA TITLE1/8HSEASON .8H .8H STAB.8HILITY CL.	BLKD 130
1	8HASS .8H WIND.8H DIRECTI.8HON .8H WIN.	BLKD 140
2	8HD SPEED .8H .8H KNOTS /	BLKD 150
	DATA REGION/18* ' ' /	BLKD 160
C	END	BLKD 170
		BLKD 180
		BLKD 190
		RI KD 200
		BLKD 210
		BLKD 220
		BLKD 230

b. Subroutine CULPLTDescription:

This subroutine generates the culpability list indicating the highest contributors to each receptor in a "selected" list of receptors. It calls POLUT to calculate the contributions from all sources for a given receptor and then calls LINSRT to order these source contributions.

Parameters: NHIGH

Number of "selected" receptors to appear in the culpability list (<10).

MSRC

Number of sources to appear in the culpability list (<20).

Output:

Culpability list containing the highest source contributions to each receptor for a given set of receptors. Under each selected receptor, sources and their effective stack heights are listed in descending order of absolute and percent pollutant contribution.

```

SUBROUTINE CULPLT(NHIGH,MSRC)                                CULP  0
C *****CULP  10
C SUBROUTINE GENERATES A CULPABILITY LIST OF THE (MSRC) HIGHEST CULP  20
C SOURCES OF POLLUTION FOR EACH RECEPTOR IN A "SELECTED" SET OF CULP  30
C (NHIGH) RECEPTORS. FOR EACH SOURCE, THE SOURCE ID, THE (ACTUAL & CULP  40
C PERCENTAGE) CONTRIBUTION FROM THIS SOURCE TO THE RECEPTOR, AND CULP  50
C THE EFFECTIVE STACK HEIGHT OF THE SOURCE IS LISTED. CULP  60
C *****CULP  70
C INTEGER SRCID,SORID. CULP  80
C REAL*8 LABEL(5),MES1(4),MES2(2),TITLE1(12),DASHES(3),RECPTR CULP  90
C COMMON/CULP/IAPERT,NCSORC CULP 100
C COMMON/POLUTYP/IPOLU1,IPOLU2 CULP 110
C COMMON/SELCT/NSELC,ISELC(2,10),POLUTC(2,10) CULP 120
C COMMON/SRCS/IPOLUT,NPTSRC,HEFF(1000),SORCON(500),SORID(500) CULP 130
C COMMON/TITLES/LABEL,TITLE1,REGION(18) CULP 140
C DIMENSION SRCON(10,20),SRCID(10,20),SRCHE(10,20),INDEX(500), CULP 150
C * TPOLUT(10),SPER(10),TSPER(10),TSCON(10) CULP 160
C DIMENSION MPOLU(2),FLAG(10) CULP 170
C CULP 180
C DATA ASTER,BLANK/1H*,1H / CULP 190
C DATA DASHES,RECPTR/3*8H-----,8HRECEPTOR/ CULP 200
C DATA MES1/8H$O2,8H,8HPARTICUL,8HATES / CULP 210
C DATA MES2/8HHIGHEST,8HSELECTED/ CULP 220
C DATA MPOLU/4H$O2,4HPRT / CULP 230
C CULP 240
C LOOP ON POLLUTANT TYPES CULP 250
C DO 20 IPOLUT = IPOLU1,IPOLU2 CULP 260
C LOOP ON "SELECTED" RECEPTORS CULP 270
C I1 = 2*IPOLUT - 1 CULP 280
C I2 = I1 + 1 CULP 290
C DO 3 NRECP = 1,NHIGH CULP 300
C INITIALIZE SUMMARY VARIABLES CULP 310
C TPOLUT(NRECP) = POLUTC(IPOLUT,NRECP) CULP 320
C TSCON(NRECP) = 0.0 CULP 330
C TSPER(NRECP) = 0.0 CULP 340
C CULP 350
C IRECEP = ISELC(IPOLUT,NRECP) CULP 360
C CALCULATE SOURCE CONTRIBUTIONS FOR THIS RECEPTOR CULP 370
C NPTSRC = 0 CULP 380
C CALL POLUT(IRECEP,.TRUE.) CULP 390
C IF (NPTSRC.EQ.0) GO TO 11 CULP 400
C SORT SOURCE CONCENTRATIONS INTO DECREASING ORDER CULP 410
C DO 1 I = 1,NPTSRC CULP 420
C INDEX(I) = I CULP 430
C 1 CONTINUE CULP 440
C CULP 450
C CALL LINSRT(NPTSRC,SORCON,INDEX) CULP 460
C NPTSRC = MIN0(NPTSRC,MSRC) CULP 470
C REORDER CONCENTRATIONS CULP 480
C DO 2 I = 1,NPTSRC CULP 490
C IPTSRC = INDEX(I) CULP 500
C SRCON(NRECP,I) = SORCON(IPTSRC) CULP 510
C SRCID(NRECP,I) = SORID(IPTSRC) CULP 520
C SRCHE(NRECP,I) = HEFF(IPTSRC) CULP 530
C 2 CONTINUE CULP 540
C CULP 550
C IF (NPTSRC.EQ.MSRC) GO TO 3 CULP 560
C INSERT DUMMY VALUES FOR CULPABILITY LIST CULP 570
C 11 M1 = NPTSRC + 1 CULP 580
C DO 12 I = M1,MSRC CULP 590
C SRCON(NRECP,I) = 0.0 CULP 600
C SRCID(NRECP,I) = 0 CULP 610
C SRCHE(NRECP,I) = 0.0 CULP 620
C 12 CONTINUE CULP 630
C CULP 640
C 3 CONTINUE CULP 650
C *****CULP 660
C N1 = 1 CULP 670

```

```

      N2 = MIN0(5,NHIGH)
      IPART = 0
C
C   OUTPUT CULPABILITY LIST
      4 IPART = IPART + 1
      IF (IPART.GT. 1) GO TO 13
      CALL CONVO('A3'), LABEL(3), 0,K, MPOLU(IPOLUT))
      IF (IPART.NE. 0) WRITE(7,170) LABEL
      WRITE(6,90) LABEL
      IF (NHIGH.GT. 5) WRITE(6,101) IPART
      GO TO 14
C
      13 WRITE(6,95)
      IF (NHIGH.GT. 5) WRITE(6,101) IPART
C
      14 WRITE(6,100) REGION
      WRITE(6,103) TITLE1, (MES1(I1), I1=I1,I2), MES2(NSELC+1)
      WRITE(6,105) (DASHES, N=N1,N2)
      WRITE(6,110) (RECPTR, N=N1,N2)
      WRITE(6,120) (ISELC(IPOLUT,NRECP), NRECP=N1,N2)
      WRITE(6,130) (DASHES, N=N1,N2)
      DO 6 I = 1,MSRC
C
      DO 5 NRECP = N1,N2
      TSCON(NRECP) = TSCON(NRECP) + SRCCON(NRECP,I)
      SPER(NRECP) = SRCCON(NRECP,I)/TPOLUT(NRECP) * 100.0
      TSPER(NRECP) = TSPER(NRECP) + SPER(NRECP)
C
      SOURCE ID > NCSORC IMPLIES AREA SOURCE
      FLAG(NRECP) = BLANK
      IF (SRCID(NRECP,I).GT. NCSORC) FLAG(NRECP) = ASTER
C
      5 CONTINUE
C
      WRITE(6,140) I, (SRCID(NRECP,I), FLAG(NRECP), SRCCON(NRECP,I),
      *   SRCHE(NRECP,I), NRECP=N1,N2)
      WRITE(6,150) (SPER(NRECP), NRECP=N1,N2)
      WRITE(6,130) (DASHES, N=N1,N2)
      6 CONTINUE
C
      WRITE(6,160) (TSCON(NRECP), NRECP=N1,N2)
      WRITE(6,150) (TSPER(NRECP), NRECP=N1,N2)
      WRITE(6,105) (DASHES, N=N1,N2)
C
      IF (N2.EQ. NHIGH) GO TO 20
      N1 = 6
      N2 = NHIGH
      GO TO 4
C
      *****
      20 CONTINUE
      CALL CONVO('A3'), LABEL(3), 0,K, ' ')
      RETURN
C
      90 FORMAT(1H1,5A8,18X,'CULPABILITY LIST')
      95 FORMAT(1H1,58X,'CULPABILITY LIST')
      100 FORMAT(1H0,10X,18A4)
      101 FORMAT(1H+,125X,'PART',I3)
      103 FORMAT(1H0,10X,12A8/1H0,10X,2A8,'FOR ',A8,
      *   ' RECEPTORS ( MICROGRAMS PER CUBIC METER )'//)
      105 FORMAT(2H ,6H-----,5(3A8,'-'))
      110 FORMAT(1H ' I ' I',5(8X,A8,8X,'I'))
      120 FORMAT(1H ' I ' I',5(9X,I4,11X,'I'))
      130 FORMAT(1H ' I----I',5(3A8,'I'))
      140 FORMAT(1H ' I',I3,' I',5(14,A1,F9.2,F9.1,' I'))
      150 FORMAT(1H ' I ' I',5(8X,F6.2,' %',8X,'I'))
      160 FORMAT(1H ' ITOT I',5(4X,F10.2,10X,'I'))
      170 FORMAT(5A8)
C
      END

```

CULP 680
 CULP 690
 CULP 700
 CULP 710
 CULP 720
 CULP 730
 CULP 740
 CULP 750
 CULP 760
 CULP 770
 CULP 780
 CULP 790
 CULP 800
 CULP 810
 CULP 820
 CULP 830
 CULP 840
 CULP 850
 CULP 860
 CULP 870
 CULP 880
 CULP 890
 CULP 900
 CULP 910
 CULP 920
 CULP 930
 CULP 940
 CULP 950
 CULP 960
 CULP 970
 CULP 980
 CULP 990
 CULP1000
 CULP1010
 CULP1020
 CULP1030
 CULP1040
 CULP1050
 CULP1060
 CULP1070
 CULP1080
 CULP1090
 CULP1100
 CULP1110
 CULP1120
 CULP1130
 CULP1140
 CULP1150
 CULP1160
 CULP1170
 CULP1180
 CULP1190
 CULP1200
 CULP1210
 CULP1220
 CULP1230
 CULP1240
 CULP1250
 CULP1260
 CULP1270
 CULP1280
 CULP1290
 CULP1300
 CULP1310
 CULP1320
 CULP1330
 CULP1340
 CULP1350

c. Subroutine IOCONVDescription:

This subroutine is a FORTRAN-callable OS/360 assembly language routine which converts from internal machine representation to EBCDIC. It also has the capability to "insert (EBCDIC) characters" into a "string".

Parameters:

FMT

The character string used as the format specification.

ARRAY

The output EBCDIC representation.

ARRIND

The byte offset from ARRAY to the starting byte.

WIDTH

The numbers of bytes used in ARRAY.

X

Variable(s) to be used.

```

PRINT NOGEN
IOCONV START 0
CONV 0
CONV 10
CONV 20
-----*
CONV 30
CONV 40
CONV 50
CONV 60
CONV 70
CONV 80
CONV 90
CONV 100
CONV 110
CONV 120
CONV 130
CONV 140
CONV 150
CONV 160
CONV 170
CONV 180
CONV 190
CONV 200
CONV 210
CONV 220
CONV 230
CONV 240
CONV 250
CONV 260
CONV 270
CONV 280
CONV 290
CONV 300
CONV 310
CONV 320
CONV 330
CONV 340
CONV 350
CONV 360
CONV 370
CONV 380
CONV 390
CONV 400
CONV 410
CONV 420
CONV 430
CONV 440
CONV 450
CONV 460
CONV 470
CONV 480
CONV 490
CONV 500
CONV 510
CONV 520
CONV 530
CONV 540
CONV 550
CONV 560
CONV 570
CONV 580

```

FORTRAN CALL: CALL CONVI (FMT, ARRAY, ARRIND, WIDTH, X1, X2, ..., XN)
 OR CALL CONVO (FMT, ARRAY, ARRIND, WIDTH, X1, X2, ..., XN)

WHERE FMT CONTAINS A FORMAT SPECIFICATION WHOSE FORM IS
 IDENTICAL A FORMAT STATEMENT EXCEPT THE WORD
 FORMAT IS OMITTED
 SEE FORMAT DIFFERENCES

ARRAY IS THE ARRAY WHICH CONTAINS (CONVI) OR WILL
 CONTAIN (CONVO) THE OUTPUT (EBCDIC) REPRESENTATION

ARRIND CONTAINS THE BYTE OFFSET FROM ARRAY

WIDTH WILL CONTAIN THE AMOUNT OF SPACE (INTEGER-IN BYTES)
 USED IN ARRAY

X1, ... ARE THE VARIABLE TO BE USED
 THE VARIABLES' LENGTHS MUST BE THE STANDARD LENGTHS
 I.E. TYPE E, F, I, L, Z, A 4 BYTES
 TYPE D, C 8 BYTES

EXAMPLE

CALL CONVO (('("SAMPLE", 3X, F8.3, 4H I, J, 2I6)', BCD, 0, WIDTH, X, I, J)

AFTER CALL BCD ARRAY WOULD CONTAIN (ASSUME X=1.234, I=1, J=2)

BCD = SAMPLE 1.234 I, J 1 2
 WIDTH = 33

CALL CONVO ((' (10E12.3)', BCD, 3, WIDTH, X)

IF X(I)=I FOR I=1, 10 THEN CALL WOULD YIELD

BCD = XXX 0.100E 01 0.200E 01 ETC
 WIDTH = 120

CALL CONVO ((' (C18.3)', BCD, 0, WIDTH, COMP)

AFTER CALL BCD ARRAY WILL CONTAIN (ASSUME COMP (REAL) = 1.0
 COMP (IMAG) = 2.0)

