MID-CONNECTICUT–LOWER PIONEER VALLEY AREA AIR POLLUTANT EMISSION INVENTORY

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MID CONNECTICUT-LOWER PIONEER VALLEY AIR POLLUTANT EMISSION INVENTORY

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4. Travelers Research Corporation

PREFACE

This report, which presents the emission inventory for the Mid Connecticut-Lower Pioneer Valley Area, is another in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and status of their control. The pollutants which include sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.[1] These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

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INTRODUCTION

This report is a summary of the Mid-Connecticut Lower Pioneer Valley inventory conducted in September 1968. Since all inventories are based upon a calendar year, the data and emissions estimates presented are representative of 1967 and should be considered as an indicator of the conditions that existed during that year.

The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of 103 cities and towns in portions of Connecticut and Massachusetts. This area covers approximately 2,700 square miles and had a 1967 population of 2,293,000.

A grid coordinate system was used to show the geographical distribution of emissions within the area. The Study Area was subdivided into 101 grid zones ranging in size from 25 square kilometers in the heavily populated and industrialized areas to 100 square kilometers in the less populated areas.

All sources of emissions were classified into four categories--transportation, stationary fuel combustion, solid-waste disposal, and industrial processes. Each of these source categories was divided into two subgroups--point sources and area sources. Facilities which emit large quantities of air pollutants were considered individually as point sources, while the many remaining contributors such as motor vehicles, residential and commercial fuel users, small industries and on-site refuse burning equipment, were considered collectively as area sources. For this report, eighty-seven individual sources, which are the largest single sources of air pollutant emissions, were classified as point sources.

Emissions were estimated by using various indicators such as fuel consumption, refuse burning rates, vehicle-miles, production data, and control efficiencies and emission factors relating these indicators to emission rates.[2] These factors represent average emission rates for a particular source category. Since individual sources have inherent differences that cannot always be taken into consideration, descrepancies

between actual and estimated emissions are more likely in individual sources than in the total emissions for a source category.

As in all emission surveys, the data presented are estimates and should not be interpreted as absolute values. The estimates are, in some cases, partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, these estimates are of sufficient accuracy and validity in defining the extent and distribution of air pollutant emissions in the Study Area.

SUMMARY OF RESULTS

The estimated emissions in 1967 of the five surveyed pollutants in the Mid Connecticut-Lower Pioneer Valley area were:

Sulfur Oxides	353,000 tons
Particulate Matter	55,000 tons
Carbon Monoxide	845,000 tons
Hydrocarbons	124,000 tons
Oxides of Nitrogen	136,000 tons

All of the major sources of emissions are included in these totals with the exception of organic solvent evaporation. Motor vehicles and the combustion of heavy fossil fuels are the primary contributing sources of these pollutants. Motor vehicles contribute a significant portion of the emissions of carbon monoxide, hydrocarbons, and nitrogen oxides while the combustion of heavy fossil fuels contribute most of the sulfur oxides, particulate matter, and oxides of nitrogen emissions.

The breakdown of pollutant emissions by source category is listed in Table 1. Tables 2 and 3 present the emissions attributable to the Connecticut and Massachusetts portions of the Study Area, respectively. The following is a brief summary of pollutant emissions and sources in the Study Area:

Sulfur Oxides: The combustion of fossil fuels in stationary sources contributes more than 98 percent of the 353,000 tons of sulfur oxides emitted annually in the Study Area. The combustion of coal and residual fuel oil for heat and power account for 45 percent and 48 percent, respectively, of sulfur oxides emissions. Steam-electric utilities contribute 61 percent of the total. Transportation, solid waste disposal, and industrial process sources account for only 2 percent of sulfur oxides emissions. About 80 percent of total emissions emanate from the Connecticut portion of the Study Area.

Particulate Matter: As is the case for sulfur oxides emissions, the combustion of fuels in stationary sources contributes the largest percentage of the 55,000 tons of particulate matter emitted annually. The combustion of fuels accounts for 60 percent of total particulate emissions. Transportation sources account for 14 percent, solid waste disposal 17 percent, and industrial process losses 9 percent of total particulate matter emissions. About 67 percent of the total emissions come from the Connecticut portion of the Study Area.

