IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR QUALITY MANAGEMENT DIVISION

THE AIR QUALITY STANDARDS ATTAINMENT-MAINTENANCE ANALYSIS FOR SUSPENDED PARTICULATES IN DUBUQUE, IOWA

JULY 1, 1977

Abstract

Total suspended particulate (TSP) is one of six pollutants for which the federal EPA has declared national air quality standards for the protection of human health and welfare. A set of strategies to control TSP emissions, and thereby reduce ambient concentrations of this pollutant to acceptable levels, was developed by the Iowa Air Pollution Control Commission in 1971 and 1972. These strategies became part of a federally approved State Implementation Plan on May 31, 1972, (40 CFR, Part 52). Since that time most air pollution sources have reached compliance with state particulate emission standards, yet air monitoring shows portions of Iowa are still plagued with unacceptably high TSP concentrations. The purpose of this analysis is to explore the causes of these high TSP concentrations and to recommend new or revised control strategies which will lead to reducing TSP to an acceptable level.

To better understand the reasons for not attaining the TSP standards, a critical evaluation of both air monitoring equipment and air pollution sources is necessary. To estimate the impact of air pollution sources on an air monitoring site, an emission source model called AQDM is used. The model AQDM takes areawide and discrete point source emissions, combines these emissions with meteorology typical of the vicinity and predicts annual average concentrations of TSP at chosen receptor sites. Receptors that correspond to actual monitoring locations help calibrate the projections to achieve greater accuracy.

Each area with high TSP levels is modeled three times to estimate TSP levels before emission control strategies set up in 1971 and 1972 by the Air Pollution Control Commission were implemented, to estimate the impact of these strategies after they were implemented, and to estimate the impact future growth and expansion will have on this area.

For Dubuque County the results of DEQ's analysis indicate that particulate emissions have been sufficiently controlled to achieve the TSP standard. The projections for the next ten years also indicate achievement of the TSP standard.

This analysis is designed to be ongoing with updates and reevaluations as necessary. Throughout this continuing process the Dubuque County Health Department as well as the East Central Intergovernmental Association will be consulted and enlisted as a conduit to the affected local governments in Dubuque County.

INTRODUCTION

The Federal Clean Air Amendments of 1970 required all states to develop an implementation plan to attain and maintain the National Ambient Air Quality Standards (NAAQS) for certain air pollutants which are detrimental to the public's health and general welfare. Most of the original implementation plans emphasized the control of air pollution from industrial sources to attain and maintain the NAAQS by July 1, 1975. However, state and Environmental Protection Agency (EPA) officials soon realized that these goals could not be achieved in all areas with the original implementation plans. The original plans were found deficient because they had not accomplished all of what they were originally developed to accomplish. Therefore, EPA called for revisions to all implementation plans in those states where the NAAQS had not been attained. EPA informed Iowa[1] that its Implementation Plan is inadequate for certain areas of the State and should, therefore, be revised to include additional control strategies.

Even prior to this notification by EPA, the Iowa Department of Environmental Quality (DEQ) began developing revisions to the current implementation plan. These revisions to the air pollution control strategy are being evaluated so that the NAAQS could eventually be attained and maintained in all parts of Iowa. To accomplish this it is necessary to analyze current air quality attainment problems as well as possible future air quality maintenance problems caused by general growth activities.

Ambient air monitoring is conducted in twenty-six cities or metropolitan areas throughout Iowa. The data collected at these sites show that fifteen of the twenty-six areas have not attained the NAAQS for suspended particulate matter, and one area (Polk County) has not attained the NAAQS for either carbon monoxide or suspended particulate. These sixteen areas (classified according to county) which have not attained the NAAQS have been designated non-attainment areas. One other area (Des Moines County) which does not have monitors, has also been designated as a non-attainment area for suspended particulates because of the potential for violations of the NAAQS due to industrialization. (Particulate and sulfur dioxide monitoring is scheduled to begin in Des Moines County at Burlington by October, 1977). A total of seventeen counties have been designated non-attainment areas and are called air basins. These air basins are shown in Figure 1.

DEQ has been examining each of the air basins by reviewing all air monitoring data and by modeling the effect of each significant air pollution source. The results of these studies have been or will be presented to those in the area having an interest in urban planning. Table 1 lists the DEQ contacts in each air basin. Following discussion with local officials, the basin plans will be reviewed by the Air Quality Commission and will be the basis for developing necessary implementation plan revisions. These revisions will be transmitted to the federal EPA for inclusion in Iowa's State Implementation Plan. A timetable for completion of basin plans is found in Figure 2.

AIR MONITORING

Air quality data for suspended particulate are obtained using the high volume sampler. The sampler draws a known quantity of ambient air through a preweighed glass fiber filter for a twenty-four-hour period once every six days.

After each twenty-four-hour period the sample filter is sent to the laboratory where it is weighed again. The weight difference measured in micrograms is the amount of particulate. Combined with the volume of air that passed through the filter during the twenty-four-hour period, the sampling results are calculated and recorded as the average micrograms of particulate matter per cubic meter of air for a twenty-four-hour period.

The primary (health related) NAAQS for particulates is based both upon a daily exposure and a year's average exposure. The daily standard (260 micrograms per cubic meter) should not be exceeded more than once per year. The yearly standard is the calculated geometric mean of all the twenty-four-hour readings taken during that year, and should not exceed 75 micrograms per cubic meter. Two single readings in excess of the twenty-four-hour standard or a calculated annual geometric mean in excess of the annual geometric mean standard is a violation of the NAAQS for suspended particulates.

Tables 2, 3 and 4 are listings of the statewide particulate sampling network, the ranking of monitoring sites by annual average and the ranking of monitoring sites by maximum twenty-four-hour value.

Because the designation of non-attainment areas and the review of existing air quality in the basin is dependent upon monitoring data, DEQ contracted to have the State's ambient monitoring network critically reviewed[2]. This review was conducted to assure that the non-attainment areas were being correctly labeled as such and that alternate control strategies developed were justified. It was learned that a few monitors were being biased by an extremely localized obstruction or other interference and thus were improperly placed. These monitors have been relocated within the area and should now be collecting data more representative of the area in which the monitor is located. DEQ, jointly with the State Hygienic Laboratory, through its continuing process of assuring that valid, representative ambient air data are collected, has been developing a written quality assurance program in which the air monitor operator sampling procedures, the laboratory procedures, and the final data transmittal procedures have been examined. A program has been developed to assure that the procedures at each level are sufficient to provide that accurate data are used in the air basin planning process and in associated rule revision development.

THE MODEL (Annual Average Estimation)

A dispersion model is a computer program that predicts what the ambient air quality will be at a certain point within an air basin. The Air Quality Display Model (AQDM)[3] is the model DEQ used in each air basin. AQDM is a computer model that combines point source emissions (industrial plants), area source emissions (residential heating, fugitive dust, solid waste disposal, transportation, etc.) and meteorological factors (wind speed, wind direction, average temperature, pressure, and mixing height) over a specified area to predict the annual distribution of pollutants for that area. Suspended particulate was modeled in each of the seventeen non-attainment air basins. A different model called APRAC-1A[4], was used to model carbon monoxide in the non-attainment area, Polk County. APRAC-1A is used by the Iowa Department of Transportation to evaluate the air quality impact of transportation plans in Cedar Rapids, Sioux City, Waterloo, the Quad Cities, Dubuque and Des Moines.

To investigate both current and future air quality problems with the use of the diffusion model, three years (1973, 1976 and 1985) have been analyzed. These years were selected for the following reasons:

1973 - Analysis of this year will illustrate particulate concentrations when emission controls were only beginning to appear in Iowa.

1976 - Analysis of this year will illustrate particulate concentrations when emissions should be controlled according to the existing State Implementation Plan or strategy for controlling air pollution.

1985 - Analysis of this year will project future particulate concentrations to help determine if general growth and expansion will cause air quality standards to be exceeded if only the existing strategy is used.