BCD = BBBB(1.00, 2.00) (B=BLANK)
 WIDTH = 18

USES IHCFCVTH* TO DO CONVERSION

TITLE 'FORMAT DIFFERENCES'
 FORMAT DIFFERENCES FROM FORTRAN IV

*** 1 LEVEL OF GROUP PARENTHESES
 *** NO T SPECIFICATION
 *** NO G SPECIFICATION
 *** / IS IGNORED
 *** ALPHA-NUMERIC STRINGS DELIMITED BY EITHER ' OR "
 *** ALPHA-NUMERIC STRINGS CAN NOT CONTAIN EITHER ' OR "
 *** SCALE FACTORS ONLY APPLY TO THE FIELD THEY ARE DEFINED IN

```

*** IF FORMAT SPECIFIES MORE VARIABLES THAN SUPPLIED THE LAST      CONV 590
VARIABLE IS ASSUMED TO BE AN ARRAY                                CONV 600
AND SUCCESSIVE ELEMENTS OF THE ARRAY ARE USED TO COMPLETE THE     CONV 610
FORMAT REQUIREMENTS                                              CONV 620
*** ALLOWS DIRECT COMPLEX SPECIFICATION USING CW,S                CONV 630
WHERE W IS THE TOTAL WIDTH FOR THE REAL AND IMAGINARY PARTS      CONV 640
PLUS ( ) AND ,                                                  CONV 650
THE COMPLEX VARIABLE IS CONVERT TO THE FORM (A,B) WHERE A        CONV 660
AND B HAVE S SIGNIFICANT DIGITS AND HAVE THE SAME FORM AS        CONV 670
THOUGH CONVERTED BY GH,S WHERE H=(W-3)/2                        CONV 680
BLANKS INTERNAL TO ( AND ) ARE SUPPRESSED                        CONV 690
TITLE 'REGISTER ASSIGNMENTS'                                     CONV 700
-----*-----*-----*-----*-----*-----*-----*-----*
REGISTER ASSIGNMENTS                                           CONV 710
-----*-----*-----*-----*-----*-----*-----*-----*
R1 POINTS TO FORMAT CHARACTER                                CONV 720
R4 USED TO ACCUMULATE INTEGERS                                CONV 730
R5 POINTS TO ARRAY POSITION                                    CONV 740
R6 POINTS TO PARAMETER LIST                                  CONV 750
R7 INDEX TO VARIABLE ADDRESSES                                CONV 760
R9 CONTAINS FIELD COUNT                                       CONV 770
R10 CONTAINS CURRENT GROUP COUNT                              CONV 780
R11 USED FOR LINKAGE TO ENLFLD ROUTINE                         CONV 790
R15 BASE REGISTER                                             CONV 800
R12 CONTAINS MAXIMUM INTEGER SIZE                             CONV 810
TITLE 'CONVI - CONVERT TO INTERNAL REPRESENTATION'            CONV 820
USING *,15                                                    CONV 830
CONVI B *,12                                                    CONV 840
      DC X'07'                                                  CONV 850
      DC CL7'CONVI'                                             CONV 860
      ENTRY CONVI                                              CONV 870
      STM 14,12,12(13)                                           CONV 880
      MVI INOUT,C'I'      NOTE DOING INPUT                     CONV 890
      LA 15,CONVO                                               CONV 900
      B 20(0,15)                                                 CONV 910
      TITLE 'CONVO - CONVERT TO OUTPUT REPRESENTATION'         CONV 920
      USING *,15                                                 CONV 930
CONVO B *,12                                                    CONV 940
      DC X'07'                                                  CONV 950
      DC CL7'CONVO'                                             CONV 960
      ENTRY CONVO                                              CONV 970
      STM 14,12,12(13)                                           CONV 980
      MVI INOUT,C'O'      NOTE DOING OUTPUT                     CONV 990
      LR 8,13                                                    CONV1000
      ST 8,SAVEAREA+4                                           CONV1010
      LA 13,SAVEAREA                                             CONV1020
      SPM 13      CLEAR CC AND PGM MASK                         CONV1030
      ST 13,8(0,8)                                              CONV1040
      MVI PSTLST,C'N'                                           CONV1050
      MVI IGCMA,C'Y'                                           CONV1060
      LA 12,255      SET MAXIMUM INTEGER SIZE                  CONV1070
      LR 6,1                                                    CONV1080
      L 1,0(0,8)      R1 POINTS TO FORMAT                      CONV1090
                        SAVE BUFFER ARRAY ADDRESS                CONV1100
      LM 2,3,4(6)                                              CONV1110
      A 2,0(0,3)                                              CONV1120
      ST 2,BUFFADD                                             CONV1130
      LR 5,2                                                    CONV1140
      SR 7,7      INITIALIZE VARIABLE ADDRESS POINTER          CONV1150

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	LR	10.7	GROUP COUNT	CONV1180
	STC	7. MINUS	POSITIVE SCALE FACTOR	CONV1190
	STC	7. SCALE	SCALE FACTOR = 0	CONV1200
	TITLE	'DETERMINE FORMAT CHARACTER'		CONV1210
	CLI	0(1).C'('		CONV1220
	BNE	ILLEG1	JUMP IF NOT BEGINNING OF FORMAT	CONV1230
	LA	1.1(0.1)		CONV1240
	SR	4.4	R4 = DIGIT	CONV1250
NEXT	SR	2.2		CONV1260
	TRT	0(256.1).TRTSTB		CONV1270
BRTAB	B	BRTAB(2)		CONV1280
	DS	0H		CONV1290
	B	NEXT	BLANK	CONV1300
	B	TDIGIT	0-9	CONV1310
	B	TLEPAR	(	CONV1320
	B	TCHARA	A	CONV1330
	B	TCHARL	L	CONV1340
	B	TCHARZ	Z	CONV1350
	B	TCHARI	I	CONV1360
	B	TMINUS	-	CONV1370
	B	TCHARP	P	CONV1380
	B	TCHARF	F	CONV1390
	B	TCHARE	E	CONV1400
	B	TCHARD	D	CONV1410
	B	TCHARG	G	CONV1420
	B	TCHART	T	CONV1430
	B	TCHARX	X	CONV1440
	B	TCHARH	H	CONV1450
	B	TQUOTE	' OR "	CONV1460
	B	TPOINT	.	CONV1470
	B	TCOMMA	,	CONV1480
	B	TSLASH	/	CONV1490
	B	TRTPAR	)	CONV1500
	B	FMterr	ILLEGAL CHAR.	CONV1510
	B	TCHARC	C (FOR COMPLEX)	CONV1520
	TITLE	'SET TYPE'		CONV1530
TCHARA	MVI	TYPO. X'54'		CONV1540
	MVI	TYPE. X'50'	SAVE TYPE	CONV1550
	B	SETFCT		CONV1560
TCHARI	MVI	TYPO. X'2C'		CONV1570
	MVI	TYPE. X'28'	SAVE TYPE	CONV1580
	B	SETFCT		CONV1590
TCHARL	MVI	TYPO. X'1C'		CONV1600
	MVI	TYPE. X'18'		CONV1610
	B	SETFCT		CONV1620
TCHARZ	MVI	TYPO. X'5C'		CONV1630
	MVI	TYPE. X'58'		CONV1640
	B	SETFCT		CONV1650
TCHARF	MVI	TYPO. X'04'		CONV1660
	MVI	TYPE. X'00'		CONV1670
SETFCT	LTR	4.4		CONV1680
	BNZ	SETFCT1		CONV1690
	LA	4.1	IMPLIED FIELD COUNT OF 1	CONV1700
SETFCT1	LR	9.4		CONV1710
	MVI	IGCOMA. C'N'	NOTE COMMA NOT TO BE IGNORED	CONV1720
CL4	SR	4.4		CONV1730
BMPRI	LA	1.1(0.1)		CONV1740
	B	NEXT		CONV1750
TCHARE	MVI	TYPO. X'0C'		CONV1760

	MVI	TYPE, X'00'		CONV1770
	B	SETFCT		CONV1780
TCHARD	MVI	TYPO, X'8C'		CONV1790
	MVI	TYPE, X'80'		CONV1800
	B	SETFCT		CONV1810
TCHARC	MVI	TYPO, X'CC'	COMPLEX	CONV1820
	MVI	TYPE, X'C8'		CONV1830
	B	SETFCT		CONV1840
TCHARG	B	ILLEG7		CONV1850
TCHART	B	ILLEG2	NO TAB SETTING	CONV1860
	TITLE	'PROCESS SPECIAL CHARACTERS'		CONV1870
TDIGIT	MOVN	FMTDIG+1(1), 0(1)		CONV1880
	MH	4, TEN		CONV1890
	AH	4, FMTDIG		CONV1900
	CR	4, 12		CONV1910
	BH	ILLEG8	JUMP IF FIELD TOO WIDE	CONV1920
	B	BMPR1		CONV1930
TLFPAR	LTR	10, 10		CONV1940
	BNZ	ILLEG3	JUMP IF MORE THAN 1 LEVEL OF GROUPING	CONV1950
	LTR	4, 4		CONV1960
	BNZ	TLFPAR1		CONV1970
	LA	4, 1	DEFAULT GROUP COUNT OF ONE	CONV1980
TLFPAR1	LR	10, 4	SAVE GROUP COUNT	CONV1990
	ST	1, GINDEX		CONV2000
	B	CL4		CONV2010
TPOINT	LTR	4, 4		CONV2020
	BZ	ILLEG4	JUMP IF INCORRECT FIELD SPECIFICATION	CONV2030
	STC	4, WIDTH		CONV2040
	B	CL4		CONV2050
			SKIP	CONV2060
TCHARX	LTR	4, 4		CONV2070
	BNZ	HNX		CONV2080
	LA	4, 1		CONV2090
HNX	MVI	IGCOMA, C'Y'	NOTE COMMA TO BE IGNORED	CONV2100
	CLI	INOUT, C'I'		CONV2110
	BE	SPACE	JUMP IF INPUT	CONV2120
XLOOP	MVI	0(5), C' '	FILL IN BLANKS FOR OUTPUT	CONV2130
	LA	5, 1(0, 5)		CONV2140
	BCT	4, XLOOP		CONV2150
	B	BMPR1		CONV2160
SPACE	AR	5, 4	SKIP FOR INPUT	CONV2170
	B	CL4		CONV2180
			HOLLERITH TEXT	CONV2190
TCHARH	S	4, =F'1'		CONV2200
	BH	ILLEG5	JUMP IF INCORRECT LENGTH	CONV2210
	MVI	IGCOMA, C'Y'	NOTE COMMA TO BE IGNORED	CONV2220
	LA	8, 1(0, 1)		CONV2230
	CLI	INOUT, C'I'		CONV2240
	BE	HI	JUMP IF INPUT	CONV2250
	EX	4, MOVECHR	MOVE IN HOLLERITH TEXT	CONV2260
HBUMP	LA	5, 1(5, 4)		CONV2270
	LA	1, 1(1, 4)		CONV2280
	B	CL4		CONV2290
HI	EX	4, MOVECHRI		CONV2300
	B	HBUMP		CONV2310
TQUOTE	LA	1, 1(0, 1)		CONV2320
	LR	8, 1		CONV2330
QTLOOP	CLI	0(1), X'7F'		CONV2340
	BE	ENDQT	JUMP IF "	CONV2350

	CLI	0(1),X'7D'		CONV2360
	BE	ENDQT	JUMP IF	CONV2370
	LA	1,1(0,1)		CONV2380
	B	QTLOOP		CONV2390
ENDQT	MVI	IGCOMA,C'Y'	NOTE COMMA TO BE IGNORED	CONV2400
	LR	2,1		CONV2410
	SR	2,8		CONV2420
	BCTR	2,0		CONV2430
	CR	2,12		CONV2440
	BH	ILLEG8	JUMP IF STRING TOO LONG	CONV2450
	CLI	INOUT,C'I'		CONV2460
	BE	ENDQTI	JUMP IF INPUT	CONV2470
	EX	2,MOVECHR	MOVE IN HOLLERITH TEXT	CONV2480
ENDQTB	LA	5,1(2,5)		CONV2490
	B	CL4		CONV2500
ENDQTI	EX	2,MOVECHRI		CONV2510
	B	ENDQTB		CONV2520
TCOMMA	CLI	IGCOMA,C'Y'		CONV2530
	BE	CL4		CONV2540
	BAL	11,ENDFLD		CONV2550
	B	CL4		CONV2560
TSLASH	EQU	TCOMMA	IGNORE / (TREAT AS COMMA)	CONV2570
TMINUS	MVI	MINUS,X'80'		CONV2580
	B	BMPR1		CONV2590
TCHARP	STC	4,SCALE		CONV2600
	OC	SCALE(1),MINUS		CONV2610
	MVI	MINUS,X'00'		CONV2620
	B	CL4		CONV2630
FMterr	B	ILLEG8	JUMP IF ILLEGAL CHARACTER	CONV2640
MOVECHR	MVC	0(0,5),0(8)	MOVE LITERAL DATA INTO ARRAY	CONV2650
MOVECHRI	MVC	0(0,8),0(5)	MOVE LITERAL DATA INTO FORMAT	CONV2660
	TITLE	'RIGHT PARENTHESIS - END OF GROUP OR FORMAT'		CONV2670
TRTPAR	CLI	IGCOMA,C'Y'		CONV2680
	BE	GEND		CONV2690
	BAL	11,ENDFLD		CONV2700
GEND	LTR	10,10		CONV2710
	BZ	EXIT	JUMP IF END OF FORMAT	CONV2720
	BCT	10,GREP	JUMP IF TO REPEAT GROUP	CONV2730
	MVI	IGCOMA,C'Y'		CONV2740
	B	CL4	CONTINUE SCAN OF FORMAT	CONV2750
GREP	L	1,GINDEX		CONV2760
	B	CL4		CONV2770
	TITLE	'PROCESS A CONVERSION FIELD'		CONV2780
ENDFLD	MVI	IGCOMA,C'Y'		CONV2790
	STC	4,DD		CONV2800
	CLI	INOUT,C'O'		CONV2810
	BE	FLDSET		CONV2820
	MVC	TYPO(1),TYPE		CONV2830
FLDSET	CLI	TYPE,X'00'		CONV2840
	BE	FCLOOP	JUMP IF E OR F CONVERSION	CONV2850
	TM	TYPE,X'80'	TEST FOR DOUBLE PRECISION OR COMPLEX	CONV2860
	BO	FLDDP	JUMP IF DOUBLE PRECISION OR COMPLEX	CONV2870
	MVI	DD,X'18'	SET 2 BYTES FOR NOP	CONV2880
	STC	4,WIDTH		CONV2890
FCLOOP	MVI	CONPAR,X'04'		CONV2900
FCLOOP3	LR	8,1	SAVE R1	CONV2910
	IC	4,WIDTH		CONV2920
FCLOOP2	CLI	PSTLST,C'Y'		CONV2930
	BE	BMPARI	JUMP IF IN ARRAY	CONV2940

	LA	2, 12(7, 6)		CONV2950
	TM	0(2), X'80'	CHECK FOR LAST VARIABLE	CONV2960
	BC	1, LISTERRI	JUMP IF NOT ENOUGH VARIABLES	CONV2970
	L	2, 16(7, 6)		CONV2980
FCLLOOP1	LR	3, 5		CONV2990
	L	1, =V(ADCON#)		CONV3000
CONTYPE	L	1, 0(1)		CONV3010
	BALR	0, 1	BRANCH TO CONVERSION ROUTINE (IHCFCVTH)	CONV3020
CONPAR	DC	XL4'00000000'		CONV3030
	AR	5, 4	BUMP ARRAY POINTER BY FIELD WIDTH	CONV3040
	LA	7, 4(0, 7)	BUMP VAR POINTER	CONV3050
	BCT	9, FCLLOOP2		CONV3060
	LR	1, 8	RESTORE R1	CONV3070
	MVI	SCALE, X'00'		CONV3080
	MVI	MINUS, X'00'		CONV3090
	BR	11		CONV3100
FLDDP	MVI	CONPAR, X'08'	SET FOR 8 BYTES	CONV3110
	XI	TYPO, X'00'		CONV3120
	R	FCLLOOP3		CONV3130
	TITLE	'EXIT ROUTINES'		CONV3140
EXIT	S	5, BUFFADD	DETERMINE AMOUNT OF ARRAY USED	CONV3150
EXITBC	L	1, 12(0, 6)		CONV3160
	ST	5, 0(0, 1)		CONV3170
	L	13, SAVEAREA+4		CONV3180
	LM	14, 12, 12(13)		CONV3190
	MVI	12(13), X'FF'		CONV3200
	SPM	14		CONV3210
	BR	14		CONV3220
	TITLE	'ERROR EXITS'		CONV3230
*		FLOATING REGISTER 0 CONTAINS FIRST 8 BYTES OF FORMAT		CONV3240
*		REGISTER 10 INDICATES ERROR		CONV3250
*		REGISTER 11 CONTAINS INDEX ON FORMAT STATEMENT TO QUESTIONABLE CHAR		CONV3260
*				CONV3270
ILLEG1	LA	10, 1	NO OPENNING (	CONV3280
	B	ILLEG		CONV3290
ILLEG2	LA	10, 2	T FIELD	CONV3300
	B	ILLEG		CONV3310
ILLEG3	LA	10, 3	MORE THAN ONE LEVEL OF GROUPING	CONV3320
	B	ILLEG		CONV3330
ILLEG4	LA	10, 4	INCORRECT FIELD SPECIFICATION	CONV3340
	B	ILLEG		CONV3350
ILLEG5	LA	10, 5	INCORRECT HOLLERITH SPECIFICATION	CONV3360
	B	ILLEG		CONV3370
ILLEG6	LA	10, 6	ILLEGAL CHARACTER	CONV3380
	B	ILLEG		CONV3390
ILLEG7	LA	10, 7	G FIELD	CONV3400
	B	ILLEG		CONV3410
ILLEG8	LA	10, 8	WIDTH GREATER THAN 255	CONV3420
	B	ILLEG		CONV3430
ILLEG9	LA	10, 9	NO VARIABLE	CONV3440
ILLEG	LR	11, 1		CONV3450
	S	11, 0(0, 6)		CONV3460
	L	1, 0(0, 6)		CONV3470
	MVC	FORMAT(8), 0(1)	MOVE IN 8 BYTES OF FORMAT	CONV3480
	LD	0, FORMAT		CONV3490
	ABEND	1001, DUMP	ERROR ENDING	CONV3500
*				CONV3510
*		IF LIST IS TOO SHORT USE LAST VARIABLE OVER		CONV3520
*				CONV3530
LISTERRI	LTR	7, 7		CONV3540
	BZ	ILLEG9	JUMP IF NO VARIABLE	CONV3550
	MVI	PSTLST, C'Y'		CONV3560
	L	2, 12(7, 6)		CONV3570
	ST	2, ARRADD		CONV3580
BMPARI	SR	2, 2		CONV3590

	IC	2. CONPAR	INCREASE ADDRESS IN ARRAY	CONV3600
	A	2. ARRADD		CONV3610
	ST	2. ARRADD		CONV3620
	B	FCLOOP1		CONV3630
	TITLE	'TRANSLATE TABLE'		CONV3640
TRTSTB	DS	0F		CONV3650
	DC	64X'54'	ILLEG CHAR	CONV3660
	DC	X'00'	BLANK	CONV3670
	DC	10X'54'		CONV3680
	DC	X'44'	PERIOD	CONV3690
	DC	X'54'		CONV3700
	DC	X'08'		CONV3710
	DC	15X'54'		CONV3720
	DC	X'50'		CONV3730
	DC	2X'54'		CONV3740
	DC	X'10'	MINUS	CONV3750
	DC	X'40'	SLASH	CONV3760
	DC	9X'54'		CONV3770
	DC	X'48'	COMMA	CONV3780
	DC	17X'54'		CONV3790
	DC	X'40'	QUOTE	CONV3800
	DC	X'54'		CONV3810
	DC	X'40'	QUOTE	CONV3820
	DC	65X'54'		CONV3830
	DC	X'00'	A	CONV3840
	DC	X'54'		CONV3850
	DC	X'58'	C	CONV3860
	DC	X'20'	D	CONV3870
	DC	X'28'	E	CONV3880
	DC	X'24'	F	CONV3890
	DC	X'30'	G	CONV3900
	DC	X'30'	H	CONV3910
	DC	X'18'	I	CONV3920
	DC	9X'54'		CONV3930
	DC	X'10'	L	CONV3940
	DC	3X'54'		CONV3950
	DC	X'20'	P	CONV3960
	DC	11X'54'		CONV3970
	DC	X'34'	T	CONV3980
	DC	3X'54'		CONV3990
	DC	X'38'	X	CONV4000
	DC	X'54'		CONV4010
	DC	X'14'	Z	CONV4020
	DC	6X'54'		CONV4030
	DC	10X'04'	0-9	CONV4040
	DC	6X'54'		CONV4050
	TITLE	'VARAIBLES AND CONSTANTS'		CONV4060
FORMAT	DS	1D		CONV4070
ARRADD	DS	1F		CONV4080
BUFFADD	DS	1F		CONV4090
GINDEX	DS	1F		CONV4100
SAVEAREA	DS	18F		CONV4110
FMTDIG	DC	H'00'		CONV4120
TEN	DC	H'10'		CONV4130
IGCOMA	DS	CL1		CONV4140
INOUT	DS	CL1		CONV4150
MINUS	DS	CL1		CONV4160
PSTLST	DS	CL1		CONV4170
TYPE	DS	CL1		CONV4180
DD	EQU	CONPAR+2		CONV4190
SCALE	EQU	CONPAR+3		CONV4200
TYPO	EQU	CONTYPE+3		CONV4210
WIDTH	EQU	CONPAR+1		CONV4220
	END			CONV4230

d. Subroutine LINSRT

Description:

This subroutine sorts the source contribution for a given receptor into descending order; sorting procedure used is linear insertion.

Parameters:

N

Number of source contributions to be sorted.

ELEM

Array containing the source contributions.

INDEX

Array which will contain the ordered indices after the sort is completed; only the indices are "moved" during the sort.

		LINS	0
C	SUBROUTINE LINSRT(N,ELEM,INDEX)	LINS	10
C	*****	LINS	20
C	SUBROUTINE "SORTS" A LIST OF ELEMENTS INTO DECREASING ORDER USING	LINS	30
C	LINEAR INSERTION SORT. ONLY THE "INDEX" LIST IS REORDERED--NOT	LINS	40
C	THE ACTUAL LIST ELEMENTS.	LINS	50
C	*****	LINS	60
C	DIMENSION ELEM(N), INDEX(N)	LINS	70
	IF (N .LE. 1) RETURN	LINS	80
	NM1 = N - 1	LINS	90
	DO 10 I = 1,NM1	LINS	100
	I1 = INDEX(I)	LINS	110
	I2 = INDEX(I+1)	LINS	120
C	COMPARISON OF "CONSECUTIVE" ELEMENTS	LINS	130
	IF (ELEM(I1) .GT. ELEM(I2)) GO TO 10	LINS	140
	INDEX(I1+1) = I1	LINS	150
C	TEST IF FIRST ELEMENT IN LIST	LINS	160
	IF (I .EQ. 1) GO TO 6	LINS	170
C	STORE ELEMENT IN TEMPORARY LOCATION	LINS	180
	TEMP = ELEM(I2)	LINS	190
	LIM = I - 1	LINS	200
C		LINS	210
C	FIND PROPER PLACE FOR ELEMENT IN PRECEDING LIST	LINS	220
	DO 4 J = 1,LIM	LINS	230
	IMJ = I - J	LINS	240
	I3 = INDEX(IMJ)	LINS	250
	IF (ELEM(I3) .GT. TEMP) GO TO 8	LINS	260
	INDEX(IMJ+1) = I3	LINS	270
	4 CONTINUE	LINS	280
C	"INSERT" ELEMENT	LINS	290
	6 INDEX(I) = I2	LINS	300
	GO TO 10	LINS	310
C	"INSERT" ELEMENT	LINS	320
	8 INDEX(IMJ+1) = I2	LINS	330
C		LINS	340
	10 CONTINUE	LINS	350
C		LINS	360
	RETURN	LINS	370
	END	LINS	380

e. MAIN ProgramDescription:

The main program inputs all data, and modifies calculation parameters as specified through input or initial values. It initiates the calculation and output of receptor concentration data through the call to POLUT. Through calls to SELECT and CULPLT it "selects" the receptors and highest contributors for the culpability list.

Input: NAMELIST, 'INDATA'

 NAMELIST, 'INSORC'

Output:

All receptor locations and concentrations and the "selected" receptors (by number) in the culpability list are output, if requested.

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C *****MAIN 0
C ARGONNE STEADY STATE MODEL. JANUARY 1972. MAIN 10
C PROGRAM CALCULATES GROUND LEVEL CONCENTRATIONS AT DESIGNATED MAIN 20
C RECEPTORS FOR A PARTICULAR SET OF METEOROLOGICAL CONDITIONS; MAIN 30
C NAMELY, SEASON, STABILITY CLASS, WIND DIRECTION, AND WIND SPEED. MAIN 40
C PROGRAM STRUCTURE IS BASED UPON THE 'AQDM' PROGRAM. MAIN 50
C *****MAIN 60
C REAL*8 LABEL(5), METSET(2), SEASON(4), TITLE1(12), WINDSP(6) MAIN 70
C INTEGER SEA(4), STAB(5), WD(16), WS(6) MAIN 80
C COMMON/CULP/IAPERT, NCSORC MAIN 90
C COMMON/PGLTYP/IPOLU1, IPOLU2 MAIN 100
C COMMON/RCPCON/NRECEP, CPOLUT(2,340) MAIN 110
C COMMON/RECPT/DM, ISTAB, IWD, IWS, LINCT, NSORCE, S, BACKGR(2), MAIN 120
C * QSORCE(1000), RECEPT(2,340), SORCE(7,1000) MAIN 130
C COMMON/SELCT/NSELC, ISELC(2,10), POLUTC(2,10) MAIN 140
C COMMON/TITLES/LABEL, TITLE1, REGION(18) MAIN 150
C DIMENSION ATEMP(4), DEDAYF(4), DELX(4), DELY(4), DPTHMX(4), MAIN 160
C 1 EMRATE(2,1000), FALL(3,1000), ICONP(10), ICONS(10), INCRX(4), MAIN 170
C 2 INCXY(4), MSEA(4), MSTAB(5), MWDSP(16), NADJS(4), RBASE(2), MAIN 180
C 3 SPRING(3,1000), STABCL(5), SUMMER(3,1000), TITLE2(24), WINDR(16), MAIN 190
C 4 WINTER(3,1000), XRECEP(2,20) MAIN 200
C EQUIVALENCE (TITLE1(1), TITLE2(1)), (LABEL(1), METSET(1)) MAIN 210
C MAIN 220
C DATA SEASON/8HDEC-FEB , 8HMAR-MAY , 8HJUNE-AUG, 8HSEPT-NOV/ MAIN 230
C DATA STABCL/4H 1 , 4H 2 , 4H 3 , 4H 4 , 4H 5 / MAIN 240
C DATA WINDR/4HN , 4HNE , 4HNE , 4HNE , 4HE , 4HESE , 4HSE , MAIN 250
C 1 4HSSE , 4HS , 4HSSW , 4HSW , 4HWSW , 4HW , 4HWNW , 4HWNW , MAIN 260
C 2 4HNNW / MAIN 270
C DATA WINDSP/8H 0 - 3 , 8H 4 - 6 , 8H 7 - 10 , 8H 11 - 16 , MAIN 280
C * 8H 17 - 21 , 8H OVER 21 / MAIN 290
C DATA MSEA/4HH , 4HS , 4HN , 4HF / MAIN 300
C DATA MSTAB/4HVU , 4HMU , 4HSU , 4HNT , 4HST / MAIN 310
C DATA MWDSP/4H 3 , 4H 6 , 4H 10 , 4H 16 , 4H 21 , 4H 25 / MAIN 320
C DATA ATEMP, DEDAYF, DPTHMX/271.89, 283.0, 296.89, 283.0, MAIN 330
C 1 2.16, 1.0, 0.04, 0.8, MAIN 340
C 2 600.0, 850.0, 1100.0, 850.0/ MAIN 350
C DATA LSEA, LSTAR, LWD, LWS/ 4*0 / MAIN 360
C DATA DELTA, IADD, IPUNCH, MSRC, NCASE, NHIGH, NPOLUT, RBASE, RCFR/ MAIN 370
C * 0.0, 0, 0, 10, 1, 10, 0, 2*0.0, 0.45/ MAIN 380
C MAIN 390
C MAIN 400
C NAMELIST/INSORC/NSORCE, NCSORC, SORCE, QSORCE MAIN 410
C NAMELIST/INDATA/REGION, METSET, RBASE, DELTA, INCRX, INCXY, NDELX, MAIN 420
C 1 DELX, NDELY, DELY, IADD, XRECEP, NPOLUT, BACKGR, RCFR, NCASE, IPUNCH, MAIN 430
C 2 LSEA, SEA, ATEMP, DEDAYF, DPTHMX, WINTER, SPRING, SUMMER, FALL, MAIN 440
C 3 LSTAB, STAB, LWD, WD, LWS, WS, NSELC, ICONS, ICONP, NHIGH, MSRC, MAIN 450
C 4 IAPERT MAIN 460
C MAIN 470
C C***INITIALIZE ARRAYS TO ZERO MAIN 480
C DO 1 J = 1,1000 MAIN 490
C QSORCE(J) = 0.0 MAIN 500
C DO 1 I = 1,3 MAIN 510
C WINTER(I, J) = 0.0 MAIN 520
C SPRING(I, J) = 0.0 MAIN 530
C SUMMER(I, J) = 0.0 MAIN 540
C FALL(I, J) = 0.0 MAIN 550
C 1 CONTINUE MAIN 560
C C***INPUT REGIONAL FILE OF SOURCE INFORMATION FROM "&INSORC" MAIN 570
C MAIN 580

```



```

      READ(10,INSORC)
      IF (NSORCE .GT. 0) GO TO 5
      WRITE(6,400) NSORCE
      GO TO 280
C
C   REDUCE "QSORCE" TO 12% IF SORCE(7,ISORCE) IS 4911; OTHERWISE TO 20%
C   5 DO 10 ISORCE = 1,NSORCE
      QSORCE(ISORCE) = QSORCE(ISORCE) * 0.20
      IF (SORCE(7,ISORCE) .EQ. 4911.0)
        *
        *   QSORCE(ISORCE) = QSORCE(ISORCE) * 0.60
10  CONTINUE
      IF (NCSORC .EQ. NSORCE) GO TO 25
C
      NAREA = NCSORC + 1
      DO 20 ISORCE = NAREA,NSORCE
C   CONVERT AREA TO SIDE LENGTH OF EQUIVALENT SQUARE
      SORCE(3,ISORCE) = 1.0E+3 * SQRT(SORCE(3,ISORCE))
20  CONTINUE
C
C   CONVERT EMISSION RATES FROM 'TONS/DAY' TO 'MICROGRAMS/SECOND'
C   AND SAVE FOR POSSIBLE SEASONAL ADJUSTMENT
C   25 DO 30 ISORCE = 1,NSORCE
      SO2
      EMRATE(1,ISORCE) = SORCE(4,ISORCE) * 1.05E+7
C   PARTICULATE
      EMRATE(2,ISORCE) = SORCE(5,ISORCE) * 1.05E+7
30  CONTINUE
C***INPUT CALCULATION AND CONTROL PARAMETERS FROM "&INDATA"
      READ(5,INDATA)
      NCASES = LSEA * LSTAB * LWD * LWS
      IF (NCASES .GT. 0) GO TO 35
      WRITE(6,410) LSEA,LSTAB,LWD,LWS
      GO TO 280
C
C   35 NCASE = NCASE - 1
      IF (NPOLUT .EQ. 1) IPOLU2 = 1
      IF (NPOLUT .EQ. 2) IPOLU1 = 2
      NHIGH = MIN0(10,NHIGH)
      MSRC = MIN0(20,MSRC)
C***CREATE THE RECEPTOR GRID WITH ORIGIN AT RBASE
      IF (DELTA .EQ. 0.0) GO TO 40
      DELX(1) = DELTA
      DELY(1) = DELTA
C
C   40 IRECEP = 0
      X = RBASE(1) - DELX(1)
      DO 60 NX = 1,NDELX
        DELTAX = DELX(NX)
        INCR1 = INCRX(NX)
C
        DO 60 LAT = 1,INCR1
          X = X + DELTAX
C
          *****
          Y = RBASE(2) - DELY(1)
          DO 50 NY = 1,NDELY
            DELTAY = DELY(NY)
            INCR2 = INCRY(NY)
C
            DO 50 LON = 1,INCR2

