EPA 904/9-76-005c

NORTH CAROLINA AIR QUALITY MAINTENANCE AREA ANALYSIS

APRIL 1976

FINAL REPORT

VOLUME III

TSP DISPERSION MODELING AND ANALYSIS FOR CHARLOTTE, WINSTON-SALEM, AND GREENSBORO AQMA'S FOR 1973, 1975, 1980, AND 1985

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV

AIR AND HAZARDOUS MATERIALS DIVISION
ATLANTA, GEORGIA 30309

AMD

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

1421 PEACHTREE ST., N. E.
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September 10, 1976

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NORTH CAROLINA AIR QUALITY MAINTENANCE AREA ANALYSIS

VOLUME III: TSP DISPERSION MODELING AND ANALYSIS FOR CHARLOTTE, WINSTON-SALEM, AND GREENSBORO AQMA'S FOR 1973, 1975, 1980, 1985

FINAL REPORT
APRIL 1976

by

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Harry L. Hamilton, Jr.

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY - REGION IV
ATLANTA, GEORGIA 30309

Under

Contract Number 68-02-1386
Task 15

RESEARCH TRIANGLE INSTITUTE
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

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Region IV Publication No. EPA 904/9-76-005C

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

1.0 INTRODUCTION

The Research Triangle Institute (RTI) is under contract* to the Environmental Protection Agency (EPA), Region IV, to assist the Air Quality Section, Division of Environmental Management, North Carolina Department of Natural and Economic Resources (NCAQS), in the Air Quality Maintenance Area (AQMA) analysis. Three (3) AQMA's in North Carolina were designated for suspended particulate matter only: the Charlotte AQMA (Mecklenburg County), the Greensboro AQMA (Guilford County), and the Winston-Salem AQMA (Forsyth County). The analysis steps have included the updating of the emissions inventories and their projections, the "calibration" of the dispersion model for the specific AQMA's for the baseline year (1973), and the subsequent modeling of projected air quality for the years 1975, 1980, and 1985. This report summarizes the analytical work which has been done by RTI.

RTI's primary responsibility has been to perform dispersion modeling of air quality for total suspended particulate matter (TSP). In doing so, RTI has assisted in the validation of air quality monitoring station data, meteorological data, and particulate emissions data from both point and area sources. All data have been furnished, directly or indirectly, to RTI by the NCAQS.

Engineering Sciences, Inc. (ES), under contract to EPA, Region IV, has had the responsibility for preparing the area source emissions inventories, their projections, and the allocation of county-wide emission totals to sub-county grid squares for modeling. Details of this effort are contained in the ES final report (Ref. 1).

The NCAQS, with the assistance of other state and local agencies, was responsible for preparing updated point source emissions inventories and

*Contract Number 68-02-1386, Task 15

their projections, meteorological data and analyses, and monitoring station data and its validation. Details of this effort are contained in the NCAQS technical report (Ref. 2).

RTI was instructed to use the Air Quality Display Model (AQDM) (Ref. 3), as modified by EPA Region IV for the dispersion modeling. During calibration, the AQDM was effectively used to detect data errors, and/or anomalies, and to systematically test hypotheses concerning the emissions and their impact on air quality. During the course of the modeling, results with suggested interpretations were jointly reviewed and discussed by RTI, NCAQS, ES, and EPA.

Mecklenburg County was modeled as an entity and Guilford and Forsyth Counties were modeled together. Therefore, calibration procedures described in Section 3 discuss Guilford and Forsyth Counties jointly. Section 2 presents the air quality analyses separately for each AQMA. Section 2 presents the analyses in both isopleth and tabular form for the baseline year 1973 and the projection years 1975, 1980, and 1985. Sections 3.1 and 3.2 present the final dispersion model calibration results with graphical (Figures 22 and 23) and tabular (Tables 17 and 18) comparisons of calculated* and observed TSP concentrations.

Although not a specific objective of this effort, several comparisons of computed concentrations are contained in Section 3 which may be of general interest to others involved in dispersion modeling analysis. Included are: AQDM results with the Briggs Plume Rise Equation (Ref. 4) versus the Holland Plume Rise Equation (Ref. 3); the results of varying

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*Throughout this report calculated emissions are referred to as "adjusted", where the best fit linear regression coefficients have been applied, and "unadjusted" where they have not been applied, i.e. effectively a slope of 1.0 and an intercept of 0.0.

area source grid sizes; the results of varying the plume heights for area sources; and the contributions to receptor concentrations of several subcategories of area sources.

North Carolina is one of the first states, (mid-1975), to include non-exhaust particulate emissions from roadway vehicles in large area dispersion modeling. Because these emissions represented such a significant portion of the total emissions inventories, a great amount of time and effort was expended in analyzing their effects.

2.0 Projected Air Quality Through 1985

The year 1973 was used as a base for the calibration of the AQDM dispersion model as described in detail in Section 3 below. Projected emissions inventories for Mecklenburg, Guilford, and Forsyth Counties for both point and area source categories for the years 1975, 1980, and 1985 were provided by the NCAQS. The calibrations were made using mean annual stability wind roses for 1973, while for all projected years, long term (5 year) mean stability wind roses were used. The 1973 meteorological data used with the AQDM for calibration for both the Charlotte AQMA (Mecklenburg County) and the Greensboro-Winston-Salem AQMA's (Guilford and Forsyth Counties) were modified sets that included data only for those days on which high-volume samples had been collected. These data sets are designated "Lund Winds" in this discussion.* Their use was agreed upon to make the wind data represent the actual monitoring days.

The reader is cautioned in interpreting the analyses for 1975, 1980, and 1985 that projected data and long term average meteorological parameters were used. For example, 1975 projected air quality can be expected to agree with observed values only to the extent that 1975 meteorological conditions were similar to the averages over the five-year period used and actual 1975 emissions agree with the emissions projected on the basis of expected economic activity, emissions control and compliance schedules and other factors. Thus, if the economic activity projected was too optimistic, then projected emissions will be too high and projected air quality will be worse than actually observed.

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*These modified stability wind roses were prepared by Steven Lund of the Air Quality Section, Division of Environmental Management, Department of Natural and Economic Resources, State of North Carolina.

2.1 Charlotte (Mecklenburg County) AQMA

The regression coefficients from the calibration* of the AQDM dispersion model (see Figure 22) were used with the 1973 emissions inventory for Mecklenburg County and 1973 meteorological data for Douglas Airport. The emissions inventory included 97 point sources and area source emissions allocated to 123 area source grid squares. Figure 1 presents the Mecklenburg County area source grid network (Ref. 1). A rectangular grid with 180 receptors with 4 km by 4 km spacing was used and 12 extra (non-grid) receptors were added. AQDM calculated concentrations at each receptor were plotted and analyzed. Figure 2 presents the AQDM receptor grid for Mecklenburg County. Figure 3 presents an isopleth analysis for 1973. Table 1 includes 1973 calculated concentrations for all receptors in Mecklenburg County. Table 2 presents an analysis of the source contribution tables from AQDM for the five receptors with the highest calculated concentrations. This table compares the contribution from point sources and from area sources to the total concentration.

For 1975, 1980, and 1985 projected air quality, the same regression coefficients were used as for 1973. The mean stability wind roses based on the five (5) year period January 1, 1969 through December 31, 1973 at the Douglas Airport were used. Emissions from both point and area sources for each of the three projected years were input to the dispersion model. Figures 4, 5, and 6 present the isopleth analyses of projected air quality for 1975, 1980, and 1985, respectively. Table 1 includes the calculated concentrations for all receptors in Mecklenburg County for each of the projected years. Table 3 presents an analysis of the source contribution

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*During the calibration of AQDM, the standard procedure is to calculate concentrations at sampling site receptors only (Ref. 3).

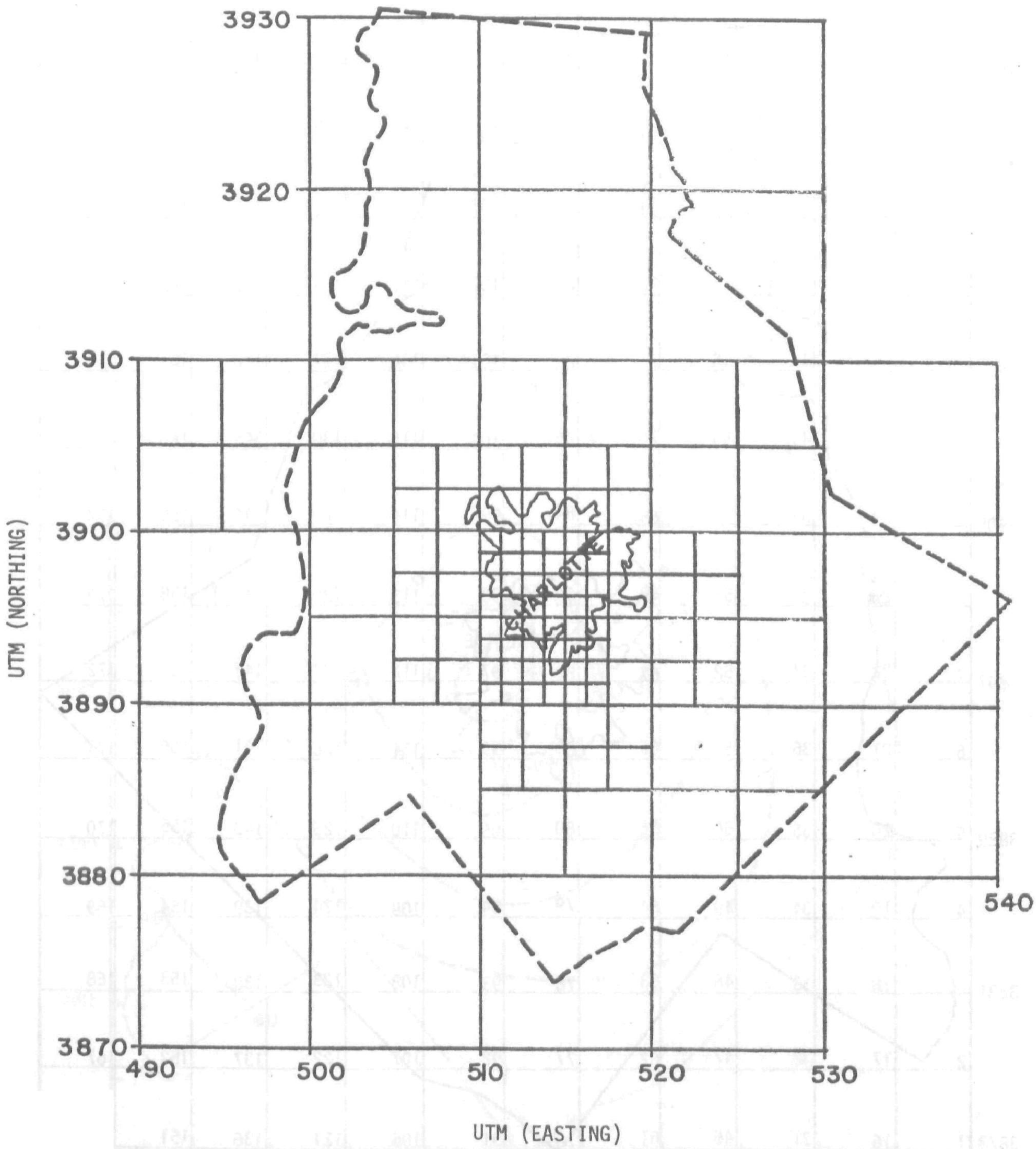

Figure 1. Mecklenburg County Area Source Grid Network

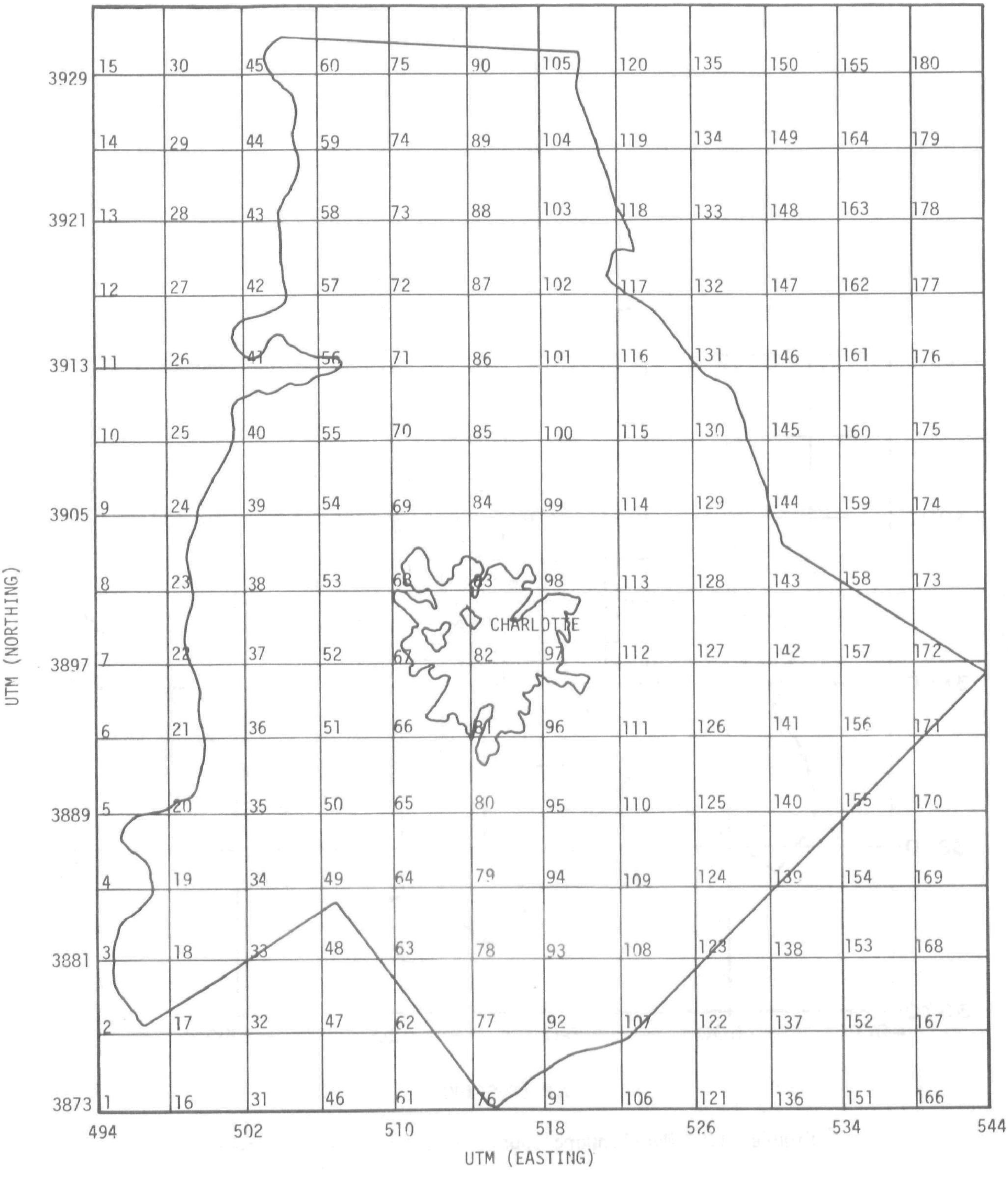

Figure 2. Mecklenburg County N.C. AQDM Receptor Grid

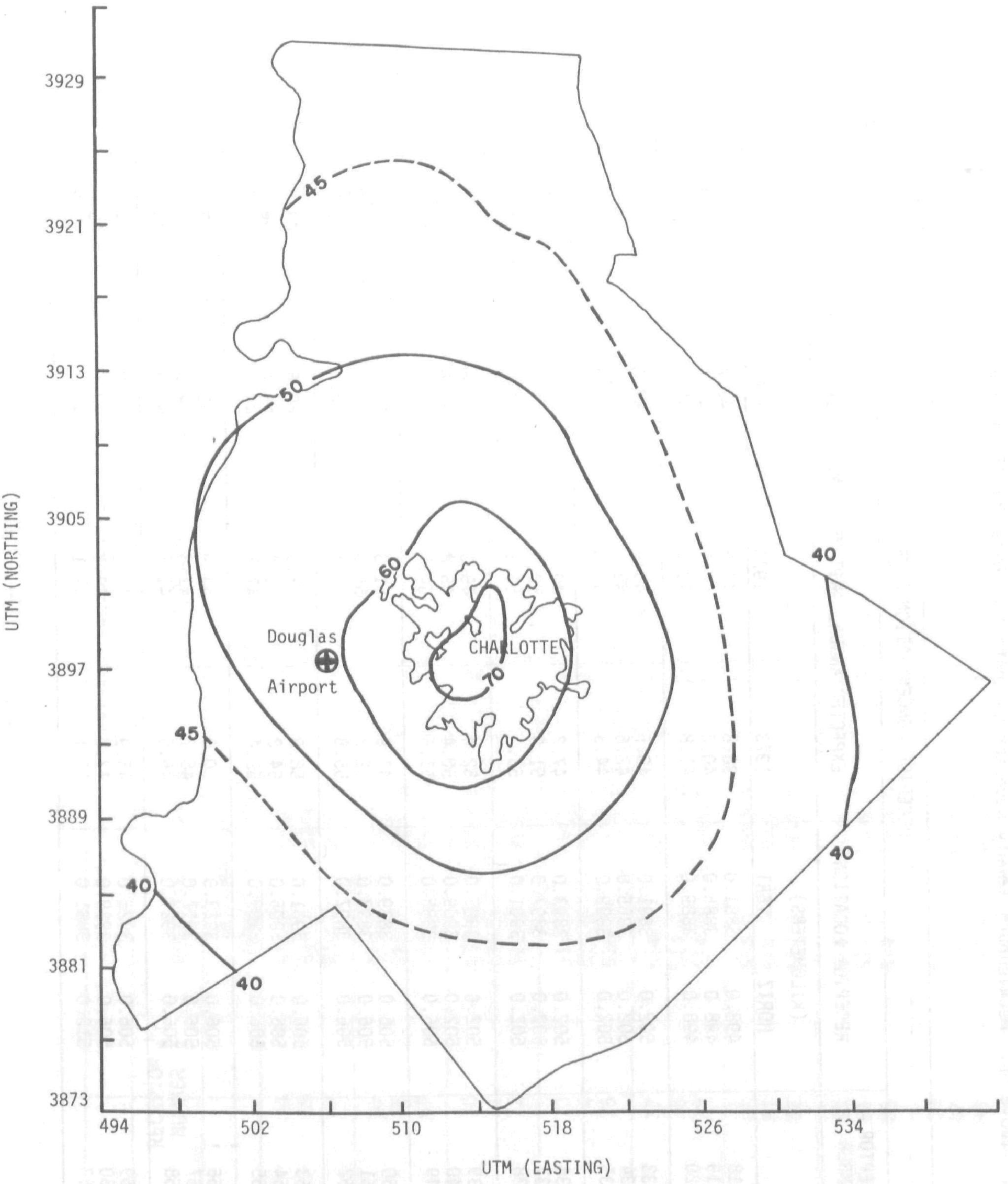

Figure 3. Mecklenburg County N.C. 1973 (Calibrated) AQDM Calculated Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