As previously described, AQDM requires the input of point source emissions, area source emissions, and meteorological factors to obtain predicted values for annual particulate concentrations at pre-designated receptor locations. The annual particulate concentrations predicted by the model for each year are plotted as isopleths over the air basin. The five maximum receptors are also broken down into specific source contribution percentages.

The computer algorithm and the program inputs reflect several assumptions. Assumptions used in the computer algorithm are:

(a) Total reflection of the pollutant plume takes place at the earth's surface.
(b) Conditions describing the plume are averaged over a time period of several minutes.
(c) All effluent gases and particulates have diameters less than 20 microns and have neutral buoyancy in the atmosphere. Zero fallout is assumed.
(d) The plume exhibits a Gaussian concentration distribution and the spread in both directions is considered to be a function of downwind distance and atmospheric stability only.
(e) The plume is a steady-state phenomenon resulting from a constant, continuous emission.

Assumptions used in the program input are:

(a) Point source data from plant emission inventory forms and from permit information are accurate and complete.
(b) Sources not reporting stack parameters were given parameters of similar sources (this was true in interstate air basins where other states occasionally were not able to provide stack parameters).
(c) Area source data from the National Emissions Data System (NEDS) are accurate and complete.
(d) Population distribution and area source emissions are directly related.
(e) Fugitive emissions from paved and unpaved roads are accurately calculated[5,6].
(f) Emissions from construction have negligible effect on the annual average particulate concentration.
(g) Agricultural tilling is assumed to be a source of background and not included as a separate area source.

(h) The background of Iowa is an arithmetic mean of 44 micrograms per cubic meter, based on eight years of monitoring at Backbone State Park in northeast Iowa.

THE MODEL (Twenty-four-hour Estimation)

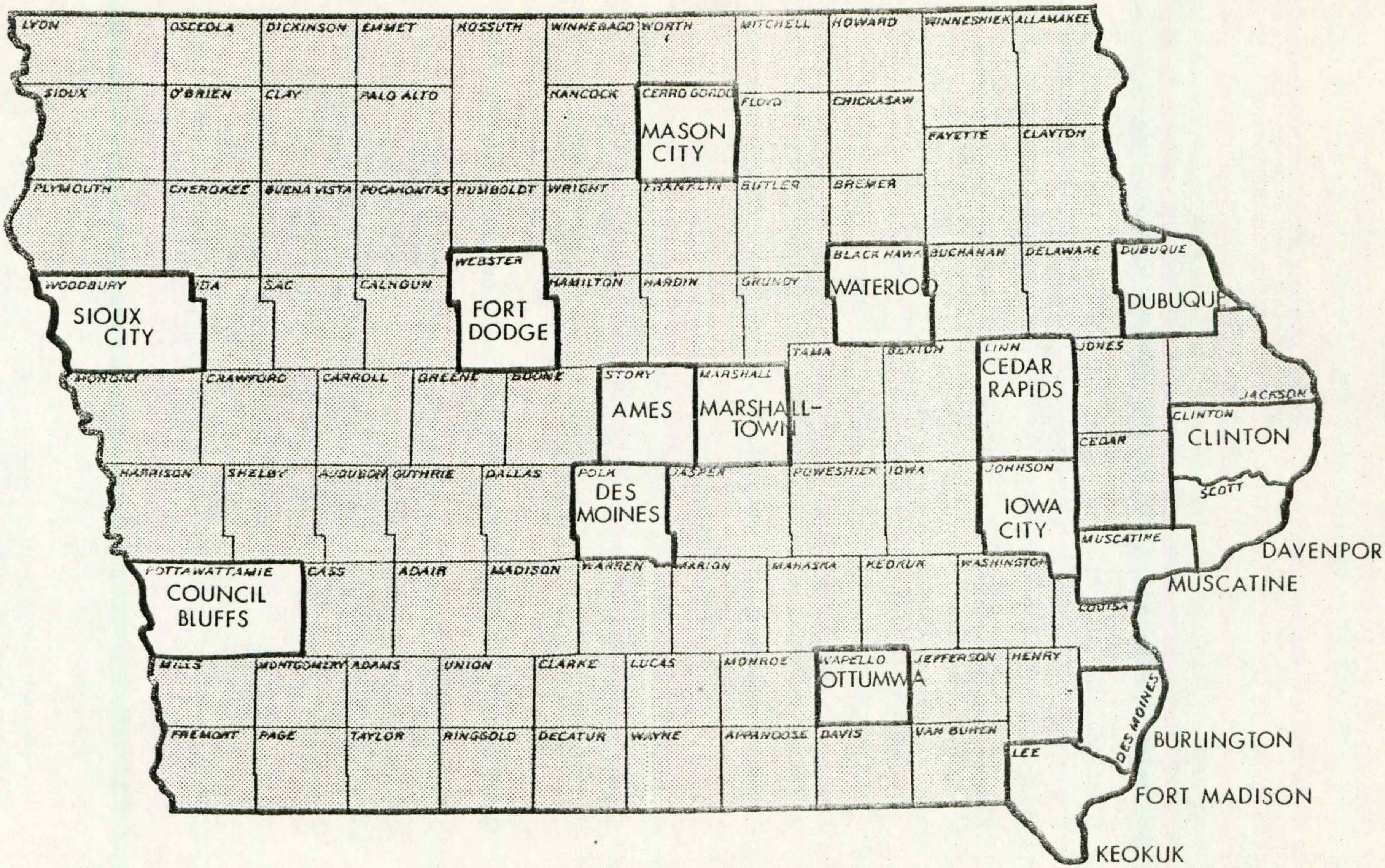
The predicted particulate concentrations for the year 1985 may be used as a planning tool with some qualifications. The AQDM model results for 1985 are obtained by inputting "normal" growth factors for point and area sources. If, for example, because of increased industrial expansion or other reasons, the growth within an air basin does not follow the "normal" growth patterns, DEQ is still able to review the increased industrial growth because of its permit system. Construction permits are required for any new installation or modification of equipment causing emissions. The permit applications are reviewed with respect to the potential for the new or modified equipment not to cause violations of NAAQS. Whether or not the installation or modification will cause violations of the NAAQS is predicted by application of a 24 hour model.

To predict the twenty-four-hour exposure to suspended particulate, a Briggs-Turner dispersion model, such as PTMAX[7] and PTMTP[7] is used. Given both point source emissions and meteorology likely to occur over a twenty-four hour period, the contribution due to single or multiple stack emissions from a single facility can be determined. This type of modeling has been done on most large industrial discharges and is regularly done on all new, proposed emission discharges in non-attainment air basins as part of DEQ's preconstruction review of these facilities. This procedure assures that the NAAQS are maintained in every air basin through a source-by-source review.

THE CONTINUING PROCESS

This entire process of air basin modeling and control strategy planning will be repeated and frequently updated for all of the seventeen air basins in Iowa. The effort is made to assure that Iowa's air will not contain harmful concentrations of known pollutants. What follows is a detailed picture of one air basin.

FIGURE 1
IOWA'S SEVENTEEN DESIGNATED NON-ATTAINMENT COUNTIES
AND ASSOCIATED POPULATION CENTERS*



* Dubuque County and Woodbury County have recently been removed from the list of non-attainment counties.