```

MAIN 590
 MAIN 600
 MAIN 610
 MAIN 620
 MAIN 630
 MAIN 640
 MAIN 650
 MAIN 660
 MAIN 670
 MAIN 680
 MAIN 690
 MAIN 700
 MAIN 710
 MAIN 720
 MAIN 730
 MAIN 740
 MAIN 750
 MAIN 760
 MAIN 770
 MAIN 780
 MAIN 790
 MAIN 800
 MAIN 810
 MAIN 820
 MAIN 830
 MAIN 840
 MAIN 850
 MAIN 860
 MAIN 870
 MAIN 880
 MAIN 890
 MAIN 900
 MAIN 910
 MAIN 920
 MAIN 930
 MAIN 940
 MAIN 950
 MAIN 960
 MAIN 970
 MAIN 980
 MAIN 990
 MAIN1000
 MAIN1010
 MAIN1020
 MAIN1030
 MAIN1040
 MAIN1050
 MAIN1060
 MAIN1070
 MAIN1080
 MAIN1090
 MAIN1100
 MAIN1110
 MAIN1120
 MAIN1130
 MAIN1140
 MAIN1150
 MAIN1160
 MAIN1170

IRECEP = IRECEP + 1	MAIN1180
Y = Y + DELTAY	MAIN1190
RECEPT(1,IRECEP) = X	MAIN1200
RECEPT(2,IRECEP) = Y	MAIN1210
50 CONTINUE	MAIN1220
C *****	MAIN1230
60 CONTINUE	MAIN1240
NRECEP = IRECEP + IADD	MAIN1250
IF (IADD .EQ. 0) GO TO 80	MAIN1260
C ADDITIONAL RECEPTOR POINTS	MAIN1270
DO 70 I = 1,IADD	MAIN1280
N = IRECEP + 1	MAIN1290
RECEPT(1,N) = XRECEP(1,I)	MAIN1300
RECEPT(2,N) = XRECEP(2,I)	MAIN1310
70 CONTINUE	MAIN1320
C ***RECEPTOR GRID CREATED**	MAIN1330
C	MAIN1340
80 IF (NSFLC .EQ. 0) GO TO 86	MAIN1350
C SELECT RECEPTORS FOR CULPABILITY LISTS FROM INPUT	MAIN1360
DO 83 N = 1,NIIICH	MAIN1370
ISELC(1,N) = ICONS(N)	MAIN1380
ISELC(2,N) = ICOMP(N)	MAIN1390
83 CONTINUE	MAIN1400
C CHECK FOR SEASONAL ADJUSTMENTS IN EMISSION RATES	MAIN1410
C WINTER	MAIN1420
86 DO 90 N = 1,1000	MAIN1430
IF (WINTER(1,N) .EQ. 0.0) GO TO 91	MAIN1440
90 CONTINUE	MAIN1450
N = 1001	MAIN1460
91 NADJS(1) = N - 1	MAIN1470
C SPRING	MAIN1480
DO 92 N = 1,1000	MAIN1490
IF (SPRING(1,N) .EQ. 0.0) GO TO 93	MAIN1500
92 CONTINUE	MAIN1510
N = 1001	MAIN1520
93 NADJS(2) = N - 1	MAIN1530
C SUMMER	MAIN1540
DO 94 N = 1,1000	MAIN1550
IF (SUMMER(1,N) .EQ. 0.0) GO TO 95	MAIN1560
94 CONTINUE	MAIN1570
N = 1001	MAIN1580
95 NADJS(3) = N - 1	MAIN1590
C FALL	MAIN1600
DO 96 N = 1,1000	MAIN1610
IF (FALL(1,N) .EQ. 0.0) GO TO 97	MAIN1620
96 CONTINUE	MAIN1630
N = 1001	MAIN1640
97 NADJS(4) = N - 1	MAIN1650
C***START OF SEASON LOOP	MAIN1660
DO 270 JSEA = 1,LSEA	MAIN1670
ISEA = SEA(JSEA)	MAIN1680
DM = DPTHMX(ISEA)	MAIN1690
ARSRCF = DEDAYF(ISEA)*RCFR + (1.0 - RCFR)	MAIN1700
TA = ATEMP(ISEA)	MAIN1710
S = 1.12056/TA	MAIN1720
TITLE1(2) = SEASON(ISEA)	MAIN1730
CALL CONVO('A1'),LABEL(3),4,K,MSEA(ISEA)	MAIN1740
C "RESTORE" EMISSION RATES FOR ALL SOURCES	MAIN1750
DO 120 IPOLUT = IPOLU1,IPOLU2	MAIN1760

K = IPOLUT + 3	MAIN1770
C POINT SOURCES	MAIN1780
DO 100 ISORCE = 1, NCSORC	MAIN1790
SORCE(K, ISORCE) = EMRATE(IPOLUT, ISORCE)	MAIN1800
100 CONTINUE	MAIN1810
IF (NCSORC .EQ. NSORCE) GO TO 120	MAIN1820
C AREA SOURCES: MODIFY EMISSION RATE BY ARSRCF	MAIN1830
DO 110 ISORCE = NAREA, NSORCE	MAIN1840
SORCE(K, ISORCE) = EMRATE(IPOLUT, ISORCE) * ARSRCF	MAIN1850
110 CONTINUE	MAIN1860
C	MAIN1870
120 CONTINUE	MAIN1880
IF (NADJS(ISEA) .EQ. 0) GO TO 220	MAIN1890
C***SEASONAL ADJUSTMENTS OF EMISSION RATES	MAIN1900
NADJ = NADJS(ISEA)	MAIN1910
DO 210 IPOLUT = IPOLU1, IPOLU2	MAIN1920
K = IPOLUT + 3	MAIN1930
L = IPOLUT + 1	MAIN1940
C SELECT SEASON	MAIN1950
GO TO (130, 150, 170, 190), ISEA	MAIN1960
C WINTER	MAIN1970
130 DO 140 N = 1, NADJ	MAIN1980
ISORCE = WINTER(1, N)	MAIN1990
SORCE(K, ISORCE) = SORCE(K, ISORCE) * WINTER(L, N)	MAIN2000
140 CONTINUE	MAIN2010
GO TO 210	MAIN2020
C SPRING	MAIN2030
150 DO 160 N = 1, NADJ	MAIN2040
ISORCE = SPRING(2, N)	MAIN2050
SORCE(K, ISORCE) = SORCE(K, ISORCE) * SPRING(L, N)	MAIN2060
160 CONTINUE	MAIN2070
GO TO 210	MAIN2080
C SUMMER	MAIN2090
170 DO 180 N = 1, NADJ	MAIN2100
ISORCE = SUMMER(1, N)	MAIN2110
SORCE(K, ISORCE) = SORCE(K, ISORCE) * SUMMER(L, N)	MAIN2120
180 CONTINUE	MAIN2130
GO TO 210	MAIN2140
C FALL	MAIN2150
190 DO 200 N = 1, NADJ	MAIN2160
ISORCE = FALL(1, N)	MAIN2170
SORCE(K, ISORCE) = SORCE(K, ISORCE) * FALL(L, N)	MAIN2180
200 CONTINUE	MAIN2190
C	MAIN2200
210 CONTINUE	MAIN2210
C ***ALL SEASONAL ADJUSTMENTS COMPLETED	MAIN2220
C***START OF STABILITY-CLASS LOOP	MAIN2230
220 DO 270 JSTAB = 1, LSTAB	MAIN2240
ISTAB = STAB(JSTAB)	MAIN2250
TITLE2(10) = STABCL(ISTAB)	MAIN2260
CALL CONVO('A2', LABEL(3), 6, K, MSTAB(ISTAB))	MAIN2270
C***START OF WIND-DIRECTION LOOP	MAIN2280
DO 270 JWD = 1, LWD	MAIN2290
IWD = WD(JWD)	MAIN2300
TITLE2(16) = WINDR(IWD)	MAIN2310
CALL CONVO('A3', LABEL(3), 9, K, WINDR(IWD))	MAIN2320
C***START OF WIND-SPEED LOOP	MAIN2330
DO 270 JWS = 1, LWS	MAIN2340
IWS = WS(JWS)	MAIN2350

```

      TITLE1(11) = WINDSP(IWS)
      CALL CONVO('A2', LABEL(3), 13, K, MWDSP(IWS))
C
      LINCT = 100
      NCASE = NCASE + 1
      CALL CONVO('I3', LABEL(5), 0, K, NCASE)
C  CALCULATE AND OUTPUT GROUND-LEVEL CONCENTRATIONS FOR ALL RECEPTORS
      DO 230 IRECEP = 1, NRECEP
      CALL POLUT(IRECEP, .FALSE.)
230 CONTINUE
C
      IF (IPUNCH .EQ. 0) GO TO 250
C  OUTPUT RECEPTOR CONCENTRATION DATA ON UNIT 'IPUNCH'
      DO 240 IRECEP = 1, NRECEP
      WRITE(IPUNCH, 300) (RECEPT(L, IRECEP), L=1, 2), (CPOLUT(IPOLUT, IRECEP),
      *      IPOLUT = IPOLU1, IPOLU2)
240 CONTINUE
C  MET SET IDENTIFIER
      IDENT = -(ISEA*10000 + ISTAB*1000 + IND*10 + IWS)
      WRITE(IPUNCH, 310) IDENT
C***"SELECT" RECEPTORS FOR CULPABILITY LIST
250 CALL SELECT(NHIGH)
C
      IF (IPUNCH .EQ. 0) GO TO 260
C  RECEPTORS FROM THE CULPABILITY LIST
      WRITE(IPUNCH, 320) (ISELC(1, K), K=1, NHIGH)
      WRITE(IPUNCH, 320) (ISELC(2, K), K=1, NHIGH)
C***"GENERATE" CULPABILITY LIST
260 CALL CULPLT(NHIGH, MSRC)
C
270 CONTINUE
C***END OF MET SET LOOP***
C
280 STOP
C
300 FORMAT(2P2F8.0, 1X, 2(2PF9.0))
310 FORMAT(I7)
320 FORMAT(10I6)
400 FORMAT(1H0, 10X, 'REGIONAL SOURCE FILE ERROR'//1H , 16X,
      *      'NSORCE =', I6)
410 FORMAT(1H0, 10X, 'INPUT DATA ERROR'//1H , 12X, 'LSEA =', I6/
      1 1H , 12X, 'LSTAB =', I6/1H , 12X, 'LWD =', I6/
      2 1H , 12X, 'LWS =', I6)
C
      END

```

MAIN2360
 MAIN2370
 MAIN2380
 MAIN2390
 MAIN2400
 MAIN2410
 MAIN2420
 MAIN2430
 MAIN2440
 MAIN2450
 MAIN2460
 MAIN2470
 MAIN2480
 MAIN2490
 MAIN2500
 MAIN2510
 MAIN2520
 MAIN2530
 MAIN2540
 MAIN2550
 MAIN2560
 MAIN2570
 MAIN2580
 MAIN2590
 MAIN2600
 MAIN2610
 MAIN2620
 MAIN2630
 MAIN2640
 MAIN2650
 MAIN2660
 MAIN2670
 MAIN2680
 MAIN2690
 MAIN2700
 MAIN2710
 MAIN2720
 MAIN2730
 MAIN2740
 MAIN2750
 MAIN2760
 MAIN2770
 MAIN2780
 MAIN2790
 MAIN2800

f. Subroutine POLUTDescription:

This subroutine computes the ground-level concentrations for all receptors and outputs a table containing the receptor concentration data. It is also used to calculate and store the contribution from each source for a selected receptor. The calculation "mode" of this routine is controlled through the input variable INDSRC.

Parameters: IRECEP

Number of the receptors for which concentration data or source contributions will be calculated.

INDSRC

Control for calculation "mode" of the routine;

 .FALSE. for receptor concentrations

 .TRUE. for source contributions

Output:

A table containing the receptor number, its location, and its SO₂ and/or particulate concentration levels.

```

SUBROUTINE POLUT(IRECEP,INDSRC)
C *****
REAL*8 TITLE1(12),LABEL(5)
INTEGER SORID
LOGICAL INDSRC
COMMON/POLYTP/IPOLU1,IPOLU2
COMMON/RCPCON/NRECEP,CPOLUT(2,340)
COMMON/RECPT/DM,ISTAB,IWD,IWS,LINCT,NSORCE,S,BACKGR(2).
* QSORCE(1000),RECEPT(2,340),SORCE(7,1000)
COMMON/SRCS/IPOLUT,NPTSRC,HEFF(1000),SORCON(500),SORID(500)
COMMON/TITLES/LABEL,TITLE1,REGION(18)
DIMENSION A(7,6),B(7,6),C(3,5),D(3,5),TIME(7),COSWD(16),
* SINWD(16),UU(6)
EQUIVALENCE (IWNDIR,IWD)
C
DATA A/.17122, .27668, .41219, .51921, .50963, .47639, .52140,
1 .11062, .39953, .41219, .57145, .76485, .71936, .88886,
2 .01338, .16640, .41219, 1.0813, 1.9467, 2.3901, 1.8877,
3 .01338, .16640, .41219, 2.2830, 2.9850, 3.8684, 6.7452,
4 .01338, .16640, .41219, 2.3333, 5.7990, 16.897, 20.673,
5 .01338, .16640, .41219, 5.6801, 14.599, 64.577, 54.149/
DATA B/1.2098, 1.0572, .92365, .84130, .79689, .76308, .69839,
1 1.2864, .99275, .92365, .82449, .72571, .69082, .60486,
2 1.5922, 1.1195, .92365, .73217, .59047, .51700, .49583,
3 1.5922, 1.1195, .92365, .63883, .53708, .45686, .33677,
4 1.5922, 1.1195, .92365, .63646, .46497, .29621, .21517,
5 1.5922, 1.1195, .92365, .55016, .37541, .16667, .12177/
DATA C/3*110.0, 3*60.0, 2*33.0, 40.0, 2*21.5, 36.0, 2*14.0, 23.5/
DATA D/1.0, 2*1.09, 3*0.92, 0.80, 0.61, 0.53, 0.70, 0.56, 0.35,
* 0.78, 0.53, 0.30/
DATA TIME/0.0, 3.0E+2, 1.0E+3, 3.0E+3, 1.0E+4, 3.0E+4, 1.72E+5/
C COSWD(IWNDIR)=COS((PI*FLOAT(IWNDIR-1))/8)
DATA COSWD/1.0, .92388, .70711, .38268, 0.0, -.38268, -.70711, -.92388,
1 -1.0, -.92388, -.70711, -.38268, 0.0, .38268, .70711, .92388/
C SINWD(IWNDIR)=SIN((PI*FLOAT(IWNDIR-1))/8)
DATA SINWD/0.0, .38268, .70711, .92388, 1.0, .92388, .70711, .38268, 0.0,
1 -.38268, -.70711, -.92388, -1.0, -.92388, -.70711, -.38268/
DATA UU/.67056, 2.45872, 4.47040, 6.92912, 9.61136, 12.51712/
DATA GDSCAL,PI4,PI8,QSCALE/1000.0, 0.7853982, 0.3926991, 1.0/
C *****
C IF (INDSRC) GO TO 100
C
C CPOLUT(1,IRECEP) = 0.0
C CPOLUT(2,IRECEP) = 0.0
C LOOP ON SOURCE
100 DO 300 ISORCE = 1, NSORCE
C***GEOMETRY BASED UPON AQDM
SDIAM = SORCE(3,ISORCE)
SRAD = 0.5 * SDIAM
DNWIND = GDSCAL * ((SORCE(2,ISORCE) - RECEPT(2,IRECEP)) *
1 COSWD(IWNDIR) + (SORCE(1,ISORCE) - RECEPT(1,IRECEP)) *
2 SINWD(IWNDIR) )
X = DNWIND + SDIAM/PI8
IF (SDIAM.GT. 100.) GO TO 110
IF (X) 300,300,120
110 IF ((SRAD+DNWIND) .LE. 0.0) GO TO 300
120 CXWIND = GDSCAL * ABS( (SORCE(2,ISORCE) - RECEPT(2,IRECEP)) *
1 SINWD(IWNDIR) - (SORCE(1,ISORCE) - RECEPT(1,IRECEP)) *
POLU 0
POLU 10
POLU 20
POLU 30
POLU 40
POLU 50
POLU 60
POLU 70
POLU 80
POLU 90
POLU 100
POLU 110
POLU 120
POLU 130
POLU 140
POLU 150
POLU 160
POLU 170
POLU 180
POLU 190
POLU 200
POLU 210
POLU 220
POLU 230
POLU 240
POLU 250
POLU 260
POLU 270
POLU 280
POLU 290
POLU 300
POLU 310
POLU 320
POLU 330
POLU 340
POLU 350
POLU 360
POLU 370
POLU 380
POLU 390
POLU 400
POLU 410
POLU 420
POLU 430
POLU 440
POLU 450
POLU 460
POLU 470
POLU 480
POLU 490
POLU 500
POLU 510
POLU 520
POLU 530
POLU 540
POLU 550
POLU 560
POLU 570
POLU 580

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```

2      COSWD(IWDIR) )
Y = X * PI8
IF (Y .LE. CXWIND) GO TO 300
IF (SRAD .GT. ABS(DNWIND)) GO TO 130
IF (SDIAM .LE. (DNWIND*PI8)) GO TO 140
Q = QSCALE * ((Y - SDIAM)/SDIAM)
DNWIND = SQRT((DNWIND*DNWIND) + (SRAD*SRAD) )
X = 2.0 * DNWIND
IF (CXWIND - (SRAD+Y)) 150, 150, 300
130 Q = QSCALE * (PI4*(X*X - 4.08*X*SDIAM + 4.1616*SDIAM*SDIAM))/
      * (SRAD*SRAD*16.0)
      DNWIND = SINWD(3) * (DNWIND + SRAD)
      X = 2.0 * DNWIND
      IF (CXWIND - SRAD) 150, 150, 300
140 Q = QSCALE
150 IF (X .LT. 100.) X = 100.0
C***END OF GEOMETRY
C
      U = UU(IWS)
      L = ISTAR
      Y = 100.0*Q/U
      IF (Y .LE. 0.0) GO TO 300
C***BRIGGS PLUME RISE FORMULATION
      HS = SORCE(6, ISORCE)
      IF (QSORCE(ISORCE) .NE. 0.0) GO TO 160
      PHT = HS
      GO TO 200
C
      1.079167E-7=3.7E-5*.07/24
160 F = 1.079167E-7 * QSORCE(ISORCE)
      IF (ISTAB .GT. 4) GO TO 170
C
      STABILITY CLASSES 1-4
      DELHA = 1.8 * F**0.3333333 * (10.0*HS)**0.6666667 /U
      PHT = HS + DELHA
      IF (PHT .LE. DM) GO TO 200
C
      EFFECTIVE STACK HEIGHT GREATER THAN LID HEIGHT : CALCULATE "NEW"
C
      EFFECTIVE STACK HEIGHT USING PLUME RISE FOR STABILITY CLASS 5
C
      STABILITY CLASS 5
170 IF (IWS .NE. 1) GO TO 180
C
      IWS = 1
      DELHM = 5.0 * F**0.25 / S**0.375
      GO TO 190
C
      IWS ^= 1
180 DELHM = 2.9 * (F/(U*S))**0.3333333
190 PHT = HS + DELHM
      IF (PHT .GT. DM) GO TO 300
C
      USE LID HEIGHT FOR EFFECTIVE STACK HEIGHT IN STABILITY CLASSES 1-4
      IF (ISTAB .NE. 5) PHT = DM
C***END OF PLUME RISE
200 IF (DNWIND .GE. 1000.) GO TO 210
      IF (DNWIND .LT. 100.) DNWIND = 100.0
C***CALCULATION OF DISPERSION COEFFICIENTS BASED ON TURNER'S WORKBOOK
210 TSEC = DNWIND/U
      DO 215 M = 2, 7
      IF (TSEC .LE. TIME(M)) GO TO 220
215 CONTINUE
      M = 6
      GO TO 230
C
220 M = M - 1

```

POLU 590
 POLU 600
 POLU 610
 POLU 620
 POLU 630
 POLU 640
 POLU 650
 POLU 660
 POLU 670
 POLU 680
 POLU 690
 POLU 700
 POLU 710
 POLU 720
 POLU 730
 POLU 740
 POLU 750
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 POLU 890
 POLU 900
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 POLU 920
 POLU 930
 POLU 940
 POLU 950
 POLU 960
 POLU 970
 POLU 980
 POLU 990
 POLU1000
 POLU1010
 POLU1020
 POLU1030
 POLU1040
 POLU1050
 POLU1060
 POLU1070
 POLU1080
 POLU1090
 POLU1100
 POLU1110
 POLU1120
 POLU1130
 POLU1140
 POLU1150
 POLU1160
 POLU1170

```

C      0.87055 = (60/120)**0.2
230 SIGZ = (A(L,M) * TSEC**B(L,M)) * 0.87055
    XXKM = DNWIND * 1.0E-3
    I = 1
    IF (XXKM .GT. 1.) I = 2
    IF (XXKM .GT. 10.) I = 3
    J = MAX0(L-1,I)
C      1.431 = (60/10)**0.2
    SIGTZ = (C(I,J) * XXKM**D(I,J)) * 1.431
    SIGZ = AMAX1(SIGZ,SIGTZ)
C***END OF DISPERSION CALCULATION - CALCULATE CONCENTRATION
    ARG1 = (-0.5*PHT*PHT)/(SIGZ*SIGZ)
    IF (ABS(ARG1) .GT. 60.) GO TO 300
C    DETERMINE X-CRITICAL FROM 2.17*SIGZ(XCRIT) = DM (LID HEIGHT)
    IF (SIGTZ .EQ. SIGZ) GO TO 240
C      1.88909 = 0.87055 * 2.17
    TSEC = ( DM/(1.88909*A(L,M)) )**(1.0/B(L,M))
    XCRIT = U * TSEC
    GO TO 250
C      3.10527 = 1.431 * 2.17
240 XXKM = ( DM/(3.10527*C(I,J)) )**(1.0/D(I,J))
    XCRIT = 1.0E+3 * XXKM
C
250 IF (X .LE. XCRIT) GO TO 260
C    UNIFORM MIXING IF X >= 2*XCRIT
    XCRIT2 = 2.0 * XCRIT
    CHI = (0.0255 * Y)/(DM * X)
    IF (X .GE. XCRIT2) GO TO 270
C    LINEAR INTERPOLATION IF XCRIT < X < 2*XCRIT
    CHI1 = (0.0203*Y)/(SIGZ*XCRIT) * EXP(ARG1)
    CHI2 = (0.0255*Y)/(DM*XCRIT2)
    CHI = CHI1 + ((CHI2 - CHI1)/XCRIT) * (X - XCRIT)
    GO TO 270
C    GAUSSIAN IF X <= XCRIT
260 CHI = (0.0203*Y)/(SIGZ*X) * EXP(ARG1)
C
C    HALF-LIFE MODIFICATION FOR SO2
270 ALIFE = EXP(-0.693*(DNWIND/U)/10800.0)
    IF (INDSRC) GO TO 280
C
    DO 280 IPOLUT = IPOLU1,IPOLU2
    CONC = CHI * SORCE(IPOLUT+3,ISORCE)
    IF (IPOLUT .EQ. 1) CONC = CONC * ALIFE
    CPOLUT(IPOLUT,IRECEP) = CPOLUT(IPOLUT,IRECEP) + CONC
280 CONTINUE
    GO TO 300
C
290 CONC = CHI * SORCE(IPOLUT+3,ISORCE)
    IF (CONC .EQ. 0.0) GO TO 300
    NPTSRC = NPTSRC + 1
    SORID(NPTSRC) = ISORCE
    IF (IPOLUT .EQ. 1) CONC = CONC * ALIFE
    SORCON(NPTSRC) = CONC
    HEFF(NPTSRC) = PHT
C
300 CONTINUE
C
    IF (INDSRC) RETURN
C

```

POLU1180
 POLU1190
 POLU1200
 POLU1210
 POLU1220
 POLU1230
 POLU1240
 POLU1250
 POLU1260
 POLU1270
 POLU1280
 POLU1290
 POLU1300
 POLU1310
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 POLU1560
 POLU1570
 POLU1580
 POLU1590
 POLU1600
 POLU1610
 POLU1620
 POLU1630
 POLU1640
 POLU1650
 POLU1660
 POLU1670
 POLU1680
 POLU1690
 POLU1700
 POLU1710
 POLU1720
 POLU1730
 POLU1740
 POLU1750
 POLU1760

g. Subroutine SELECTDescription:

This subroutine "selects" the N receptors that are to appear in the culpability list. Receptor selection is based upon either input values or the receptors with highest concentration levels.