Carbon Monoxide: Motor vehicles, the predominant source of carbon monoxide, contribute 93 percent of the total of 845,000 tons of carbon monoxide emitted annually in the Study Area. Other transportation sources account for an additional 1 percent, fuel combustion in stationary sources 1 percent, solid waste disposal 4 percent, and industrial processes 1 percent of total carbon monoxide emissions. Almost 83 percent of the total is emitted in the Connecticut portion of the Study Area.

Hydrocarbons: Motor vehicles contribute about 85 percent of the total of 124,000 tons of hydrocarbons emitted annually (with the exclusion of hydrocarbons from organic solvent evaporation). Industrial processes are the next largest source category, contributing 10 percent of total hydrocarbons. Other transportation sources contribute 1 percent, fuel combustion in stationary sources 3 percent, and solid waste disposal 1 percent.

Oxides of Nitrogen: The two largest sources of the 136,000 tons of nitrogen oxides emitted are motor vehicles and fuel combustion in stationary sources. They contribute 36 percent and 61 percent, respectively, of the total emissions. Other transportation sources account for 1 percent and solid waste disposal accounts for the remaining 2 percent of nitrogen oxides emissions.

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE MID-CONNECTICUT LOWER PIONEER VALLEY STUDY AREA, 1967 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Motor Vehicles					
Exhaust	2,950	3,930	782,000	59,500	41,800
Evaporation	--	--	--	41,300	--
Diesel Vehicles	1,180	3,260	1,780	4,020	6,570
Aircraft	--	420	6,920	1,860	650
Subtotal	4,130	7,610	790,700	106,680	48,920
Stationary Fuel Combustion					
Industry	75,200	9,310	610	450	16,700
Steam-Electric	214,400	14,000	820	890	50,900
Residential	20,800	5,570	4,670	1,680	5,580
Other	36,900	4,010	1,680	540	10,400
Subtotal	347,300	32,890	7,780	3,560	83,580
Solid Waste Disposal					
Incineration	560	4,930	12,300	220	710
Open Burning	--	4,410	22,300	1,240	2,490
Subtotal	560	9,340	34,600	1,460	3,200
Process Losses	1,500	5,300	12,300	12,100	--
GRAND TOTAL	353,000	55,000	845,000	124,000	136,000

N = Negligible

TABLE 1A SUMMARY OF AIR POLLUTANT EMISSIONS IN THE MID-CONNECTICUT LOWER PIONEER VALLEY STUDY AREA, 1967

(10^3 Kg/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	2,680	3,570	709,430	53,980	37,920
Evaporation	--	--	--	37,470	--
Diesel Vehicles	1,070	2,960	1,610	3,650	5,960
Aircraft	N	380	6,280	1,690	590
Subtotal	3,750	6,910	717,320	96,790	44,470
Stationary Fuel Combustion					
Industrial	68,220	8,450	550	410	15,150
Steam-Electric	194,500	12,700	740	810	46,180
Residential	18,870	5,050	4,240	1,520	5,060
Commercial-Institutional	33,480	3,640	1,520	490	9,430
Subtotal	315,070	29,840	7,050	3,230	75,820
Solid Waste Disposal					
Incineration	510	4,470	11,160	200	640
Open Burning	N	4,000	20,230	1,120	2,260
Subtotal	510	8,470	31,390	1,320	2,900
Process Losses	1,360	4,810	11,160	10,980	N
GRAND TOTAL	321,000	50,000	767,000	112,000	123,000