TABLE 1
DEQ CONTACTS FOR THE
SEVENTEEN NON-ATTAINMENT AIR BASINS

Council Bluffs

Fredric Ridel
Director, Transportation Planning
Metropolitan Area Planning Agency

Sioux City

Donald Meisner
Planning Director
Siouxland Interstate Metropolitan Planning Council

Des Moines
Ames

Brent Bean
Central Iowa Regional Association of Local Governments

Waterloo

Hugh J. Copeland
Planning Director
Iowa Northland Regional Council of Governments

Cedar Rapids

Riley Simpson
Planner III
Linn County Regional Planning Commission

Quad Cities
Muscatine

F. Glen Erickson
Executive Director
Bi-State Metropolitan Planning Commission

Mason City

Tom Simmering
Planning Director
Mid-Iowa Development Association
Regional Planning Commission

Fort Dodge

Jonathan Rutstein
Planning Director
Mid-Iowa Development Association Regional Planning Commission

Marshalltown

Gerald Suchan
Planning Director
Area Six Regional Planning Commissi

Dubuque
Clinton

Karl Biasi
Planning Director
East Central Intergovernmental Association

Iowa City

James Elza
Planning Director
East Central Iowa Association of Regional Planning Commissions

Ottumwa

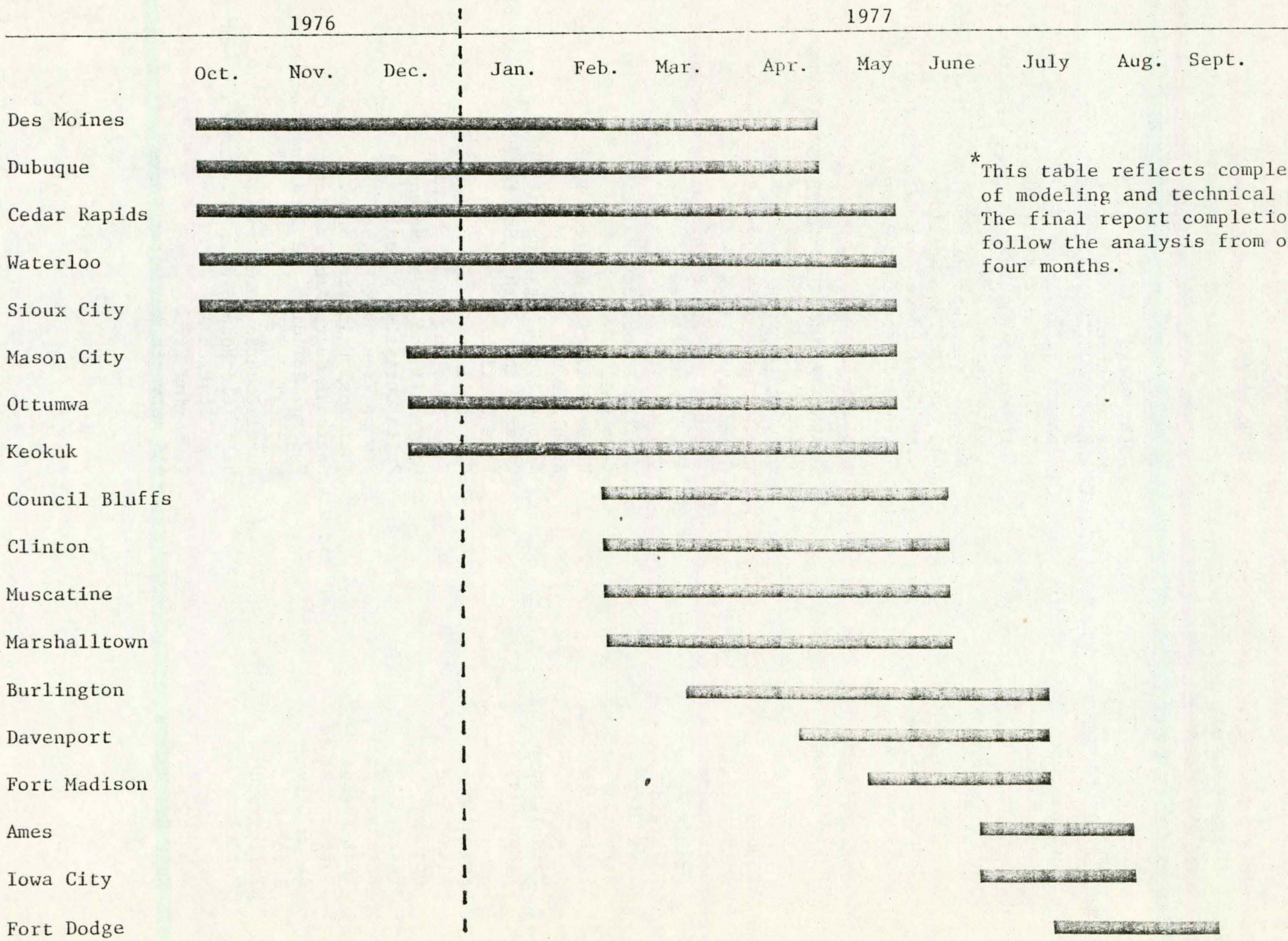
Bruce Bullamore
Planning Director
Area XV Regional Planning Commissio

Keokuk, Ft. Madison and Burlington

Mike Dunn
Planning Director
Southeast Iowa Regional Planning Commission

FIGURE 2

ESTIMATED TIME TABLE FOR COMPLETION OF BASIN PLANS*



*This table reflects completion of modeling and technical analysis. The final report completion will follow the analysis from one to four months.

TABLE 2
LIST OF STATEWIDE PARTICULATE SAMPLING NETWORK
AS OF 1/1/77

City	Site Location
Altoona	Water Works Building
Ames	Meeker School
Ankeny	Public Works Garage
Bettendorf	Pleasant Valley School
Cedar Rapids	751 Center Point Road, NE; 445 First St. SW; 14th Avenue and 10th St. SE; 4426 Council St. NE; 4401 Sixth St. SW
Clinton	Sewage Treatment Plant; Lyons Junior High School; and Central Fire Station
Council Bluffs	City Hall; Dodge Park Lift Station and Water Plant
Davenport	Third and Pershing; Monroe School and 3200 Elmore Ave.
Denison	Water Plant
Des Moines	Ninth and Mulberry; East Seventh and Court; 2217 Beaver; 1249 McKinley; Texaco Bulk Station; and 5299 NE 15th
Dubuque	Water Plant; Post Office
Estherville	Community College
Fort Dodge	Water Plant and Highland Park School
Grimes	404 Second Street
Holstein	510 Merkley
Iowa City	Medical Laboratory Building
Johnston	City Hall
Keokuk	Water Pollution Control Plant; Fire Station and High School
Marshalltown	Marshalltown Mfg. and City Hall
Mason City	Water Plant; 14th & So. Kentucky Ave. and Central Fire Station
Muscatine	City Hall
Olin	Fire Station
Ottumwa	City Hall and Douma School
Pella	Pella Christian School
Pleasant Hill	Sewage Treatment Plant
Rock Rapids	Municipal Utilities Bldg.
Sergeant Bluff	National Guard Armory Bldg.
Sioux City	Federal Building and 27th and Chambers
Spencer	Hospital
Talleyrand	Rural Cochran Farm
Waterloo	Bell Telephone Bldg.; St. Marys Convent and Fire Station #2
Webster City	T. Loring Farm
West Des Moines	916 Ashworth and Water Works