Table 1. Mecklenburg County Receptor Concentration Data for TSP by Year

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS)		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	HORIZ	VERT	1973	1975	1980	1985
18	498.0	3881.0	38.8	40.8	42.2	43.4
19	498.0	3885.0	40.2	42.4	44.0	45.5
20	498.0	3889.0	41.8	43.9	45.6	47.2
33	502.0	3881.0	40.5	43.0	44.6	46.2
34	502.0	3885.0	42.6	45.3	47.4	49.3
35	502.0	3889.0	44.3	47.0	49.2	51.2
36	502.0	3893.0	47.2	49.7	52.1	54.4
37	502.0	3897.0	51.9	52.0	55.1	57.7
38	502.0	3901.0	53.7	51.1	54.0	56.5
39	502.0	3905.0	52.4	48.3	50.6	52.7
40	502.0	3909.0	50.4	45.8	47.6	49.2
49	506.0	3885.0	51.6	54.7	58.9	63.6
50	506.0	3889.0	47.9	51.3	54.2	57.0
51	506.0	3893.0	52.3	55.6	59.0	62.0
52	506.0	3897.0	55.8	58.1	62.2	65.8
53	506.0	3901.0	58.8	57.1	60.6	63.5
54	506.0	3905.0	54.8	51.4	54.1	56.6
55	506.0	3909.0	52.4	47.8	49.9	51.7
56	506.0	3913.0	50.0	44.9	46.5	48.0
57	506.0	3917.0	48.7	42.8	44.3	45.4
58	506.0	3921.0	46.5	41.3	42.5	43.5
59	506.0	3925.0	43.9	40.1	41.2	42.1
60	506.0	3929.0	42.3	39.2	40.1	41.0
63	510.0	3881.0	43.1	47.1	49.5	51.9

Table 1. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS)		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	HORIZ	VERT	1973	1975	1980	1985
64	510.0	3885.0	47.2	52.7	56.1	59.4
65	510.0	3889.0	52.0	57.8	61.9	65.6
66	510.0	3893.0	62.1	68.3	75.1	80.6
67	510.0	3897.0	65.2	69.2	75.2	80.4
68	510.0	3901.0	63.9	64.5	69.8	74.2
69	510.0	3905.0	58.0	55.9	59.8	63.2
70	510.0	3909.0	52.1	50.1	52.6	54.8
71	510.0	3913.0	50.4	46.6	48.5	50.2
72	510.0	3917.0	47.5	44.3	45.9	47.3
73	510.0	3921.0	45.6	42.3	43.7	44.9
74	510.0	3925.0	44.5	41.3	42.5	43.5
75	510.0	3929.0	42.7	39.9	40.9	41.8
77	514.0	3877.0	41.3	44.9	46.9	48.8
78	514.0	3881.0	43.7	47.9	50.3	52.7
79	514.0	3885.0	47.5	52.6	55.7	58.7
80	514.0	3889.0	54.1	60.6	64.9	68.9
81	514.0	3893.0	62.9	71.2	77.1	82.5
82	514.0	3897.0	73.0	82.5	92.1	99.6
83	514.0	3901.0	69.1	71.2	77.3	82.6
84	514.0	3905.0	60.4	61.0	65.9	70.0
85	514.0	3909.0	54.2	52.8	55.8	58.4
86	514.0	3913.0	50.7	48.4	50.6	52.7
87	514.0	3917.0	47.1	45.4	47.1	48.7
88	514.0	3921.0	45.5	43.5	45.0	46.3

Table 1. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
89	514.0	3925.0	44.2	42.1	43.4	44.5
90	514.0	3929.0	42.8	40.7	41.8	42.8
92	518.0	3877.0	41.9	44.6	46.5	48.4
93	518.0	3881.0	44.1	47.3	49.7	52.0
94	518.0	3885.0	47.1	51.1	54.1	57.1
95	518.0	3889.0	51.6	56.7	60.4	64.1
96	518.0	3893.0	58.0	64.5	69.2	73.8
97	518.0	3897.0	63.5	71.4	77.7	83.3
98	518.0	3901.0	62.4	68.3	72.8	77.9
99	518.0	3905.0	56.0	58.4	62.5	66.1
100	518.0	3909.0	52.7	53.2	56.1	58.6
101	518.0	3913.0	49.1	48.4	50.6	52.6
102	518.0	3917.0	46.3	45.4	47.1	48.7
103	518.0	3921.0	44.4	43.2	44.7	46.1
104	518.0	3925.0	43.2	41.9	43.1	44.3
105	518.0	3929.0	41.9	40.6	41.7	42.8
107	522.0	3877.0	42.0	43.7	45.5	47.2
108	522.0	3881.0	43.9	46.0	48.2	50.3
109	522.0	3885.0	46.2	49.0	52.6	54.2
110	522.0	3889.0	48.9	52.6	55.8	58.9
111	522.0	3893.0	52.9	57.7	61.8	65.7

Table 1. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
112	522.0	3897.0	53.6	59.2	63.2	67.0
113	522.0	3901.0	51.9	57.0	60.9	64.5
114	522.0	3905.0	49.8	54.1	57.7	60.9
115	522.0	3909.0	48.0	50.4	53.3	55.9
116	522.0	3913.0	45.9	46.6	48.8	50.7
117	522.0	3917.0	44.2	44.2	45.9	47.5
118	522.0	3921.0	42.6	42.3	43.7	45.0
123	526.0	3881.0	42.8	44.1	46.0	47.8
124	526.0	3885.0	44.2	46.0	48.1	50.3
125	526.0	3889.0	45.6	48.2	50.8	53.3
126	526.0	3893.0	46.5	50.1	52.8	55.4
127	526.0	3897.0	46.7	51.4	54.2	57.0
128	526.0	3901.0	45.8	50.5	53.2	55.9
129	526.0	3905.0	44.7	48.9	51.2	53.9
130	526.0	3909.0	43.9	47.0	49.3	51.4
131	526.0	3913.0	43.3	45.1	47.1	48.8
139	530.0	3885.0	42.0	43.3	45.0	46.7
140	530.0	3889.0	42.2	44.3	46.2	48.0
141	530.0	3893.0	42.6	45.7	47.7	49.7
142	530.0	3897.0	42.6	46.5	48.6	50.7
143	530.0	3901.0	41.9	46.0	48.1	50.2

Table 1. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
144	530.0	3905.0	41.5	45.3	47.3	49.2
155	534.0	3889.0	39.9	41.6	43.0	44.5
156	534.0	3893.0	40.1	42.7	44.2	45.7
157	534.0	3897.0	40.0	43.3	45.0	46.5
158	534.0	3901.0	39.5	43.1	44.8	46.4
171	538.0	3893.0	38.4	40.8	42.0	43.2
172	538.0	3897.0	38.3	41.3	42.6	43.9
181	510.6	3897.8	69.6	73.9	81.3	87.4
182	516.1	3900.7	66.3	69.9	76.1	81.4
183	518.4	3892.3	55.8	61.9	66.3	70.7
184	513.3	3897.8	75.0	82.3	91.7	99.3
185	514.4	3928.1	43.1	41.0	42.2	43.2
186	509.2	3928.7	42.8	39.7	40.8	41.7
187	514.7	3895.0	65.8	74.3	80.8	86.6
188	513.1	3900.8	68.3	70.7	76.9	82.1
189	531.9	3892.5	41.2	43.9	45.6	47.3
190	522.5	3906.5	48.8	52.5	55.9	58.9
191	511.4	3880.3	42.8	46.9	49.3	51.5
192	501.9	3887.3	43.7	46.1	48.1	50.1

Table 2. 1973 Mecklenburg County Source Contributions to Five (5) Receptors with the Highest Calculated Concentrations (From AQDM Source Contribution Tables)

Receptor Number	Receptor Name	Receptor Location (Kilometers) HORIZ	Receptor Location (Kilometers) VERT	Point Source Contribution (Percent)	Area Source Contribution (Percent)	Expected Total Concentration at Receptor (Micrograms/Cu. Meter)
184	Charlotte Community Hospital*	513.3	3897.8	7.96	92.04	75.03
82	82	514.0	3897.0	7.00	93.00	73.03
181	Fire Station #10*	510.6	3897.8	8.73	91.27	69.67
83	83	514.0	3901.0	11.38	88.62	69.12
188	Beatties Ford Water Plant*	513.1	3900.8	10.19	89.81	68.40

*See Figure 19 for relative location.

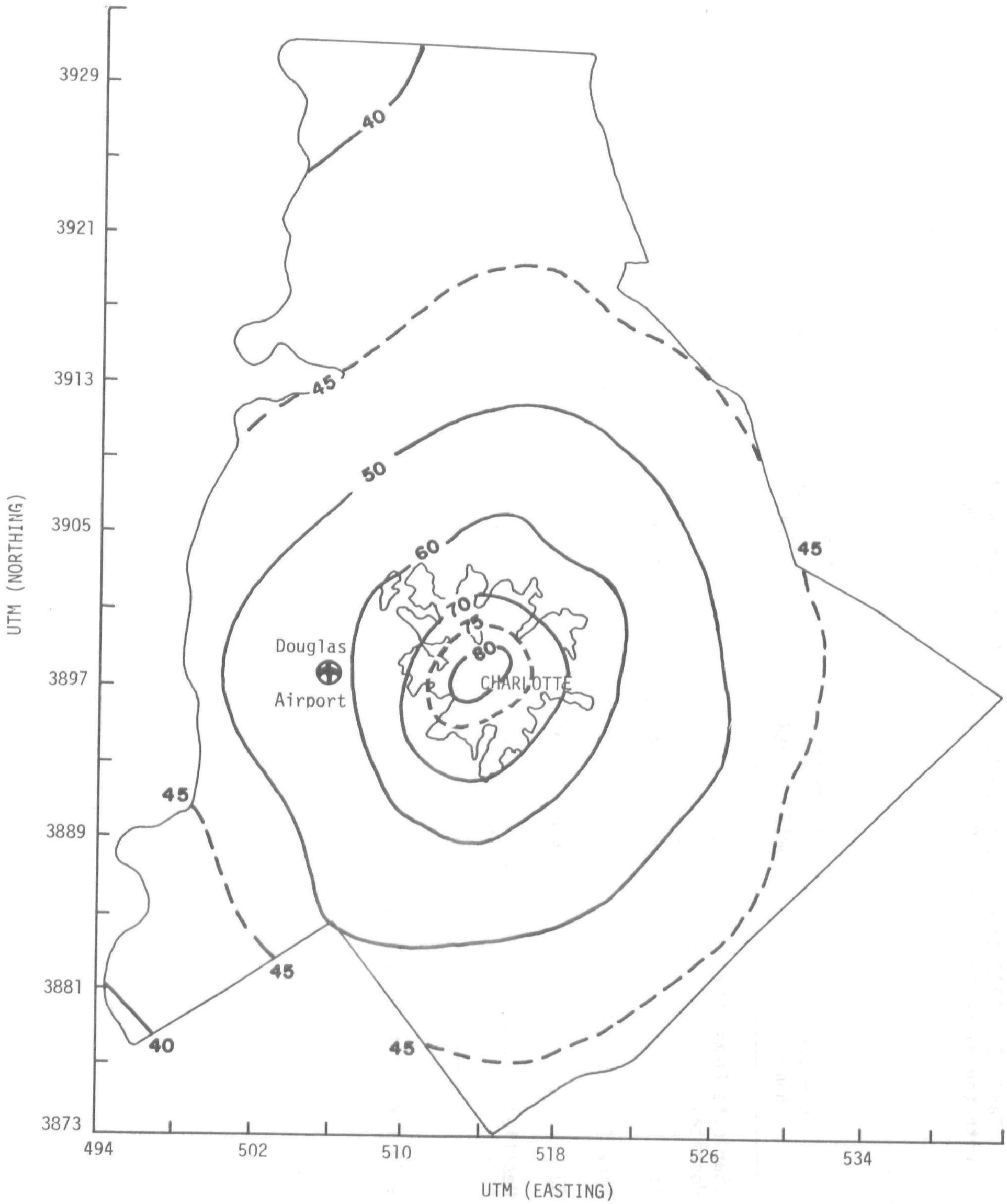

Figure 4. Mecklenburg County N.C. Projected 1975 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

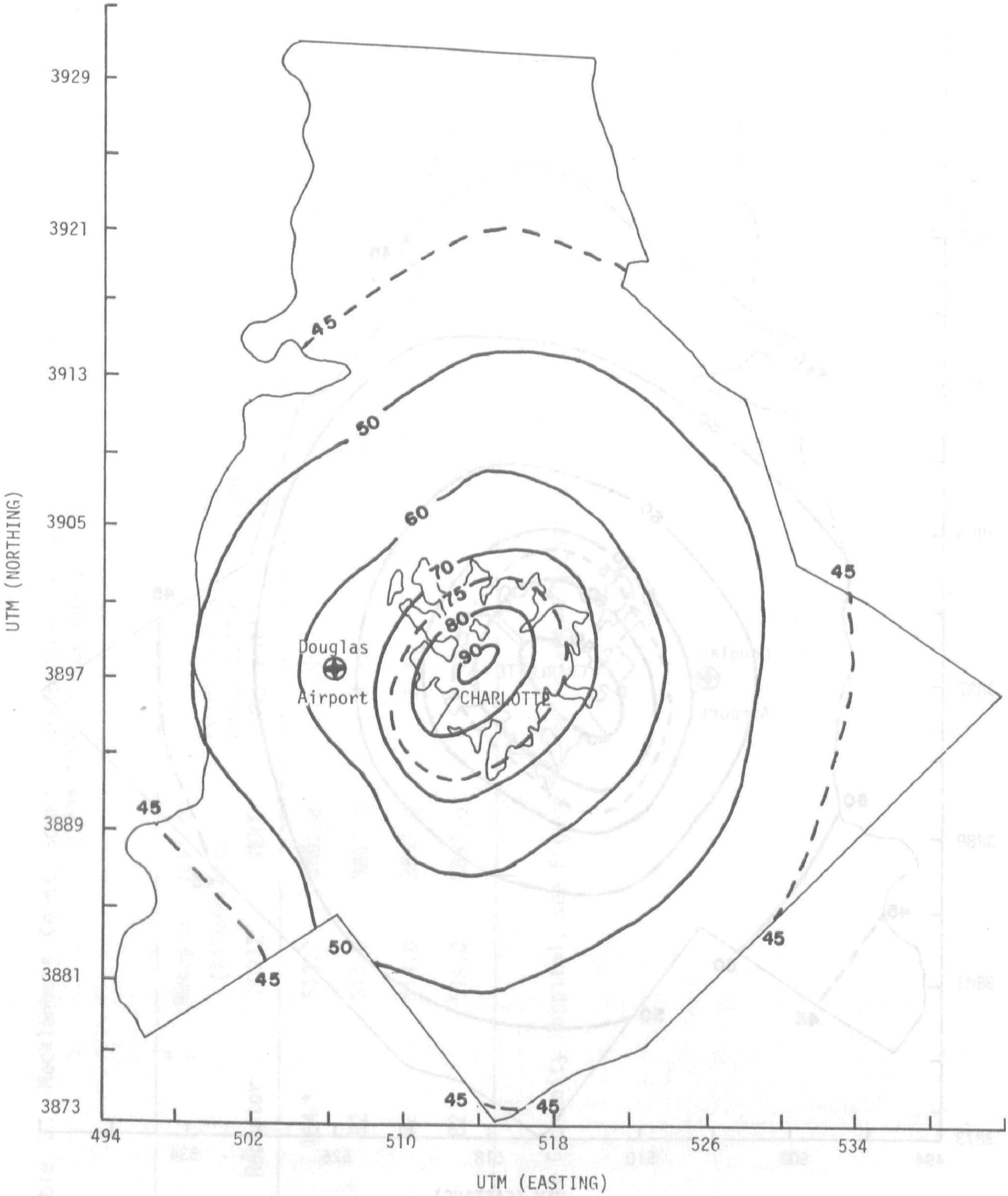

Figure 5. Mecklenburg County N.C. Projected 1980 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

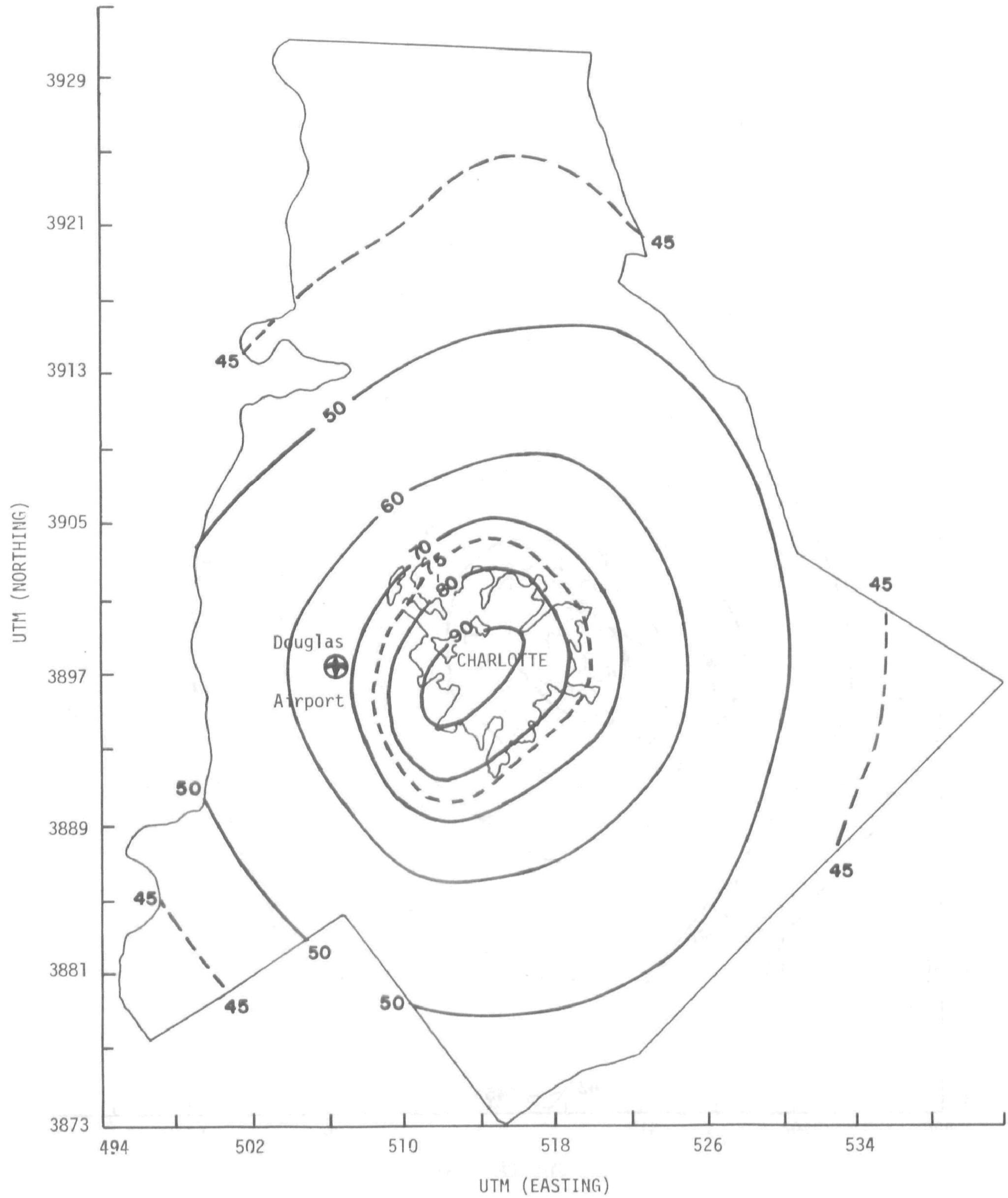

Figure 6. Mecklenburg County N.C. Projected 1985 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

Table 3. Mecklenburg County Source Contributions to Receptor with Highest Calculated Concentrations (From AQDM Source Contribution Tables)

Year	Receptor	Receptor Location (Kilometers) HORIZ	VERT	Point Source Contribution (Percent)	Area Source Contribution (Percent)	Total Concentration at Receptor (Micrograms/Cu. Meter)
1973	184 *	513.3	3897.8	7.96	92.04	75.03
1975	82	514.0	3897.0	3.36	96.64	82.54
1980	82	514.0	3897.0	3.34	96.66	92.14
1985	82	514.0	3897.0	3.40	96.60	99.69

*Charlotte Community Hospital, see Figure 19 for relative location.

tables from AQDM for the receptor with the highest calculated concentrations for each of the projected years, specifically, the percentage of the total receptor concentrations from point sources and from area sources.