Parameters: N

Number of receptors to be selected for the culpability list.

```

      SUBROUTINE SELECT(N)                                SELC  0
C *****SELSC *****SELSC  10
C SUBROUTINE "SELECTS" N RECEPTORS BASED UPON EITHER INPUT OR THE N SELC  20
C   HIGHEST CONCENTRATION VALUES. THE CONCENTRATION VALUES ARE STOREDSELSC  30
C   IN POLUTC AND THE RECEPTOR NUMBERS ARE IN ISELC. SELC  40
C *****SELSC *****SELSC  50
C   COMMON/POLUTYP/IPOLU1, IPOLU2 SELC  60
C   COMMON/RCPCON/NRECEP, CPOLUT(2, 340) SELC  70
C   COMMON/SELCT/NSELCT, ISELCT(2, 10), POLUTC(2, 10) SELC  80
C SELC  90
C   DO 50 IPOLUT = IPOLU1, IPOLU2 SELC 100
C   IF (NSELCT.EQ. 0) GO TO 15 SELC 110
C RECEPTORS SELECTED BY INPUT SELC 120
C   DO 10 I = 1, N SELC 130
C   IRECP = ISELCT(IPOLUT, I) SELC 140
C   POLUTC(IPOLUT, I) = CPOLUT(IPOLUT, IRECP) SELC 150
10 CONTINUE SELC 160
C   GO TO 50 SELC 170
C ***** SELC 180
C RECEPTORS SELECTED BY N HIGHEST CONCENTRATION VALUES SELC 190
15 DO 30 K = 1, N SELC 200
C   IRECP = 1 SELC 210
C   DO 20 I = 2, NRECEP SELC 220
C   IF (CPOLUT(IPOLUT, I) .GT. CPOLUT(IPOLUT, IRECP)) IRECP = I SELC 230
20 CONTINUE SELC 240
C SELC 250
C   ISELCT(IPOLUT, K) = IRECP SELC 260
C   POLUTC(IPOLUT, K) = CPOLUT(IPOLUT, IRECP) SELC 270
C DUMMY CONCENTRATION VALUE WITH -1.0 SELC 280
C   CPOLUT(IPOLUT, IRECP) = -1.0 SELC 290
30 CONTINUE SELC 300
C SELC 310
C RESTORE CONCENTRATION VALUES SELC 320
C   DO 40 I = 1, N SELC 330
C   IRECP = ISELCT(IPOLUT, I) SELC 340
C   CPOLUT(IPOLUT, IRECP) = POLUTC(IPOLUT, I) SELC 350
40 CONTINUE SELC 360
C ***** SELC 370
50 CONTINUE SELC 380
C SELC 390
C RETURN SELC 400
C END SELC 410

```

h. ASSM Job Control Language: Execution

ASSM has been compiled using S/360 FORTRAN IV (H) with OPT=02.

It's currently running on an IBM S/360 50-75 using OS MVT Release 20 under ASP.

The following JCL represents the use of the system facilities that ASSM could possibly require. It is the JCL used for the Chicago region sample problem. [Note: IAPERT = 1 requires FT07F001 and IPUNCH = 20 requires FT20F001.]

//	JOB
//	CLASS=C,REGION=176K
/*SETUP DDNAME=DISKUNIT,DEVICE=2314,LD=DISK85	
//JOB LIB	DD DSN=ASSM.PROGLIB,UNIT=2314,DISP=SHR,VOL=SER=DISK85
//	EXEC PGM=ASSM
//FT06F001	DD SYSOUT=A,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1596)
//FT07F001	DD SYSOUT=B
//FT10F001	DD DSN=CMAQCR.INSORC,UNIT=2314,DISP=SHR,VOL=SER=DISK85
//FT20F001	DD DSN=CMAQCR.RECPCONC,UNIT=2314,DISP=(,KEEP),
//	DCB=(RECFM=FB,LRECL=80,BLKSIZE=2000),SPACE=(TRK,(10,5),RLSE),
//	VOL=SER=DISK85
//FT05F001	DD *
&INDATA	
.	
.	
.	
&END	
/*	

2. Input Description

All input to the ASSM program uses the NAMELIST format. The following restrictions apply to each of the records (cards) in the input data sets (file or card deck).

- The first character (column) in each record (card) must be blank.
- The second character (column) in the first record (card) must be an &, immediately followed by the NAMELIST name. E.g., &INDATA or &INSORC.
- This name is followed by data items separated by commas. The form of the data item is:

VARIABLE NAME = CONSTANT(S)

The end of the data group is signaled by an &END.

- Only names in the Glossary* can be input. They must appear exactly as shown, and there must be no embedded blanks.
Only variables whose values need be assigned or changed should appear in the data group.
- There should be no blanks between the end of a constant and the comma. That is, all constants must be right justified. The constants should be of the same type as the in-

*See Sec. 3 of this appendix.

put variable. (Three types of constants are considered, namely

- alphameric - characters enclosed by
single quotation marks,
- integer - numeric value without a
decimal point, and
- real - numeric value with a
decimal point.)

The number of constants in the list must be less than or equal to the number of elements in the array.

With the exception of the first character (column) of each record (card), data items may appear anywhere in the record (card).

Input to ASSM is composed of two separate, but complementary, data sets (file). One is composed primarily of control parameters and meteorological data, and is input from logical unit 5 (card reader) through the NAMELIST name INDATA. The other contains regional source data and is input from logical unit 10 through the NAMELIST name INSORC. NAMELIST INDATA is considered first. Its deck structure is displayed in Figure B-2. Whenever possible, examples will reference the input and output for the sample problem. Thus, it would be advantageous to consult Figure B-3, the completed input form for the sample problem.

Fig. B-2. ASSM Card Input Deck

COMPUTER INPUT DATA FORM
9 8-COLUMN FIELDS

COST CODE _____

PROGRAM ASSM

PROBLEM Sample Problem

ORIGINATOR Matthies

DATE March 1972

PAGE 1 OF 1

1									2									3									4									5									6									7									8																	
1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9									
&INDATA																																																																																
																		IDENTIFICATION DATA																																																														
REGION=									'CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION'																																																																							
METSET=									'CHICAGO REGION'																																																																							
																		RECEPTOR GRID PARAMETERS																																																														
REASE=									375.0 , 4565.0 ,																																																																							
NDELX=									3 , DELX= 15.0 , 7.5 , 10.0 ,									INCRX= 2 , 12 , 2 ,																																																														
NDELY=									3 , DELY= 15.0 , 7.5 , 10.0 ,									INCRY= 2 , 12 , 2 ,																																																														
IADD=									12 ,																																																																							
XRECEP=									444.40 , 4650.01 , 444.40 , 4645.02 ,									447.61 , 4636.17 , 437.48 , 4634.96 ,																																																														
									432.73 , 4625.06 , 443.67 , 4625.62 ,									450.51 , 4625.55 , 445.04 , 4607.21 ,																																																														
									454.05 , 4606.88 , 464.51 , 4609.62 ,									402.56 , 4588.38 , 446.33 , 4615.73 ,																																																														
																		METEOROLOGICAL PARAMETERS																																																														
LSEA=									2 , SEA= 1 , 3 ,																																																																							
WINTER=									69. , 0.80 , 1.0 , 107. , 0.80 , 1.0 ,									171. , 1.0 , 0.85 ,																																																														
									178. , 1.0 , 0.85 , 362. , 0.80 , 0.85 ,																																																																							
LSTAB=									1 , STAB= 4 ,																																																																							
LWD=									2 , WD= 11 , 15 ,																																																																							
LWS=									2 , WS= 1 , 2 ,																																																																							
																		PROGRAM OPTIONS																																																														
IPUNCH=									20 ,																																																																							
IAPERT=									1 ,																																																																							
&END																																																																																

AMD-13 (7-66)

Fig. B-3. Data Input for Sample Problem

a. Identification Data

<u>Parameter</u>	<u>Type</u>	<u>Description</u>
REGION	Alphameric	Identifying information, of at most 72 characters enclosed in single quote marks, used as the primary title for all printed output. [Default* is all blanks]
METSET	Alphameric	Identifying information, of at most 16 characters enclosed in single quote marks, used as part of a label that appears on all output from the ASSM system. This "label" functions as a cross-reference for all output. [Default is all blanks]

*"Default" refers to value(s) assigned if variable is omitted from input.

b. Receptor-grid Parameters*

<u>Parameter</u>	<u>Type</u>	<u>Description</u>
RBASE	Real	<p>X (horizontal) and Y (vertical) coordinates, in kilometers, of the receptor <u>grid origin</u>. E.g., if the origin is (375,4565), then RBASE = 375.0, 4565.0 [Default is (0.0,0.0)]</p>
DELTA	Real	<p>Control parameter for the receptor grid type.</p> <p>If DELTA >0, a uniform grid is used and 'DELTA' is the spacing (kilometers) between consecutive grid points in both the X- and Y- directions.</p> <p>If DELTA is 0 or omitted, a variable spacing in either one or both directions (non-uniform grid) is used.</p> <p>E.g., in the sample problem a non-uniform grid was used and DELTA was omitted. If a uniform grid was desired, then DELTA = 12.5 could be used.</p> <p>[Default is 0]</p>

*Examples refer to the receptor grid displayed in Figure B-4. (Sample problem grid)

Fig. B-4. Chicago Region Receptor Grid

If a uniform grid is used, then omit the next four variables.

NDELX	Integer	Number of sections (<u><3</u>) in the X- direction of the receptor grid. E.g., the grid in the sample problem has 3 sections, NDELX = 3. [Default is 1]
NDELY	Integer	Similar to NDELX but for the Y- direction. (<u><3</u>). [Default is 1]
DELX	Real	Spacing(kilometers) between consecutive columns (mesh size) for each horizontal section of the grid. There must be NDELX such values. E.g., for the three horizontal sections of the sample grid, DELX = 15.0, 7.5, 10.0.
DELY	Real	Similar to DELX but for the Y- direction.

INCRX **Integer** For uniform grid, INCRX is the number of columns in the X- direction. E.g., for the grid of width 125 kilometers and DELTA = 12.5, then INCRX = 11

For non-uniform grid, INCRX is a list of the number of columns in the K uniform sections ($1 \leq K \leq 3$) of the grid in the X- direction. In the 2nd and 3rd sections, the leftmost (shared) column is not counted. E. g., for the grid of the sample problem with NDELX = 3 and DELX = 15.0, 7.5, 10.0, then INCRX = 2, 12, 2

INCRY **Integer** Similar to INCRX but for the Y-direction.

NOTE: The grid is defined independently in each direction. That is, the spacing in the horizontal direction need not correspond to that in the vertical direction.

IADD **Integer** Number of non/grid receptors.
[Default is zero]

XRECEP **Real** X and Y coordinates (kilometers) of the non-grid receptors. There must be IADD such coordinate pairs. E.g., In the same problem 12 such pairs are included.

NOTE: The total number of receptor locations (grid + non-grid) must not exceed 340. For the sample problem there are 268 receptor locations.

grid	
X: 12 + 2 + 2	} 16 X 16 = 256
Y: 12 + 2 + 2	
non-grid	$\frac{12}{268}$

c. Meteorological Parameters*

Parameter	Type	Description
LSEA	Integer	Number of seasons (≤ 4) to be considered.
SEA	Integer	List of indices (see Figure B-5) for the seasons considered. There must be LSEA such values. E.g., In the sample problem the winter and summer seasons are being considered, thus SEA = 1, 3.

The next three parameters are seasonally dependent. That is, selection of a particular season includes their values. Only if the values in Figure B-5 are to be changed should that parameter be included. In that case, the values for each season must be specified.

DPTHMX	Real	Mixing height for each season in meters.
DEDAYF	Real	Degree day factor for each season.
ATEMP	Real	Ambient temperature for each season in °K.

*Table B-1 contains the default meteorological data for ASSM.

TABLE B-1. Default Meteorological Data

Number	Wind Direction	Wind Speed (Knots)	Stability Class	Season	Mixing Height (Meters)	Degree Day Factor	Temperature	
							(°K)	(°F)
1	N	0-3	Unstable	Dec-Feb (Winter)	600	2.16	271.89	30
2	NNE	4-6	Moderately Unstable	Mar-May (Spring)	850	1.0	283.00	50
3	NE	7-10	Slightly Unstable	Jun-Aug (Summer)	1100	0.04	296.89	75
4	ENE	11-16	Neutral	Sept-Nov (Fall)	850	0.8	283.00	50
5	E	17-21	Stable					
6	ESE	over 21						
7	SE							
8	SSE							
9	S							
10	SSW							
11	SW							
12	WSW							
13	W							
14	WNW							
15	NW							
16	NNW							

It is possible to seasonally adjust the annual average emission rates of SO_2 and/or particulates for a selected set of sources. The following parameters perform this function.

WINTER	Real	List of triples specifying the source identifier and the emission rate adjustment factors for that source for the winter season only. For each source being modified, the first value is the source identification number (its input position in the regional source file*), the second value is the adjustment factor for SO_2 , and the last is the adjustment factor for particulates. No ordering of the sources being modified is assumed. E.g., in the sample problem five sources are being modified. In the first of these, source number 69, the SO_2 rate is being reduced by 20% while the particulate value is not to be changed. Thus, input is:
--------	------	---

WINTER = 69., 0.80, 1.0

*See the description of SORCE, p. 145.

SPRING	Real	Similar to WINTER but for the spring season only.
SUMMER	Real	Similar to WINTER but for the summer season only.
FALL	Real	Similar to WINTER but for the fall season only.

For the seasonal adjustment factors, each source that appears in the regional source file may be adjusted. If a source is selected, adjustment factors for both SO₂ and particulate must be input. Adjustments are always made to the emission rates in the input source file, regardless of what may have occurred for some other season. In the sample problem five sources will be modified for calculations of the winter season but the emission rates will revert back to their input values for calculations of the summer season.

LSTAB	Integer	Number of stability classes (<u><5</u>) to be considered.
STAB	Integer	List of indices (see Table B-1) for the stability classes considered. There must be LSTAB such values. E.g., in sample problem the stability class is neutral, STAB = 4
LWD	Integer	Number of wind directions (<u><16</u>) to be considered.
WD	Integer	List of indices (see Table B-1) for the wind directions considered. There must be LWD such values. E.g., for a SW and NW wind, WD = 11, 15

LWS	Integer	Number of wind speeds (≤ 6) to be considered.
WS	Integer	List of indices (see Table B-1) for the wind speeds considered. There must be LWS such values. E.g., for wind speeds of 0 - 3 knots and 4 - 6 knots,

$$WS = 1, 2$$

The total number of meteorological sets that are considered in a given run is simply the product of LSEA x LSTAB x LWD x LWS. For the sample problem, eight (2 x 1 x 2 x 2) meteorological sets were considered.

d. Program Options

<u>Parameter</u>	<u>Type</u>	<u>Description</u>
NPOLUT	Integer	Specifies the pollutants to be considered.
$\text{If NPOLUT} = \begin{cases} 1 & \text{SO}_2 \text{ only} \\ 2 & \text{particulate only} \\ 0 & \text{both} \end{cases}$		

[Default is 0]

The next five parameters specify the composition of the culpability list.

NSELC	Integer	Selection parameter for the culpability list.
<p>If NSELC = 0 or omitted, receptors are selected by highest concentrations.</p> <p>If NSELC is $\neq$ 0, receptors are selected by input.</p>		

[Default is 0]

If NSELC $\neq$ 0, the following two parameters must be input.

ICONS	Integer	List of those SO ₂ receptors to be included in the culpability list. There are NHIGH such values. This parameter is omitted if NPOLUT is 2.
ICONP	Integer	Similar to ICONS but for particulates. This parameter is omitted if NPOLUT is 1.
NHIGH	Integer	Number of receptors (≤ 10) to be listed in the culpability lists.
[Default is 10]		
MSRC	Integer	Number of sources (≤ 20) to be listed for each receptor in the culpability list.
[Default is 10]		

In the sample problem, defaults were assumed for the culpability list parameters. The culpability list is thus composed of the 10 highest source contributors to the 10 highest receptors in the region.

BACKGR Real Background concentration for SO₂ and particulates in micrograms per cubic meter. If BACKGR is included, both values must be specified.

[Default is 1.0 for both]

RCFR Real Residential/commercial fraction for area sources.

[Default is 0.45]

The next two parameters control additional output.

IPUNCH Integer Control parameter for output of receptor coordinates and concentrations, and "selected" receptors.

If IPUNCH >0, the values are output onto logical unit IPUNCH in card image format.* If punched cards are desired then IPUNCH = 7. The data output onto unit IPUNCH is designed for plotting using the SYMAP - 2280 display program described in Appendix C.

If IPUNCH is 0 or omitted, no output of receptor and culpability data occurs.

E.g., in the sample problem, output to unit 20 was requested by IPUNCH = 20

[Default is 0]

*Exact format is described in Table B-2.

TABLE B-2. Description of LABEL Identifier

Position	Variable	Codes	Values
1-16	Metset		Input, characters, p. 132
17-19	Pollutant Type	SO ₂ PRT	SO ₂ Particulate
21	Season	H S N F	Winter (heating) Dec-Feb Spring Mar-May Summer (non-heating) June-Aug Fall Sept-Nov
23-24	Stability Class	VU MU SU NT ST	1: very unstable 2: moderately unstable 3: slightly unstable 4: neutral 5: stable
26-28	Wind Direction	See Table B-1	See Table B-1
30-31	Wind Speed	3 6 10 16 21 25	0-3 knots 4-6 knots 7-10 knots 11-16 knots 17-21 knots over 21 knots
33-35	Case Number		

IAPERT	Integer	Control parameter for punching (unit 7) cards containing a cross-referencing label for each meteorological set considered.
--------	---------	--

If IAPERT $\neq$ 0, cards are punched.

If IAPERT is 0, no cards are punched.

[Default is 0]

NCASE	Integer	As the meteorological sets are considered they are numbered for cross-referencing output. NCASE is the initial value.
-------	---------	---

[Default is 1]

We will now consider NAMELIST INSORC. It contains four variables that describe the sources in a given region.

NSORCE	Integer	Number of sources (≤ 1000) that are input.
NCSORC	Integer	Number of point sources in the region source file. The first NCSORC are the point sources.
SORCE	Real	Array that defines the sources. There must be NSORCE such sources. For each source the following seven values must be input:

(1) X - coordinate in kilometers,

(2) Y - coordinate in kilometers,

(3) area in square kilometers,

(4) annual average SO₂ emission rate
in tons/day,

(5) annual average particulate emission rate in tons/day,

(6) physical stack height in meters,

and (7) SIC (Standard Industrial Classification) code.

QSORCE

Real

Array defining the heat emission rate (BTU/day) for each source. There must be NSORCE such values.