TABLE 3

RANKING OF PARTICULATE SAMPLING SITES
BASED ON VALID ANNUAL GEOMETRIC MEANS*
1976

Rank		Site and Location	Annual Geometric Mean (ug/m^3)
1	Keokuk	Water Pollution Control Plant	171.0
2	Des Moines	Industrial Park	129.1
3	Mason City	Water Plant	107.9
4	Cedar Rapids	Jane Boyd Comm. Center	105.6
5	Grimes	Fire Station	102.2
6	West Des Moines	Water Works	100.7
7	Cedar Rapids	Linn County Health Department	98.6
8	Cedar Rapids	City Garages	97.8
9	Des Moines	Fire Station #1	97.7
10	Davenport	Ia. Highway Patrol Station	95.2
11	Davenport	Ia.-Ill. Gas & Electric	93.2
12	Clinton	Sewage Treatment Plant	90.7
13	Mason City	Central Fire Station	88.6
14	Iowa City	Medical Laboratory Building	86.3
15	Ottumwa	City Hall	83.6
16	Des Moines	Fire Station #7	83.2
17	Waterloo	County Courthouse (EPA)	83.1
18	Olin	Fire Station	82.4
19	Ankeny	Water Works Garage	80.7
20	Cedar Rapids	City Garages (EPA)	80.6
21	Des Moines	Fire Station #8	79.5
22	Davenport	Central Fire Station (EPA)	77.1
23	Muscatine	City Hall	76.3
		Primary Standard	75.0
24	Mason City	Water Tower	71.7
25	Altoona	Water Works Bldg.	71.3
26	Cedar Rapids	Noelridge Park	70.4
27	Des Moines	State Hygienic Lab	69.0
28	Denison	Municipal Water Plant	68.4
29	Davenport	Monroe School	67.7
30	West Des Moines	Crestview Acres	67.1
31	Bettendorf	Pleasant Valley School	62.7
32	Rock Rapids	Municipal Utilities Bldg.	61.8
		Secondary Standard	60.0
33	Ames	Meeker School	57.4
34	Talleyrand	Cochran Farm	55.9
35	Pella	Pella Christain School	55.0
36	Spencer	Hospital	54.9
37	Dubuque	Eagle Pt. Pump Station (EPA)	51.9
38	Pleasant Hill	Sewage Treatment Plant	49.3
39	Dubuque	Fire Station #4 (EPA)	46.8
40	Fort Dodge	Municpal Water Plant	41.0

* A valid year represents a minimum of forty-five samples with at least nine in each quarter.

TABLE 4
RANKING OF VALID* PARTICULATE SAMPLING SITES
BASED ON NUMBER OF TIMES SECONDARY 24-HOUR STANDARD WAS EXCEEDED
1976

Rank		Site and Location	No. of 24-Hour Samples Exceeding Secondary Standard
1	Keokuk	Water Pollution Control Plant	33
2	Des Moines	Industrial Park	22
3	West Des Moines	Water Works	17
4	Mason City	Water Plant	15
5	Cedar Rapids	City Garages	13
6	Grimes	Fire Station	12
7	Cedar Rapids	Jane Boyd Comm. Center	12
8	Cedar Rapids	Linn County Health Dept.	11
9	Clinton	Sewage Treatment Plant	11
10	Davenport	Ia. Highway Patrol Station	11
11	Des Moines	Fire Station #1	10
12	Cedar Rapids	City Garages (EPA)	9
13	Davenport	Ia.-Ill. Gas & Electric	8
14	Des Moines	Fire Station #8	6
15	West Des Moines	Crestview Acres	5
16	Denison	Municipal Water Plant	5
17	Olin	Fire Station	5
18	Des Moines	Fire Station #17	4
19	Des Moines	State Hygienic Lab	4
20	Altoona	Water Works Bldg.	3
21	Ankeny	Water Works Garage	3
22	Iowa City	Medical Laboratory Bldg.	3
23	Mason City	Water Tower	3
24	Mason City	Central Fire Station	3
25	Ottumwa	City Hall	3
26	Ames	Meeker School	2
27	Cedar Rapids	Noelridge Park	2
28	Davenport	Central Fire Station (EPA)	2
29	Davenport	Monroe School	2
30	Dubuque	Eagle Pt. Pump Station (EPA)	2
31	Talleyrand	Cochran Farm	2
32	Pleasant Hill	Sewage Treatment Plant	2
33	Rock Rapids	Municipal Utilities Bldg.	2
34	Bettendorf	Pleasant Valley School	2
35	Spencer	Hospital	2
36	Waterloo	County Courthouse (EPA)	2
		24-Hour Standard	
37	Dubuque	Fire Station #4 (EPA)	1
38	Muscatine	City Hall	1
39	Fort Dodge	Municipal Water Plant	0
40	Pella	Pella Christain School	0

* A valid year represents a minimum of forty-five samples with at least nine in each quarter.

ANALYSIS OF SUSPENDED PARTICULATES
FOR DUBUQUE COUNTY, IOWA

The following sections discuss the considerations for controlling suspended particulate emissions in Dubuque County and present documentation of research supporting these considerations, All control considerations are proposals that must be approved by the Air Quality Commission before rulemaking can be considered.

The Air Quality Commission is responsible for a statewide plan for controlling and abating air pollution and for rules controlling air pollution. Following adequate public hearings, the Air Quality Commission has the ultimate authority of adopting new standards of air pollution control in Iowa. The specific authorities of the Executive Director of DEQ and the Iowa Air Quality Commission are outlined in Sections 455B.3, 455B.5, 455B.12, and 455B.13 of the Code of Iowa.

METHODS CONSIDERED NECESSARY TO MAINTAIN THE STANDARDS

The Dubuque Air Quality Maintenance Area is not expected to exceed the annual primary ambient air quality standard through 1985. It appears that the industrial sources have installed adequate control equipment and will have only a small effect on the air quality in Dubuque. The area source emissions do not appear to be contributing a significant amount of suspended particulates to the area. However one source of particulates excluded from the model's input parameters, fugitive emissions from transportation, may have a significant impact in areas of high vehicular travel or unpaved road surface conditions. This source has been shown to increase the annual particulate arithmetic mean as much as twenty micrograms per cubic meter in other areas of the state. Consequently, violations of the secondary standard may occur, but violations of the primary standard are not expected to occur.

To assure that the standards are maintained, DEQ will continue to review new or expanded sources under its construction permit review program. All proposed new construction capable of producing air pollution will be reviewed to determine the effect of the proposed new construction on the ambient air quality. Where applicable, DEQ will continue its review of new or modified equipment for compliance with New Source Performance Standards as defined in 40 Code of Federal Regulations Part 60. Existing source surveillance will also continue to assure DEQ that sources now in compliance will stay in compliance with the rules of the Air Quality Commission.

It is recommended that no additional control strategies, other than those mentioned above, be considered to maintain the primary and secondary standards in Dubuque. If future monitoring data indicates that the area is not maintaining the primary and secondary standards, additional control measures will then be considered.

BACKGROUND

Dubuque County is located in the rolling hills of northeast Iowa. The eastern section of Dubuque County is part of a long bluff line rising over one hundred and fifty feet above the Mississippi River. The City of Dubuque is the major urban center and borders the Mississippi River in the east-central section of the county. The 1970 population for the Dubuque metropolitan area was 62,309; the 1970 population for Dubuque County was 90,609. Major industrial processes in Dubuque County consist of machinery manufacturing, wood processing, grain transferring, mineral product manufacturing and electricity generation. Major sources of fugitive dust and fugitive emissions include grain transferring, construction, agricultural tilling, and roads (both paved and unpaved).

Dubuque County is situated in a temperate climate in the middle of a large land mass. The area is largely influenced by pressure systems moving in a general west-east direction. The winds are dominant from the northwest and the south to southeast, except for the area east of the bluffs, which tends to channel winds in a more north-south direction. The mean annual temperature is 48 degrees Fahrenheit, the mean annual precipitation is 34 inches. Neutral atmospheric stability is dominant for this area with slightly unstable and stable conditions occurring less frequently. Inversions also occur frequently in this area in the evenings and early mornings throughout the year.

RESOURCE INFORMATION

Program inputs for the Air Quality Display Model consist of point source emissions, area source emissions, and meteorological parameters.

Point source emissions for 1973 were obtained from emission inventory questionnaires distributed by the Iowa Department of Environmental Quality (DEQ). Each major industrial or manufacturing plant that emits an air pollutant completed a questionnaire. From these reports and emission factors from AP-42[8], estimated suspended particulate emissions were calculated for each emission source. In addition stack parameters, such as height, diameter, gas velocity, and gas temperature are included in the questionnaire. The 1976 point source emissions were calculated from the 1975 emission inventory questionnaires. The 1976 figures were modified by notifications of plant shutdowns or construction permit information. Also, all sources reflect maximum required emission reduction whether air pollution control equipment was in operation or not in operation. This was done to indicate the effectiveness of total compliance with the existing emission control strategies, even though some sources are not yet in compliance. Projected 1985 point source emissions were calculated from construction permit information and economic projections from the federal Office of Business Economics and the Economic Research Service (OBERS)[9]. The table below lists the projected growth used in Dubuque County.