N = Negligible

TABLE 2 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE CONNECTICUT PORTION OF THE STUDY AREA, 1967 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Gasoline					
Exhaust	2,360	3,140	656,250	49,460	33,400
Evaporation	--	--	--	33,000	--
Diesel	690	1,900	1,040	2,350	3,840
Aircraft	--	340	3,070	600	360
Subtotal	3,050	5,380	660,360	85,410	37,600
Stationary Fuel Combustion					
Industry	59,600	7,110	380	320	12,770
Steam-Electric	171,300	5,330	550	770	39,500
Residential	16,300	4,070	3,270	1,250	4,080
Other	28,900	2,970	1,220	410	7,960
Subtotal	276,100	19,480	5,420	2,750	64,310
Solid Waste Disposal					
Incineration	430	4,090	7,510	140	510
Open Burning	--	3,260	16,200	880	1,700
Subtotal	430	7,350	23,710	1,020	2,210
Process Losses	1,500	4,690	5,900	12,100	40
GRAND TOTAL	281,000	36,900	695,400	101,300	104,200

TABLE 3 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE LOWER PIONEER VALLEY PORTION OF THE STUDY AREA, 1967 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Gasoline					
Exhaust	590	790	125,800	10,000	8,400
Evaporation	--	--	--	8,300	--
Diesel	490	1,360	740	1,670	2,730
Aircraft	--	80	3,850	1,260	290
Subtotal	1,080	2,230	130,390	21,230	11,420
Stationary Fuel Combustion					
Industry	15,600	2,200	230	130	3,900
Steam-Electric	43,100	8,640	270	120	11,400
Residential	4,500	1,500	1,400	430	1,500
Other	8,000	1,040	460	130	2,500
Subtotal	71,200	13,380	2,360	810	19,300
Solid Waste Disposal					
Incineration	130	840	4,790	80	200
Open Burning	--	1,150	6,120	360	790
Subtotal	130	1,990	10,910	440	990
Process Losses	N	640	6,400	N	N
GRAND TOTAL	72,000	18,000	150,000	22,000	32,000

N = Negligible

STUDY AREA

The Study Area for the Mid Connecticut-Lower Pioneer Valley Air Pollutant Emission Inventory consists of 103 cities and towns in the states of Connecticut and Massachusetts. This area includes the entire central portion of Connecticut and the Lower Pioneer Valley in Massachusetts. Figure 1 shows the Study Area in relation to the surrounding states in the Northeast.

The Connecticut portion of the Study Area consists of 82 cities and towns, extending from the northern border of the state to Long Island Sound on the south. Figure 2 shows the location of these cities and towns along with the 21 cities and towns in the Lower Pioneer Valley. The Study Area occupies a total of 2653 square miles and contains an estimated 1967 population of 2,293,000.[3] The Connecticut portion accounts for 80 percent and 77 percent of the total land area and population, respectively, in the Study Area (see Table 2).

This area contains six Standard Metropolitan Statistical Areas (SMSA) as defined by the Bureau of Budget. These are the Hartford, New Haven, New Britain, Meridan, Waterbury, and Springfield-Chicopee-Holyoke SMSA's. Collectively, these SMSA's contain 84 percent of the population in the Study Area. The location of the various SMSA's are shown on Figure 3. By definition, most of the SMSA's contain the more populated areas of the states. Figure 4 shows the continuous or near-continuous broad belt of urbanization from north of Springfield to Hartford and south to include Waterbury, New Britain, Meridan, and New Haven.

TOPOGRAPHY AND CLIMATE

The Study Area lies in the south portion of the upland region of New England. Its surface is generally that of a greatly undulating upland divided by the lowland of the Connecticut River Valley. Adjacent to the Connecticut River, the land is lower and level or rolling. However, there are ridges of traprock which rise several hundred feet above the valley floor. The range of hills forming the boundaries of the valley rise 400 to 600 feet above the valley floor.

The Study Area is frequented by extensive winter storm activity and a day-to-day variability of local weather. During the winter, northerly winds are predominant, while southerly winds predominate during the summer. Surface-level winds in the Connecticut Valley are markedly from a northerly or southerly direction and are infrequently from the east or west.