Each element represents:

coal heat content (BTU/ton) x annual

coal rate (tons/day)

+

oil heat content (BTU/gal) x annual

oil rate (gal/day)

+

gas heat content (BTU/cu.ft.) x

annual gas rate (cu.ft./day)

3. Glossary of ASSM Input Variables

<u>Name</u>	<u>Description</u>	<u>Page</u>
ATEMP	Ambient temperature	137
BACKGR	Array containing the background concentrations for SO ₂ and particulates	143
DEDAYF	Degree day factor	137
DELTA	Parameter to select receptor grid type	133
DELX	Mesh size(s) for grid in X- direction	135
DELY	Mesh size(s) for grid in Y- direction	135
DPTHMX	Mixing height	137
FALL	Array containing the source number and the (FALL) seasonal adjustment factors for the SO ₂ and part- iculate emission rates of this source	140
IADD	Number of non-grid receptors	136
IAPERT	Control parameter for "aperture" cards	145
ICONP	Receptor numbers for those particulate receptors selected for the culpability list	142
ICONS	Receptor numbers for those SO ₂ receptors selected for the culpability list	142
INCRX	Number of columns (X- direction) in the receptor grid	136
INCRY	Number of rows (Y- direction) in the receptor grid	136
&INDATA	NAMelist control card for the "parameter" file	
&INSORC	NAMelist control card for the regional "source" file	

<u>Name</u>	<u>Description</u>	<u>Page</u>
IPUNCH	Control parameter for outputting the receptor concentration data	143
LSEA	Number of seasons to be considered	137
LSTAB	Number of stability classes to be considered	140
LWD	Number of wind directions to be considered	140
LWS	Number of wind speeds to be considered	141
METSET	Identifying information for "cross-referencing" various output	132
MSRC	Number of sources to be displayed for each receptor in the culpability list	142
NCASE	Initial value for numbering the cases as they are output	145
NCSORC	Number of point sources in the regional source file	145
NDELX	Number of sections of the receptor grid in the X- direction	135
NDELY	Number of sections of the receptor grid in the Y- direction	135
NHIGH	Number of receptors to be included in the culpability list	142
NPOLUT	Parameter indicating the pollutants to be considered	142
NSELC	Parameter indicating receptor selection for the culpability list	142

<u>Name</u>	<u>Description</u>	<u>Page</u>
NSORCE	Number of sources in the regional source file	145
QSORCE	Array containing the heat emission rate for each source	146
RBASE	Array containing the coordinates of the receptor grid origin	133
RCFR	Residential/commercial fraction for area sources	143
REGION	Identifying information for printed output	132
SEA	Array containing the seasonal indices	137
SORCE	Array containing the source location, area, emission rates, and physical stack height for each source	145
SPRING	Array containing the source number and the (SPRING) seasonal adjustment factors for the SO ₂ and particulate emission rates of this source	140
STAB	Array containing the stability-class indices	140
SUMMER	Array containing the source number and the (SUMMER) seasonal adjustment factors for the SO ₂ and particulate emission rates of this source	140
WD	Array containing the wind direction	140
WINTER	Array containing the source number and the (WINTER) seasonal adjustment factors for the SO ₂ and particulate emission rates of this source	139
WS	Array containing the wind-speed indices	141
XRECEP	Locations of the non-grid receptors	136

4. Output Description

The output for a complete case from the Chicago region sample problem is presented in Figure B-5. The printed output consists of two parts. The first is the receptor concentration data, and the second is the culpability lists. Each is headed by three lines of identifying information.

The first line contains a 'label' that serves as cross-referencing information for all output. It is composed of 35 characters and is described in Table B-2. This label is the output that is punched on cards if IAPERT = 1. The second line contains the characters input through the REGION variable (page 132). The third line is an enumeration of the coded data appearing in the 'label'.

a. Receptor Concentration Data

The principal output of the diffusion model is contained in the first part of Fig. B-5 (pages 153-159). Each grid and non-grid receptor is listed by receptor number, its location, and the ground-level concentration for each pollutant as "estimated" by the diffusion model.

b. Culpability List

The contributions of each of the MSRC highest point and area sources in the region to NHIGH selected or highest receptors (specified in table heading) are presented in the second part of Fig. B-5 (pages 160-163).

For each source in the table, the source number (followed by an asterisk for area sources), the contribution of that source to this receptor both as a percentage of the total concentration at this receptor and as the actual concentration (micrograms/cubic meter), and the effective stack height of the source (meters) are listed. The last entry for each receptor contains the total concentration of the sources listed and their percentage of the total concentration (from all sources) at that receptor. One culpability list appears for each pollutant.

For example, in the culpability list for SO_2 (page 160) receptor 266 has the highest estimated concentration of all receptors. Point source 69 is the highest contributor to this receptor. Its contribution was 362.92 micrograms/cubic meter, which represents 23.49% of the total concentration from all sources at receptor 266. The ten sources listed contributed 1386.35 micrograms/cubic meter, which represents 89.74% of the total concentration from all sources at receptor 266.

c. Iospleth Plots

The data printed in the RECEPTOR CONCENTRATION TABLE is also optionally (IPUNCH) output for subsequent input into a plotting system. Such a system utilizing SYMAP and the IBM 2280 is described in Appendix C. Included in the output is a numeric code identifying the meteorological set (season, stability class, wind direction, and wind speed; see Table B-1 for interpretation of the values) and, also, the receptors appearing in the culpability lists for SO_2 and particulates.

(Note: The output occurs in MAIN, statements MAIN2240 through MAIN2510 and MAIN2560 through MAIN2580)

d. Aperture Cards

Optionally available (IAPERT) is the output of cards containing the LABEL as described in Table B-2. These cards have proven useful for duplicating onto aperture cards containing the 35mm film displays of the isopleths. The cards output from the sample problem of the Chicago region appear in Figure B-6.

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS)		EXPECTED ARITHMETIC MEAN	
	HORIZ	VERT	SO ₂	PARTICULATES
1	375.0	4565.0	1.	1.
2	375.0	4580.0	1.	1.
3	375.0	4587.5	1.	1.
4	375.0	4595.0	1.	1.
5	375.0	4602.5	1.	1.
6	375.0	4610.0	1.	2.
7	375.0	4617.5	1.	2.
8	375.0	4625.0	1.	3.
9	375.0	4632.5	1.	4.
10	375.0	4640.0	2.	4.
11	375.0	4647.5	2.	5.
12	375.0	4655.0	2.	6.
13	375.0	4662.5	1.	4.
14	375.0	4670.0	1.	4.
15	375.0	4680.0	1.	10.
16	375.0	4690.0	1.	2.
17	390.0	4565.0	1.	1.
18	390.0	4580.0	1.	2.
19	390.0	4587.5	1.	2.
20	390.0	4595.0	1.	2.
21	390.0	4602.5	1.	2.
22	390.0	4610.0	1.	2.
23	390.0	4617.5	2.	4.
24	390.0	4625.0	2.	5.
25	390.0	4632.5	2.	6.
26	390.0	4640.0	2.	7.
27	390.0	4647.5	2.	10.
28	390.0	4655.0	2.	9.
29	390.0	4662.5	2.	10.
30	390.0	4670.0	2.	8.
31	390.0	4680.0	2.	8.
32	390.0	4690.0	1.	8.
33	397.5	4565.0	1.	1.
34	397.5	4580.0	1.	1.
35	397.5	4587.5	1.	2.
36	397.5	4595.0	1.	2.
37	397.5	4602.5	1.	2.
38	397.5	4610.0	1.	4.
39	397.5	4617.5	2.	6.
40	397.5	4625.0	1.	5.

Fig. B-5. Printed Output from the Sample Problem

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS)		EXPECTED ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	HORIZ.	VERT.	SO ₂	PARTICULATES
41	397.5	4632.5	2.	12.
42	397.5	4640.0	1.	22.
43	397.5	4647.5	2.	27.
44	397.5	4655.0	2.	15.
45	397.5	4662.5	2.	18.
46	397.5	4670.0	1.	12.
47	397.5	4680.0	2.	11.
48	397.5	4690.0	1.	3.
49	405.0	4565.0	1.	1.
50	405.0	4580.0	1.	2.
51	405.0	4587.5	355.	575.
52	405.0	4595.0	1.	30.
53	405.0	4602.5	1.	4.
54	405.0	4610.0	2.	4.
55	405.0	4617.5	2.	9.
56	405.0	4625.0	2.	8.
57	405.0	4632.5	2.	13.
58	405.0	4640.0	3.	25.
59	405.0	4647.5	3.	29.
60	405.0	4655.0	3.	25.
61	405.0	4662.5	2.	28.
62	405.0	4670.0	2.	17.
63	405.0	4680.0	2.	15.
64	405.0	4690.0	2.	12.
65	412.5	4565.0	1.	2.
66	412.5	4580.0	1.	3.
67	412.5	4587.5	1.	3.
68	412.5	4595.0	46.	211.
69	412.5	4602.5	39.	168.
70	412.5	4610.0	1.	16.
71	412.5	4617.5	2.	10.
72	412.5	4625.0	2.	10.
73	412.5	4632.5	2.	15.
74	412.5	4640.0	2.	16.
75	412.5	4647.5	3.	26.
76	412.5	4655.0	2.	28.
77	412.5	4662.5	2.	28.
78	412.5	4670.0	2.	25.
79	412.5	4680.0	2.	24.
80	412.5	4690.0	2.	16.

Fig. B-5 (Contd.)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ARITHMETIC MEAN	
	(KILOMETERS) HORIZ	VERT	(MICROGRAMS/CU. METER) SO2	PARTICULATES
81	420.0	4565.0	1.	2.
82	420.0	4580.0	1.	2.
83	420.0	4587.5	1.	4.
84	420.0	4595.0	22.	153.
85	420.0	4602.5	18.	135.
86	420.0	4610.0	9.	122.
87	420.0	4617.5	13.	203.
88	420.0	4625.0	21.	155.
89	420.0	4632.5	21.	31.
90	420.0	4640.0	21.	29.
91	420.0	4647.5	30.	40.
92	420.0	4655.0	5.	27.
93	420.0	4662.5	2.	27.
94	420.0	4670.0	7.	32.
95	420.0	4680.0	2.	28.
96	420.0	4690.0	2.	24.
97	427.5	4565.0	1.	1.
98	427.5	4580.0	1.	3.
99	427.5	4587.5	1.	4.
100	427.5	4595.0	2.	5.
101	427.5	4602.5	7.	109.
102	427.5	4610.0	6.	107.
103	427.5	4617.5	20.	113.
104	427.5	4625.0	43.	151.
105	427.5	4632.5	53.	148.
106	427.5	4640.0	62.	156.
107	427.5	4647.5	33.	80.
108	427.5	4655.0	38.	72.
109	427.5	4662.5	26.	69.
110	427.5	4670.0	16.	59.
111	427.5	4680.0	4.	32.
112	427.5	4690.0	2.	28.
113	435.0	4565.0	1.	1.
114	435.0	4580.0	1.	3.
115	435.0	4587.5	1.	4.
116	435.0	4595.0	1.	5.
117	435.0	4602.5	43.	115.
118	435.0	4610.0	14.	93.
119	435.0	4617.5	29.	110.
120	435.0	4625.0	55.	148.

Fig. B-5 (Contd.)

SEASON DEC-FEB STABILITY CLASS 4 WIND DIRECTION SW WIND SPEED 0 - 3 KNOTS PAGE 4

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ARITHMETIC MEAN	
	(KILOMETERS)		(MICROGRAMS/CU. METER)	
	HORIZ	VERT	SO ₂	PARTICULATES
121	435.0	4632.5	54.	759.
122	435.0	4640.0	70.	384.
123	435.0	4647.5	88.	198.
124	435.0	4655.0	82.	222.
125	435.0	4662.5	35.	116.
126	435.0	4670.0	21.	100.
127	435.0	4680.0	8.	65.
128	435.0	4690.0	3.	48.
129	442.5	4565.0	1.	1.
130	442.5	4580.0	1.	2.
131	442.5	4587.5	1.	5.
132	442.5	4595.0	41.	30.
133	442.5	4602.5	41.	115.
134	442.5	4610.0	40.	115.
135	442.5	4617.5	62.	153.
136	442.5	4625.0	94.	186.
137	442.5	4632.5	421.	701.
138	442.5	4640.0	478.	911.
139	442.5	4647.5	234.	640.
140	442.5	4655.0	93.	430.
141	442.5	4662.5	46.	235.
142	442.5	4670.0	28.	217.
143	442.5	4680.0	9.	100.
144	442.5	4690.0	3.	63.
145	450.0	4565.0	1.	2.
146	450.0	4580.0	3.	4.
147	450.0	4587.5	2.	6.
148	450.0	4595.0	41.	43.
149	450.0	4602.5	45.	59.
150	450.0	4610.0	36.	123.
151	450.0	4617.5	97.	205.
152	450.0	4625.0	199.	280.
153	450.0	4632.5	379.	548.
154	450.0	4640.0	688.	1320.
155	450.0	4647.5	383.	1095.
156	450.0	4655.0	152.	760.
157	450.0	4662.5	60.	509.
158	450.0	4670.0	23.	357.
159	450.0	4680.0	8.	188.
160	450.0	4690.0	4.	164.

Fig. B-5 (Contd.)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ARITHMETIC MEAN	
	(KILOMETERS)		(MICROGRAMS/CU. METER)	
	HORIZ	VERT	SC2	PARTICULATES
161	457.5	4565.0	1.	2.
162	457.5	4580.0	3.	4.
163	457.5	4587.5	3.	8.
164	457.5	4595.0	31.	49.
165	457.5	4602.5	73.	127.
166	457.5	4610.0	105.	255.
167	457.5	4617.5	72.	855.
168	457.5	4625.0	108.	2253.
169	457.5	4632.5	132.	405.
170	457.5	4640.0	195.	785.
171	457.5	4647.5	227.	1107.
172	457.5	4655.0	121.	950.
173	457.5	4662.5	58.	737.
174	457.5	4670.0	26.	573.
175	457.5	4680.0	9.	365.
176	457.5	4690.0	3.	244.
177	465.0	4565.0	1.	2.
178	465.0	4580.0	3.	6.
179	465.0	4587.5	2.	8.
180	465.0	4595.0	14.	27.
181	465.0	4602.5	69.	103.
182	465.0	4610.0	1090.	347.
183	465.0	4617.5	794.	570.
184	465.0	4625.0	173.	1514.
185	465.0	4632.5	58.	1195.
186	465.0	4640.0	54.	1064.
187	465.0	4647.5	86.	834.
188	465.0	4655.0	62.	850.
189	465.0	4662.5	36.	774.
190	465.0	4670.0	20.	706.
191	465.0	4680.0	8.	527.
192	465.0	4690.0	4.	390.
193	472.5	4565.0	1.	2.
194	472.5	4580.0	2.	6.
195	472.5	4587.5	2.	8.
196	472.5	4595.0	18.	35.
197	472.5	4602.5	74.	115.
198	472.5	4610.0	134.	1650.
199	472.5	4617.5	189.	583.
200	472.5	4625.0	170.	841.

Fig. B-5 (Contd.)

SEASON DEC-FEB STABILITY CLASS 4 WIND DIRECTION SW WIND SPEED 0 - 3 KNOTS PAGE 6

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ARITHMETIC MEAN	
	(KILOMETERS)		(MICROGRAMS/CU. METER)	
	HORIZ	VERT	SO ₂	PARTICULATES
201	472.5	4632.5	83.	1112.
202	472.5	4640.0	45.	889.
203	472.5	4647.5	29.	1073.
204	472.5	4655.0	33.	1168.
205	472.5	4662.5	20.	719.
206	472.5	4670.0	12.	655.
207	472.5	4680.0	6.	582.
208	472.5	4690.0	3.	500.
209	480.0	4565.0	1.	2.
210	480.0	4580.0	3.	7.
211	480.0	4587.5	2.	7.
212	480.0	4595.0	15.	33.
213	480.0	4602.5	31.	82.
214	480.0	4610.0	59.	194.
215	480.0	4617.5	80.	992.
216	480.0	4625.0	92.	742.
217	480.0	4632.5	46.	943.
218	480.0	4640.0	29.	880.
219	480.0	4647.5	19.	879.
220	480.0	4655.0	17.	1004.
221	480.0	4662.5	11.	972.
222	480.0	4670.0	7.	894.
223	480.0	4680.0	4.	556.
224	480.0	4690.0	2.	497.
225	490.0	4565.0	1.	2.
226	490.0	4580.0	3.	8.
227	490.0	4587.5	3.	10.
228	490.0	4595.0	8.	24.
229	490.0	4602.5	9.	39.
230	490.0	4610.0	19.	110.
231	490.0	4617.5	16.	646.
232	490.0	4625.0	22.	718.
233	490.0	4632.5	21.	794.
234	490.0	4640.0	12.	926.
235	490.0	4647.5	8.	959.
236	490.0	4655.0	7.	883.
237	490.0	4662.5	7.	963.
238	490.0	4670.0	4.	897.
239	490.0	4680.0	2.	761.
240	490.0	4690.0	2.	680.

Fig. B-5 (Contd.)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS)		EXPECTED ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	HORIZ	VEBI	SC2	PARTICULATES
241	500.0	4565.0	1.	3.
242	500.0	4580.0	2.	9.
243	500.0	4587.5	2.	9.
244	500.0	4595.0	3.	13.
245	500.0	4602.5	5.	33.
246	500.0	4610.0	5.	46.
247	500.0	4617.5	7.	108.
248	500.0	4625.0	8.	464.
249	500.0	4632.5	10.	555.
250	500.0	4640.0	6.	668.
251	500.0	4647.5	4.	815.
252	500.0	4655.0	3.	809.
253	500.0	4662.5	3.	977.
254	500.0	4670.0	2.	980.
255	500.0	4680.0	2.	762.
256	500.0	4690.0	1.	700.
257	444.4	4650.0	240.	666.
258	444.4	4645.0	418.	902.
259	447.6	4636.2	676.	1131.
260	437.5	4635.0	104.	623.
261	432.7	4625.1	44.	139.
262	443.7	4625.6	113.	196.
263	450.5	4625.5	187.	283.
264	445.0	4607.2	50.	125.
265	454.0	4606.9	53.	217.
266	464.5	4605.6	1545.	376.
267	402.6	4588.4	1.	3.
268	446.3	4615.7	161.	170.

Fig. B-5 (Contd.)

CHICAGO REGION SO2-H-NT-SW - 3 1

CULPABILITY LIST

PART 1

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB STABILITY CLASS 4 WIND DIRECTION SW WIND SPEED 0 - 3 KNOTS

SO2 FOR HIGHEST RECEPTORS. (MICROGRAMS PER CUBIC METER)

		RECEPTOR 266				RECEPTOR 182				RECEPTOR 183				RECEPTOR 154				RECEPTOR 259		
1	69	362.92	60.0		69	292.36	60.0		107	380.78	54.9		494*	65.22	39.9		465*	66.26	39.9	
		23.49 %				26.83 %				47.97 %				9.48 %				9.80 %		
2	101	296.09	21.3		101	170.60	21.3		105	112.17	64.9		461*	46.18	39.9		362	52.85	49.7	
		19.17 %				15.66 %				14.13 %				6.71 %				7.82 %		
3	111	247.42	27.1		111	142.65	27.1		98	50.30	61.9		465*	41.77	39.9		470*	48.33	39.9	
		16.52 %				13.09 %				6.34 %				6.07 %				7.15 %		
4	108	245.31	57.3		108	142.27	57.3		97	42.23	39.9		460*	39.02	39.9		471*	46.93	39.9	
		15.88 %				13.06 %				5.32 %				5.67 %				6.54 %		
5	67	116.67	89.9		67	101.01	89.9		99	38.49	29.9		466*	37.45	39.9		472*	42.09	39.9	
		7.55 %				9.27 %				4.85 %				5.44 %				6.23 %		
6	591*	36.93	10.1		591*	32.40	10.1		100	34.05	39.9		500*	34.62	10.1		498*	37.60	10.1	
		2.39 %				2.57 %				4.29 %				5.03 %				5.56 %		
7	103	22.94	22.6		573*	17.57	10.1		102	19.82	41.1		471*	26.50	39.9		477*	35.58	39.9	
		1.49 %				1.61 %				2.50 %				3.85 %				5.32 %		
8	113	21.67	54.9		574*	17.56	10.1		544*	13.42	10.1		362	26.06	49.7		473*	31.37	39.9	
		1.40 %				1.61 %				1.65 %				3.79 %				4.64 %		
9	574*	18.41	10.1		583*	13.53	10.1		573*	7.71	10.1		467*	23.77	39.9		475*	30.11	39.9	
		1.19 %				1.24 %				0.97 %				3.45 %				4.45 %		
10	573*	17.98	10.1		103	13.22	22.6		574*	6.85	10.1		462*	22.80	39.9		481*	27.32	39.9	
		1.16 %				1.21 %				0.86 %				3.31 %				4.04 %		
TOT		1386.35				943.18				705.83				363.40				418.84		
		89.74 %				86.57 %				88.92 %				52.81 %				61.97 %		

Fig. B-5 (Contd.)

CULPABILITY LIST

PART 2

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB

STABILITY CLASS 4

WIND DIRECTION SW

WIND SPEED 0 - 3 KNOTS

S02

FOR HIGHEST RECEPTORS (MICROGRAMS PER CUBIC METER)

	RECEPTOR 138			RECEPTOR 137			RECEPTOR 258			RECEPTOR 155			RECEPTOR 153		
1	362	61.83 12.94 %	49.7	362	179.70 42.71 %	49.7	494*	66.53 15.92 %	39.9	461*	48.20 12.59 %	10.1	500*	62.89 16.60 %	10.1
2	463*	56.02 11.73 %	39.9	498*	56.86 13.51 %	10.1	491*	53.49 12.80 %	10.1	494*	40.76 10.65 %	39.9	505*	43.32 11.43 %	10.1
3	494*	54.13 11.33 %	39.9	502*	27.85 6.62 %	10.1	492*	38.86 9.30 %	10.1	492*	23.81 6.22 %	10.1	486*	34.12 9.01 %	39.9
4	496*	41.22 8.63 %	10.1	484*	20.82 4.95 %	39.9	495*	36.68 8.78 %	10.1	529*	23.49 6.14 %	10.1	481*	29.11 7.68 %	39.9
5	498*	40.84 8.55 %	10.1	483*	19.59 4.66 %	39.9	496*	28.85 6.90 %	10.1	495*	18.63 4.87 %	10.1	480*	26.10 6.89 %	39.9
6	495*	33.20 6.95 %	10.1	499*	15.80 3.75 %	39.9	362	27.75 6.64 %	49.7	461*	17.45 4.56 %	39.9	488*	23.37 6.17 %	39.9
7	469*	30.66 6.42 %	10.1	490*	15.75 3.74 %	10.1	493*	26.47 6.33 %	10.1	460*	16.43 4.25 %	39.9	506*	19.34 5.10 %	10.1
8	474*	27.95 5.85 %	10.1	503*	14.47 3.44 %	10.1	463*	22.22 5.32 %	39.9	466*	14.34 3.75 %	39.9	501*	18.74 4.95 %	10.1
9	497*	27.93 5.85 %	10.1	507*	13.75 3.27 %	10.1	498*	20.78 4.97 %	10.1	493*	13.45 3.51 %	10.1	487*	16.29 4.30 %	39.9
10	464*	25.70 5.38 %	10.1	537*	13.35 3.17 %	10.1	497*	16.43 3.93 %	10.1	496*	12.86 3.36 %	10.1	502*	16.25 4.29 %	10.1
TOT		399.48 83.61 %			377.95 85.82 %			338.07 80.88 %			229.43 59.94 %			289.54 76.41 %	

Fig. B-5 (Contd.)