1985 Estimated Growth
For Dubuque County

Source	Percent Increase 1975-1985
Electric Generation	5
Machinery Manufacturing	15
Food/Agricultural Products	12

Area source emissions were based primarily on population. 1970 census figures were used as a base while OBERS growth estimates were used for projections.

Base year area emission estimates by county were obtained from the National Emissions Data System (NEDS). Residential fuel and solid waste disposal emissions were distributed by population and housing density. Commercial-institutional fuel and solid waste disposal emissions were distributed by commercial-institutional zoning area. Vehicle transportation emissions were calculated by using traffic flow maps for Dubuque County and emission factors from AP-42[8]. Emissions were calculated from traffic volumes on major city roads and limited access highways. Transportation emissions not allocated by traffic volumes were distributed by population. Fugitive emissions from paved and unpaved roads were not calculated for Dubuque.

Extrapolation of base year area source emissions to 1976 and 1985 was primarily done with the use of population growth estimates. Emissions were modified using growth factors from OBERS. A table of particulate emission estimates from 1973 to 1985 for Dubuque County is given in Table 5.

Meteorological data were obtained from the National Oceanic and Atmospheric Administration. Windrose information was not available for Dubuque; therefore, windrose data for Burlington, Iowa, was chosen because of similar topography orientation of the Mississippi River bluff line is similar for both cities producing similar north-southand wind directions. Climatological data consisting of average temperature[10], average barometric pressure[11], and average daily afternoon mixing height[12] were obtained for Dubuque for necessary inputs to the model.

MODELING RESULTS

The Air Quality Display Model results for Dubuque County indicate recent installations of air pollution control equipment on industrial sources have reduced the annual average for suspended particulate from levels of over 100 micrograms per cubic meter in 1973 to less than 60 micrograms per cubic meter in 1976. Also, this result is shown to hold relatively constant through 1985.

1973

Figure 3 illustrates the 1973 results calculated by the Air Quality Display Model. The lines represent isopleths of annual arithmetic means for suspended particulate concentrations calculated by the with and the corresponding values in micrograms per cubic meter (µg/m^3). The major contributors to the five receptors with the highest concentrations calculated by the model are listed in Table 6. The table shows Thruput Terminals as the major source contributor at four of the five highest receptors with the contribution calculated as 75 to 80 percent of the total concentration because of the fugitive emissions from receiving and shipping of grain. The Pillsbury Company is also shown to be a significant source at three of the five highest receptors because of fugitive emissions from the receiving and shipping of grain. The highest concentrations are located in the industrial park along the Mississippi River and decrease rapidly in all directions. The rapid decline to the east and west, compared to the relatively gradual decline in the other two directions, is caused by the lack of significant easterly and westerly winds in the river valley.

Table 7 lists the observed versus calculated particulate concentrations for the two monitors located in Dubuque in 1972. Monitor 1 is positioned on the City Garage at 14th and Elm Streets, which is located in the industrial park on the Mississippi River flood plain. The highest percentage of source oriented suspended particulate concentrations calculated at this site result from Thruput Terminals (29.7%), Celotex (5.0%) and Caradco (3.7%). The 1973 monitoring data for this site showed an arithmetic mean of 81 µg/m^3 which is within five micrograms per cubic meter of the level predicted by the model. Monitor 2 is located at University and Atlantic Streets on the bluff west of the industrial park. Because the winds are predominately north-south, only a small contribution to the annual mean is expected from the industrial sources. Consequently, a large percentage of the annual concentration appears to be from localized transportation and residential emissions. Comparison of the observed and calculated concentrations shows a difference of over twenty micrograms per cubic meter. This difference is probably caused by the difference in topography. The model assumes a flat terrain which would cause most of the major industrial emissions (Interstate Power and Celotex) to impact beyond the monitor. Since the monitor is located on the bluff, which is nearly the same elevation as the stack, some of the sources' emissions could impact the monitor and increase the levels instead of carrying over the monitor and contributing nothing, as the model predicts.

Since the annual primary and secondary ambient air quality standards for suspended particulates are a geometric mean, Figure 4 shows the approximate areas that would exceed the primary standard for suspended particulates of 75 micrograms per cubic meter (solid line) and the secondary standard for suspended particulates of 60 micrograms per cubic meter (dashed line) from results obtained in Figure 3[13]. The eastern half of Dubuque is calculated to have exceeded both the secondary standard and the primary standard in 1973.

1976

Model inputs for 1976 reflect compliance of industrial emission sources with current regulations. Figure 5 illustrates the projected 1976 suspended particulate concentrations calculated by the model for Dubuque. A large improvement is noticeable when the results for 1973 (Figure 3) and 1976 are compared. The difference can be attributed to the installation of control equipment on industrial sources that have reduced particulate emissions.

The major contributors to the five receptors with the highest concentration calculated by the model are shown in Table 8. The major contributors at three of the receptors are area sources (residential, commercial and transportation sources). In two areas the industrial point sources contribute five percent of the total concentration. It must also be noted that Thruput Terminal which was contributing 70% of the suspended particulates to the annual arithmetic mean in the areas of highest concentrations in 1973, contributed less than 1% in 1976. This reduction is due to the installation of control equipment.

To calibrate the model it is necessary to compare the calculated values with the actual observed concentrations. Table 9 compares the model's calculated arithmetic mean with actual arithmetic means from two monitoring sites operating in 1976. In both cases the calculated value was similar to the 1976 observed concentrations. The difference between the calculated and observed values at monitor 3 can be attributed to fugitive emissions from transportation sources that were not included in the model inputs.

As shown in Figure 5 and Table 9, the Dubuque modeling area is projected to be below both the primary and secondary national ambient air quality standards in 1976.

1985

Projected future emissions for 1985 were calculated using growth estimates from OBERS. Figure 6 illustrates the results for 1985 calculated by the Air Quality Display Model. The pattern for 1985 is very similar to that of 1976 except for a small area of 55 micrograms per cubic meter that has developed around the monitor 1 location in the industrial area of Dubuque and an area of greater than 50 micrograms per cubic meter that has developed north of Dubuque due to emissions from the John Deere plant. OBERS projections for small population and economic growth in this area in the next ten years is the reason why there are only minor deviations in projected 1985 particulate concentrations when compared with current particulate concentrations.

Table 10 lists the major contributors to the five highest receptors. The largest contributors are area sources (5 to 10%), while industrial sources contribute about half of that amount (2 to 7%). The highest annual arithmetic mean is expected to be 56 micrograms per cubic meter north of Dubuque. The AQDM calculations project a pattern of good air quality for the model region in the next ten years. No annual violations of the annual secondary or primary standards are expected.

Conclusions

The Dubuque Air Quality Maintenance Area is not expected to exceed the annual primary ambient air quality standard through 1985. The ambient air quality monitoring data collected for the Dubuque Air Quality Maintenance Area indicate that the area has attained both the primary and secondary standards for suspended particulate on an annual basis. Because the monitoring data and the modeling results indicate similar conditions, the point source data and area source data entered into AQDM are assumed to be representative of the Dubuque area.

To assure that the standards are maintained, DEQ will continue to review new or expanded sources under its construction permit review program. Existing source surveillance will also continue to assure DEQ that sources now in compliance will stay in compliance with the rules of the Air Quality Commission. It is recommended that no additional control strategies, other than those mentioned above, be considered to maintain the primary and secondary standards in Duquque.