2.2 Greensboro (Guilford County) AQMA

The regression coefficients from the calibration* of the AQDM dispersion model (see Figure 23) were used with the 1973 emissions inventory and the 1973 meteorological data for the Greensboro-High Point-Winston-Salem Airport. Guilford and Forsyth Counties were combined for dispersion modeling purposes;† after modeling, most of the analyses are presented for each county separately. The inventory for the two-county area included 255 point sources and area source emissions allocated to 253 area source grid squares. Figures 7 and 8 present the Guilford and Forsyth County area source grid network, respectively (Ref. 1). A rectangular grid with 180 receptors with 5 km by 5 km spacing was used and 12 extra (non-grid) receptors were added. Figures 9 and 10 present the AQDM receptor grids for Guilford and Forsyth Counties, respectively. AQDM-calculated concentrations at each receptor were plotted and analyzed. Figure 11 presents the isopleth analysis for 1973. Table 4 includes 1973 calculated concentrations for all receptors located within Guilford County. Table 5 includes the 1973 source contributions for all point sources and for all area sources (for both Guilford and Forsyth sources) to the five receptors with the highest calculated concentrations.

For 1975, 1980, and 1985 projected air quality, the same regression coefficients were used as for 1973. The mean stability wind roses based on the five (5) year period from January 1, 1968 through December 31,

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*During the calibration of AQDM, the standard procedure is to calculate concentrations at sampling site receptors only (Ref. 3).

†This procedure is discussed in Section 3.

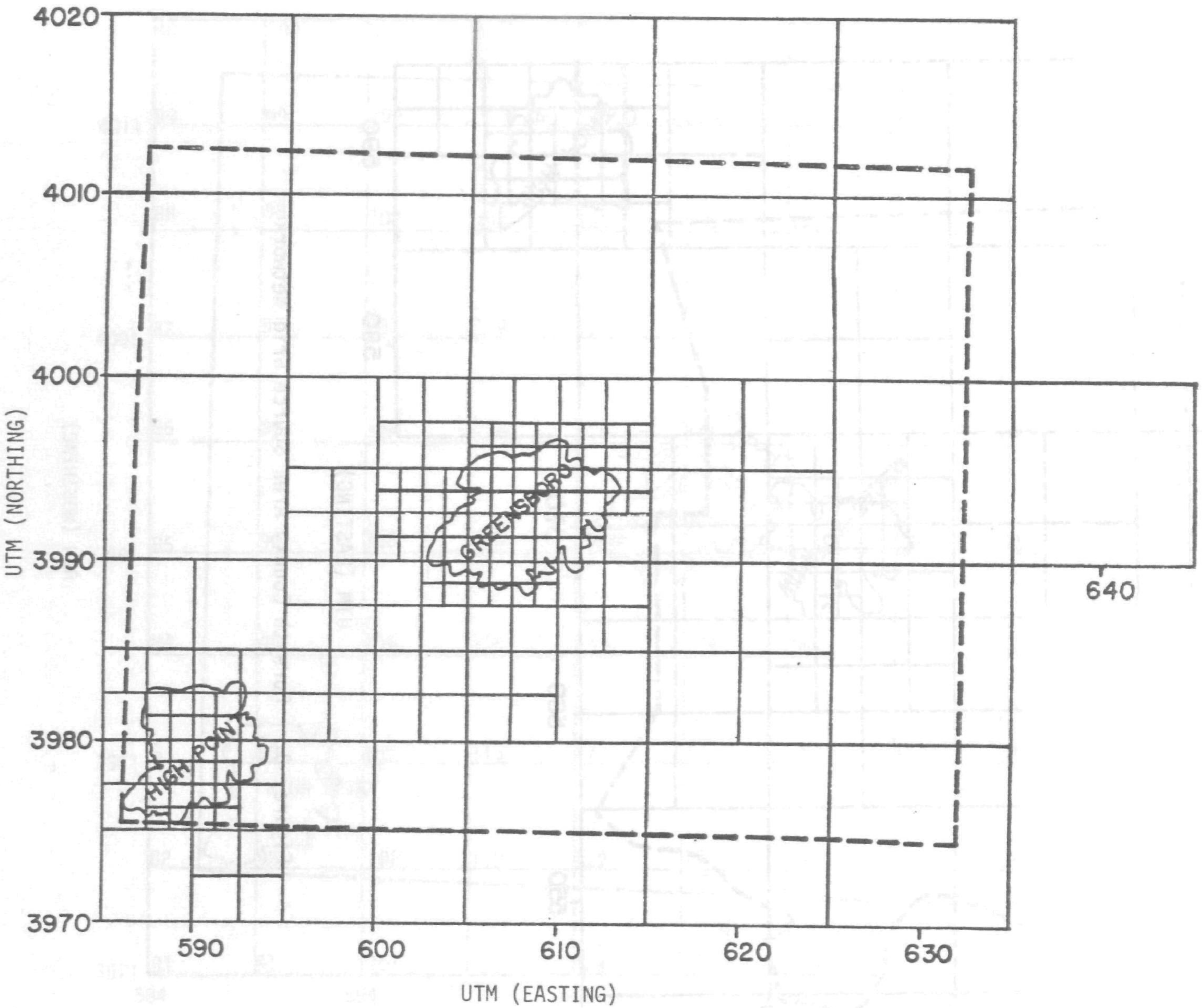

Figure 7. Guilford County Area Source Grid Network

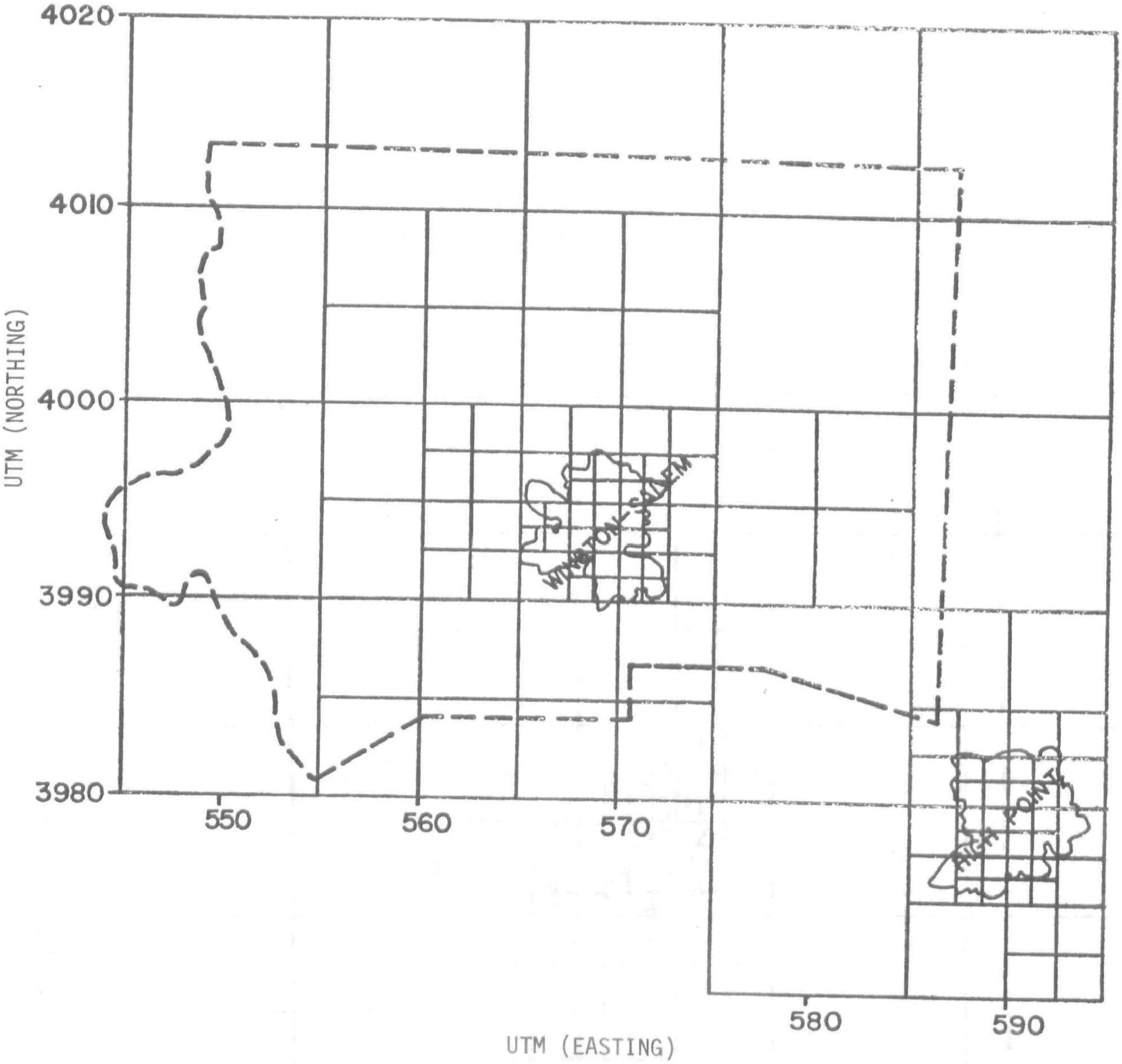

Figure 8. Forsyth County Area Source Grid Network

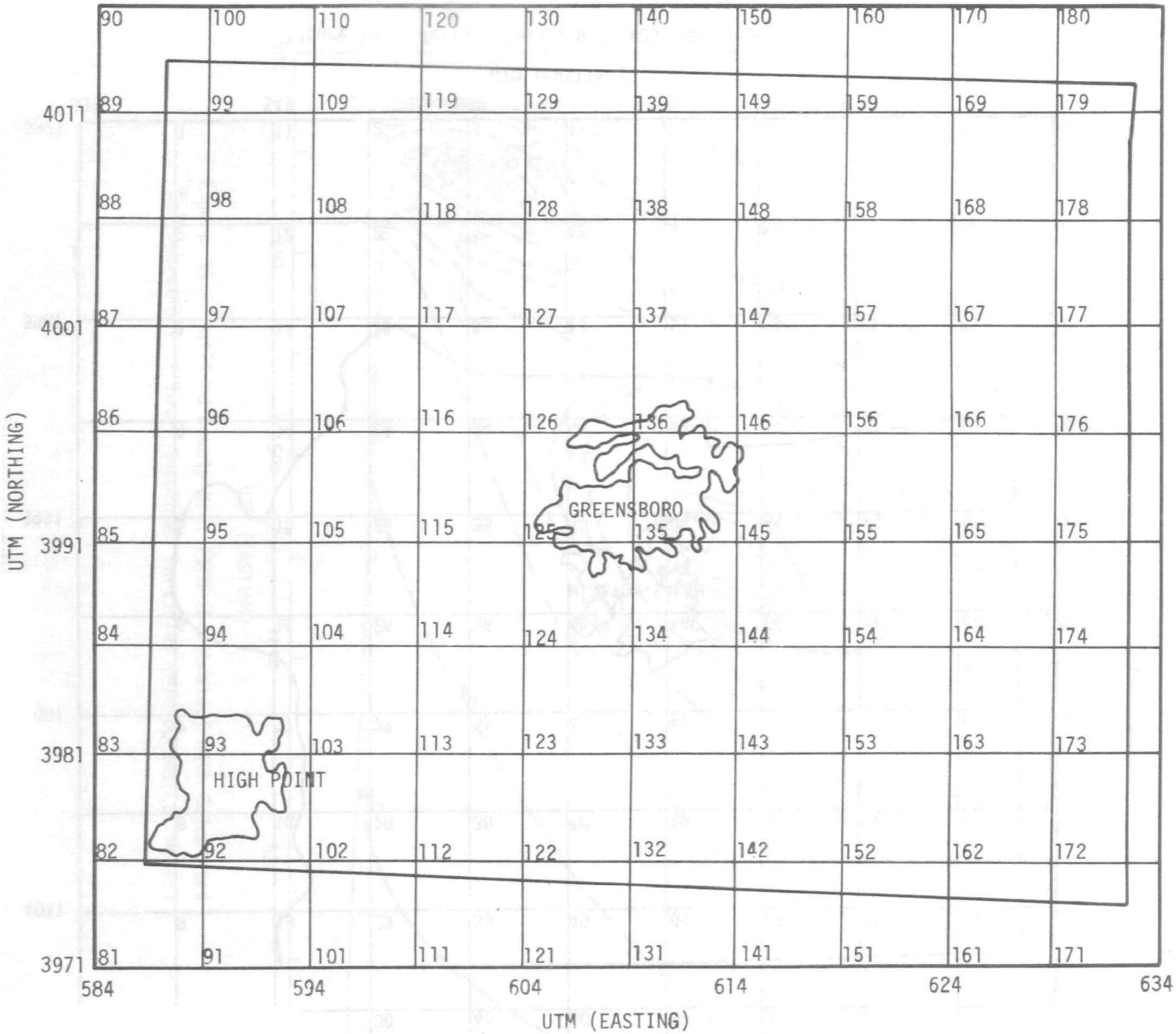

Figure 9. Guilford County N.C. AQDM Receptor Grid

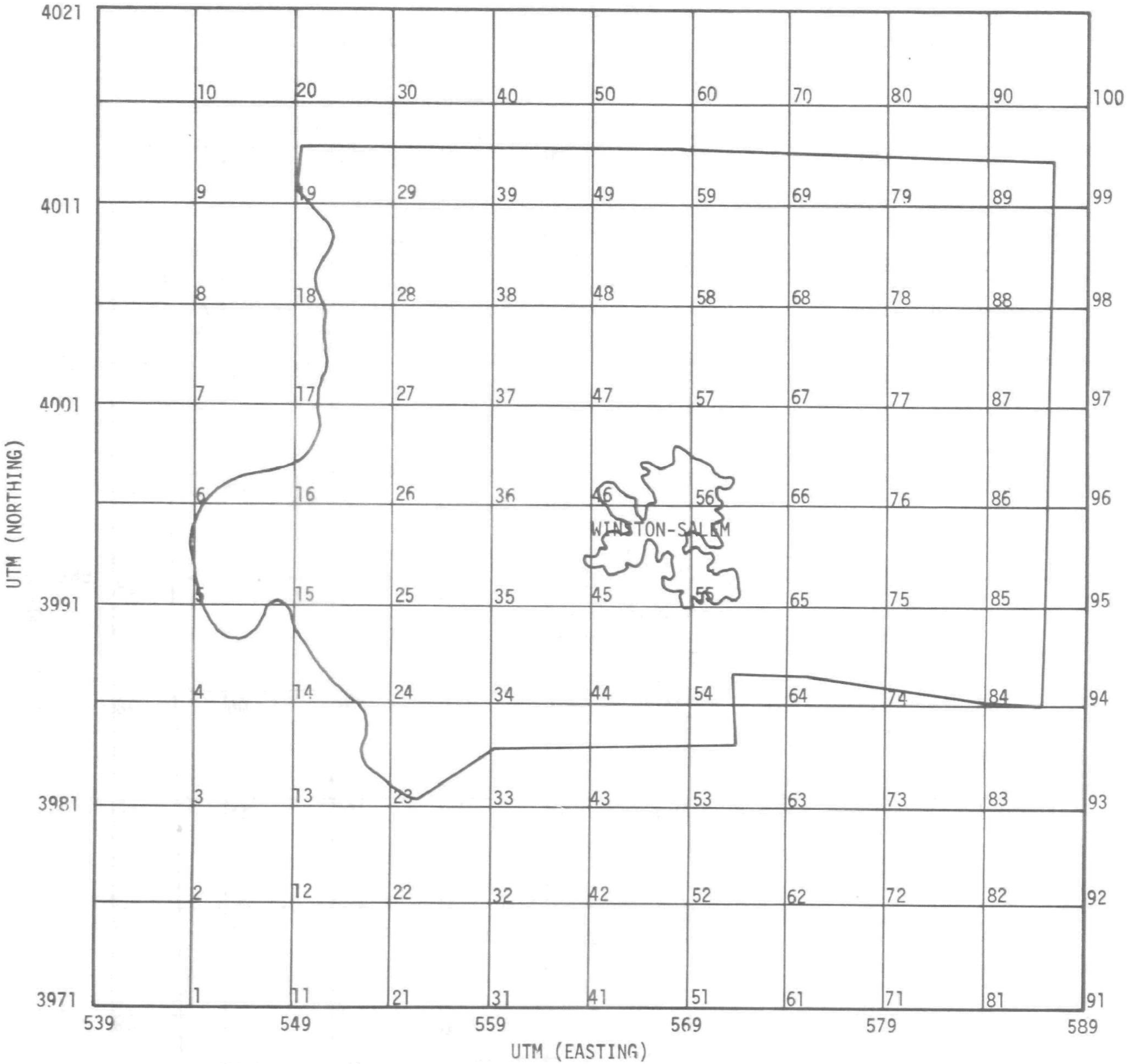

Figure 10. Forsyth County N.C. AQDM Receptor Grid

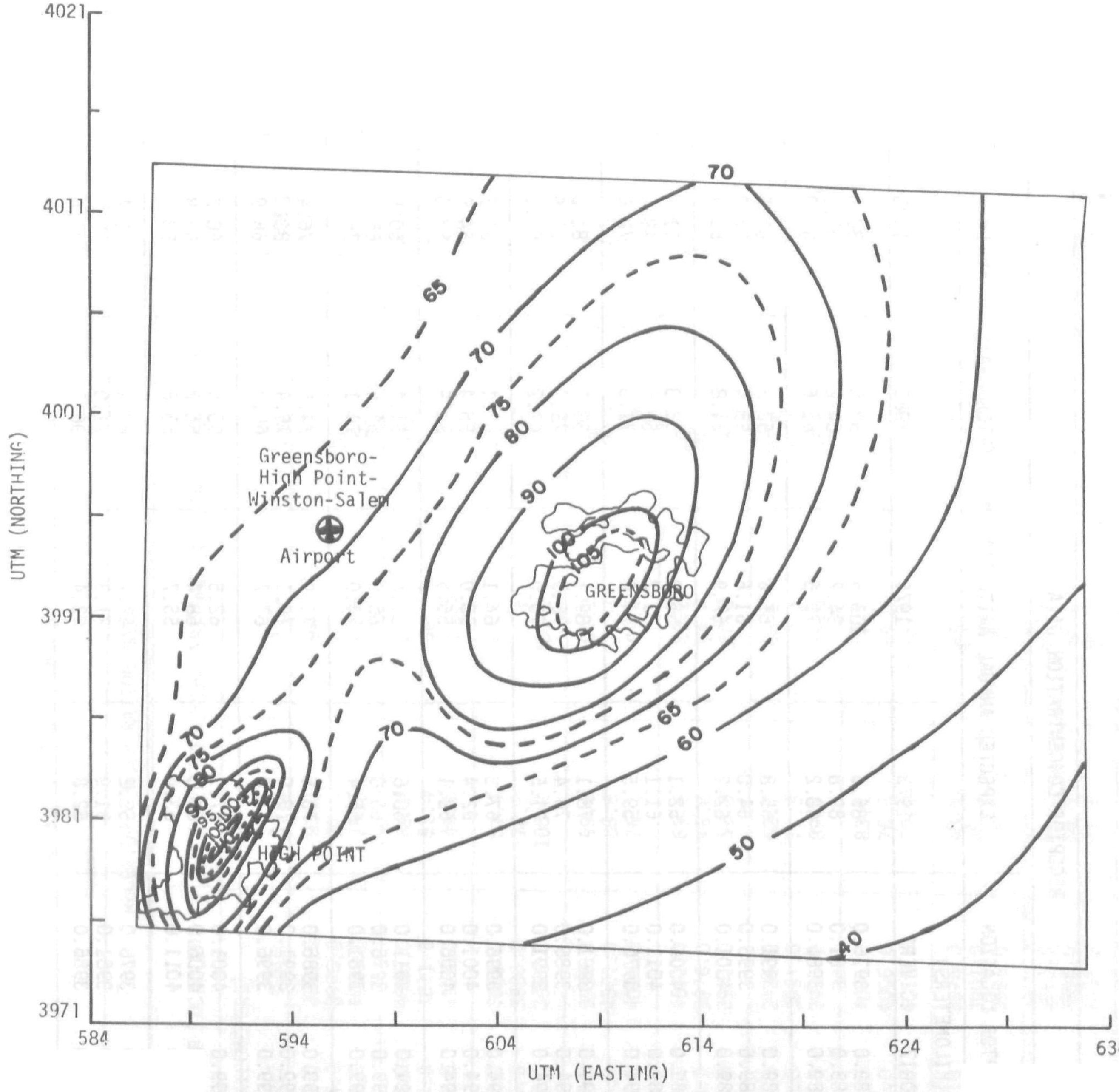

Figure 11. Guilford County N.C. 1973 (Calibrated) AQDM Calculated Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