CHICAGO REGION PRT-H-NT-SW - 3 1

CULPABILITY LIST

PART 1

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB STABILITY CLASS 4 WIND DIRECTION SW WIND SPEED C - 3 KNOTS

PARTICULATES FOR HIGHEST RECEPTORS (MICROGRAMS PER CUBIC METER)

	RECEPTOR 168				RECEPTOR 198				RECEPTOR 184				RECEPTOR 154				RECEPTOR 185			
1	171	657.89 29.29 %	52.1		178	1394.64 84.53 %	50.9		171	322.36 21.25 %	52.1		362	92.77 7.03 %	49.7		171	213.49 17.86 %	52.1	
2	168	429.70 19.07 %	32.9		602*	25.86 1.57 %	10.1		168	210.55 13.90 %	32.9		494*	73.13 5.54 %	39.9		168	139.44 11.67 %	32.9	
3	169	393.65 17.47 %	52.1		603*	24.63 1.49 %	10.1		169	192.89 12.74 %	52.1		142	70.78 5.36 %	16.2		169	127.74 10.69 %	52.1	
4	176	149.88 6.65 %	20.1		556*	20.99 1.27 %	10.1		176	94.79 6.26 %	20.1		498*	59.58 4.52 %	10.1		176	69.31 5.60 %	20.1	
5	160	107.85 4.79 %	52.1		591*	18.23 1.11 %	10.1		160	67.82 4.48 %	52.1		500*	57.36 4.35 %	10.1		160	49.46 4.14 %	52.1	
6	505*	54.55 2.42 %	10.1		599*	11.44 0.69 %	10.1		164	54.39 3.59 %	20.1		467*	51.41 3.30 %	39.9		500*	44.90 3.76 %	10.1	
7	174	47.99 2.13 %	52.1		600*	10.54 0.64 %	10.1		166	50.25 3.32 %	52.1		145	42.59 3.23 %	3.0		164	40.47 3.39 %	20.1	
8	173	43.18 1.92 %	52.1		616*	10.10 0.61 %	10.1		165	38.46 2.54 %	35.1		260	35.36 2.68 %	19.8		166	37.39 3.13 %	52.1	
9	363	36.91 1.64 %	4.9		601*	8.85 0.54 %	10.1		544*	34.59 2.28 %	10.1		461*	34.59 2.62 %	39.9		505*	34.29 2.87 %	10.1	
10	544*	34.03 1.51 %	10.1		607*	7.79 0.47 %	10.1		363	34.29 2.26 %	4.9		544*	34.59 2.62 %	10.1		363	32.01 2.68 %	4.9	
TOT		1955.63 86.81 %				1533.07 92.92 %				1100.38 72.67 %				552.26 41.35 %				788.49 65.97 %		

Fig. B-5 (Contd.)

CULPABILITY LIST

PART 2

CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION

SEASON DEC-FEB STABILITY CLASS 4 WIND DIRECTION SW WIND SPEED 0 - 3 KNOTS

PARTICULATES FOR HIGHEST RECEPTORS (MICROGRAMS PER CUBIC METER)

	RECEPTOR 204			RECEPTOR 259			RECEPTOR 201			RECEPTOR 171			RECEPTOR 155		
1	171	90.81 7.78 %	52.1	362	123.51 10.92 %	49.7	171	159.59 14.36 %	52.1	362	57.99 5.24 %	49.7	494*	73.70 6.73 %	39.9
2	168	59.31 5.08 %	32.9	142	86.69 7.66 %	16.2	168	104.23 9.38 %	32.9	494*	56.60 5.11 %	39.9	362	71.37 6.52 %	49.7
3	169	54.33 4.65 %	52.1	498*	75.15 6.64 %	10.1	169	95.49 8.59 %	52.1	142	49.07 4.43 %	16.2	142	57.96 5.29 %	16.2
4	362	37.12 3.18 %	49.7	260	43.83 3.87 %	19.8	185	65.93 5.93 %	50.3	491*	46.00 4.16 %	10.1	491*	56.22 5.13 %	10.1
5	529*	36.98 3.17 %	10.1	366	41.45 3.67 %	82.0	176	54.63 4.91 %	20.1	529*	44.40 4.01 %	10.1	498*	47.81 4.37 %	10.1
6	142	33.61 2.88 %	16.2	268	40.36 3.57 %	13.7	160	38.92 3.50 %	52.1	498*	39.88 3.60 %	10.1	529*	42.29 3.86 %	10.1
7	176	33.40 2.86 %	20.1	363	36.44 3.22 %	4.9	184	33.23 2.99 %	10.1	500*	36.89 3.33 %	10.1	145	34.65 3.16 %	3.0
8	494*	33.37 2.86 %	39.9	544*	34.16 3.02 %	10.1	164	32.22 2.90 %	20.1	363	30.02 2.71 %	4.9	467*	34.05 3.11 %	39.9
9	493*	26.63 2.28 %	10.1	13	32.91 2.91 %	33.5	363	30.02 2.70 %	4.9	145	29.20 2.64 %	3.0	495*	32.21 2.94 %	10.1
10	491*	25.95 2.22 %	10.1	488*	28.67 2.53 %	39.9	166	29.77 2.68 %	52.1	505*	28.61 2.59 %	10.1	363	32.01 2.92 %	4.9
TOT		431.51 36.96 %			543.21 48.03 %			644.02 57.54 %			418.65 37.83 %			482.26 44.04 %	

Fig. B-5 (Contd.)

CHICAGO REGION PRT-H-NT-SW - 3

1

A-I	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+</
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Fig. B-6. Punched-card Output from the Sample Problem

5. Sample Problem

Included in this Appendix is a sample problem based upon data for the Chicago Metropolitan Air Quality Control Region. Since most of the components of the sample problem have been discussed in previous sections of this Appendix, the description contained here will be more in the way of a summary.

Figure B-4 contains the regular receptor grid used for the Chicago Region. The grid is of variable mesh in both directions and contains 256 points. There are an additional 12 non-grid receptors. Their X- and Y-coordinates (UTM System) are

1 -	444.40	4650.01
2 -	444.40	4645.02
3 -	447.61	4636.17
4 -	437.48	4634.96
5 -	432.73	4625.06
6 -	443.67	4625.62
7 -	450.51	4625.55
8 -	445.04	4607.21
9 -	454.05	4606.88
10 -	464.51	4609.62
11 -	402.56	4588.38
12 -	446.33	4615.73

The total receptor grid contains 268 points.

There are a total of eight meteorological cases to be considered. They include the winter and summer seasons. For each season, SW and NW winds with speeds of 0-3 knots and 4-6 knots are considered. For all these cases, the stability class is neutral, class 4. Additionally, in the winter

season, the emission rates of the following sources will be adjusted.

<u>Source</u>	<u>SO₂ Rate</u>	<u>Particulate Rate</u>
69	Reduced by 20%	Remains unchanged
107	Reduced by 20%	Remains unchanged
171	Remains unchanged	Reduced by 15%
178	Remains unchanged	Reduced by 15%
362	Reduced by 20%	Reduced by 15%

The culpability list will assume the default format of the ten highest sources for each of the ten highest receptors.

A data file containing the receptor concentration data for all eight cases will be output to logical unit 10. Additionally, aperture cards will be punched for SO₂ and particulate isopleth plots.

Figure B-5 contains the printed output, receptor concentration data, and culpability lists for the first meteorological case, namely, winter season, neutral stability, and southwest wind of 0-3 knots. The isopleths for the SO₂ concentrations are contained in Figures C-4 and C-5 (in Appendix C).

APPENDIX C

Description and Use of ASSM Plotter Program
(see Fig. C-1)

1. Plotter Program Listing and Documentation

LIST OF SUBROUTINES

<u>SUBROUTINE</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
AXES	draws and labels coordinate axes on film	168
DECIDE	internal subroutine to decide ambiguous cases	170
FLEXIN	inputs most of the data for producing film and printer displays; controls all routines for obtaining (2280) film output	171
GRAPH	produces isopleths (SO_2 or particulate) on film	179
IOCONV	converts machine representation to EBCDIC	106
OUTLIN	displays the geographical characteristics of a given region	181
SECDRV	internal routine for deciding ambiguous cases	183

Fig. C-1. ASSM Plotting System

a. Subroutine AXES

Description: This subroutine draws and labels the X (horizontal) and Y (vertical) axes on film. Tick marks appear at every 10-kilometer interval, and coordinate values appear at every 20-kilometer interval.

Parameters: SUBSQ logical variable whose value controls the generation of the axes labels,
 .FALSE. for generating labels and
 .TRUE. for bypassing label generation. Labels are generated each time a new grid system is input (B-DATA POINTS).

Output: Axes, together with labels, are drawn on film.

```

      SUBROUTINE AXES(SUBSQ)
C*****
C  SUBROUTINE DRAWS AND LABELS THE X(HORIZONTAL) AND Y(VERTICAL) AXES.
C  AXES ARE LABELLED WITH TIC MARKS AT EACH 10 KILOMETER INTERVAL
C  AND WITH THE COORDINATE VALUE AT EACH 20 KILOMETER INTERVAL.
C*****
      LOGICAL SUBSQ
      COMMON/GRID/X1PLT,Y1PLT,X2PLT,Y2PLT,CENTER,RU56
      DIMENSION XLABEL(20),YLABEL(20)
C
      IF (SUBSQ) GO TO 15
      SUBSQ = .TRUE.
C***GENERATE THE "AXES" VALUES
      NN = MIN1((X2PLT - X1PLT - 10.0)/20.0 + 1.0,20.0)
C  GENERATE THE LABELS FOR THE HORIZONTAL AXIS
      INTX = X1PLT - 10.0
      DO 5 I = 1,NN
      INTX = INTX + 20
      CALL CONVO(' (I4)',XLABEL(I),0,K,INTX)
5  CONTINUE
C  GENERATE THE LABELS FOR THE VERTICAL AXIS
      INTY = Y1PLT - 10.0
      DO 10 J = 1,NN
      INTY = INTY + 20
      CALL CONVO(' (I4)',YLABEL(J),0,K,INTY)
10 CONTINUE
C  RUDD : DD RASTER UNITS IN 'USER' UNITS
      RU22 = 0.393 * RU56
      RU50 = 0.893 * RU56

```

	AXES 0
C*****	AXES 10
C SUBROUTINE DRAWS AND LABELS THE X(HORIZONTAL) AND Y(VERTICAL) AXES.	AXES 20
C AXES ARE LABELLED WITH TIC MARKS AT EACH 10 KILOMETER INTERVAL	AXES 30
C AND WITH THE COORDINATE VALUE AT EACH 20 KILOMETER INTERVAL.	AXES 40
C*****	AXES 50
LOGICAL SUBSQ	AXES 60
COMMON/GRID/X1PLT,Y1PLT,X2PLT,Y2PLT,CENTER,RU56	AXES 70
DIMENSION XLABEL(20),YLABEL(20)	AXES 80
C	AXES 90
IF (SUBSQ) GO TO 15	AXES 100
SUBSQ = .TRUE.	AXES 110
C***GENERATE THE "AXES" VALUES	AXES 120
NN = MIN1((X2PLT - X1PLT - 10.0)/20.0 + 1.0,20.0)	AXES 130
C GENERATE THE LABELS FOR THE HORIZONTAL AXIS	AXES 140
INTX = X1PLT - 10.0	AXES 150
DO 5 I = 1,NN	AXES 160
INTX = INTX + 20	AXES 170
CALL CONVO(' (I4)',XLABEL(I),0,K,INTX)	AXES 180
5 CONTINUE	AXES 190
C GENERATE THE LABELS FOR THE VERTICAL AXIS	AXES 200
INTY = Y1PLT - 10.0	AXES 210
DO 10 J = 1,NN	AXES 220
INTY = INTY + 20	AXES 230
CALL CONVO(' (I4)',YLABEL(J),0,K,INTY)	AXES 240
10 CONTINUE	AXES 250
C RUDD : DD RASTER UNITS IN 'USER' UNITS	AXES 260
RU22 = 0.393 * RU56	AXES 270
RU50 = 0.893 * RU56	AXES 280

RU84 = 1.5 * RU56	AXES 290
XPL0T = X1PLT + RU50	AXES 300
X1 = X1PLT + RU22	AXES 310
X2 = X1PLT - RU22	AXES 320
YPL0T = Y1PLT + RU50	AXES 330
Y1 = Y1PLT + RU22	AXES 340
Y2 = Y1PLT - RU22	AXES 350
C	AXES 360
C DRAW VERTICAL AXIS	AXES 370
15 CALL FLNSG(X1PLT, Y1PLT, X1PLT, Y2PLT)	AXES 380
C DRAW HORIZONTAL AXIS	AXES 390
CALL FLNSG(X1PLT, Y1PLT, X2PLT, Y1PLT)	AXES 400
C MARK "CENTER" GUIDES	AXES 410
CALL FCHSZ(3)	AXES 420
DO 20 NTIMES = 1,2	AXES 430
CALL FCHAR('+', CENTER, Y1PLT)	AXES 440
CALL FCHAR('+', CENTER, Y2PLT)	AXES 450
20 CONTINUE	AXES 460
CALL FCHSZ(2)	AXES 470
C***LABEL HORIZONTAL AXIS	AXES 480
X = X1PLT	AXES 490
L = 0	AXES 500
M = 1	AXES 510
25 X = X + 10.0	AXES 520
IF (X .GT. X2PLT) GO TO 45	AXES 530
GO TO (30,40),M	AXES 540
C '20' KILOMETER INTERVAL : TIC MARK + LABEL	AXES 550
30 M = 2	AXES 560
L = L + 1	AXES 570
DO 35 NTIMES = 1,2	AXES 580
CALL FTEXT(XLABEL(L), 4, 1, X-RU84, YPL0T)	AXES 590
CALL FLNSG(X, Y1, X, Y2)	AXES 600
35 CONTINUE	AXES 610
GO TO 25	AXES 620
C '10' KILOMETER INTERVAL : TIC MARK ONLY	AXES 630
40 M = 1	AXES 640
CALL FLNSG(X, Y1, X, Y2)	AXES 650
CALL FLNSG(X, Y1, X, Y2)	AXES 660
GO TO 25	AXES 670
C***LABEL VERTICAL AXIS	AXES 680
45 Y = Y1PLT	AXES 690
L = 0	AXES 700
M = 1	AXES 710
50 Y = Y + 10.0	AXES 720
IF (Y .GT. Y2PLT) GO TO 70	AXES 730
GO TO (55,65),M	AXES 740
C '20' KILOMETER INTERVAL : TIC MARK + LABEL	AXES 750
55 M = 2	AXES 760
L = L + 1	AXES 770
DO 60 NTIMES = 1,2	AXES 780
CALL FTEXT(YLABEL(L), 4, 1, XPL0T, Y)	AXES 790
CALL FLNSG(X1, Y, X2, Y)	AXES 800
60 CONTINUE	AXES 810
GO TO 50	AXES 820
C '10' KILOMETER INTERVAL : TIC MARK ONLY	AXES 830
65 M = 1	AXES 840
CALL FLNSG(X1, Y, X2, Y)	AXES 850
CALL FLNSG(X1, Y, X2, Y)	AXES 860
GO TO 50	AXES 870
C	AXES 880
70 RETURN	AXES 890
END	AXES 900

c. Subroutine FLEXIN

Description: This subroutine is an optional part of the SYMAP program. It is used to input data under formats differing from standard SYMAP and to manipulate that data after it has been input and prior to its transmittal to SYMAP. A further description of this routine and the SYMAP program is contained in Reference 10.

In the ASSM plotting system, this subroutine inputs the grid system and concentration data from ASSM and converts it to a form compatible with SYMAP. It also controls all film-plotting capabilities of the system.

Parameters:

IFORM	parameter selecting the "entry point" in FLEXIN corresponding to the appropriate SYMAP package. Its value and corresponding function are described in Section 2 of this appendix.
T	used to transmit to SYMAP the X and Y coordinate values (B-DATA POINTS) and the corresponding function value (E-VALUES).
FIRST	logical variable whose value is .TRUE. the first time FLEXIN is called for a given package.

Output: The subroutine writes the identifying labels on film, and lists one page per display containing descriptive information for that display, including a table of the selected receptors.

```

SUBROUTINE FLEXIN(IFORM,T,FIRST)                                FLEX  0
C*****FLEX  10
C SUBROUTINE DESIGNED TO ADD (2280) FILM PLOTTING CAPACITY TO SYMAPFLEX 20
C FOR ASSM DATA. OPTION 21 MUST BE USED TO CREATE "TAPE 8". FLEX 30
C*****FLEX 40
REAL*8 LABEL(2),LINE2(2),SEASON(4),WINDSP(6) FLEX 50
LOGICAL FIRST,NOREAD,SKPMSH,SUBSQ FLEX 60
COMMON/GRID/X1PLT,Y1PLT,X2PLT,Y2PLT,CENTER,RUS6 FLEX 70
DIMENSION CZ(12),IRECEP(2,10),LINE1(5),MARK(10),MPOLU(2),MSEA(4), FLEX 80
1 MSTAB(5),MWDSP(6),RX(340),RY(340),S(130,78),STABCL(15),T(2), FLEX 90
2 WINDR(16),X(130),Y(78),Z(12),ZPART(340),ZSO2(340) FLEX 100
EQUIVALENCE (LINE1(1),LABEL(1)) FLEX 110
C FLEX 120
DATA LINE1/5*4H / FLEX 130
DATA LINE2/8H - - - ,8H- - - / FLEX 140
DATA MARK/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0/ FLEX 150
DATA MPOLU/3HSO2,3HPRT/ FLEX 160
DATA MSEA/1HH,1HS,1HN,1HF/ FLEX 170
DATA MSTAB/2HVU,2HMU,2HSU,2HNT,2HST/ FLEX 180
DATA MWDSP/2H 3,2H 6,2H10,2H16,2H21,2H25/ FLEX 190
DATA SEASON/8HWINTER ,8HSPRING ,8HSUMMER ,8HFALL / FLEX 200
DATA STABCL/4HV-UN,4HSTAB,4HLE ,4HM-UN,4HSTAB,4HLE ,4HS-UN, FLEX 210
* 4HSTAB,4HLE ,4HNEUT,4HRAL ,4H ,4HSTAB,4HLE ,4H / FLEX 220
DATA WINDR/4HN ,4HNE ,4HNE ,4HNE ,4HE ,4HESE ,4HSE , FLEX 230
1 4HSSE ,4HS ,4HSSW ,4HSH ,4HSHW ,4HSH ,4HSHW ,4HSHW , FLEX 240
2 4HNNW / FLEX 250
DATA WINDSP/8H 0 - 3 ,8H 4 - 6 ,8H 7 - 10 ,8H11 - 16 , FLEX 260
* 8H17 - 21 ,8HOVER 21 / FLEX 270
DATA IMAX,JMAX,SUBSQ/130,78, .FALSE./ FLEX 280
C FLEX 290
GO TO (10,20,30,35,40,45),IFORM FLEX 300
C*****FLEX 310
C B-DATA POINTS : IFORM = 1 FLEX 320
C*****FLEX 330
10 IF (.NOT. FIRST) GO TO 14 FLEX 340
READ(S,100) INPUT,ICASE,NCASE,NSELC,NRECEP,NCOPYS,NZ,LABEL, FLEX 350
1 YMAX,XMIN,SIZE,X1PLT,Y1PLT,X2PLT,Y2PLT,{Z(I), I=1,NZ} FLEX 360
IF (NCOPYS .LE. 0) NCOPYS = 1 FLEX 370
C FLEX 380
DO 5 I = 1,NZ FLEX 390
IZ = Z(I) FLEX 400
CALL CONVO('I4',CZ(I),0,K,IZ) FLEX 410
5 CONTINUE FLEX 420
ZNZ = Z(NZ) FLEX 430
C FLEX 440
NSKIP = NCASE - ICASE FLEX 450
IF (NSKIP) 16,4,1 FLEX 460
C SKIP THE FIRST 'NSKIP' CASE(S) ON UNIT 'INPUT' FLEX 470
1 DO 3 NN = 1,NSKIP FLEX 480
2 READ(INPUT,105) IDENT FLEX 490
IF (IDENT .GE. 0) GO TO 2 FLEX 500
C NEXT TWO RECORDS CONTAIN THE SELECTED RECEPTORS FLEX 510
READ(INPUT,105) IDENT FLEX 520
READ(INPUT,105) IDENT FLEX 530
3 CONTINUE FLEX 540
C FLEX 550
'LAST' IS THE NUMBER OF LAST CASE INPUT FLEX 560
4 LAST = NCASE - 1 FLEX 570
IF (NSELC .LE. 0) NCASE = LAST FLEX 580
IF (SIZE .GT. 1.15) SIZE = 1.15 FLEX 590

```



```

      N = 0
12  N = N + 1
      READ(INPUT, 110) RX(N), RY(N), ZS02(N), ZPART(N)
      IF (RX(N) .GE. 0.0) GO TO 12
      READ(INPUT, 140) (IRECEP(1,L), L=1,10)
      READ(INPUT, 140) (IRECEP(2,L), L=1,10)
C
      NRECS = N + 2
      NPTS = N - 1
      NOREAD = .TRUE.
      SKPMISH = .FALSE.
C  DECODE RX(N)
      IDENT = 100.0 * (ABS(RX(N)) + 0.005)
      ISEA = IDENT/10000
      IDENT = IDENT - 10000*ISEA
      ISTAB = IDENT/1000
      IDENT = IDENT - 1000*ISTAB
      IWD = IDENT/10
      IHS = IDENT - 10*IWD
C***SET UP PLOTTING LIMITS AND POSITIONS FOR IDENTIFYING LABELS :
C  ASSUME LENGTH OF X AND Y AXES ARE IDENTICAL
      WIDTH = X2PLT - X1PLT
      CENTER = X1PLT + 0.5*WIDTH
      XL = WIDTH * 1.17/SIZE
C  RUS6 : 56 RASTER UNITS IN USER' UNITS
      RUS6 = 0.013672 * XL
      DL = 0.5 * (XL - WIDTH)
C  LIMITS OF ACTUAL FILM PLOTTING AREA
      X1 = X1PLT - DL
      Y1 = Y1PLT - DL
      X2 = X2PLT + DL
      Y2 = Y2PLT + DL
C  HORIZONTAL POSITIONS FOR LABELS
      AXPOS = X2PLT - 0.34*WIDTH
      BXPOS = X2PLT - 0.215*WIDTH
      CXPOS = X2PLT - 0.19*WIDTH
      YPOS1 = Y2PLT - 0.075*WIDTH
C
C  VERTICAL SPACING FOR LABELS : 33 LINES FOR LARGE-SIZE CHARACTERS;
C  48 LINES FOR BASIC-SIZE CHARACTERS
      S1 = WIDTH/33
      YPOS2 = YPOS1 - S1
      YPOS3 = YPOS2 - S1
      S2 = WIDTH/48
C
      N = 0
C
14  N = N + 1
      IF (N .GT. NPTS) GO TO 98
      T(1) = -RY(N)
      T(2) = RX(N)
      GO TO 99
C***ERROR EXIT FOR CASE SELECTED
16  WRITE(6, 290) ICASE, NCASE, INPUT
      STOP 99
C*****
C  E-VALUES (S02) : IFORM = 2
C*****
20  IF (.NOT. FIRST) GO TO 26
      NCASE = NCASE + 1