The Continuing Process

The modeling that has been completed for this air basin is only a part of a continuing process to estimate the contribution of local and regional emissions to the ambient suspended particulate levels and to control the excessive emissions sufficiently. Numerous sources not included in the modeling must be investigated and documented for future modeling work. Sources such as fugitive dust produced from agriculture, construction, and wind or fugitive emissions from the transfer and storage of materials from industries associated with cement, sand, and grain must be researched further. Through this process appropriate emissions estimates may be developed to improve the accuracy of the modeling results. The model itself must be refined to accept small localized sources, such as unpaved alleys and parking lots and model their affect accurately. Continued development of point source and area source emission inventories is necessary to improve the accuracy of model inputs and to account for the maintenance and breakdown of control equipment. All of these developments are part of the continuing process of attaining and maintaining quality air throughout Iowa.

TABLE 5

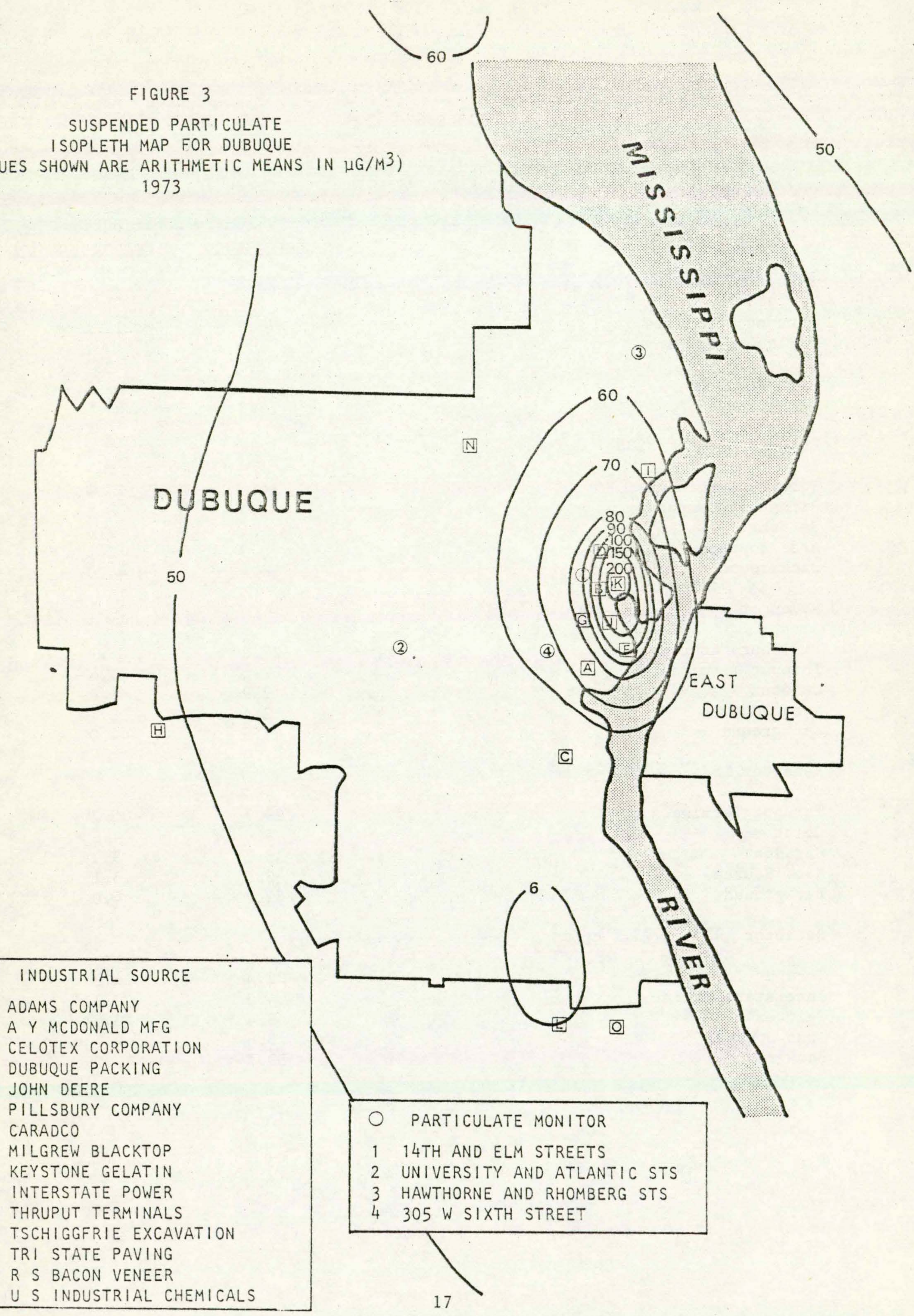
DUBUQUE
COUNTY PARTICULATE EMISSION PROJECTIONS
EMISSIONS[a] (tons/year)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Population[b] (x 10^4)	9.10	9.10	9.00	9.00	9.00	8.99	8.99	9.99	9.02	9.07	9.19	9.33	9.49
Industrial Process													
Chem. Mfg.	94	94	94	94	94	94	94	94	94	94	94	94	94
Food/Agri.	337	320	3	6	6	6	6	7	7	7	7	7	8
Elec. Gen.	2885	2885	2404	285	285	285	285	285	285	285	290	295	300
Secondary Metals	5	5	5	5	5	5	5	5	5	5	5	5	5
Mineral Prod.	857	685	172	172	172	172	172	172	172	172	172	172	172
Machinery	1644	1291	938	586	586	597	608	619	630	641	652	663	674
Wood Products	50	50	14	7	7	7	7	7	7	7	7	7	7
Total	5872	5330	3630	1155	1155	1156	1167	1179	1190	1201	1217	1243	1260
Fuel Combustion													
Residential	75	76	77	79	79	78	78	78	79	81	84	87	90
Comm./Inst.	116	118	120	122	123	122	123	123	123	127	131	136	140
Industrial[c]													
Total	191	194	197	201	202	200	200	201	202	208	215	223	230
Solid Waste													
Residential	732	732	730	730	730	730	730	730	734	740	751	762	773
Comm./Inst.	63	64	65	66	67	66	66	67	67	69	71	73	75
Total	795	796	795	796	797	796	796	797	801	809	822	835	848
Transportation													
Gasoline	285	287	290	292	294	295	296	297	299	302	306	310	314
Off Highway	30	31	31	31	31	31	31	31	31	32	32	32	32
Rail	21	21	21	21	21	21	21	21	21	21	21	21	21
Aircraft	18	18	18	18	18	18	18	18	18	18	18	18	18
Total	354	357	360	362	364	365	366	367	369	373	377	381	385
Misc.	7	7	7	7	7	7	7	7	7	7	7	7	7
Total	7219	6684	4989	2521	2525	2525	2537	2551	2569	2598	2638	2689	2730

[a]Projections based on 1973 NEDS data and projected using OBERS estimates.
[b]Based on linear growth estimates using OBERS projections and 1975 Dubuque census.
[c]Included in industrial process.