Table 4. Guilford County Receptor Concentration Data for TSP by Year

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
92	589.0	3976.0	86.6	103.5	88.8	88.8
93	589.0	3981.0	89.8	94.2	84.2	82.6
94	589.0	3986.0	68.2	70.6	66.6	65.8
95	589.0	3991.0	65.8	65.6	62.3	61.5
96	589.0	3996.0	64.0	61.6	58.4	57.3
97	589.0	4001.0	62.2	57.9	54.8	53.4
98	589.0	4006.0	62.1	55.9	52.8	51.3
99	589.0	4011.0	61.1	53.2	50.5	49.3
102	594.0	3976.0	59.5	74.6	71.5	72.0
103	594.0	3981.0	78.1	89.1	80.7	81.0
104	594.0	3986.0	76.4	76.5	73.1	73.5
105	594.0	3991.0	71.5	70.0	67.2	67.5
106	594.0	3996.0	67.3	64.1	61.1	60.7
107	594.0	4001.0	62.4	58.0	55.4	54.8
108	594.0	4006.0	62.1	56.5	53.9	53.0
109	594.0	4011.0	60.6	53.6	51.4	50.8
112	599.0	3976.0	55.0	66.0	64.6	65.3
113	599.0	3981.0	65.4	74.0	74.1	76.5
114	599.0	3986.0	70.5	74.9	74.6	76.4
115	599.0	3991.0	79.0	79.1	79.4	82.2
116	599.0	3996.0	71.8	67.7	66.2	66.9
117	599.0	4001.0	67.7	62.5	60.4	60.2
118	599.0	4006.0	64.3	58.4	56.2	55.9
119	599.0	4011.0	63.4	55.7	53.8	53.7
122	604.0	3976.0	52.2	62.1	60.9	61.4
123	604.0	3981.0	61.9	71.3	71.0	72.4
124	604.0	3986.0	82.8	93.4	96.1	100.6

Table 4. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
125	604.0	3991.0	93.3	96.1	98.4	102.4
126	604.0	3996.0	87.5	81.8	83.4	86.7
127	604.0	4001.0	75.2	67.4	66.9	68.2
128	604.0	4006.0	69.7	61.6	60.4	60.8
129	604.0	4011.0	65.4	56.7	55.3	55.4
132	609.0	3976.0	49.1	58.6	57.2	57.2
133	609.0	3981.0	57.4	67.1	66.2	66.8
134	609.0	3986.0	70.2	81.6	82.9	85.6
135	609.0	3991.0	108.2	108.9	114.5	121.2
136	609.0	3996.0	99.6	91.2	93.5	97.6
137	609.0	4001.0	85.6	73.7	74.0	75.8
138	609.0	4006.0	76.3	65.4	64.8	65.7
139	609.0	4011.0	69.6	59.2	58.2	58.7
142	614.0	3976.0	45.6	54.4	52.9	52.7
143	614.0	3981.0	52.3	60.0	58.6	58.6
144	614.0	3986.0	62.7	68.5	67.8	68.3
145	614.0	3991.0	77.5	77.7	77.8	79.4
146	614.0	3996.0	89.7	79.0	78.9	80.4
147	614.0	4001.0	83.1	69.5	69.5	70.8
148	614.0	4006.0	76.6	64.3	63.7	64.7
149	614.0	4011.0	70.3	58.9	58.2	59.0
152	619.0	3976.0	43.5	50.6	49.0	48.5
153	619.0	3981.0	49.3	54.8	53.1	52.6
154	619.0	3986.0	55.2	58.5	57.1	56.9
155	619.0	3991.0	64.3	62.9	61.8	62.0
156	619.0	3996.0	68.9	62.1	60.7	60.6
157	619.0	4001.0	71.3	60.3	58.9	58.8

Table 4. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
158	619.0	4006.0	71.3	59.0	57.8	57.9
159	619.0	4011.0	68.3	56.5	55.5	55.9
162	624.0	3976.0	41.1	46.9	45.4	44.8
163	624.0	3981.0	45.9	50.1	48.4	47.9
164	624.0	3986.0	51.8	53.4	51.8	51.4
165	624.0	3991.0	58.2	56.1	54.8	54.7
166	624.0	3996.0	61.8	56.3	54.5	54.0
167	624.0	4001.0	62.5	53.9	52.2	51.7
168	624.0	4006.0	64.7	53.7	52.1	51.5
169	624.0	4011.0	63.7	52.0	50.7	50.4
172	629.0	3976.0	39.2	43.9	42.5	42.0
173	629.0	3981.0	43.8	46.6	45.1	44.6
174	629.0	3986.0	48.6	49.1	47.6	47.1
175	629.0	3991.0	53.8	51.1	49.7	49.4
176	629.0	3996.0	56.1	51.3	49.8	49.3
177	629.0	4001.0	56.7	49.9	48.2	47.6
178	629.0	4006.0	58.5	49.5	47.8	47.2
179	629.0	4011.0	58.9	48.4	46.8	46.3
188	609.7	3989.1	92.9	101.5	106.7	115.4
189	598.1	3992.6	75.2	72.6	71.4	72.8
190	587.6	3977.4	75.1	90.9	78.3	77.2
191	589.6	3979.1	113.9	116.8	100.3	101.0
192	609.2	3992.8	106.0	103.0	106.9	112.3

Table 5. 1973 Guilford/Forsyth Source Contributions to Five (5) Receptors with the Highest Calculated Concentrations (From AQDM Source Contribution Tables)*

Receptor Number	Receptor Location (Kilometers) HORIZ	VERT	Point Source Contribution (Percent)	Area Source Contribution (Percent)	Total Concentration at Receptor (Micrograms/Cu. Meter)
191**	589.6	3979.1	32.53	67.47	113.95
135	609.0	3991.0	11.77	88.23	108.26
192†	609.2	3992.8	8.05	91.95	106.04
136	609.0	3996.0	7.12	92.88	99.72
125	604.0	3991.0	9.32	90.68	93.37

* All Five of the Receptors are Located in Guilford County.

** S. Main, W. Green (see Figure 20 for relative location)

† Davie Mebane (see Figure 20 for relative location)

1972 at the Greensboro-High Point-Winston-Salem Airport were used. Emission inventories from both point and area sources for both Guilford and Forsyth Counties for each of the three projected years were input to the dispersion model. Figures 12, 13, and 14 present the isopleth analyses of projected air quality for 1975, 1980, and 1985, respectively. Table 4 includes the calculated concentrations for all receptors located within Guilford County for each of the projected years. Table 6 presents an analysis of the source contribution tables from AQDM for the receptor with the highest calculated concentration for each of the projected years, specifically, the percentage of the total receptor concentration from point sources and from area sources.

2.3 Winston-Salem (Forsyth County) AQMA

As discussed in Section 2.2, Guilford and Forsyth Counties were modeled together. Part of the detail of that section is repeated here for completeness.

The regression coefficients from the calibration of the AQDM dispersion model were used with the 1973 emissions inventory and the 1973 meteorological data for the Greensboro-High Point-Winston-Salem Airport. Guilford and Forsyth Counties were combined for dispersion modeling purposes;* after modeling, most of the analyses are presented for each county separately. The emissions inventory for the two-county area included 255 point sources and area sources allocated to 253 area source grid squares. Figures 7 and 8 present the Guilford and Forsyth area source grid squares, respectively (Ref. 1). A rectangular grid with 180 receptors with 5 km by 5 km spacing was used and 12 extra (non-grid) receptors were added. Figures 9 and 10 present the AQDM receptor grids for Guilford and Forsyth Counties, respectively. AQDM-calculated

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*This procedure is discussed in Section 3.

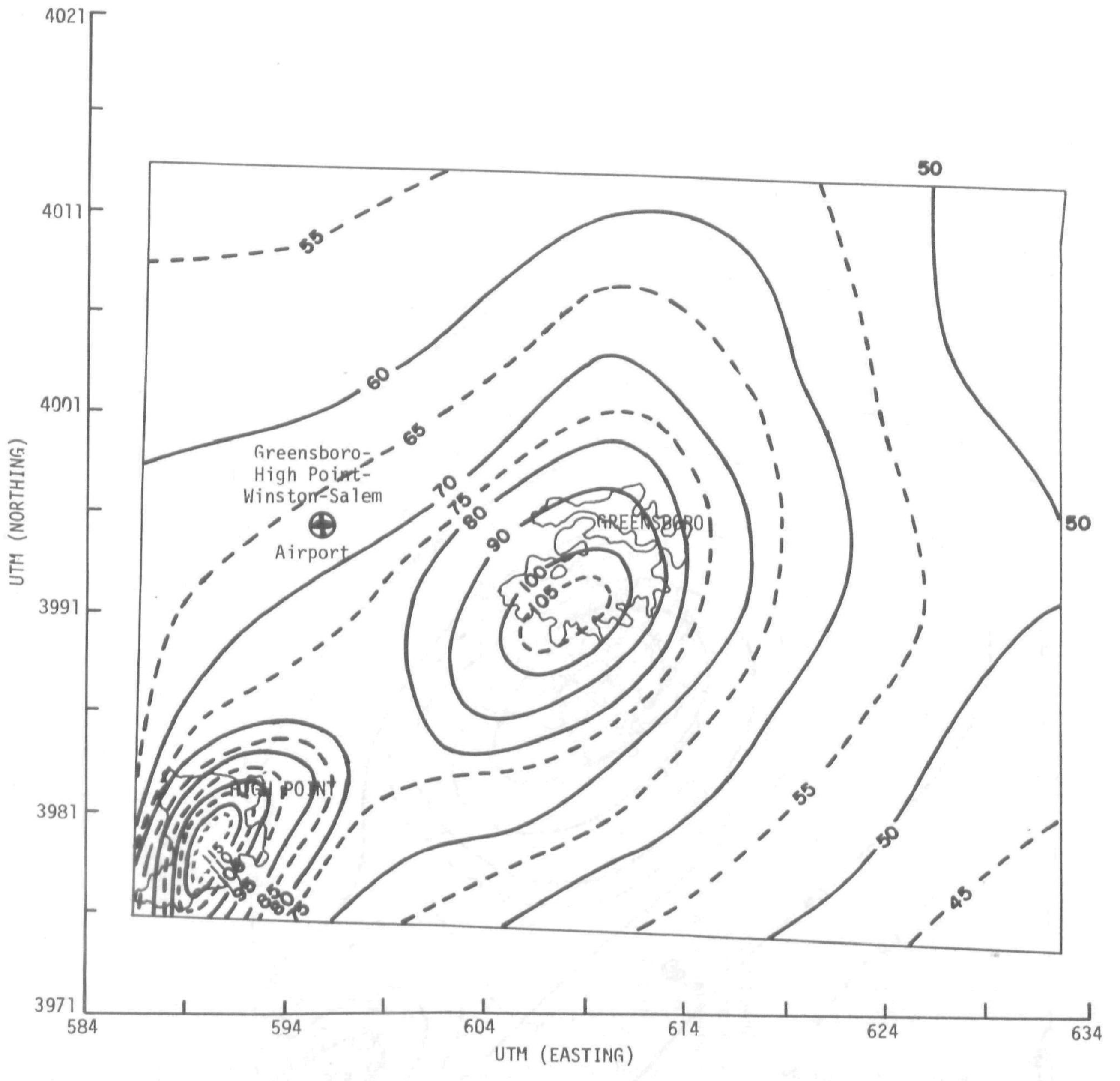

Figure 12. Guilford County N.C. Projected 1975 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

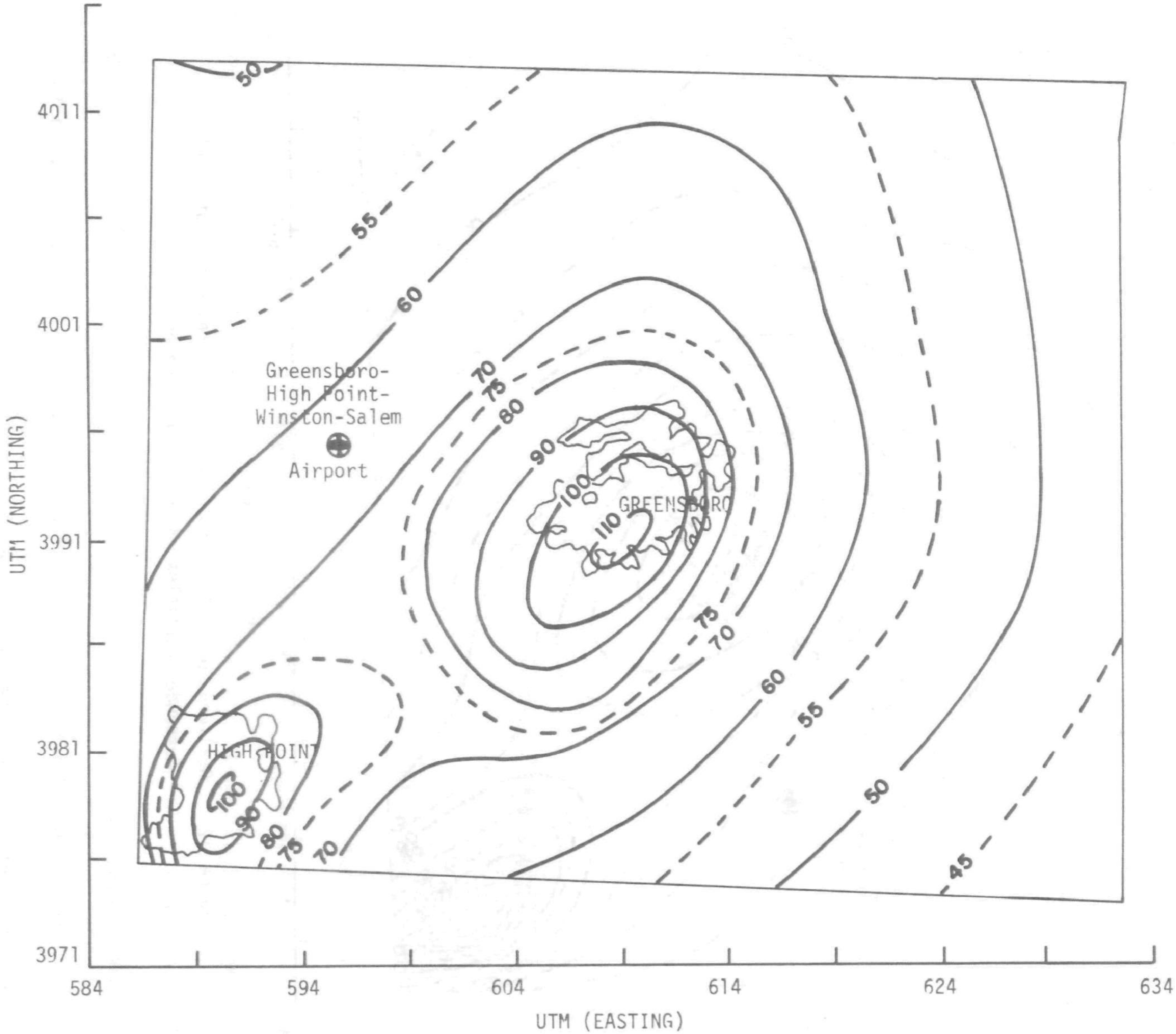

Figure 13. Guilford County N.C. Projected 1980 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

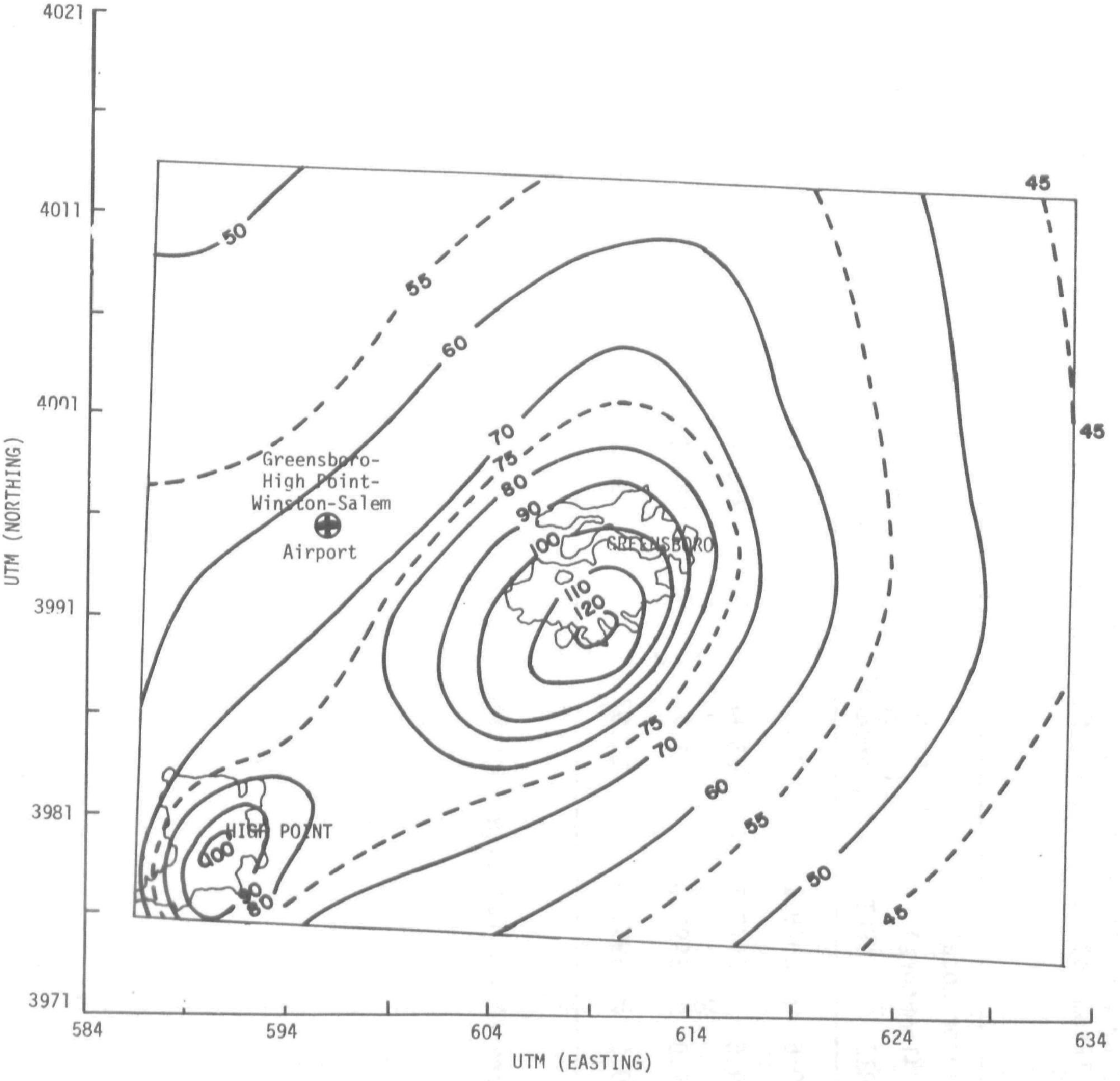

Figure 14. Guilford County N.C. Projected 1985 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

Table 6. Guilford County Source Contributions to Receptor with Highest Calculated Concentrations (From both Guilford and Forsyth Sources)

Year	Receptor Number	Receptor Location (Kilometers) HORIZ	VERT	Point Source Contribution (Percent)	Area Source Contribution (Percent)	Total Concentration at Receptor (Micrograms/Cu. Meter)
1973	191*	589.6	3979.1	32.53	67.47	113.95
1975	191*	589.6	3979.1	25.66	74.34	116.95
1980	135	609.0	3991.0	11.74	88.26	114.60
1985	135	609.0	3991.0	11.97	88.03	121.28

* S. Main, W. Green (see Figure 20 for relative location)

concentrations at each receptor were plotted and analyzed. Figure 15 presents the isopleth analysis for 1973. Table 7 includes 1973 calculated concentrations for all receptors located within Forsyth County. In 1973, 1975, and 1980 none of the five receptors with the highest calculated concentrations for the two-county area were located in Forsyth County. In 1985 receptor 184 (R. J. Reynolds) and receptor 181 (Government Center) were the receptors with the fourth and fifth highest calculated concentrations, respectively. Table 8 presents a comparison of the percentage contribution from total point sources and total area sources to each of these Forsyth County receptors.