```

```

FLEX 600
FLEX 610
FLEX 620
FLEX 630
FLEX 640
FLEX 650
FLEX 660
FLEX 670
FLEX 680
FLEX 690
FLEX 700
FLEX 710
FLEX 720
FLEX 730
FLEX 740
FLEX 750
FLEX 760
FLEX 770
FLEX 780
FLEX 790
FLEX 800
FLEX 810
FLEX 820
FLEX 830
FLEX 840
FLEX 850
FLEX 860
FLEX 870
FLEX 880
FLEX 890
FLEX 900
FLEX 910
FLEX 920
FLEX 930
FLEX 940
FLEX 950
FLEX 960
FLEX 970
FLEX 980
FLEX 990
FLEX1000
FLEX1010
FLEX1020
FLEX1030
FLEX1040
FLEX1050
FLEX1060
FLEX1070
FLEX1080
FLEX1090
FLEX1100
FLEX1110
FLEX1120
FLEX1130
FLEX1140
FLEX1150
FLEX1160
FLEX1170
FLEX1180
FLEX1190

```

```

      IF (NSELC .GT. 0) READ(5,100) NCASE
      NSKIP = NCASE - LAST - 1
      IF (NSKIP .LE. 0) GO TO 21
C   POSITION UNIT 'INPUT'
      DO 122 NN = 1, NSKIP
      READ(INPUT,105) (IDENT, I=1, NRECS)
122 CONTINUE
      NOREAD = .FALSE.
C
      21 LAST = NCASE
      IF (NOREAD) GO TO 22
      READ(INPUT,120) (ZSO2(N), ZPART(N), N = 1, NPTS)
C   READ IDENTIFIER RECORD AND SELECTED RECEPTORS
      READ(INPUT,130) ISEA, ISTAB, IWD, IWS
      READ(INPUT,140) (IRECEP(1,N), N=1,10)
      READ(INPUT,140) (IRECEP(2,N), N=1,10)
      GO TO 24
C
      22 NOREAD = .FALSE.
C
      24 N = 0
      26 N = N + 1
      IF (N .GT. NPTS) GO TO 98
      T(1) = ZSO2(N)
      GO TO 99
C****
C   E-VALUES (PARTICULATE) : IFORM = 3
C****
      30 IF (FIRST) N = 0
      32 N = N + 1
      IF (N .GT. NPTS) GO TO 98
      T(1) = ZPART(N)
      GO TO 99
C
C****
C   ENTRY FOR INPUTTING PARTICULATE ONLY - SO2 NOT CONSIDERED FOR THIS
C   CASE : IFORM = 4
C****
      35 IF (.NOT. FIRST) GO TO 32
      NCASE = NCASE + 1
      IF (NSELC .GT. 0) READ(5,100) NCASE
      NSKIP = NCASE - LAST - 1
      IF (NSKIP .LE. 0) GO TO 38
C   POSITION UNIT 'INPUT'
      DO 37 NN = 1, NSKIP
      READ(INPUT,105) (IDENT, I=1, NRECS)
      37 CONTINUE
      NOREAD = .FALSE.
C
      38 LAST = NCASE
      IF (NOREAD) GO TO 39
      READ(INPUT,125) (ZPART(N), N=1, NPTS)
C   READ IDENTIFIER RECORD AND SELECTED RECEPTORS
      READ(INPUT,130) ISEA, ISTAB, IWD, IWS
      READ(INPUT,140) (IRECEP(1,N), N=1,10)
      READ(INPUT,140) (IRECEP(2,N), N=1,10)
      GO TO 30
C
      39 NOREAD = .FALSE.
      GO TO 30

```

```

FLEX1200
FLEX1210
FLEX1220
FLEX1230
FLEX1240
FLEX1250
FLEX1260
FLEX1270
FLEX1280
FLEX1290
FLEX1300
FLEX1310
FLEX1320
FLEX1330
FLEX1340
FLEX1350
FLEX1360
FLEX1370
FLEX1380
FLEX1390
FLEX1400
FLEX1410
FLEX1420
FLEX1430
FLEX1440
FLEX1450
FLEX1460
FLEX1470
FLEX1480
FLEX1490
FLEX1500
FLEX1510
FLEX1520
FLEX1530
FLEX1540
FLEX1550
FLEX1560
FLEX1570
FLEX1580
FLEX1590
FLEX1600
FLEX1610
FLEX1620
FLEX1630
FLEX1640
FLEX1650
FLEX1660
FLEX1670
FLEX1680
FLEX1690
FLEX1700
FLEX1710
FLEX1720
FLEX1730
FLEX1740
FLEX1750
FLEX1760
FLEX1770
FLEX1780
FLEX1790

```

```

C
C*****
C ENTRY FOR PLOTTING S02 : IFORM = 5
C*****
40 IPOLUT = 1
C
C***FIND MAXIMUM CONTOUR VALUE
NCNTR = NZ
ZMAX=0.0
DO 41 N = 1,NPTS
I = NPTS - N + 1
IF (ZS02(I) .GT. ZNZ) GO TO 50
IF (ZS02(I) .GT. ZMAX) ZMAX = ZS02(I)
41 CONTINUE
C
IF (ZMAX.GE.Z(1)) GO TO 141
NCNTR=0
GO TO 50
141 CONTINUE
DO 42 N = 1,NZ
K = NZ - N + 1
IF (ZMAX .GE. Z(K)) GO TO 43
42 CONTINUE
GO TO 50
43 NCNTR = K
GO TO 50
C*****
C ENTRY FOR PLOTTING PARTICULATE : IFORM = 6
C*****
45 IPOLUT = 2
C
C***FIND MAXIMUM CONTOUR VALUE
NCNTR = NZ
ZMAX = 0.0
DO 46 N = 1,NPTS
I = NPTS - N + 1
IF (ZPART(I) .GT. ZNZ) GO TO 50
IF (ZPART(I) .GT. ZMAX) ZMAX = ZPART(I)
46 CONTINUE
IF (ZMAX.GE.Z(1)) GO TO 147
NCNTR=0
GO TO 50
147 CONTINUE
DO 47 N = 1,NZ
K = NZ - N + 1
IF (ZMAX .GE. Z(K)) GO TO 48
47 CONTINUE
GO TO 50
48 NCNTR = K
C
C*****
C PRODUCE (2280) GRAPHICAL DISPLAYS : INPUT VALUES ON "TAPE 8"
C*****
50 REWIND 8
READ(8) NY,NX,DY,DX
IF (SKPMSH) GO TO 56
SKPMSH = .TRUE.
DO 52 JJ = 1,NY
J = NY - JJ + 1

```

```

FLEX1800
FLEX1810
FLEX1820
FLEX1830
FLEX1840
FLEX1850
FLEX1860
FLEX1870
FLEX1880
FLEX1890
FLEX1900
FLEX1910
FLEX1920
FLEX1930
FLEX1940
FLEX1950
FLEX1960
FLEX1970
FLEX1980
FLEX1990
FLEX2000
FLEX2010
FLEX2020
FLEX2030
FLEX2040
FLEX2050
FLEX2060
FLEX2070
FLEX2080
FLEX2090
FLEX2100
FLEX2110
FLEX2120
FLEX2130
FLEX2140
FLEX2150
FLEX2160
FLEX2170
FLEX2180
FLEX2190
FLEX2200
FLEX2210
FLEX2220
FLEX2230
FLEX2240
FLEX2250
FLEX2260
FLEX2270
FLEX2280
FLEX2290
FLEX2300
FLEX2310
FLEX2320
FLEX2330
FLEX2340
FLEX2350
FLEX2360
FLEX2370
FLEX2380
FLEX2390

```

```

      Y(J) = YMAX - JJ/DY
52 CONTINUE
C
      DO 54 I = 1,NX
      X(I) = XMIN + I/DX
54 CONTINUE
C
C   DETERMINE CORNERS OF EXCLUSION AREA
      DO 53 J = 1,NY
      IF (Y(J) .GE. YPOS3) GO TO 153
53 CONTINUE
      J = NY
153 LY1 = J - 2
C
      DO 57 I = 1,NX
      IF (X(I) .GE. AXPOS) GO TO 157
57 CONTINUE
      I = NX
157 LX1 = I - 1
C
      DO 58 JJ = 1,NY
      J = NY - JJ + 1
      READ(8) (S(I,J), I = 1,NX)
58 CONTINUE
      REWIND 8
C
      IF (SUBSQ) GO TO 60
C   INITIALIZE FSP
      CALL FINIT(1,2)
      CALL FLIND(1)
      CALL FLINH(1)
      CALL FDATM(2)
      SUBSQ = .TRUE.
C
C***PLOT ISOPLETHS
      DO 60 LOOP = 1,NCOPY3
      CALL FXYLIM(X1,Y1,X2,Y2)
C
      CALL AXES(XYDATA)
      CALL FERROR(KERR)
      IF (KERR .NE. 0) WRITE(6,255) KERR
C
      CALL OUTLIN
      CALL FERROR(KERR)
      IF (KERR .NE. 0) WRITE(6,260) KERR
C
      IF (NCNTR.EQ.0) GO TO 163
      DO 62 NTIMES = 1,2
      CALL GRAPH(NCNTR,Z,X,Y,S,IMAX,JMAX,1,1,LX1,NY)
      CALL GRAPH(NCNTR,Z,X,Y,S,IMAX,JMAX,LX1,1,NX,LY1)
      62 CONTINUE
      CALL FERROR(KERR)
      IF (KERR .NE. 0) WRITE(6,270) KERR
      163 CONTINUE
      IF (LOOP .GT. 1) GO TO 63
C
C***CREATE MAP IDENTIFICATION
      CALL CONVO('I3',LINE1,16,K,NCASE)
      CALL CONVO('A3',LINE2,0,K,MPOLU(IPOLUT))
      CALL CONVO('A1',LINE2,4,K,MSEA(ISEA))

```

```

FLEX2400
FLEX2410
FLEX2420
FLEX2430
FLEX2440
FLEX2450
FLEX2460
FLEX2470
FLEX2480
FLEX2490
FLEX2500
FLEX2510
FLEX2520
FLEX2530
FLEX2540
FLEX2550
FLEX2560
FLEX2570
FLEX2580
FLEX2590
FLEX2600
FLEX2610
FLEX2620
FLEX2630
FLEX2640
FLEX2650
FLEX2660
FLEX2670
FLEX2680
FLEX2690
FLEX2700
FLEX2710
FLEX2720
FLEX2730
FLEX2740
FLEX2750
FLEX2760
FLEX2770
FLEX2780
FLEX2790
FLEX2800
FLEX2810
FLEX2820
FLEX2830
FLEX2840
FLEX2850
FLEX2860
FLEX2870
FLEX2880
FLEX2890
FLEX2900
FLEX2910
FLEX2920
FLEX2930
FLEX2940
FLEX2950
FLEX2960
FLEX2970
FLEX2980
FLEX2990

```

CALL CONVO('A2'), LINE2, 6, K, MSTAB(ISTAB))	FLEX3000
CALL CONVO('A3'), LINE2, 9, K, WINDR(IWD))	FLEX3010
CALL CONVO('A2'), LINE2, 13, K, MWDSP(IWS))	FLEX3020
C	FLEX3030
63 CALL FCHSZ(3)	FLEX3040
DO 64 NTIMES = 1, 3	FI FY3050
CALL FTEXT(LINE1(5), 3, 1, BXPOS, YPOS1)	FLEX3060
CALL FTEXT(LINE1, 16, 1, AXPOS, YPOS2)	FLEX3070
CALL FTEXT(LINE2, 15, 1, AXPOS, YPOS3)	FLEX3080
64 CONTINUE	FLEX3090
CALL FCHSZ(2)	FLEX3100
IF(NCNTR.EQ.0) GO TO 166	FLEX3110
YY = YPOS3	FLEX3120
DO 65 I = 1, NCNTR	FLEX3130
N = NCNTR - I + 1	FLEX3140
YY = YY - 52	FLEX3150
DO 165 NTIMES = 1, 2	FLEX3160
IF (I .EQ. 1) CALL FTEXT('CONTOURS', 8, 1, AXPOS, YPOS3-52)	FLEX3170
CALL FTEXT(CZ(N), 4, 1, CXPOS, YY)	FLEX3180
165 CONTINUE	FLEX3190
C	FLEX3200
65 CONTINUE	FLEX3210
C	FLEX3220
166 CONTINUE	FLEX3230
IF (LOOP .GT. 1) GO TO 71	FLEX3240
C	FLEX3250
WRITE(6, 250) LINE1, LINE2	FLEX3260
C	FLEX3270
GO TO (66, 68), IPOLUT	FLEX3280
66 WRITE(6, 150)	FLEX3290
GO TO 70	FLEX3300
68 WRITE(6, 160)	FLEX3310
C	FLEX3320
70 WRITE(6, 170) SEASON(ISEA)	FLEX3330
I1 = (ISTAB - 1)*3 + 1	FLEX3340
I2 = I1 + 2	FLEX3350
WRITE(6, 180) (STABOL(I), I=I1, I2)	FLEX3360
WRITE(6, 190) WINDR(IWD)	FLEX3370
WRITE(6, 200) WINDSP(IWS)	FLEX3380
C***MARK RECEPTOR LOCATIONS	FLEX3390
71 IF (NRECEP .EQ. 0) GO TO 80	FLEX3400
IF (LOOP .GT. 1) GO TO 73	FLEX3410
C	FLEX3420
WRITE(6, 220)	FLEX3430
C	FLEX3440
73 DO 78 N = 1, NRECEP	FLEX3450
I = IRECEP(IPOLUT, N)	FLEX3460
RXI = RX(I)	FLEX3470
RYI = RY(I)	FLEX3480
DO 72 NTIMES = 1, 2	FLEX3490
CALL FCHAR(MARK(N), RXI, RYI)	FLEX3500
72 CONTINUE	FLEX3510
IF (LOOP .GT. 1) GO TO 78	FLEX3520
C	FLEX3530
C LIST THE SELECTED RECEPTORS	FLEX3540
WRITE(6, 230) N, I, RXI, RYI	FLEX3550
GO TO (74, 76), IPOLUT	FLEX3560
74 WRITE(6, 240) Z502(I)	FLEX3570
GO TO 78	FLEX3580
76 WRITE(6, 240) ZPART(I)	FLEX3590

78 CONTINUE	FLEX3600
CALL FERROR(KERR)	FLEX3610
IF (KERR .NE. 0) WRITE(6,280) KERR	FLEX3620
C 80 CALL FADV(4)	FLEX3630
C 90 CONTINUE	FLEX3640
C 98 IFORM = 99999	FLEX3650
C 99 RETURN	FLEX3660
	FLEX3670
	FLEX3680
	FLEX3690
	FLEX3700
100 FORMAT(7I6,8X,2A8/7F8.0/12F6.0)	FLEX3710
105 FORMAT(I7)	FLEX3720
110 FORMAT(2(F7.2,1X),1X,2(F8.2,1X))	FLEX3730
120 FORMAT(17X,F8.2,1X,F8.2)	FLEX3740
125 FORMAT(26X,F8.2)	FLEX3750
130 FORMAT(2X,2I1,I2,I1)	FLEX3760
140 FORMAT(10I6)	FLEX3770
150 FORMAT(1H0,10X,'POLUTANT',9X,'SO2')	FLEX3780
160 FORMAT(1H0,10X,'POLUTANT',9X,'PARTICULATE')	FLEX3790
170 FORMAT(1H0,10X,'SEASON',11X,A8)	FLEX3800
180 FORMAT(1H0,10X,'STABILITY',8X,3A4)	FLEX3810
190 FORMAT(1H0,10X,'WIND DIRECTION',3X,A4)	FLEX3820
200 FORMAT(1H0,10X,'WIND SPEED',7X,A8,' KNOTS')	FLEX3830
220 FORMAT(/1H0,17X,'RECEPTOR CONCENTRATION DATA'/1H,10X,	FLEX3840
1 'RECEPTOR',7X,'X(KM)',7X,'Y(KM)',7X,'CONC.(MICROGMS/CU.',	FLEX3850
2 ' METER)')	FLEX3860
230 FORMAT(1H0,I6,5X,I5,2X,2F12.2)	FLEX3870
240 FORMAT(1H+,42X,F14.2)	FLEX3880
250 FORMAT(1H1,10X,'MAP SUMMARY INFORMATION'/1H0,10X,5A4/	FLEX3890
* 1H,10X,2A8/)	FLEX3900
255 FORMAT(1H0,10X,'ERROR CODE',I4,' FROM GRIDS'/)	FLEX3910
260 FORMAT(1H0,10X,'ERROR CODE',I4,' FROM OUTLIN'/)	FLEX3920
270 FORMAT(1H0,10X,'ERROR CODE',I4,' FROM GRAPH'/)	FLEX3930
280 FORMAT(1H0,10X,'ERROR CODE',I4,' FOR RECEPTORS'/)	FLEX3940
290 FORMAT(1H0,10X,'INITIAL CASE ('',I4,'') ON UNIT',I4,	FLEX3950
* ' LARGER THAN DESIRED CASE ('',I4,'') -- TERMINATE'/)	FLEX3960
C	FLEX3970
END	FLEX3980

d. Subroutine GRAPH

Description: This subroutine produces isopleths of the function $\phi(X, Y)$ on film. A more detailed description is contained in Reference 13.

Parameters:

- IZ number of contour values to be plotted
- Z array containing the IZ contour values
- X array containing the horizontal coordinate values of the grid
- Y array containing the vertical coordinate values of the grid
- A array containing the function values $\phi(X, Y)$, i.e., $A_{ij} = \phi(X_i, Y_j)$
- IMAX row dimension of A
- JMAX column dimension of A

I1, J1, I2, J2 indices that delineate that portion of the grid to be used in plotting. That is, only the function values $A(I, J)$, where $I1 \leq I \leq I2$ and $J1 \leq J \leq J2$, are considered.

Isopleths (SO_2 or particulate) are drawn on film.

<pre> SUBROUTINE GRAPH(IZ, Z, X, Y, A, IMAX, JMAX, I1, J1, I2, J2) C*** C MODIFICATION OF SUBROUTINE WRITTEN BY ROY WESSEL : C GRAPH SIZE PREVIOUSLY DETERMINED - PLOT CONTOURS ONLY. C*** DIMENSION A(IMAX, JMAX), X(IMAX), Y(JMAX), Z(IZ) IF (IZ) 130, 130, 100 100 CONTINUE II=I2-1 JJ=J2-1 M=1 L=1 DO 42 J=J1, JJ Y41=Y(J) Y32=Y(J+1) DO 41 I=I1, II X21=X(I) X34=X(I+1) </pre>	<pre> GRAP 0 ***GRAP 10 GRAP 20 GRAP 30 ***GRAP 40 GRAP 50 GRAP 60 GRAP 70 GRAP 80 GRAP 90 GRAP 100 GRAP 110 GRAP 120 GRAP 130 GRAP 140 GRAP 150 GRAP 160 GRAP 170 </pre>
---	--

A1=A(I, J)	GRAP 180
S1=A1	GRAP 190
A4=A(I+1, J)	GRAP 200
B1=A4	GRAP 210
A2=A(I, J+1)	GRAP 220
S2=A2	GRAP 230
A3=A(I+1, J+1)	GRAP 240
B2=A3	GRAP 250
IF (A1-A4) 2, 2, 1	GRAP 260
1 B1=A1	GRAP 270
S1=A4	GRAP 280
2 IF (A3-A2) 3, 4, 4	GRAP 290
3 B2=A2	GRAP 300
S2=A3	GRAP 310
4 B1=AMAX1(B1, B2)	GRAP 320
S1=AMIN1(S1, S2)	GRAP 330
DO 40 K=1, IZ	GRAP 340
B=Z(K)	GRAP 350
IF (B-S1) 40, 7, 7	GRAP 360
7 IF (B-B1) 8, 8, 40	GRAP 370
8 C1=A1-B	GRAP 380
C2=A2-B	GRAP 390
C3=A3-B	GRAP 400
C4=A4-B	GRAP 410
N=INT(8.51- ABS(SIGN(.5, C1)+SIGN(1., C2)+SIGN(2., C3)+SIGN(4., C4)))	GRAP 420
GO TO (40, 35, 30, 25, 20, 6, 10, 5), N	GRAP 430
6 M=0	GRAP 440
Y34=(Y41*C3-Y32*C4)/(C3-C4)	GRAP 450
X41=(X21*C4-X34*C1)/(C4-C1)	GRAP 460
Y21=(Y41*C2-Y32*C1)/(C2-C1)	GRAP 470
X32=(X21*C3-X34*C2)/(C3-C2)	GRAP 480
CALL DECIDE(IMAX, JMAX, X, Y, A, Y21, X32, Y34, X41, I, J, N, L)	GRAP 490
GO TO (40, 22, 9), N	GRAP 500
5 Y34=(Y41*C3-Y32*C4)/(C3-C4)	GRAP 510
X41=(X21*C4-X34*C1)/(C4-C1)	GRAP 520
9 CALL FLNSG(X34, Y34, X41, Y41)	GRAP 530
IF (M) 40, 31, 40	GRAP 540
10 Y34=(Y41*C3-Y32*C4)/(C3-C4)	GRAP 550
Y21=(Y41*C2-Y32*C1)/(C2-C1)	GRAP 560
CALL FLNSG(X34, Y34, X21, Y21)	GRAP 570
GO TO 40	GRAP 580
20 Y34=(Y41*C3-Y32*C4)/(C3-C4)	GRAP 590
X32=(X21*C3-X34*C2)/(C3-C2)	GRAP 600
22 CALL FLNSG(X34, Y34, X32, Y32)	GRAP 610
IF (M) 40, 36, 40	GRAP 620
25 X32=(X21*C3-X34*C2)/(C3-C2)	GRAP 630
X41=(X21*C4-X34*C1)/(C4-C1)	GRAP 640
CALL FLNSG(X32, Y32, X41, Y41)	GRAP 650
GO TO 40	GRAP 660
30 Y21=(Y41*C2-Y32*C1)/(C2-C1)	GRAP 670
X32=(X21*C3-X34*C2)/(C3-C2)	GRAP 680
31 CALL FLNSG(X21, Y21, X32, Y32)	GRAP 690
GO TO 40	GRAP 700
35 Y21=(Y41*C2-Y32*C1)/(C2-C1)	GRAP 710
X41=(X21*C4-X34*C1)/(C4-C1)	GRAP 720
36 CALL FLNSG(X21, Y21, X41, Y41)	GRAP 730
40 M= 1	GRAP 740
41 L= 1	GRAP 750
42 CONTINUE	GRAP 760
C CALL ADVANC	GRAP 770
130 RETURN	GRAP 780
END	GRAP 790

e. Subroutine OUTLIN

Description: This subroutine displays the geographical characteristics (boundaries, rivers, ...) of the region. Coordinates are in the UTM system.