FIGURE 3

SUSPENDED PARTICULATE
ISOPLETH MAP FOR DUBUQUE
(VALUES SHOWN ARE ARITHMETIC MEANS IN µG/M^3)
1973



☐ INDUSTRIAL SOURCE

A ADAMS COMPANY
B A Y MCDONALD MFG
C CELOTEX CORPORATION
D DUBUQUE PACKING
E JOHN DEERE
F PILLSBURY COMPANY
G CARADCO
H MILGREW BLACKTOP
I KEYSTONE GELATIN
J INTERSTATE POWER
K THRUPUT TERMINALS
L TSCHIGGFRIE EXCAVATION
M TRI STATE PAVING
N R S BACON VENEER
O U S INDUSTRIAL CHEMICALS

○ PARTICULATE MONITOR

1 14TH AND ELM STREETS
2 UNIVERSITY AND ATLANTIC STS
3 HAWTHORNE AND RHOMBERG STS
4 305 W SIXTH STREET

TABLE 6

Major Source Contributors to the
Highest Five Recetors

Source		Source Contributions Percentage	Amount (ug/m^3)
Receptor 144	270.2 ug/m^3		
Thruput Terminals		78.9	213.1
Pillsbury Company		1.2	3.2
Celotex		1.2	3.2
Area Sources		0.8	2.3
Background		16.3	44.0
Receptor 184	238.7 ug/m^3		
Thruput Terminals		74.6	178.0
Pillsbury Company		3.4	8.2
Celotex		1.1	2.6
Area Sources		0.9	2.1
Background		18.4	44.0
Receptor 143	103.6 ug/m^3		
Pillsbury Company		25.2	26.1
Thruput Terminals		22.6	23.4
Celotex		2.9	3.0
Area Sources		2.6	2.7
Background		42.5	44.0
Receptor 182	85.1 ug/m^3		
Thruput Terminals		29.7	25.2
Celotex		5.0	4.3
Caradco		3.7	3.1
Area Sources		3.6	3.1
Background		51.7	44.0
Receptor 145	73.7 ug/m^3		
Thruput Terminals		22.4	16.5
Interstate Power		4.5	3.3
Celotex		3.4	2.5
Area Sources		3.6	2.7
Background		59.7	44.0

TABLE 7

Comparison of Monitoring Data and
Expected Annual Concentrations

Monitor		Expected Annual Concentration ug/m^3	1972 Air Monitor Data ug/m^3
1.	14th & Elm Streets	85	81
2.	University & Atlantic	55	76
3.	Hawthorne & Rhomberg	60	Not in Operation
4.	305 W. Sixth Street	60	Not in Operation

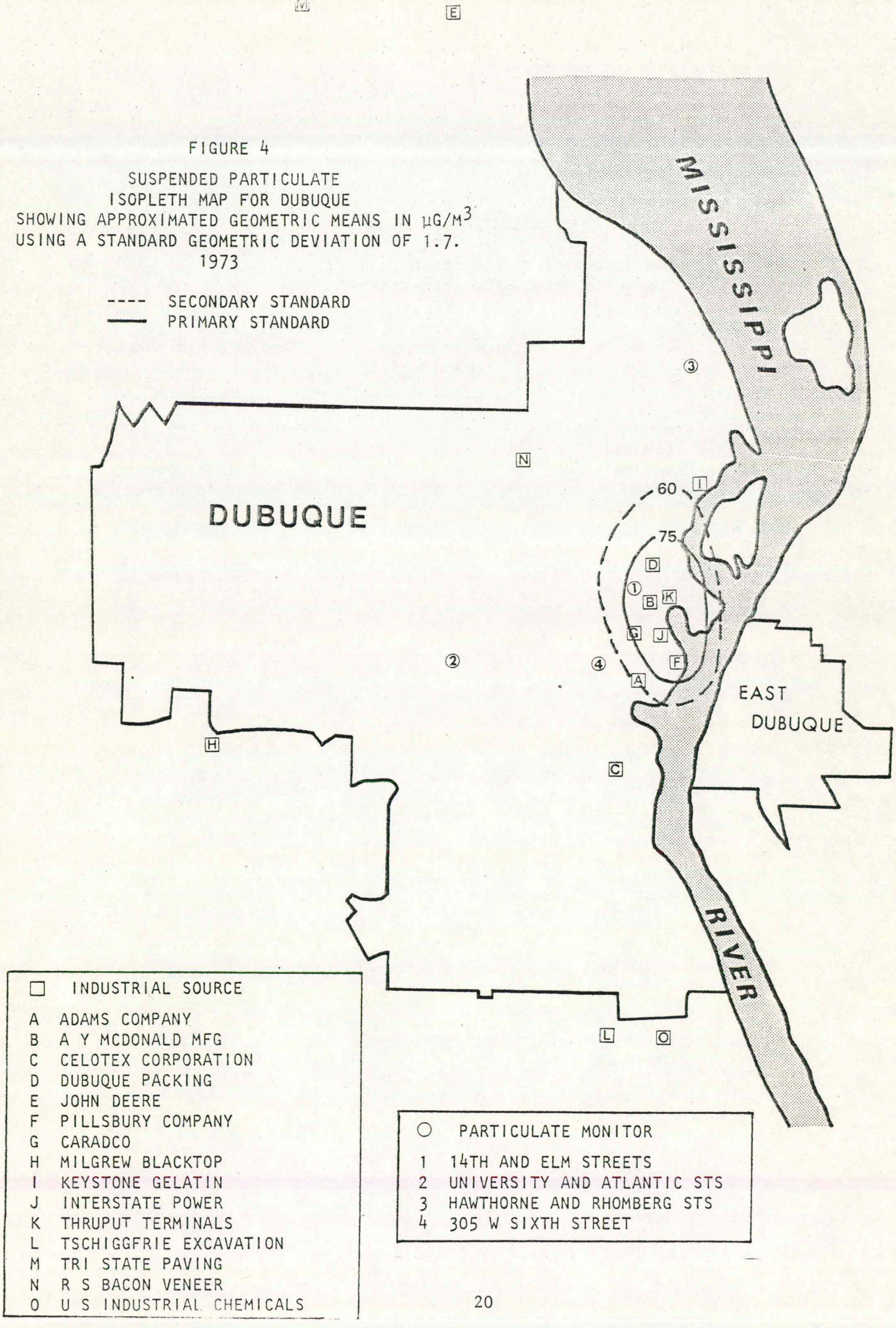


FIGURE 4
SUSPENDED PARTICULATE
ISOPLETH MAP FOR DUBUQUE
SHOWING APPROXIMATED GEOMETRIC MEANS IN $\mu G/M^3$
USING A STANDARD GEOMETRIC DEVIATION OF 1.7.
1973