For 1975, 1980, and 1985 projected air quality, the same regression coefficients were used as those for 1973. The mean stability wind roses based on the five (5) year period from January 1, 1968 through December 31, 1972 at the Greensboro-High Point-Winston-Salem Airport were used. Emissions inventories from both point and area sources for both Guilford and Forsyth Counties for each of the three projected years were input to the dispersion model. Figures 16, 17, and 18 present the isopleth analyses of projected air quality for 1975, 1980, and 1985, respectively. Table 7 includes the calculated concentrations for all receptors located in Forsyth County for each of the projected years.

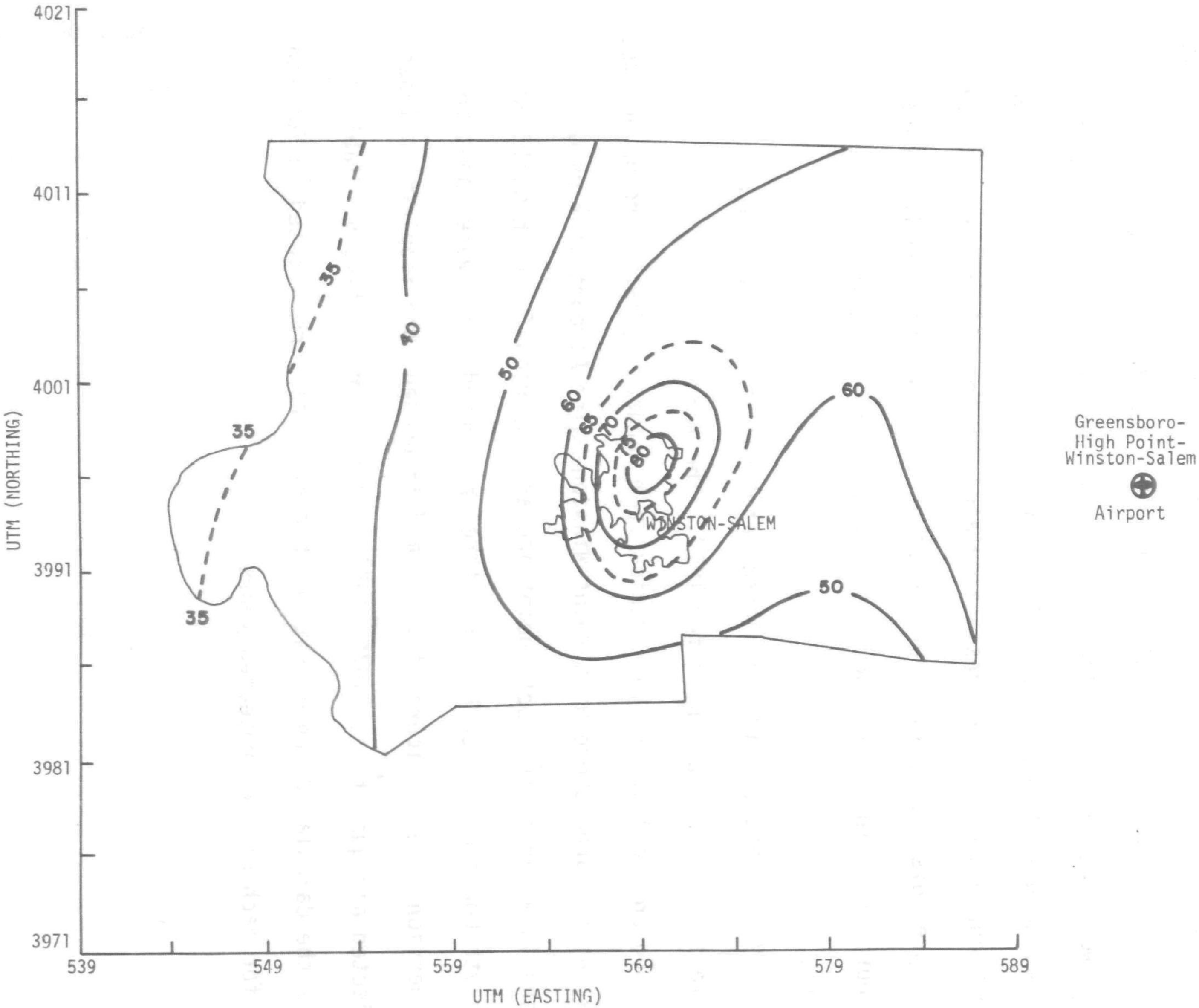

Figure 15. Forsyth County N.C. 1973 (Calibrated) AQDM Calculated Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

Table 7. Forsyth County Receptor Concentration Data for TSP by Year

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
15	549.0	3991.0	37.6	41.3	40.9	41.1
16	549.0	3996.0	36.6	39.8	39.3	39.4
24	554.0	3986.0	39.5	45.6	45.6	46.1
25	554.0	3991.0	39.5	44.8	44.6	45.1
26	554.0	3996.0	39.8	43.8	43.4	43.5
27	554.0	4001.0	37.6	40.8	40.1	40.0
28	554.0	4006.0	36.9	39.4	38.6	38.4
29	554.0	4011.0	35.2	36.9	36.4	36.3
34	559.0	3986.0	43.9	51.7	52.1	53.2
35	559.0	3991.0	46.3	53.7	54.6	56.2
36	559.0	3996.0	45.9	50.6	50.5	51.2
37	559.0	4001.0	44.6	47.7	47.1	47.2
38	559.0	4006.0	43.6	45.1	44.3	44.2
39	559.0	4011.0	42.0	42.2	41.5	41.4
44	564.0	3986.0	48.4	57.0	57.5	58.7
45	564.0	3991.0	54.9	64.4	66.9	70.0
46	564.0	3996.0	57.7	62.7	64.5	66.9
47	564.0	4001.0	54.8	56.6	57.2	58.4
48	564.0	4006.0	51.6	51.6	51.6	52.3
49	564.0	4011.0	48.6	46.9	46.7	47.2
54	569.0	3986.0	48.8	58.2	57.8	58.3
55	569.0	3991.0	68.2	72.9	76.4	80.7
56	569.0	3996.0	83.2	82.5	87.6	93.3
57	569.0	4001.0	69.0	64.6	66.5	69.0
58	569.0	4006.0	61.1	57.1	57.5	58.5
59	569.0	4011.0	56.2	51.9	51.7	52.2
65	574.0	3991.0	57.0	63.7	62.2	61.8

Table 7. (Continued)

RECEPTOR CONCENTRATION DATA						
RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)			
	(KILOMETERS) HORIZ	VERT	1973	1975	1980	1985
66	574.0	3996.0	64.4	65.9	66.7	68.5
67	574.0	4001.0	65.1	61.2	60.6	61.0
68	574.0	4006.0	63.0	57.5	56.9	57.2
69	574.0	4011.0	59.2	53.2	52.6	52.9
75	579.0	3991.0	53.3	59.2	57.0	56.0
76	579.0	3996.0	58.6	60.3	58.3	57.6
77	579.0	4001.0	60.5	58.0	55.7	54.7
78	579.0	4006.0	62.0	56.4	54.2	53.3
79	579.0	4011.0	61.0	53.8	52.2	51.5
84	584.0	3986.0	49.4	58.1	55.5	54.6
85	584.0	3991.0	56.2	60.7	57.7	56.5
86	584.0	3996.0	61.1	60.7	57.5	56.1
87	584.0	4001.0	61.2	57.8	54.7	53.1
88	584.0	4006.0	62.3	56.1	53.1	51.6
89	584.0	4011.0	61.1	53.2	50.7	49.5
181	568.0	3994.8	77.5	86.0	94.3	102.9
182	567.5	3995.1	71.2	77.6	82.9	88.7
183	568.0	3999.2	73.4	71.0	74.1	77.8
184	568.3	3995.1	82.7	88.9	96.9	105.3
185	563.3	4010.8	47.8	46.4	46.1	46.4
186	560.7	3993.1	51.8	58.9	61.0	63.8
187	576.7	4007.7	62.4	56.4	55.0	54.5

Table 8. Forsyth County: Source Contributions to the Two Forsyth County Receptors with the Highest 1985 Calculated Concentrations (From both Guilford and Forsyth County Emissions)

Receptor Number	Receptor Location (Kilometers) HORIZ	VERT	Point Source Contribution (Percent)	Area Source Contribution (Percent)	Total Concentration at Receptor (Micrograms/Cu. Meter)
184*	568.3	3995.1	8.62	91.38	105.3
181**	568.0	3994.8	5.78	94.22	102.9

* R. J. Reynolds (see Figure 21 for relative location)
** Government Center (see Figure 21 for relative location)

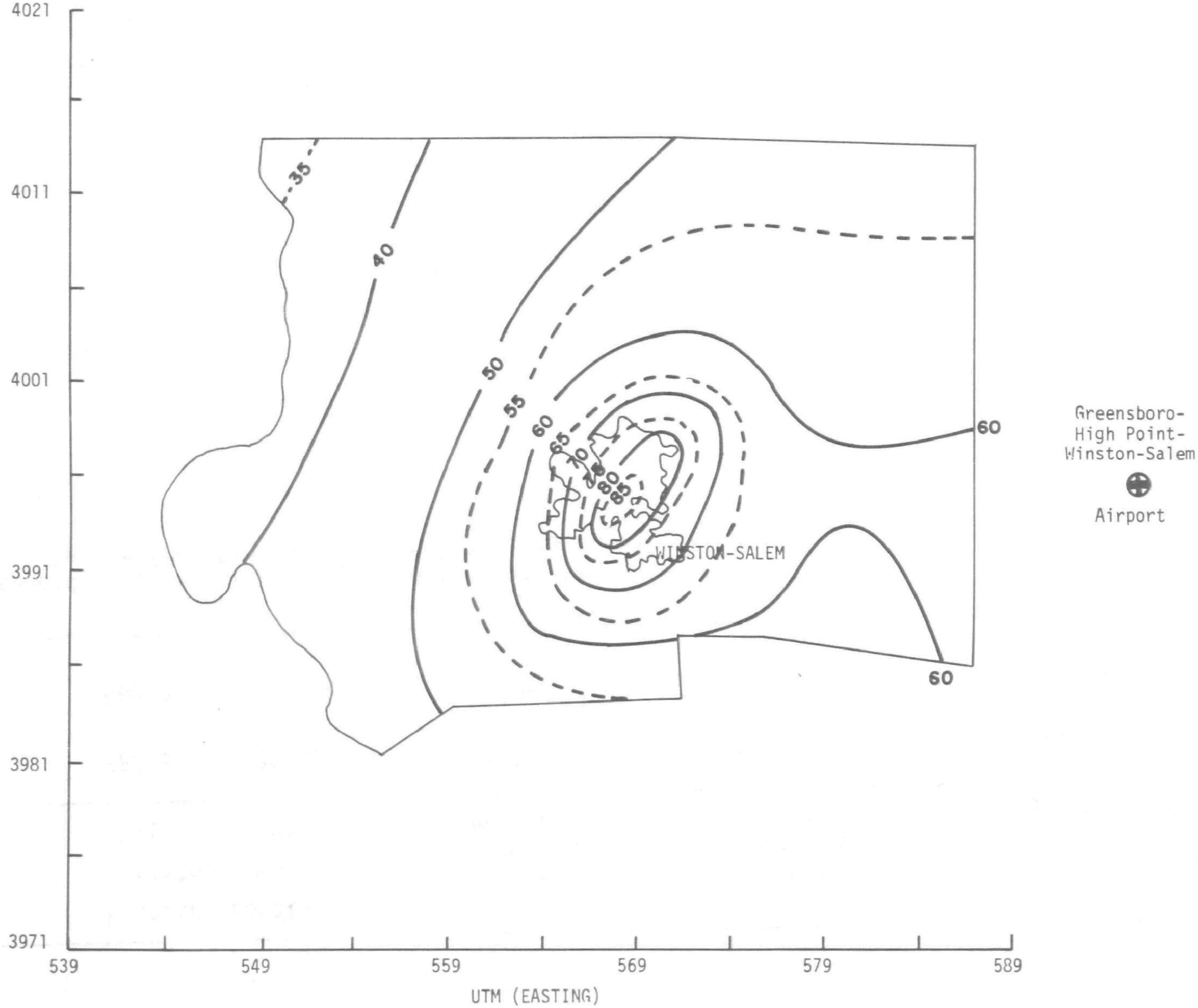

Figure 16. Forsyth County N.C. Projected 1975 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

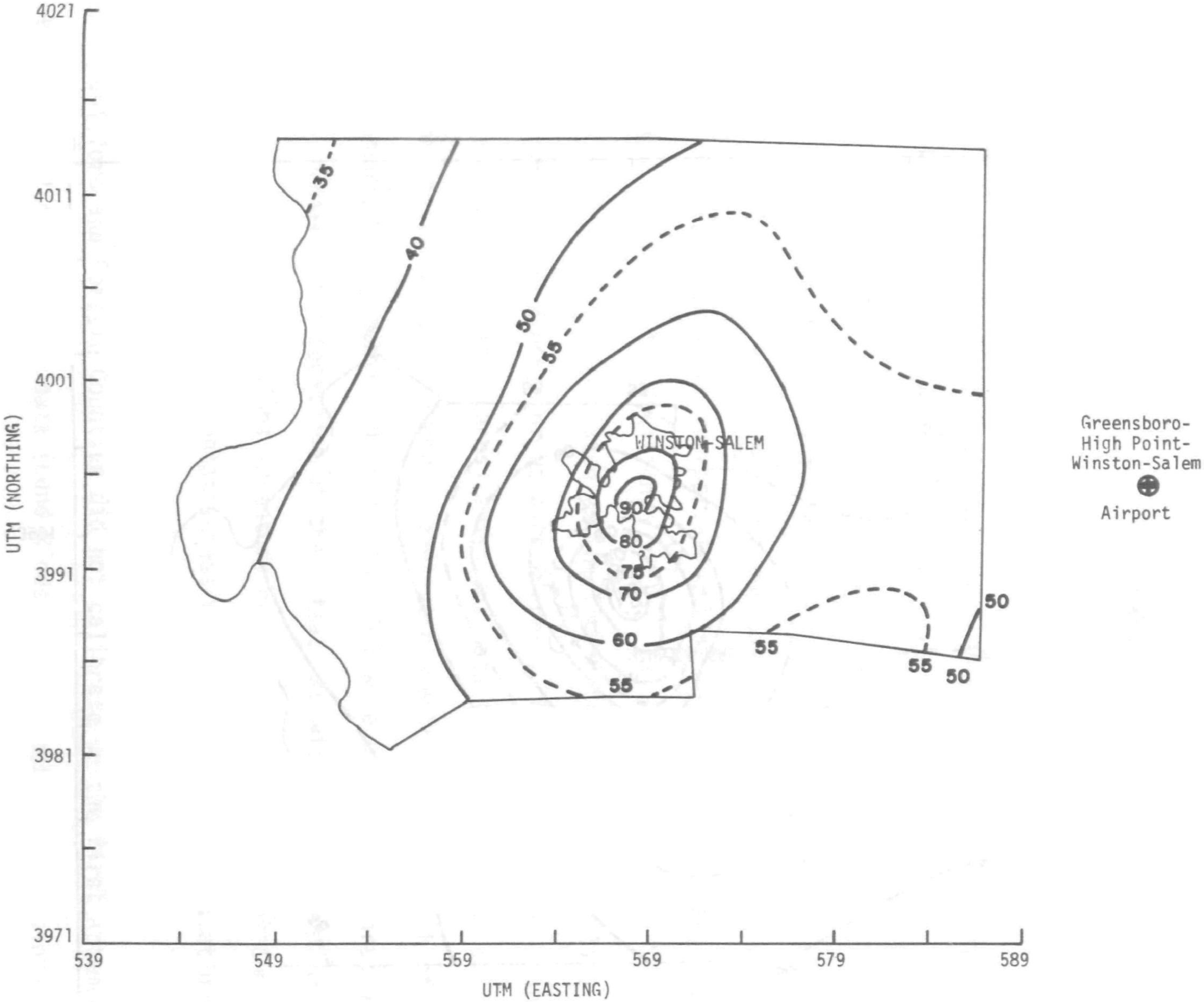

Figure 17. Forsyth County N.C. Projected 1980 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

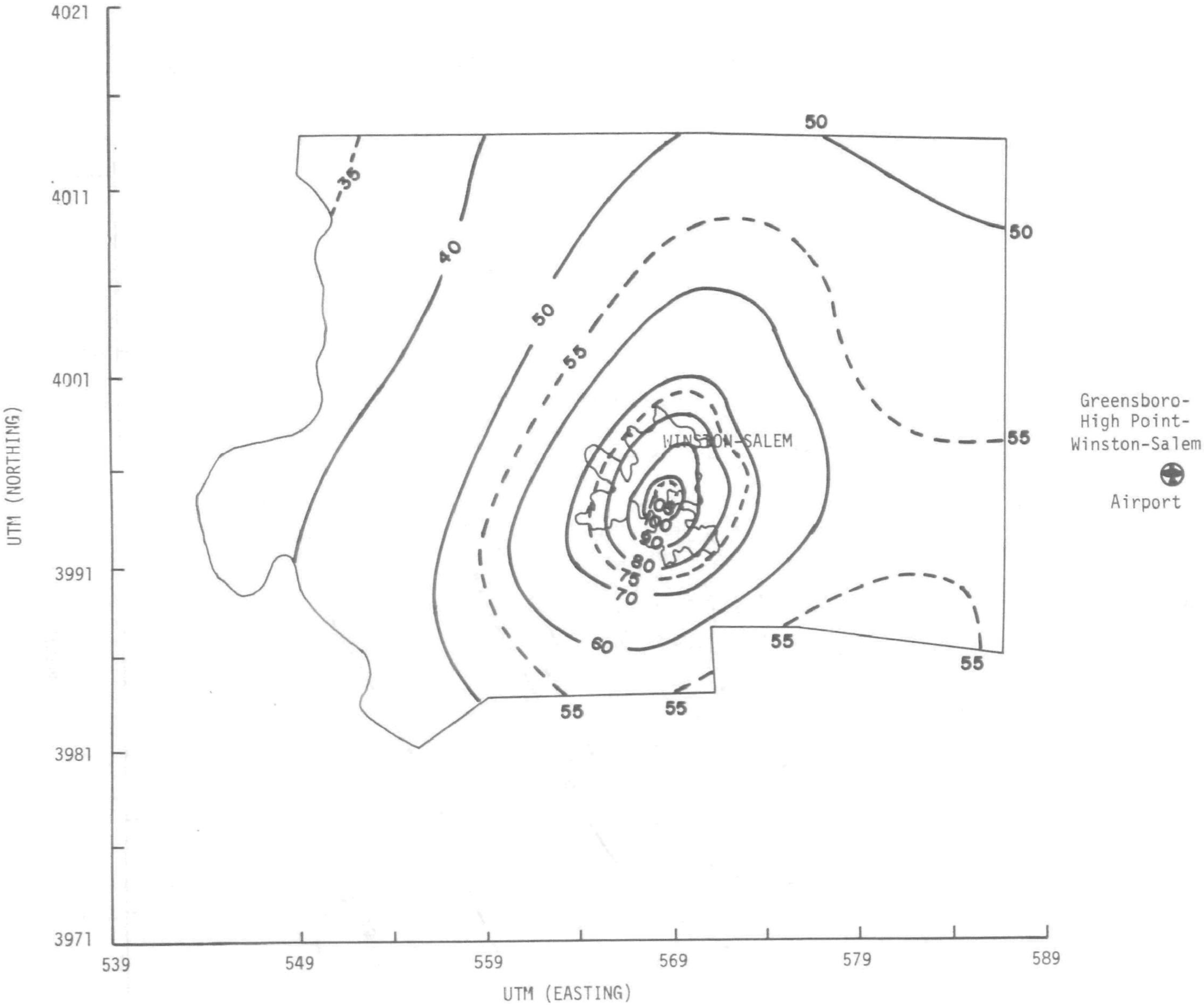

Figure 18. Forsyth County N.C. Projected 1985 Concentrations of Total Suspended Particles (Micrograms/Cu. Meter)

3.0 Calibration Procedures

The AQDM as modified to use the Briggs Plume Rise Equation instead of the Holland Plume Rise Equation was used for the dispersion modeling of emitted particulate matter and air quality for the North Carolina AQMAs. The first step in the modeling process was to prepare base year (1973) emissions data (from both point sources and area sources), meteorological data, and TSP concentrations data at monitoring (sampling) sites for input to the AQDM to calibrate the model for each area in the study.