Since the subroutine describes a particular region, a different routine is required (user-supplied) for every region. The routine listed here is for the Chicago region.

Output: The geographical characteristics of the particular study region are drawn on film.

```

      SUBROUTINE OUTLIN
C*****OUTL  0
C  SUBROUTINE DISPLAYS THE GEOGRAPHICAL CHARACTERISTICS OF THE
C  CHICAGO METROPOLITAN AIR QUALITY CONTROL REGION. COORDINATES
C  ARE IN THE UTM SYSTEM (KILOMETERS).
C*****OUTL  10
      REAL LINE1(2,48), LINE2(2,17), LINE3(2,3), LINE4(2,4)
      DIMENSION CHICAG(2,31), RIVER(2,12), SEGS(4,2)
C*****OUTL  20
C  LINE_(1,I) : X-COORDINATE OF ITH POINT
C  LINE_(2,I) : Y-COORDINATE OF ITH POINT
C*****OUTL  30
      DATA LINE1/ 360.7, 4707.4, 359.0, 4669.2, 368.8, 4668.8,
1  368.8, 4659.2, 367.8, 4659.2, 367.2, 4620.2, 394.5, 4620.2,
2  395.6, 4562.45, 413.6, 4562.7, 414.0, 4571.6, 454.6, 4571.4,
3  454.5, 4557.0, 461.3, 4557.8, 464.0, 4556.5, 466.6, 4557.3,
4  470.9, 4558.6, 475.0, 4562.3, 480.4, 4565.0, 487.6, 4569.9,
5  500.6, 4502.3, 504.8, 4564.1, 504.6, 4616.5, 480.4, 4607.4,
6  475.0, 4606.9, 472.6, 4607.7, 465.6, 4609.6, 462.9, 4611.0,
7  465.0, 4612.7, 463.6, 4614.1, 460.8, 4612.7, 455.6, 4617.2,
8  455.5, 4617.4, 451.2, 4626.7, 451.2, 4628.3, 449.2, 4632.1,
9  449.4, 4638.2, 446.8, 4645.5, 447.6, 4646.3, 444.4, 4651.7,
A  443.5, 4657.6, 437.2, 4666.2, 433.9, 4674.5, 431.5, 4682.5,
B  433.1, 4688.9, 434.6, 4702.6, 434.3, 4704.9, 401.7, 4706.2,
C  360.7, 4707.4/
      DATA LINE2/ 401.7, 4706.2, 400.8, 4668.0, 397.4, 4668.0,
1  397.4, 4658.4, 395.3, 4658.4, 395.3, 4649.2, 423.6, 4649.5,
2  423.4, 4619.0, 418.6, 4615.9, 413.6, 4615.4, 413.6, 4610.6,
3  423.3, 4610.6, 423.3, 4600.9, 433.1, 4600.9, 433.1, 4591.0,
4  455.2, 4590.8, 456.0, 4617.3/
      DATA LINE3/ 368.8, 4668.8, 400.8, 4668.0, 437.2, 4667.2/
      DATA LINE4/ 395.3, 4649.2, 394.5, 4620.2, 413.6, 4620.2,
1  413.6, 4615.4/
      DATA SEGS/ 455.2, 4590.8, 454.6, 4571.4, 480.4, 4607.4,
1  480.4, 4565.0/
C*****OUTL  330

```

C***CITY OF CHICAGO

DATA CHICAG/ 444.4,4652.7, 441.2,4652.7, 441.2,4650.3,
 1 438.0,4650.3, 436.4,4649.5, 434.6,4649.5, 435.5,4648.7,
 2 433.1,4648.7, 433.1,4651.1, 431.8,4651.1, 431.5,4648.4,
 3 429.1,4648.4, 429.1,4643.1, 433.1,4642.3, 433.1,4639.5,
 4 434.7,4639.5, 434.7,4635.0, 438.0,4635.0, 438.0,4630.2,
 5 436.4,4628.6, 433.1,4628.6, 433.1,4625.4, 438.0,4625.4,
 6 438.0,4620.6, 442.8,4620.6, 442.8,4617.3, 439.5,4617.3,
 7 439.5,4614.1, 443.6,4613.5, 448.4,4610.9, 455.6,4610.9/

OUTL 340
 OUTL 350
 OUTL 360
 OUTL 370
 OUTL 380
 OUTL 390
 OUTL 400
 OUTL 410
 OUTL 420

C***DESPLAINE RIVER

DATA RIVER/ 396.1,4583.5, 400.9,4588.4, 401.8,4591.6,
 1 407.4,4596.4, 409.8,4603.8, 412.2,4613.3, 423.4,4624.0,
 2 428.6,4623.8, 433.1,4627.8, 446.8,4633.9, 446.8,4637.1,
 3 449.2,4637.5/
 DATA NPTS1,NPTS2,NPTS3,NPTS4,NSEGS,NCHIC,NRIVER/ 48, 17, 3, 4,
 * 2, 31, 12 /

OUTL 430
 OUTL 440
 OUTL 450
 OUTL 460
 OUTL 470
 OUTL 480
 OUTL 490

C DO 10 LOOP = 1,2

OUTL 500
 OUTL 510

C DRAW LINE_1
 DO 1 I = 2,NPTS1
 CALL FLNSG(LINE1(1,I-1),LINE1(2,I-1),LINE1(1,I),LINE1(2,I))
 1 CONTINUE

OUTL 520
 OUTL 530
 OUTL 540
 OUTL 550
 OUTL 560

C DRAW LINE_2
 DO 2 I = 2,NPTS2
 CALL FLNSG(LINE2(1,I-1),LINE2(2,I-1),LINE2(1,I),LINE2(2,I))
 2 CONTINUE

OUTL 570
 OUTL 580
 OUTL 590
 OUTL 600

C DRAW LINE_3
 DO 3 I = 2,NPTS3
 CALL FLNSG(LINE3(1,I-1),LINE3(2,I-1),LINE3(1,I),LINE3(2,I))
 3 CONTINUE

OUTL 610
 OUTL 620
 OUTL 630
 OUTL 640

C DRAW LINE_4
 DO 4 I = 2,NPTS4
 CALL FLNSG(LINE4(1,I-1),LINE4(2,I-1),LINE4(1,I),LINE4(2,I))
 4 CONTINUE

OUTL 650
 OUTL 660
 OUTL 670
 OUTL 680

C DRAW LINE_SEGMENTS
 DO 5 I = 1,NSEGS
 CALL FLNSG(SEGS(1,I),SEGS(2,I),SEGS(3,I),SEGS(4,I))
 5 CONTINUE

OUTL 690
 OUTL 700
 OUTL 710
 OUTL 720

C DRAW CHICAGO
 DO 6 I = 2,NCHIC
 CALL FLNSG(CHICAG(1,I-1),CHICAG(2,I-1),CHICAG(1,I),CHICAG(2,I))
 6 CONTINUE

OUTL 730
 OUTL 740
 OUTL 750
 OUTL 760

C DRAW "RIVER"
 DO 7 I = 2,NRIVER
 CALL FLNSG(RIVER(1,I-1),RIVER(2,I-1),RIVER(1,I),RIVER(2,I))
 7 CONTINUE

OUTL 770
 OUTL 780
 OUTL 790
 OUTL 800

C 10 CONTINUE
 RETURN
 END

OUTL 810
 OUTL 820
 OUTL 830
 OUTL 840

f. Subroutine SECDRV

Description: This internal subroutine is used for deciding which contour line should be drawn in certain ambiguous cases. A further description of the routine is contained in Reference 13.

SUBROUTINE SECDRV(E0, E1, E2, E3, E4, E5, D)	SECD 0
DIMENSION E0(3), E1(3), E2(3), E3(3), E4(3), E5(3), D(2, 2)	SECD 10
P= E3(1)-E0(1)	SECD 20
Q= E1(1)-E0(1)	SECD 30
R= E4(2)-E0(2)	SECD 40
S= E2(2)-E0(2)	SECD 50
T= E5(1)-E0(1)	SECD 60
U= E5(2)-E0(2)	SECD 70
A0= E0(3)	SECD 80
B1= (E1(3)-A0)/Q/(P-Q)	SECD 90
B2= (E2(3)-A0)/S/(R-S)	SECD 100
B3= (E3(3)-A0)/P/(P-Q)	SECD 110
B4= (E4(3)-A0)/R/(R-S)	SECD 120
DADX2= B3-B1	SECD 130
DADY2= B4-B2	SECD 140
DADX= P*B1 -Q*B3	SECD 150
DADY= R*B2 -S*B4	SECD 160
DADXDY= E5(3)-A0 -T*DADX -U*DADY -T*T*DADX2 -U*U*DADY2	SECD 170
D(1, 1)= 2.*DADX2	SECD 180
D(2, 2)= 2.*DADY2	SECD 190
D(1, 2)= DADXDY/T/U	SECD 200
D(2, 1)= D(1, 2)	SECD 210
RETURN	SECD 220
END	SECD 230

g. Job Control Language: Execution

The ASSM plotting routines and the SYMAP (Version V) program have been compiled using S/360 FORTRAN IV(H) with OPT = 02. It is currently running on an IBM S/360 50-75 using OS MVT Release 20 under ASP.

The following JCL represents the execution step of the ASSM plotting system. SYMAP and the ASSM plotting routines have been linked into the ASSM.PROGLIB Library.

The data sets represented by ddnames FT01F001,..., FT04F001 are standard SYMAP scratch files. The receptor concentration data generated by ASSM is specified through logical unit 10 (FT10F001). The scratch file on logical unit 8 (FT08F001) contains the function values for contouring. It is written by SYMAP, and read and repositioned by FLEXIN.

```
//          JOB
//          CLASS=C,REGION=392K

/*SETUP DDNAME=DISKUNIT,DEVICE=2314,ID=DISK85
/*SETUP UNIT=2280,ID=FILM
//JOB LIB DD DSN=ASSM.PROGLIB,UNIT=2314,DISP=SHR,VOL=SER=DISK85
//          EXEC PGM=ASSMPLOT
//FT01F001 DD DSN=&SYMAP01,SPACE=(TRK,(2,1)),UNIT=2314,
//          DCB=(RECFM=VBS,LRECL=84,BLKSIZE=1684)
//FT02F001 DD DSN=&SYMAP02,SPACE=(TRK,(2,1)),UNIT=2314,
//          DCB=(RECFM=VBS,LRECL=84,BLKSIZE=1684)
//FT03F001 DD DSN=&SYMAP03,SPACE=(TRK,(2,1)),UNIT=2314,
//          DCB=(RECFM=VBS,LRECL=84,BLKSIZE=1684)
//FT04F001 DD DSN=&SYMAP04,SPACE=(TRK,(2,1)),UNIT=2314,
//          DCB=(RECFM=VBS,LRECL=84,BLKSIZE=1684)
//FT06F001 DD SYSOUT=A,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=1596)
//FT08F001 DD DSN=&SYMAP08,SPACE=(TRK,(5,5)),UNIT=2314,
//          DCB=(RECFM=VBS,BLKSIZE=7200)
//FT10F001 DD DSN=CMAQCR.RECPCONC,UNIT=2314,DISP=OLD,VOL=SER=DISK85
//FILM UNIT DD UNIT=2280
//FT05F001 DD *
B-DATA POINTS      C      P
.
.
.
999999
/*
```

2. Input Description

The SYMAP contouring system serves as the basis for the ASSM plotting system. Familiarity with the use of the SYMAP program is assumed in this appendix. However, References 10 and 11 contain the necessary background information.

Input to the plotting system is composed of two separate data sets (files). One is the receptor concentration data output from ASSM. The other contains the plotting options. It is the latter input that is described here. Its deck structure, composed of four SYMAP packages, is displayed in Figure C-2. Whenever possible, examples will reference the input and output for the sample problem.* Thus, it would be advantageous to consult Figure C-3, the completed input form for the sample problem.

Since our plotting system is based upon the SYMAP program, the input description will be considered in terms of the SYMAP packages. Distinctions will always be made to separate the options used for the SYMAP printer plots and the (2280) film plots.

Fig. C-2
Plotting-system
Input Deck

* Note: There is but one "sample problem" being considered in Appendices B and C.

a. B-DATA POINTS

This package inputs the coordinates of the receptor grid from the ASSM data file. It should be used but once for a given receptor grid. Additionally, this entry describes the ASSM data file and initializes the graphics parameters. The package is composed of the following five cards.

Card 1

This card must contain B-DATA POINTS in columns 1-13, and any non-blank character in column 18. A non-blank character in column 23 will suppress the listing of the receptor grid coordinates.

Card 2

This card must contain a 1 in column 5 (IFORM) and a value not less than 340 in columns 8-10. The current system can input a receptor grid with a maximum of 340 points.

```

E-DATA POINTS      C      P
  1  340
  10      1      1      0      10      1      6      CHICAGO REGION
  4690      375  1.1325      355      4555      510      4710
  100      300      500      700      900      1100
E-VALUES            C      P
  2  340
F-MAP
C
C
C
CHICAGO REGION
SO2 ISOPLETHS
  1      12.5      12.5
  2      -4690      375      -4565      500
  3      3
  4      100
  5      700
  7
000      123      .LOH      S
--      23      XH
X      3      AH
      VH
  8
  9
  17
  21
99999
E1-VALUES            C
  5  10
E-VALUES            C      P
  3  340
F+MAP
C
C
C
CHICAGO REGION
PARTICULATE ISOPLETHS
  12
99999
E1-VALUES            C
  6  10
999999

```

Fig. C-3. Input for Sample Problem

Card 3VariableColumns

INPUT

1-6

Logical unit number of the receptor-concentration-data file. It must not be 1, 2, 3, 4, or 8.

The next two variables position the input file.

ICASE

7-12

Number of the initial case or unit 'INPUT'. This corresponds to the NCASE parameter of ASSM.

NCASE

13-18

Number of the first case to be considered on unit 'INPUT'. The receptor grid is taken from NCASE. If NCASE > ICASE, the first NCASE - ICASE cases are skipped on the file.

NSELC

19-24

Control parameter for selection of cases being considered.

If ≤ 0 , cases are considered in order from NCASE.

If > 0 , only particular cases are considered. Under this option, the case number is input through the appropriate E-VALUES package. Cases must still be selected in order.

For example, if the first 10 cases were to be considered, then NSELC is ≤ 0 . If only cases 3, 7, and 10 were desired, then NSELC > 0 and the three case numbers must be input through the E-VALUES packages.

NRECEP	25-30	The number of (selected) receptors to be marked on the film plot. Their numbers are input through the ASSM file.
NCOPYS	31-36	The number of copies of each film plot to be made. The minimum value for NCOPYS is 1.
NZ	37-42	The number of contour values to be input. (See Card 5.) $NZ \leq 12$.
LABEL	51-66	Identifying information of at most 16 characters that appears on film output. Designed to repeat the METSET parameter from ASSM for cross-referencing purposes.

Card 4

<u>Variable</u>	<u>Columns</u>	
YMAX	1-8	Coordinate value of the upper row (Y) of the SYMAP printer plot. It is equivalent to the "minimum vertical coordinate" of FMAP elective number 2.
YMIN	9-16	Coordinate value of the leftmost column (X) of the SYMAP printer plot. It is equivalent to the "minimum horizontal coordinate" of FMAP elective number 2.
SIZE	17-24	Physical size, in inches, of the plotting area on film. It must be ≤ 1.15 inches.

The next four parameters specify the lower left and upper right corners of the film plotting area in the same units that specify the receptor grid.

X1PLT	25-32	X - coordinate of the lower left corner
X1PLT	33-40	Y - coordinate of the lower left corner
X2PLT	41-48	X - coordinate of the upper right corner
X2PLT	49-56	Y - coordinate of the upper right corner

These four values determine a square of side 'SIZE' over which the isopleths will be drawn. In the sample problem, the receptor grid (Figure B-4) and the SYMAP grid are identical. However, the film plotting area is larger to accommodate the entire region.

Card 5

This card contains the NZ values to be contoured. They appear in fields of length six.

b. E-VALUES

This package inputs the concentration levels of SO₂ and particulate to be contoured. It contains two cards if NSELC $\leq$ 0; otherwise a third card must be included.

Card 1

This card must contain E-VALUES in columns 1-8 and any non-blank character in column 18. A non-blank character in column 23 will suppress the listing of the concentration data at each receptor.

Card 2

- This card contains, in column 5, either a
- 2 if SO₂ levels are plotted, or a
 - 3 if particulate levels are plotted after SO₂ levels are plotted, or a
 - 4 if particulate levels are plotted and SO₂ are not plotted

for a given input case. Columns 8-10 must contain a value not less than 340.

If NSELC > 0, then include the following card.

Card 3

Columns 1-6 contain the case number (right-justified) of the particular case to be considered.

c. F-MAP

This package inputs the specifications for the printer isopleth plot to be made. All input to this package follows the standard SYMAP format. This is the only package in which no input through the supplied FLEXIN routine is made.

The options selected in this package will depend on the degree of complexity desired by the user. However, the following eleven options have proved to be most sufficient. A description of each is contained in References 10 and 11.

For the first map in a given run,

<u>Elective number</u>	<u>Description</u>
1	size
2	extreme points
3	number of contour levels

<u>Elective number</u>	<u>Description</u>
4	maximum contour value
5	maximum contour value
7	symbolism
8	suppress contour lines
9	suppress histogram bars
17*	suppress tabulated data
21*	create "Type 8"

For subsequent maps, the use of elective number 12 to repeat previous map options is recommended. In the sample problem, this elective was used for the second map to repeat those options specified in the first F-MAP package.

d. E1-VALUES

This package is used to provide additional entries into FLEXIN for purposes of contouring on film the values generated and stored on "Type 8" by the preceding F-MAP package. It is necessary that an E1-VALUES package immediately follow the F-MAP package to which it corresponds. The SYMAP function of this package is no longer applicable in this system. The package is composed of two cards.

*Described in Reference 10 only.

Card 1

This card must contain E1-VALUES in columns 1-9 and any nonblank character in columns 18 and 23.

Card 2

This card contains, in column 5, either a 5 if SO₂ values are being contoured or a 6 if particulate values are being contoured. Column 10 of this card must contain a positive value.

3. Output Description and Sample Problem

In Appendix B a sample problem, based upon the Chicago region for 16 different meteorological cases, was discussed. Included in Section 4 of that appendix was the output for the first of those 16 cases. In this section we present the plotting output corresponding to that sample case. A by-product of this discussion will be a description of the output obtained through the film-plotting portion of this system. A description of the SYMAP - generated output is contained in Reference 11.

The output from the ASSM plotting system is composed of three parts. The first is the SYMAP printer plot displayed in Figure C-4. The second is the (2280) film plot. A print of that 35mm film is displayed in Figure C-5. The third part is the "Map Summary Information". It is composed of the film-labeling information for cross-reference purposes, a complete description of the meteorological data for this case, and a list of the selected receptors containing the location and pollutant concentration for each. Figure C-6 contains the Map Summary Information for the sample problem.

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Fig. C-4. SYMAP Output for Sample Problem

Fig. C-5. Film Output for Sample Problem

MAP SUMMARY INFORMATION

CHICAGO REGION 1

SO2-H-NT-SW - 3

POLLUTANT SO2

SEASON WINTER

STABILITY NEUTRAL

WIND DIRECTION SW

WIND SPEED 0 - 3 KNOTS

RECEPTOR CONCENTRATION DATA				
	RECEPTOR	X(KM)	Y(KM)	CONC. (MICROGMS/CU. METER)
1	266	464.51	4609.52	1544.30
2	182	465.10	4615.00	1089.55
3	183	465.00	4617.50	793.76
4	154	459.10	4645.10	688.12
5	259	447.51	4635.17	675.39
6	138	442.50	4645.10	477.79
7	137	442.50	4631.30	420.78
8	258	444.40	4645.02	417.89
9	155	450.00	4647.50	392.76
10	153	450.00	4632.50	373.92

Fig. C-6. "Map Summary Information" for Sample Problem

An explanation of the labels that appear on the film and in the Map Summary Information is contained in Table C-1.

The upper right-hand portion of the film output contains three lines of identifying information, followed by the contour levels plotted. A description of the three lines follows.

The first line contains the case number. The LABEL parameter* forms the next line. The third line is a description of the pollutant and meteorological data. It is composed of at most 15 characters.

<u>Position</u>	<u>Description</u>
1-3	pollutant
5	season
7-8	stability class
10-12	wind direction
14-15	wind speed

*See page 189.

TABLE C-1. Film and Printer Labels

Parameter	Printed Label	Film Label
Pollutant	SO ₂ PARTICULATE	SO ₂ PRT
Season	WINTER SPRING SUMMER FALL	H (heating) S N (non-heating) F
Stability Class		
Very Unstable	V-UNSTABLE	VU
Moderately Unstable	M-UNSTABLE	MU
Slightly Unstable	S-UNSTABLE	SU
Neutral	NEUTRAL	NT
Stable	STABLE	ST
Wind Direction	Identical to the description in Figure C-5 on both printer and film.	
Wind Speed (knots)	0- 3 4- 6 7-10 11-17 17-21 OVER 21	3 6 10 17 21 25

APPENDIX D

Episode Display

A manual display method can be used to provide a medium for graphically planning control strategies. Pollution contours plotted on 35mm film can be mounted on a traditional slide mount or aperture card. The aperture card provides a simple means for sorting the different contours. Figure D-1 shows the outline of a typical aperture with a film contour mounted. The aperture card is nothing more than an IBM card with a hole cut in it for mounting film. Data which identifies the contour is punched on the left half of the card (50 columns), and the cards can be sorted using a manual sorter or an IBM 082 Card Sorter.

The pollution contours, mounted on either traditional or aperture card mounts, can be projected onto a screen for viewing with a large format. A special projector made for aperture cards and traditional 35mm slide mounts is available from the 3M company. An artist's sketch of a display unit which can be used to plan episode control strategies is shown in Figure D-2. The film is inserted in the opening below the viewing area and an internal reflecting mirror projects the image onto a rear-frosted clear plexiglas viewing screen. The viewing area is approximately 40" x 40" and has a smooth front surface. Episode strategy planning can include plotting individual source contributions onto plexiglas, which can later be washed clean with water or alcohol.

Fig. D-1. Typical Aperture Card with Regional Isopleths

Fig. D-2. Episode Display Unit. ANL Neg. No. 190-35.

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*Available upon request from Applied Mathematics Division,
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