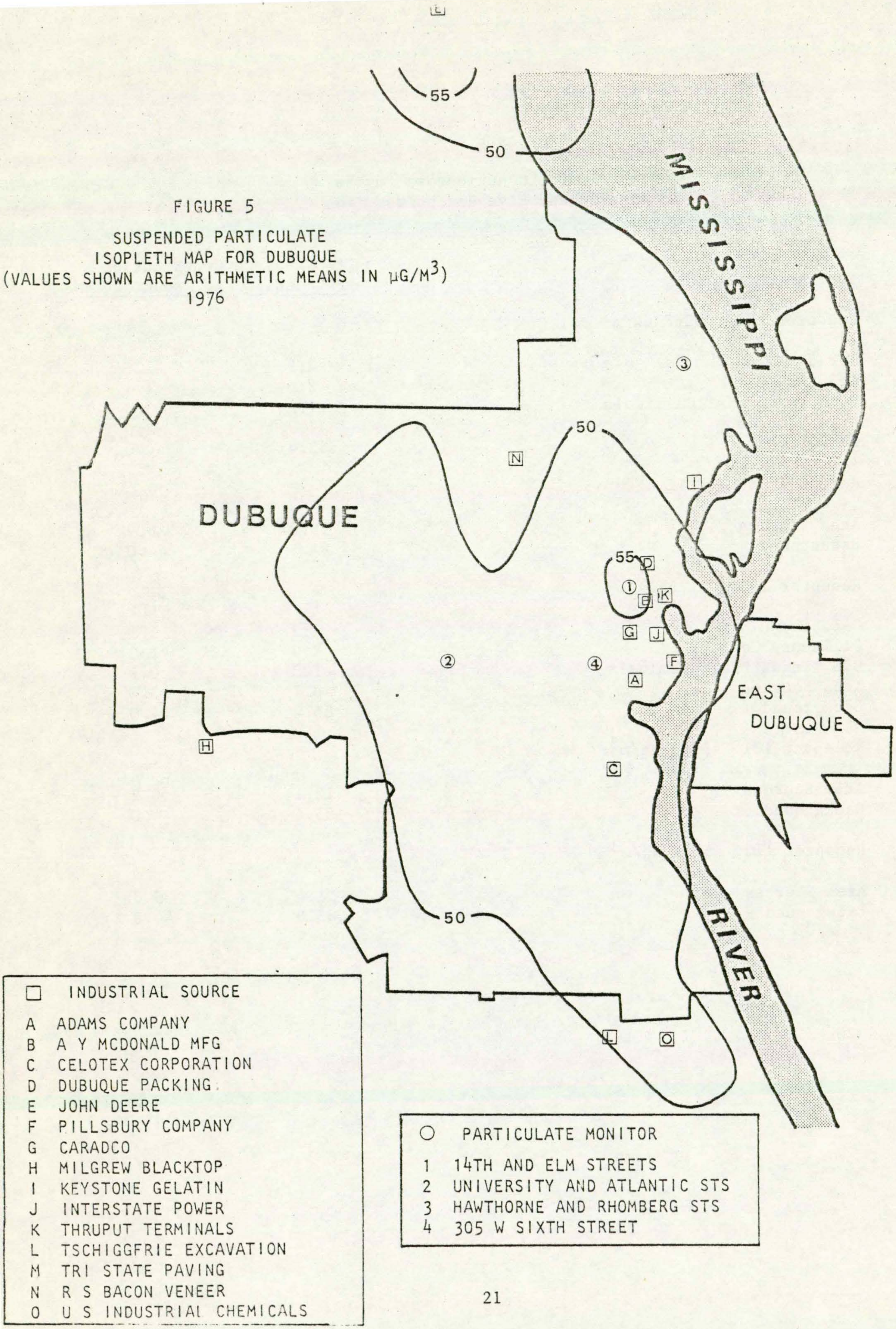


FIGURE 5

SUSPENDED PARTICULATE ISOPLETH MAP FOR DUBUQUE (VALUES SHOWN ARE ARITHMETIC MEANS IN $\mu G/M^3$) 1976

TABLE 8

Major Source Contributors to the Highest Five Receptors

Source	Source Contributions Percentage	Amount ug/m^3
Receptor 182 52.7 ug/m^3		
Caradco	2.9	1.6
Celotex	2.6	1.4
U.S. Industrial Chemicals	1.2	0.6
Area Sources	7.3	3.9
Background	83.4	44.0
Receptor 98 52.1 ug/m^3		
Area Sources	13.2	6.9
Background	84.5	44.0
Receptor 143 51.5 ug/m^3		
Celotex	2.2	1.1
Pillsbury Company	2.0	1.0
U.S. Industrial Chemicals	1.3	0.7
Area Sources	6.7	3.4
Background	85.4	44.0
Receptor 181 51.5 ug/m^3		
Area Sources	12.1	6.2
Background	85.4	44.0
Receptor 113 51.3 ug/m^3		
Area Sources	11.4	5.8
Background	85.8	44.0

TABLE 9

Comparison of Monitoring Data and
Expected Annual Concentrations

Monitor	Expected 1976 Annual Concentration ug/m^3	1976 Air Monitor Data ug/m^3
1. 14th & Elm Streets	53	Not in Operation
2, University & Atlantic	52	53
3. Hawthorn & Rhomberg	47	61
4. 305 W. Sixth Street	51	Not in Operation

FIGURE 6

SUSPENDED PARTICULATE
ISOPLETH MAP FOR DUBUQUE
(VALUES SHOWN ARE ARITHMETIC MEANS IN µG/M^3)
1985

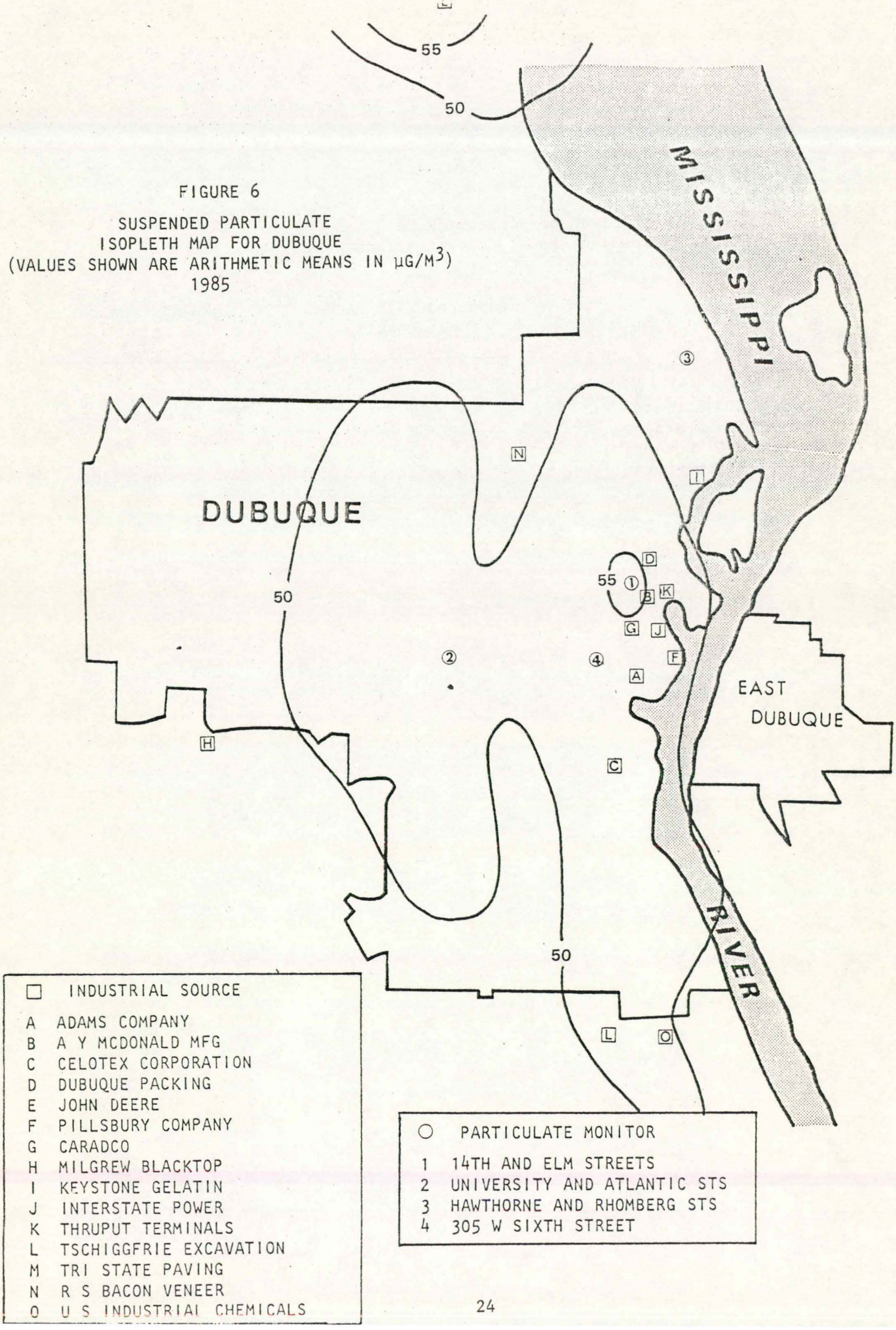


TABLE 10
Major Source Contributors to the
Maximum Five Receptors

Source		Source Contributions Percentage	Amount (um/m^3)
Receptor 105	55.8 ug/m^3		
John Deere		2.7	1.5
Area Sources		4.0	2.2
Background		78.9	44.0
Receptor 182	54.6 ug/m^3		
Caradco		5.7	3.1
US Industrial Chemicals		1.1	0.6
Area Sources		7.9	4.4
Background		80.6	44.0
Receptor 98	52.5 ug/m^3		
Area Sources		13.9	7.3
Background		83.8	44.0
Receptor 143	52.2ug/m^3		
Pillsbury		2.0	1.0
Area Sources		7.5	3.9
Background		84.2	44.0
Receptor 128	52.1 ug/m^3		
Caradco		1.8	0.9
Area Sources		9.8	5.1
Background		84.4	44.0

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