The Charlotte (Mecklenburg County) AQMA was modeled as a unit, but the Greensboro (Guilford County) AQMA and the Winston-Salem (Forsyth County) AQMA were modeled together. The common boundary of these latter AQMAs and the availability of only one appropriate set of meteorological data were determining factors in the decision.

Mecklenburg County calibrated on the first attempt using stability wind rose data (Lund Winds) for Douglas Airport. Point source (93* sources) and area source (123 grid squares) emissions data (1973) were input to the dispersion model. Annual arithmetic average concentrations for each of the 12 Mecklenburg County monitoring sites for 1973 were used for calibration. Figure 19 presents the locations of the sites. As will be discussed in detail later, several emissions inventory corrections/modifications and further analyses of the representativeness of certain monitoring stations required additional calibration runs for Mecklenburg County.

Guilford and Forsyth Counties did not calibrate on the first attempt. Annual stability wind rose data (Lund Winds) for Greensboro-High Point-Winston-Salem Airport, emissions data for 255 point sources and 250 area

*During later calibration runs, an additional source (stack) was added at one location and three (3) Rowan County sources were added: the final number of point sources used for calibration was 97.

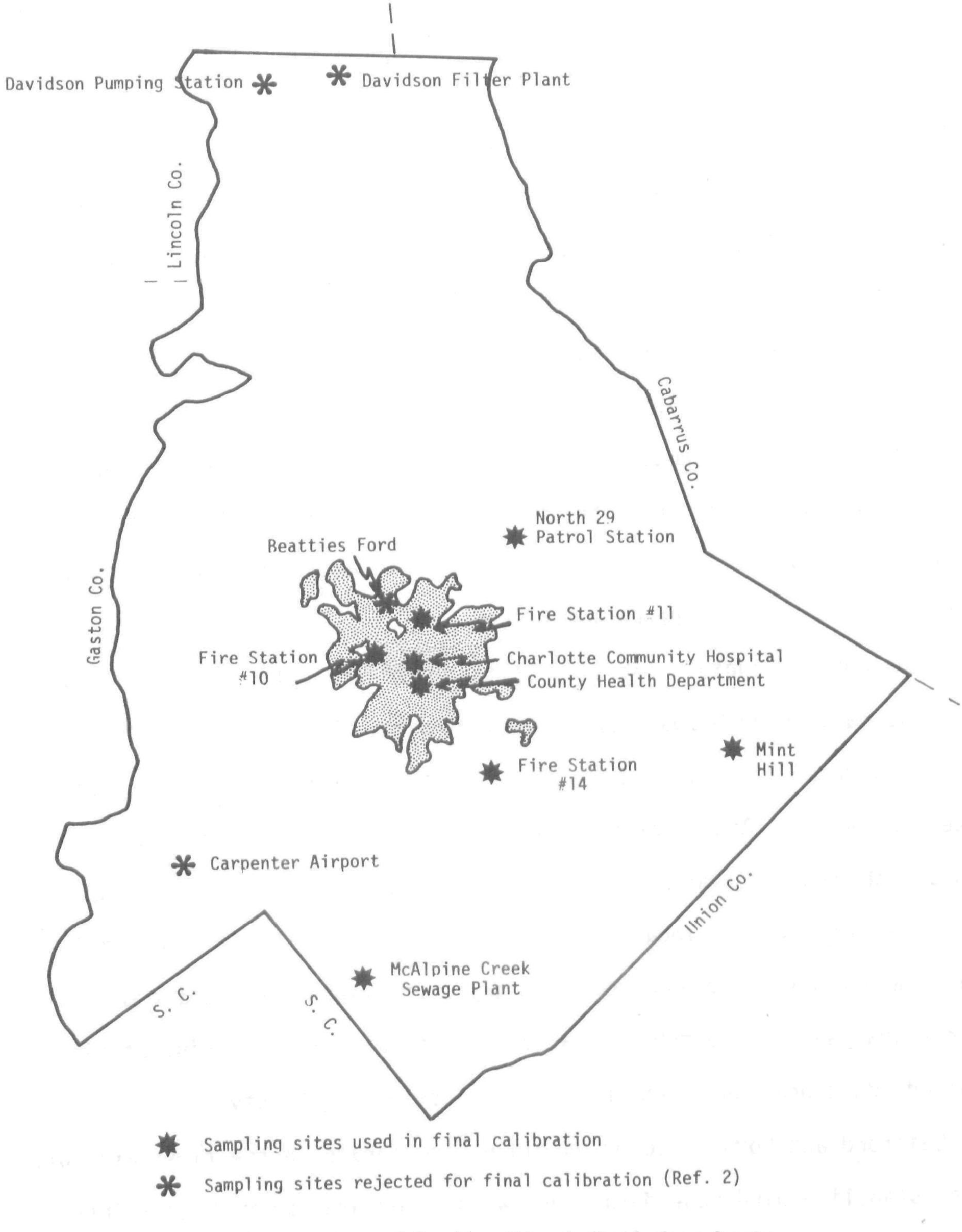

Figure 19. Locations of Sampling Sites in Mecklenburg County

source grid squares, and 1973 annual arithmetic average concentrations at thirteen (13) Guilford and Forsyth County monitoring sites were used for calibration. Figures 20 and 21 present the locations of sites in Guilford and Forsyth Counties, respectively. In a technical review meeting at RTI, we discussed the emissions inventory and AQDM source-receptor contribution tables with NCAQS project personnel and noted the overwhelming contributions (≈90% of the total emissions inventory) of the area sources and particularly the dominance of fugitive dust emissions from vehicles. During the analysis, a systematic error was discovered in the apportioning of unpaved road emissions. The area source emissions inventory was corrected and another AQDM calibration run was made. This run resulted in a "successful calibration". However, as will be discussed in detail later, corrections to the emissions inventory, further analyses of representativeness of monitoring stations, and an analysis of the AQDM source-receptor contribution tables caused additional AQDM calibration runs to be made for the Guilford and Forsyth County areas. The additional calibration runs were made for the AQMAs to include several changes in the emissions inventory, and to investigate new approaches and techniques (applied to one of the areas but with general, or overall, applications). The following narrative is a description of the procedures and approaches used; the ramifications of whether the techniques applied in one AQMA solved a problem peculiar to that AQMA or had more general applicability were at all times considered.

The need for additional calibration runs evolved as we attempted to resolve what were, in the judgement of the participants in the N.C. AQMA analysis, unacceptable calibration results or because changes were made in the emissions inventory or other data. In the case of the Guilford/

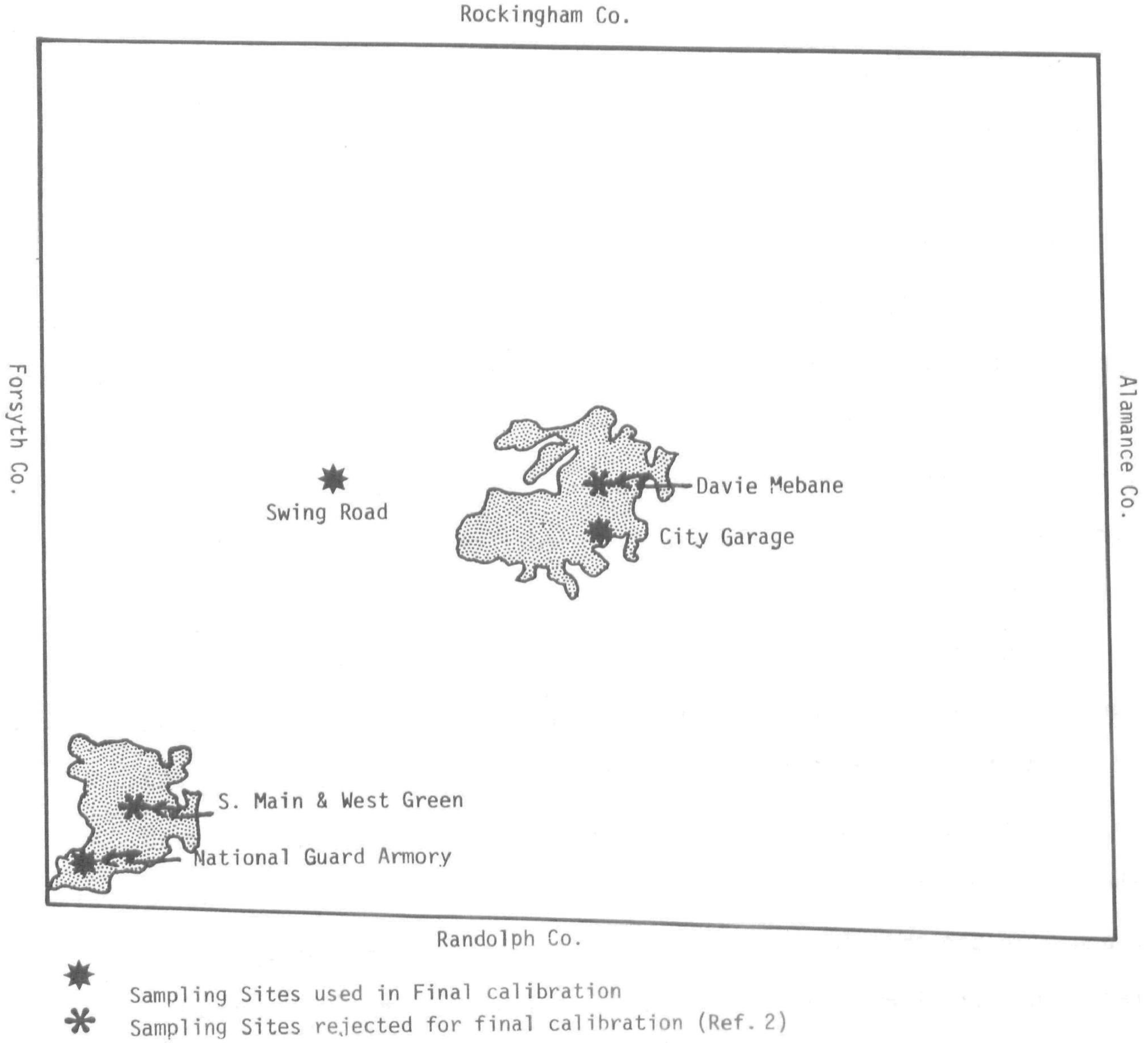

Figure 20. Locations of Sampling Sites in Guilford County

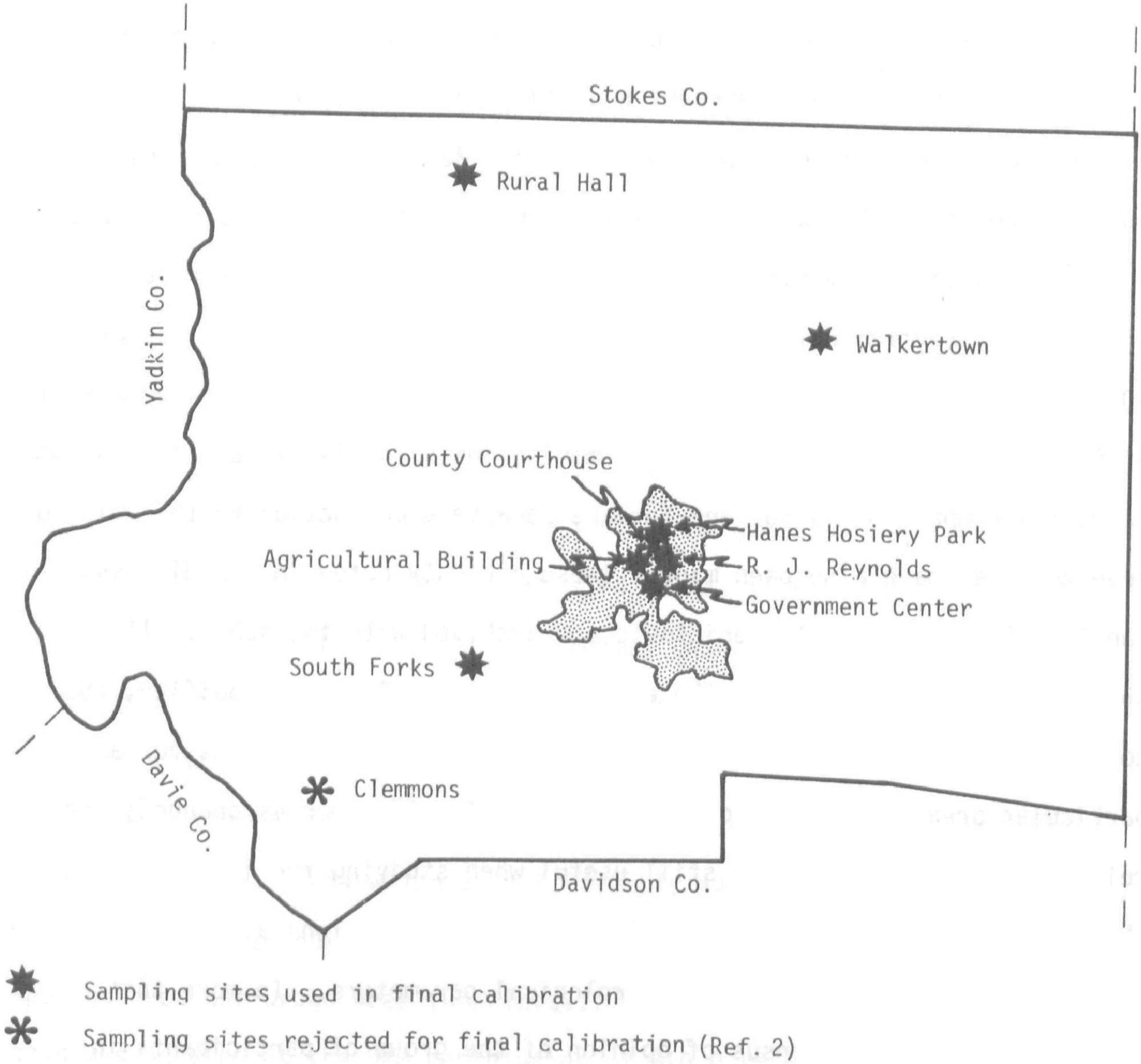

Figure 21. Locations of Sampling Sites in Forsyth County

Forsyth areas, we were having problems in obtaining statistically significant regression parameters and in the case of Mecklenburg County we were looking for "better" regression parameters and studying the contributions of the various source categories. Of the two areas, Mecklenburg County, being smaller geographically and with a smaller number of total sources to model, was selected to systematically study the contributions of the various source categories. Several comparisons of the effect of changing input values to AQDM on calculated concentrations are presented. Where appropriate, a table of AQDM calculated concentrations at monitoring sites is presented. In some cases the comparison is not one-for-one because a correction to the emissions inventory may have also been made — these are duly noted in the discussion. The (single copy) computer printouts are archived with the NCAQS. It should also be noted that as the emissions inventories were modified, the total emissions, and hence the percentage of the total emissions for a particular area source category or a subset of point sources changed; the relative effect, however, is still useful when studying the interrelationships between the source contributions, the concentrations as measured at the monitoring sites, and the meteorological parameters. In more than one case, when the concensus of opinion of the group of participants in the N.C. AQMA study was that certain changes in the input data would produce certain effects, when the changes were incorporated and the AQDM was re-run, the modeling results simply did not follow the predictions.

The objective of reporting these comparisons is twofold; first, that the results presented in Section 2 above are the result of these detailed analyses of the AQMAs, and secondly, that others may benefit from these dispersion modeling efforts.

No attempt is made, nor is it considered pertinent, to present AQDM modeling results in a chronological order. However, the very nature of the calibration process and the one-by-one testing of various hypotheses suggest that a step-by-step (hence chronological) presentation is significant. Subsequent sections discuss the effects of systematically varying these AQDM input values: area source plume heights, size of the area source grid squares, and the magnitude of area source non-exhaust TSP emission factors for the vehicle miles traveled (VMT) on paved and unpaved roads. In addition, the effect of using the Holland Plume Rise Equation rather than the Briggs Plume Rise Equation was tested as was also the use of National Weather Service (NWS) stability wind roses, based on all 365 days in 1973 in contrast to wind data for only those days when sampling was done, i.e. the Lund Wind roses.

In an attempt to gain insight into the contribution of the several source categories (data which is not directly available from the AQDM outputs) RTI modeled Mecklenburg County using a 12 x 12 receptor grid with 1 km spacing over the urban area (Charlotte). The southwest corner of the receptor grid was located at the UTM coordinates of 510.0 km easting and 3893.0 km northing. Twelve (12) additional receptors were specified; some of these receptors, however, were near the geographic limits of the county and were not representative, especially when wind directions were from neighboring counties. (The Mecklenburg emissions inventory does not include area sources outside the county.) It should be noted that the 12 x 12 receptor grid (1 km spacing) was located near the center of the county, and therefore, the (unadjusted) calculated concentrations from the several source category combinations are, in our opinion, more representative at these receptors than at the geographically outlying ones.

The 1973 emissions inventory of point sources was separated into two subsets of data, (13) large point sources (those equal to or greater than 50 tons per year), and (81) other point sources (those less than 50 tons per year). The area source emissions, apportioned to 123 grid squares, were input to AQDM in five combinations: 1) all categories, 2) non-exhaust emissions from unpaved roads only, 3) non-exhaust emissions from paved roads only, 4) road vehicle exhaust emissions only, and 5) other area source categories, i.e., 1-(2+3+4) above. The 1973 Lund Winds, a slope of 1.0 and an intercept of 0.0 were input to AQDM. Table 9 presents the (unadjusted) calculated minimum and maximum concentrations at the grid receptors for the various combinations of source categories. Table 10 contains the observed and (unadjusted) calculated concentrations at the twelve (12) extra receptors for the combinations of sources as described above. As noted above, these AQDM runs were made before the final (corrected) area source emissions inventory had been compiled.

Attempts were made to quantitatively estimate the magnitude of contributions from emissions not included in the inventory available for the areas being modeled. Study of the stability wind roses make it obvious that treating all emissions from neighboring counties as contributing to a constant, county-wide background concentration is not realistic and that actual contributions probably are responsive to wind direction frequencies and the particular sources upwind of each monitoring site. However, 1973 base year emissions data for neighboring counties were not available and the concensus of opinion was that time and manpower required to obtain

Table 9. Comparison of the Ranges of (Unadjusted) Calculated TSP Emissions for Mecklenburg County by Source Category (1973 Annual Arithmetic Average, $\mu g/m^3$)

SOURCE CATEGORY	LOWEST CONCENTRATION ON RECEPTOR GRID	HIGHEST CONCENTRATION ON RECEPTOR GRID
1. Point Sources ≥ 50 tons/yr.	1.34	4.95
2. Point Sources < 50 tons/yr.	0.44	6.21
3. Total Area Sources	13.07	25.97
4. Fugitive Dust from Unpaved Roads Only	5.88	8.50
5. Fugitive Dust from Paved Roads Only	3.69	10.33
6. Road Vehicle Exhaust Only	1.79	5.00
7. Other Area Sources [3-(4+5+6)]	1.42	4.74

Table 10. Comparison of Observed and (Unadjusted) Calculated Concentrations of TSP (by Source Category) for Mecklenburg County (1973 Annual Arithmetic Average) ($\mu g/m^3$)

Receptor	UTM Coordinates Horizontal	UTM Coordinates Vertical	Point Sources ≥50 t/yr Only	Point Sources <50 t/yr Only	Total Area Source	Unpaved Roads Only	Paved Roads Only	Road Vehicle Exhaust Only	Other Area Source	All Categories (Point & Area)	1973 Observed
Fire Station #10	510.6	3897.8	2.12	1.50	21.93	6.49	8.17	3.98	3.28	25.55	71.
Fire Station #11	516.1	3900.7	3.22	1.87	19.82	6.63	6.86	3.33	3.02	24.91	66.
Fire Station #14	518.4	3892.3	1.42	0.60	14.97	5.93	4.90	2.38	1.76	16.99	51.
Charlotte Community Hospital	513.3	3897.8	2.20	1.61	24.97	6.39	9.50	4.62	4.48	28.78	79.
Davidson Filter Plant	514.4	3928.1	2.30	0.30	7.13	4.24	1.42	0.69	0.79	9.73	49.
Davidson Pump Station	509.2	3928.7	2.58	0.25	6.66	4.01	1.34	0.65	0.66	9.49	35.
Mecklenburg County Health Dept.	514.7	3895.0	1.75	0.88	20.01	6.20	7.47	3.62	2.72	22.64	59.
Beatties Ford Water Plant	513.1	3900.8	2.55	1.56	21.12	6.59	7.66	3.72	3.15	25.23	108.
Mint Hill	531.9	3892.5	0.79	0.17	7.09	4.37	1.41	0.69	0.63	8.05	42.
North 29 Patrol Station	522.5	3906.5	1.34	0.40	11.51	5.73	3.00	1.46	1.32	13.25	58.
McAlpine Creek Sewage Plant	511.4	3880.3	1.42	0.38	7.22	3.82	1.77	0.86	0.78	9.02	39.
Carpenter Airport	501.9	3887.3	2.18	0.48	7.58	4.30	1.67	0.82	0.78	10.24	32.

such data was beyond the scope of the N.C.AQMA study. Crude approaches to apportioning total area source and point source emissions in neighboring counties were abandoned because the geographic positioning of the sources of emissions was so sensitive to the wind direction frequencies and the orientation and proximity of receptors to these outlying sources. The projection of any values used for 1973 into future years would also have been a formidable task, again far beyond the manpower and time available.

In reviewing the source contribution tables and investigating the very low concentrations calculated by the AQDM at monitoring sites within Mecklenburg County, but near the county border, it became apparent that any regression analysis using those sampling stations would be biased because emissions from a large wind direction sector are not included in the inventory; in one case (Carpenter Airport, in the southwest corner of Mecklenburg County) the station was downwind to emissions included in the inventory for only approximately 70 degrees of the compass. By a concensus of opinion, three (3) sampling sites — Carpenter Airport, Davidson Filter Plant, and Davidson Pump Station — were removed from further consideration and were not used in any subsequent calibration attempts.

At this time revised area source emissions data for Guilford and Forsyth Counties were received by RTI, and another calibration run was made for those counties. In reviewing the AQDM run outputs, it appeared that the Walkertown monitoring site (rural) was an outlyer in the data array relating observed and calculated air quality. This monitoring station was located interior to a 100 km^2 grid square (#19) containing over 1450 tons/year of (area source) particulate emissions; over 95% of the 1450 tons/year was attributed to fugitive dust from vehicles traveling on unpaved roads. To reduce the effect of treating area sources as virtual point sources by AQDM and to provide more resolution for emissions from unpaved roads, the large (100 km^2) grid square was subdivided into four (4) smaller (25 km^2) grid squares (numbered 19a, 19b, 19c, and 19d)* and the 1450 tons/year of particulate emissions were then reallocated to these smaller grid squares to better represent the infulence on the Walkertown monitoring site. Based on VMT analysis, RTI was instructed to allocate the unpaved road emissions into the four subdivided grid squares (as compared to the large grid square) in the following percentages: NE, 38.6%; SE, 23.2%; SW, 22.0%; and NW, 16.2%. The area source emissions from other source categories were evenly allocated to the four smaller grid squares. The AQDM was again run and the (unadjusted) calculated concentration at Walkertown changed less than 0.1 $\mu g/m^3$, i.e. it rounded to 27 $\mu g/m^3$ for both the large grid square (100 km^2) and the four (4) smaller grid squares (25 km^2) cases. This was the only change made in the total emissions inventory between the two runs.

It had also been suggested during a technical review with EPA and NCAQS personnel that our dispersion modeling problems with fugitive dust from paved and unpaved roads might result from the fact that emission factors in the literature are not representative of N.C. Questions were also raised regarding the filtering effect of vegetation and the appropriateness of a 10-ft. effective plume height for area sources in N.C. (because vehicular activity dominated the area source emissions totals). By modeling only fugitive dust emissions from unpaved roads at more than one effective plume height, and then comparing the results, we could thus evaluate the effect of plume height.

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*Subsequently, from this point in time, all runs for Guilford and Forsyth Counties were made with 253 area source grid squares.

Because we already had on hand the area source emissions, by category, for Mecklenburg County, the "height of plume" runs were made with Mecklenburg emissions from unpaved roads. The AQDM input deck for unpaved road emissions was duplicated three (3) times using 3 meters, 10 meters, and 20 meters effective plume heights. Three (3) AQDM runs were then made using a slope of 1.0, and intercept of 0.0, and an 8 x 8 km receptor grid spanning the entire county. Table 11 presents the resulting concentrations calculated at the locations of each of the monitoring sites; also given in the table are the minimum and maximum values calculated anywhere on the rectangular receptor grid. The changes in effective plume height obviously had very little impact on the calculated concentrations — generally less than 0.1 $\mu g/m^3$.

Before evaluating the effect of possible vegetation filtering, two other questions posed during technical review discussions were resolved: 1) Assuming a correct emissions inventory, might we have erred in selecting the AQDM, as modified to use the Briggs Plume Rise Equation, and therefore be using a model that was under-predicting? (AQDM using the Holland Plume Rise Equation reportedly over-predicts [Ref. 4].) 2) Were the Lund Winds causing a latent problem, that is, how would the use of National Weather Service winds based on all 365 days in 1973 compare with the use of Lund Winds?

The AQDM with the Holland Plume Rise Equation was run with the same emissions inventory and stability wind rose tables as for a previous Briggs Plume Rise Equation run for Mecklenburg County. The calculated concentrations at monitoring stations bear out higher (unadjusted) calculated concentrations using the Holland Plume Rise Equation. The calibration (regression) equation

Table 11. Comparison of Effect of Effective Plume Height Changes on Calculated Concentrations of TSP for Mecklenburg County Using 1973 Unpaved Road Emissions Only ($\mu g/m^3$, Regression Slope 1.0, Intercept 0.0)

RECEPTOR	UTM COORDINATES		EFFECTIVE PLUME HEIGHT (METERS)		
	Horizontal	Vertical	3.0	10.0	20.0
Fire Station #10	510.6	3897.8	6.5	6.5	6.5
Fire Station #11	516.1	3900.7	6.6	6.6	6.6
Fire Station #14	518.4	3892.3	5.9	5.9	5.9
Charlotte Community Hospital	513.3	3897.8	6.4	6.4	6.4
Davidson Filter Plant	514.4	3928.1	4.2	4.2	4.2
Davidson Pump Station	509.2	3928.7	4.0	4.0	4.0
Mecklenburg County Health Dept.	514.7	3895.0	6.2	6.2	6.2
Beatties Ford Water Plant	513.1	3900.8	6.6	6.6	6.6
Mint Hill	531.9	3892.5	4.4	4.4	4.3
North 29 Patrol Station	522.5	3906.5	5.7	5.7	5.7
McAlpine Creek Sewage Plant	511.4	3880.3	3.8	3.8	3.8
Carpenter Airport	501.9	3887.3	4.3	4.3	4.3
Minimum (on Receptor Grid)			1.8	1.8	1.8
Maximum (on Receptor Grid)			7.5	7.4	7.2

using the Holland Plume Rise Equation had a lower slope, a slightly higher intercept, but a slightly smaller correlation coefficient. At the monitoring stations, the comparison between (unadjusted) calculated concentrations, for the two plume rise equations ranged from "no change" to 3 $\mu g/m^3$ higher for the Holland equation. Table 12 is a comparison of the (unadjusted) calculated concentrations at the monitoring stations and the observed concentrations. Table 13 presents a comparison of the (adjusted) calculated concentrations for each receptor on the grid and for twelve (12) extra receptors using, in turn, the Briggs Plume Rise Equation and the Holland Plume Rise Equation versions of the AQDM. The regression equations used (from calibration) were: Briggs, $\hat{\chi} = 1.6126x + 27.5$ (computed regression coefficient = 0.936, 5% confidence level = 0.707); Holland, $\hat{\chi} = 1.4395x + 28.1$ (computed regression coefficient = 0.933, 5% confidence level = 0.707). It should be noted that emissions inventory data were modified subsequent to these comparison runs, therefore, 1973 (adjusted) calculated emissions differ from those in Table 1 in Section 2; not withstanding, the comparison of the results of using the two plume rise equations is considered of enough interest to report.

During early calibration attempts with the Guilford and Forsyth areas, parallel AQDM runs were made where the only difference in the runs was the stability wind rose tables used; one run was made using the 1973 Lund Winds data, and a second run using the 1973 Greensboro-High Point-Winston-Salem Airport stability wind rose data from the National Weather Service (NWS) where all 365 days of 1973 were included. The results of the two runs did not indicate significant differences. This suggests that for 1973 the 61-days on which hi-vol samples were obtained were representative days, from a meteorological standpoint, of the entire year. This may be true for any year. However,

Table 12. Comparison of (Unadjusted) Calculated Concentrations and Observed Concentrations of TSP at Sampling Sites in Mecklenburg County Using AQDM with the Briggs Plume Rise Equation and the Holland Plume Rise Equation (1973 Annual Arithmetic Average Concentration, $\mu g/m^3$)

SAMPLING SITE	UTM COORDINATES HORIZONTAL	UTM COORDINATES VERTICAL	BRIGGS	HOLLAND	OBSERVED
Fire Station #10	510.6	3897.8	26	29	71
Mecklenburg County Health Dept.	514.7	3895.0	23	25	59
Fire Station #11	516.1	3900.7	25	28	66
Fire Station #14	518.4	3892.3	17	19	51
Mint Hill	531.9	3892.5	8	9	42
Charlotte Community Hospital	513.3	3897.8	29	32	79
North 29 Patrol Station	522.5	3906.5	14	14	58
McAlpine Creek Sewage Plant	511.4	3880.3	9	10	39

Table 13. Comparison of Mecklenburg County Receptor Concentration Data for 1973 Using AQDM with Briggs Plume Rise Equation and Holland Plume Rise Equation

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		(ADJUSTED) CALCULATED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	(KILOMETERS) HORIZ	VERT	BRIGGS	HOLLAND
18	498.0	3881.0	37.4	38.6
19	498.0	3885.0	39.8	41.5
20	498.0	3889.0	42.1	45.1
33	502.0	3881.0	39.6	40.5
34	502.0	3885.0	42.9	43.9
35	502.0	3889.0	45.2	47.4
36	502.0	3893.0	48.5	51.3
37	502.0	3897.0	54.2	59.2
38	502.0	3901.0	56.2	60.7
39	502.0	3905.0	55.5	60.4
40	502.0	3909.0	54.4	65.6
49	506.0	3885.0	59.0	58.5
50	506.0	3889.0	49.5	50.7
51	506.0	3893.0	54.3	55.9
52	506.0	3897.0	56.9	58.6
53	506.0	3901.0	61.9	64.4
54	506.0	3905.0	57.9	62.3
55	506.0	3909.0	56.7	64.1
56	506.0	3913.0	54.6	63.8
57	506.0	3917.0	53.5	63.0
58	506.0	3921.0	50.2	55.9
59	506.0	3925.0	46.0	49.3
60	506.0	3929.0	43.4	46.0
61	510.0	3881.0	37.6	38.2

Table 13. (Continued)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		(ADJUSTED) CALCULATED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	(KILOMETERS) HORIZ	VERT	BRIGGS	HOLLAND
64	510.0	3885.0	48.6	49.4
65	510.0	3889.0	53.0	53.1
66	510.0	3893.0	61.8	62.0
67	510.0	3897.0	65.7	65.6
68	510.0	3901.0	65.1	66.5
69	510.0	3905.0	61.0	62.9
70	510.0	3909.0	54.4	56.1
71	510.0	3913.0	54.2	56.8
72	510.0	3917.0	50.3	52.9
73	510.0	3921.0	48.0	50.9
74	510.0	3925.0	46.7	59.2
75	510.0	3929.0	44.1	46.4
77	514.0	3877.0	40.4	40.9
78	514.0	3881.0	43.2	43.6
79	514.0	3885.0	47.2	47.5
80	514.0	3889.0	53.6	53.5
81	514.0	3903.0	61.6	61.3
82	514.0	3897.0	71.3	70.5
83	514.0	3901.0	70.2	70.1
84	514.0	3905.0	63.2	63.1
85	514.0	3909.0	57.7	57.7
86	514.0	3913.0	54.2	54.7
87	514.0	3917.0	49.3	50.0
88	514.0	3921.0	47.6	49.0

Table 13. (Continued)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		(ADJUSTED) CALCULATED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	(KILOMETERS) HORIZ	VERT	BRIGGS	HOLLAND
89	514.0	3925.0	45.9	47.4
90	514.0	3929.0	44.0	45.6
92	518.0	3877.0	40.8	41.2
93	518.0	3881.0	43.3	43.6
94	518.0	3885.0	46.4	46.6
95	518.0	3889.0	51.4	51.3
96	518.0	3893.0	57.4	57.1
97	518.0	3897.0	62.8	61.9
98	518.0	3901.0	63.6	62.4
99	518.0	3905.0	57.8	57.0
100	518.0	3909.0	55.7	55.1
101	518.0	3913.0	51.6	51.5
102	518.0	3917.0	47.9	48.1
103	518.0	3921.0	45.5	46.0
104	518.0	3925.0	44.2	45.0
105	518.0	3929.0	42.4	43.3
107	522.0	3877.0	40.7	41.0
108	522.0	3881.0	43.1	43.2
109	522.0	3885.0	45.7	45.7
110	522.0	3889.0	48.9	48.7
111	522.0	3893.0	53.0	52.6

Table 13. (Continued)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		(ADJUSTED) CALCULATED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	(KILOMETERS) HORIZ	VERT	BRIGGS	HOLLAND
112	522.0	3897.0	54.0	53.4
113	522.0	3901.0	52.4	51.8
114	522.0	3905.0	50.1	49.5
115	522.0	3909.0	48.5	48.2
116	522.0	3913.0	46.7	46.6
117	522.0	3917.0	44.7	44.8
118	522.0	3921.0	42.7	43.0
123	526.0	3881.0	41.8	42.0
124	526.0	3885.0	43.5	43.8
125	526.0	3889.0	45.4	45.4
126	526.0	3893.0	47.0	46.8
127	526.0	3897.0	47.6	47.3
128	526.0	3901.0	46.3	46.0
129	526.0	3905.0	44.8	44.5
130	526.0	3909.0	44.0	43.8
131	526.0	3913.0	43.5	43.4
139	530.0	3885.0	41.1	41.3
140	530.0	3889.0	41.6	41.8
141	530.0	3893.0	42.6	42.7
142	530.0	3897.0	42.6	42.6
143	530.0	3901.0	41.5	41.5

Table 13. (Continued)

RECEPTOR CONCENTRATION DATA				
RECEPTOR NUMBER	RECEPTOR LOCATION		(ADJUSTED) CALCULATED ANNUAL ARITHMETIC MEAN (MICROGRAMS/CU. METER)	
	(KILOMETERS) HORIZ	VERT	BRIGGS	HOLLAND
144	530.0	3905.0	41.1	41.0
155	534.0	3889.0	38.9	39.1
156	534.0	3893.0	39.4	39.6
157	534.0	3897.0	39.2	39.4
158	534.0	3901.0	38.4	38.6
171	538.0	3893.0	37.1	37.4
172	538.0	3897.0	36.9	37.2
181	510.6	3897.8	69.4	69.5
182	516.1	3900.7	68.3	68.5
183	518.4	3892.3	55.4	55.1
184	513.3	3897.8	74.6	74.7
185	514.4	3928.1	44.3	45.8
186	509.2	3928.7	44.2	46.6
187	514.7	3895.0	64.6	64.4
188	513.1	3900.8	69.0	68.8
189	531.9	3892.5	40.8	41.0
190	522.5	3906.5	49.3	48.9
191	511.4	3880.3	42.5	43.0
192	501.9	3887.3	44.6	46.1

because of the reasonableness of the Lund concept of using wind data only for those days on which hi-vol samples were obtained, the NC AQMA study group decided to proceed with the use of the Lund winds for the AQMA analysis.

Another question which arose during a joint technical meeting was whether modeling of the Forsyth and Guilford County areas might be biased against the "down-wind" county considering that emissions were not also included for other neighboring counties. After much discussion, it was decided to separate the emissions inventory into two subsets, one containing only Forsyth County emissions (both point source and area source) and the other containing only those emissions in Guilford County. Likewise, the Forsyth County monitoring stations were paired with the Forsyth County emissions and the Guilford County monitoring stations were paired with the Guilford County emissions. The Greensboro-High Point-Winston-Salem Airport meteorological data (Lund Winds) were used for both counties. Separating the set of sampling sites obviously would cause the required correlation (5% confidence level) to be higher because of the smaller number of sampling sites for each AQDM calibration run. All sampling sites for each county were used — nine (9) in Forsyth County and five (5) in Guilford County. The entire two-county receptor grid was used for both AQDM runs and twelve (12) extra receptors were included; these were located at sampling sites in both counties for each of the AQDM runs. It was reasoned that even though some sampling sites had been tentatively considered as not representative from earlier analyses, we should have AQDM calculate an unadjusted concentration for each, and by using a desk-top programmable calculator, one could evaluate regression equations using any subset of sampling sites.

Neither AQDM run, however, produced an acceptable calibration. The contribution of Guilford County sources in both counties, and likewise, the contribution of Forsyth County sources to receptors in both counties, are presented in Table 14. The concentrations in parentheses are contributions to the other county's receptors (at sampling sites). The calculated values are unadjusted; further, the observed 1973 annual arithmetic average concentrations are presented for comparison.

The dominance of fugitive dust emissions from vehicle activity on unpaved roads in the emissions inventories, and the debate over whether the emission factor used was valid for N.C. roads led to an investigation of reducing these emissions by a constant percentage and using the AQDM to evaluate the impact on calculated concentrations. With the emissions inventories in hand at that time, the unpaved roads emissions represented a much higher contribution to total emissions than most sources and in the cases of Guilford and Forsyth Counties were the primary source category. Table 15 presents the 1973 particulate emissions totals for paved roads, unpaved roads, total area sources, point sources, total for all sources and the percentage of the total emissions contributed by each of these source categories.

It was decided to prepare the AQDM input data for two (2) runs in which point sources emissions would be included but in one run one-half of the emissions from unpaved roads would be removed from each area source grid square and in the second run all of the emissions from unpaved roads would be removed from each area source grid square. To limit computer time, a 3 x 3 receptor grid was used with twelve (12) extra receptors (all located at sampling sites), the AQDM calibrate option was used with the eight (8)

Table 14. Comparison of (Unadjusted) Calculated and Observed Concentrations of TSP from Forsyth County and Guilford County Emission Sources when Modeled Separately with the AQDM (1973 Annual Arithmetic Averages, $\mu g/m^3$)

RECEPTOR	UTM COORDINATES HORIZ	VERT	FORSYTH SOURCES ONLY	GUILFORD SOURCES ONLY	OBSERVED
County Courthouse	568.0	3994.9	29	-	95
Government Center	568.0	3994.8	29	(5)†	84
R. J. Reynolds	568.3	3995.1	34	(5)	91
Agricultural Bldg.*	567.5	3995.1	26	(5)	86
Hanes Hosiery Park*	568.0	3999.2	31	(4)	87
Clemmons	556.0	3986.3	11	-	74
Rural Hall*	563.3	4010.8	17	(3)	49
South Forks*	560.7	3993.1	16	(5)	63
Walkertown*	576.7	4007.7	24	(5)	39
City Garage*	609.7	3989.1	(7)†	39	95
Davie Mebane	609.2	3992.8	(8)	43	100
Swing Road*	598.1	3992.6	(10)	30	53
South Main-West Green	589.6	3979.1	(7)	55	95
National Guard Armory*	587.6	3977.4	(7)	31	65

* Eight (8) sampling sites used in most calibration attempts.

† Parentheses indicate contribution from other county.

Table 15. Comparison of Contribution of Source Categories to Total Emissions (1973 Tons/Year and Percentages)

EMISSIONS SOURCE CATEGORIES	MECKLENBURG	FORSYTH	GUILFORD
Total Emissions (Tons/Yr.)	47670.2	20144.3	32076.8
Point Sources (Tons/Yr.)	35286.0	1746.3	3088.1
Percentage of Total Emissions	74.0	8.7	9.6
Area Sources (Tons/Yr.)	12384.2	18398.0	28988.7
Percentage of Total Emissions	26.0	91.3	90.4
Unpaved Roads (Tons/Yr.)	7116.5	15665.0	24580.8
Percentage of Area Source Emissions	57.5	85.2	84.8
Percentage of Total Emissions	14.9	77.8	76.6
Paved Roads (Tons/Yr.)	2689.5	1439.7	2182.9
Percentage of Area Source Emissions	21.7	7.8	7.5
Percentage of Total Emissions	5.6	7.2	6.8

monitoring stations in Forsyth and Guilford Counties which were being used for calibration attempts.

The Guilford/Forsyth area was selected because of the percentages that unpaved road emissions represented of the total emissions (see Table 15). Table 16 is a comparison of the (unadjusted) calculated and observed concentrations at calibration monitoring stations and the calculated regression parameters for the three (3) runs (the original one plus the two as described above). The range of contributions to the (unadjusted) calculated emissions at the eight (8) monitoring stations, of emissions from unpaved roads is from 32.4% to 72.2%. As would be expected, with the removal of such a significant percentage of the total emissions in the inventory, the regression slope and intercept increased, but so did the correlation, approaching but not reaching the 5% confidence level (see Table 16). For any given monitoring station the effect of removal of 0%, 50%, and 100% of the emissions from unpaved roads is linear although the percentage reduction across the several monitoring stations varied. It was therefore possible to use a programmable desk-top calculator to test the impact of removing any percentage of emissions from unpaved roads and to calculate the resulting slope, intercept, and correlation. Several percentage reductions were tested including 25% and 75% with no success. It was then obvious that pursuing the appropriate unpaved roads emission factor, considering vegetation filtering and N.C. soil types would not, in itself, solve the Guilford and Forsyth calibration problem; hence, that approach was abandoned.

RTI was then requested to test the effect of removing emissions from both paved and unpaved roads for a more "conventional" AQDM run, i.e., is the fugitive dust from roadways amenable to dispersion modeling, specifically with the AQDM. The requested run was made and the resulting

Table 16. Comparison of (Unadjusted) Calculated and Observed Concentrations at Calibration Monitoring Stations in Guilford and Forsyth Counties and Calculated Regression Parameters with: 1) None Removed, 2) One-half Removed, and 3) Total Removal of Fugitive Dust from Unpaved Roads from the Emissions Inventory (1973 Annual Arithmetic Averages, $\mu g/m^3$)

Receptor	UTM Coordinates HORIZ	UTM Coordinates VERT	(AQDM Run 1) Unpaved Roads Emissions Unchanged	(AQDM Run 2) Removal of 1/2 Unpaved Roads Emissions from Each Area Source Grid Square	(AQDM Run 3) Removal of All Unpaved Roads Emissions from Each Area Source Grid Square	Contribution to Total Unadjusted Calculated Concentrations of Unpaved Road Emissions ($\mu g/m^3$)	Contribution to Total Unadjusted Calculated Concentrations of Unpaved Road Emissions (%)	Observed Concentrations
Agricultural Bldg.	567.5	3995.1	29	22	15	14	48.3	96
Hanes Hosiery Park	568.0	3999.2	33	27	20	13	39.4	87
Rural Hall	563.3	4010.8	18	12	5	13	72.2	49
South Forks	560.7	3993.1	19	13	7	12	63.2	63
Walkertown	576.7	4007.7	27	18	9	18	66.7	39
City Garage	609.7	3989.1	43	33	23	20	46.5	95
Swing Road	598.1	3992.6	36	27	16	20	55.6	53
National Guard Armory	587.6	3977.4	34	29	23	11	32.4	65

Regression Parameters:	Slope	Intercept	Correlation	5% Confidence Level
AQDM Run 1	1.2690	29.0	0.534	.707
AQDM Run 2	1.5966	31.1	0.609	.707
AQDM Run 3	1.9453	38.6	0.684	.707

intercept was near 50, the slope near 1.7, and the correlation coefficient was less than the correlation coefficient obtained after the "unpaved roads" only had been eliminated.

The N.C. AQMA study group also considered forcing an intercept for the Guilford/Forsyth area and least squares fitting a slope to the calculated-observed concentration data, however, with a poor correlation, that approach did not appear to have merit. The concensus of the group was that we should not abandon attempts to calibrate the AQDM for the Guilford/Forsyth area as long as a valid alternative remained. In reviewing, during a joint technical meeting, all calibration attempts to date, the discussion again centered on the dispersion modeling efforts producing apparently adequate, or even high, calculated concentrations in the non-urban areas and significantly low concentrations in the urban areas. The source of, and confidence in, the emissions factor for paved road emissions was discussed and especially its validity for N.C. The group whose task it was to update and project the area source emissions (Ref. 1) and the NCAQS personnel studied further the emission factor used. The paved road emission factor originally used was determined to be too low and RTI was provided modified area source emissions reflecting the changes for Guilford, Forsyth, and Mecklenburg Counties. Using these modified area source emissions, the AQDM calibrated successfully for both the Mecklenburg and Guilford/Forsyth modeling areas.

3.1 Charlotte (Mecklenburg County) AQMA, Final Calibration

The final Mecklenburg AQDM calibration run calculated a regression equation with a slope of 0.8194, an intercept of 31.6, a computed correlation of 0.928 and a 5% confidence correlation of 0.707. Table 17

Table 17. Final AQDM Calibration Run Results for Mecklenburg County (1973 Annual Arithmetic Averages, $\mu g/m^3$)

TSP Sampling Site	SAROAD* NO.	Location (KILOMETERS) HORIZ	VERT	TSP Concentration (MICROGRAMS/CU. METER) OBSERVED	CALCULATED (Unadjusted)	CALCULATED (Adjusted)
Fire Station 10	34-0700-010	510.6	3897.8	71	46	70
Mecklenburg County Health Department	34-0700-011	514.7	3895.0	59	42	66
Fire Station 11	34-0700-003	516.1	3900.7	66	42	66
Fire Station 14	34-0700-004	518.4	3892.3	51	30	56
Mint Hill	34-2580-001	531.9	3892.5	42	12	41
Charlotte Community Hospital	34-0700-002	513.3	3897.8	79	53	75
North 29 Patrol Station	34-0700-008	522.5	3906.5	58	21	49
McAlpine Sewage Plant	34-0700-014	511.4	3880.3	39	14	43

*Storage and Retrieval of Aerometric Data (SAROAD)

is a presentation of the TSP sampling site receptors, their locations and SAROAD* number, and the observed, (unadjusted) calculated, and (adjusted) calculated concentrations. Figure 22 is a graph of the AQDM (unadjusted) calculated concentrations (X axis), observed concentrations (Y axis), and the least squares best fit regression line (equation).

3.2 Greensboro and Winston-Salem (Guilford County and Forsyth County) AQMAs, Final Calibration

The final Guilford/Forsyth AQDM calibration run calculated a regression equation with a slope of 0.8204, an intercept of 23.1, a computed correlation of 0.705 and a 5% confidence correlation of 0.632. Table 18 is a presentation of the TSP sampling site receptors, their locations and SAROAD* number, and the observed, (unadjusted) calculated, and (adjusted) calculated concentrations. Figure 23 is a graph of the AQDM (unadjusted) calculated concentrations (X axis), observed concentrations (Y axis), and the least squares best fit regression line (equation).

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*Storage and Retrieval of Aerometric Data (SAROAD)

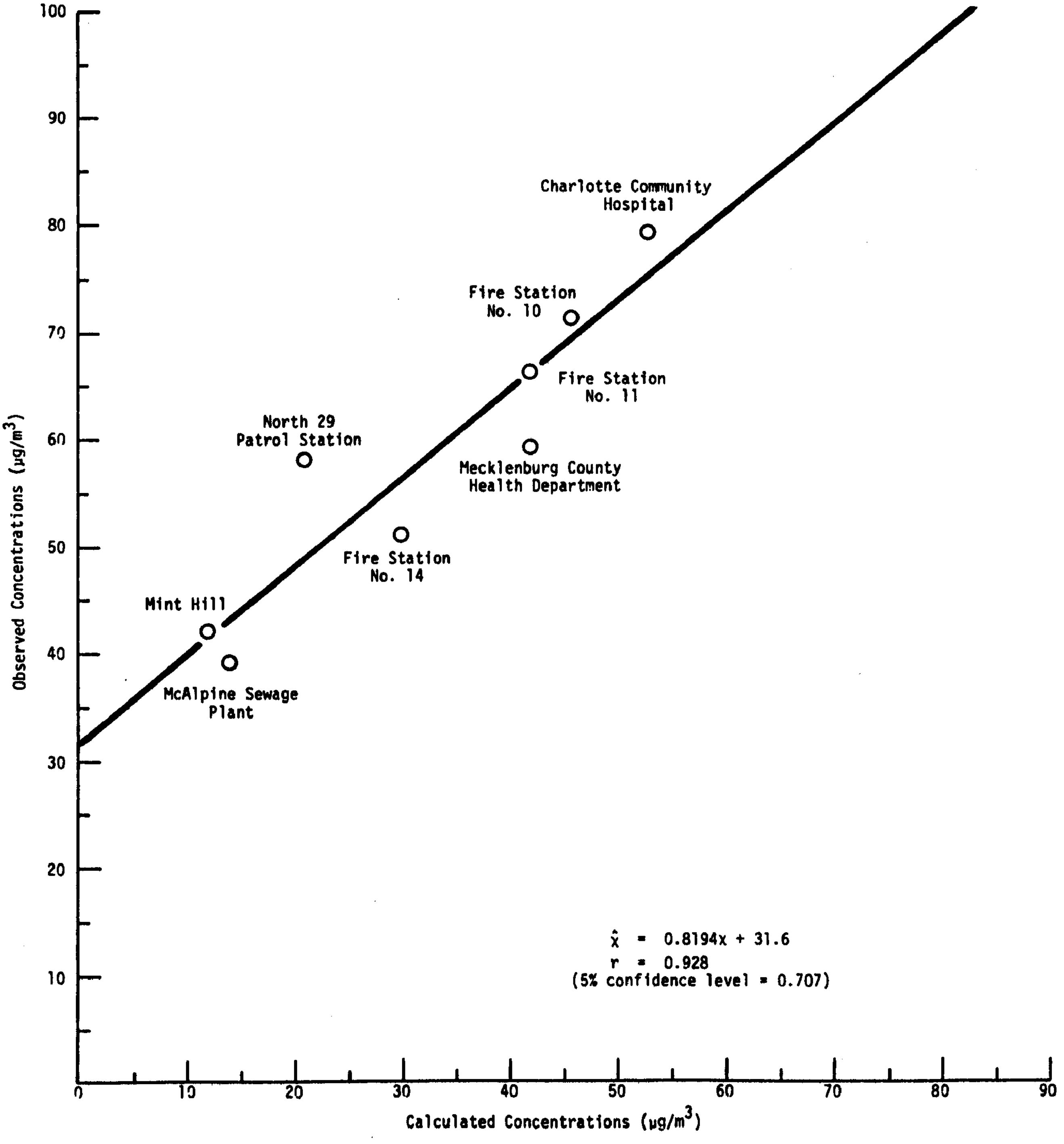

Figure 22. Mecklenburg Final Calibration, Total Suspended Particles 1973 Annual Arithmetic Average

Table 18. Final AQDM Calibration Run Results for Guilford and Forsyth Counties (1973 Annual Arithmetic Averages, $\mu g/m^3$)

TSP Sampling Site	SAROAD* NO.	Location (KILOMETERS)		TSP Concentration (MICROGRAMS/CU. METER)		
		HORIZ	VERT	OBSERVED	CALCULATED (Unadjusted)	CALCULATED (Adjusted)
Government Center	34-4460-008	568.0	3994.8	84	66	77
Agricultural Building	34-4460-002	567.5	3995.1	86	59	71
Hanes Hosiery Park	34-4460-009	568.0	3999.2	87	61	73
R. J. Reynolds	34-4460-003	568.3	3995.1	91	73	83
Rural Hall	34-1480-002	563.3	4010.8	49	30	48
South Forks	34-4460-005	560.7	3993.1	63	35	52
Walkertown	34-1480-001	576.7	4007.7	39	48	62
City Garage	34-1740-002	609.7	3989.1	95	87	95
Swing Road	34-1780-010	598.1	3992.6	53	64	75
National Guard Armory	34-2000-003	587.6	3977.4	65	63	75

*Storage and Retrieval of Aerometric Data (SAROAD)

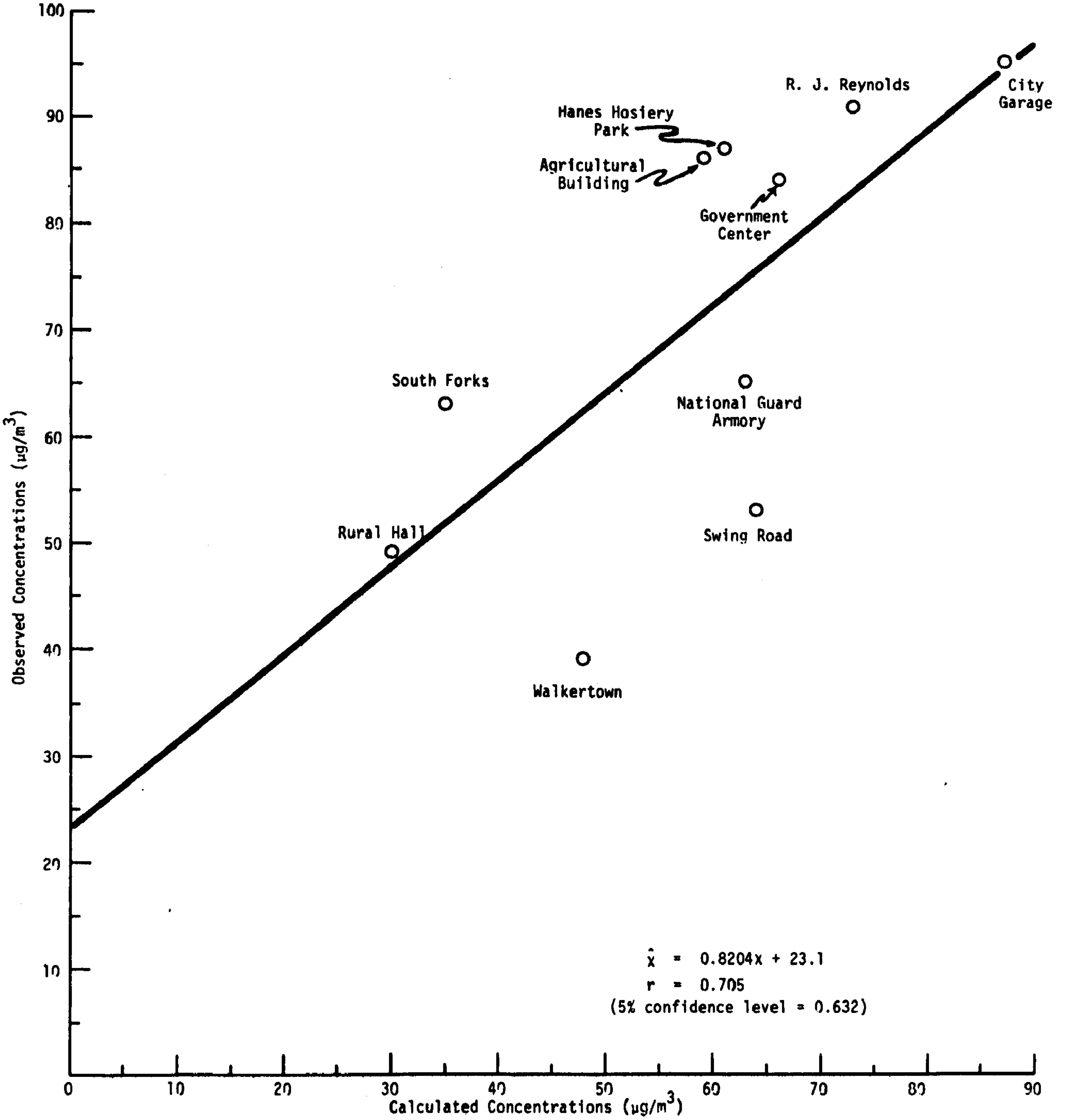

Figure 23. Guilford/Forsyth Final Calibration, Total Suspended Particles
1973 Annual Arithmetic Average

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4. Title and Subtitle North Carolina Air Quality Maintenance Area Analysis, Volume III: TSP Dispersion Modeling and Analysis for Charlotte, Winston-Salem, and Greensboro AQMA's for 1973, 1975, 1980, 1985			5. Report Date April 1976
			6.
7. Author(s) Richard C. Haws and Harry L. Hamilton, Jr.			8. Performing Organization Rept. No. 41U-946-15
9. Performing Organization Name and Address Research Triangle Institute Research Triangle Park, N.C. 27709			10. Project/Task/Work Unit No. 15
			11. Contract/Grant No. 68-02-1386
12. Sponsoring Organization Name and Address Air & Hazardous Materials Div., EPA, Region IV, 1421 Peachtree St., N.E. Atlanta, GA 30309 AND Air Quality Section, Division of Environmental Management, N.C. Department of Natural and Economic Resources, P. O. Box 27687, Raleigh, N.C. 27611			13. Type of Report & Period Covered
			14.

15. Supplementary Notes

16. Abstracts This report gives the results of a study designed to advance air quality maintenance planning for North Carolina on the basis of area and point source emission inventories supplied respectively by Engineering-Science, Inc. and the N. C. Air Quality Section. The study involved calibration of the Air Quality Display Model to detect data errors and to test hypotheses on emissions and their air quality impact. Final dispersion model calibration results and both graphical and tabular comparisons of calculated and observed TSP concentrations are presented. Mecklenburg County was modeled separately; Guilford and Forsyth Counties were modeled together. A unique feature of this study stems from the fact that North Carolina was one of the first to include non-exhaust particulate emissions from roadway vehicles in total large area dispersion modeling; because these emissions represented such a significant part of total emissions a great amount of time and effort was expended to find the best way to deal with them.

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

Air Pollution
Statistical Inference
Suspended Particulates

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 85
Unlimited release	20. Security Class (This Page) UNCLASSIFIED	22. Price