The average annual temperature is about 50 degrees. Annual degree days vary from about 5800 in the coastal areas to 7200 in the hilly portions in the northwestern portion of the Study Area.[4]

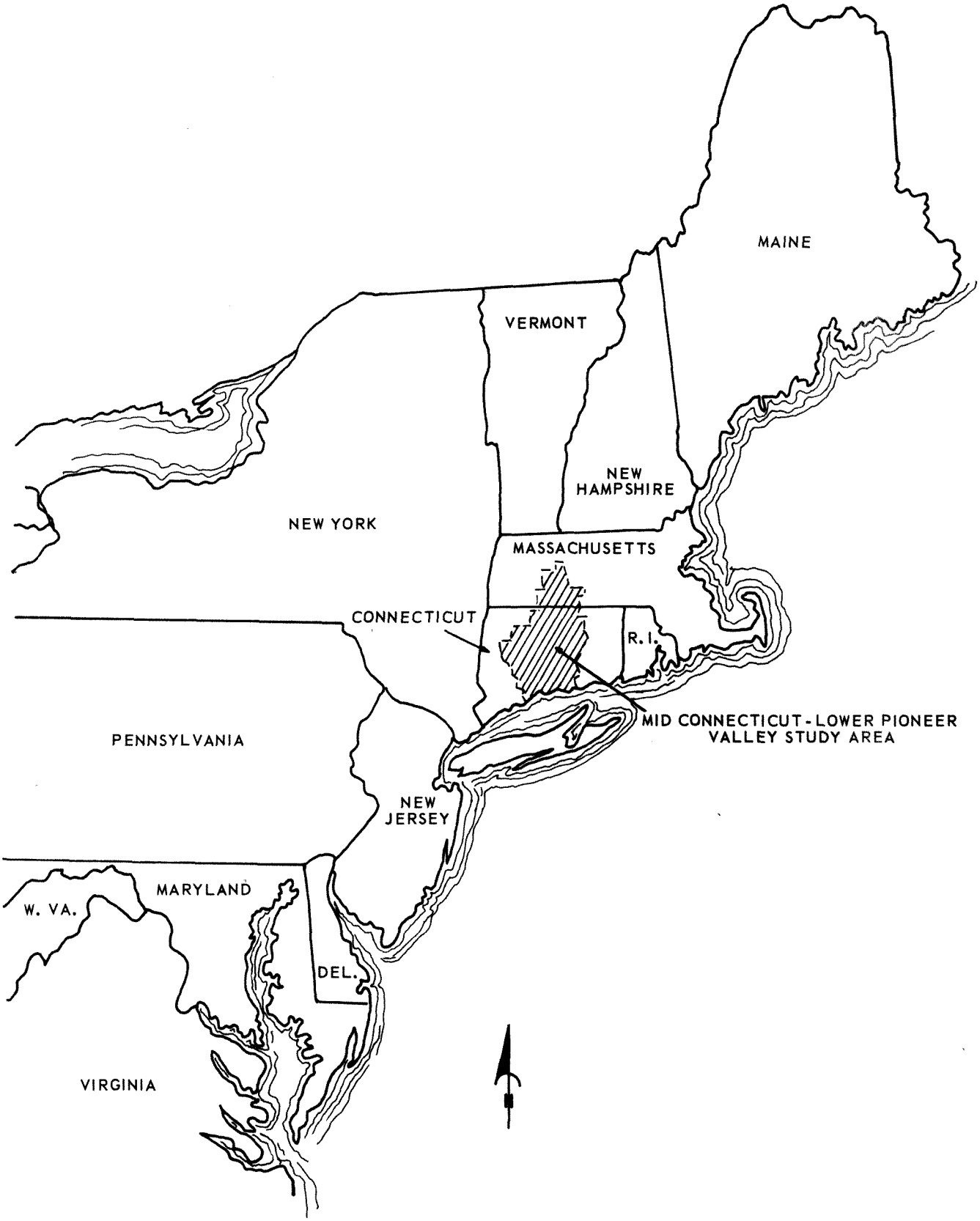

Figure 1. Location of the Mid Connecticut-Lower Pioneer Valley study area with respect to surrounding states.

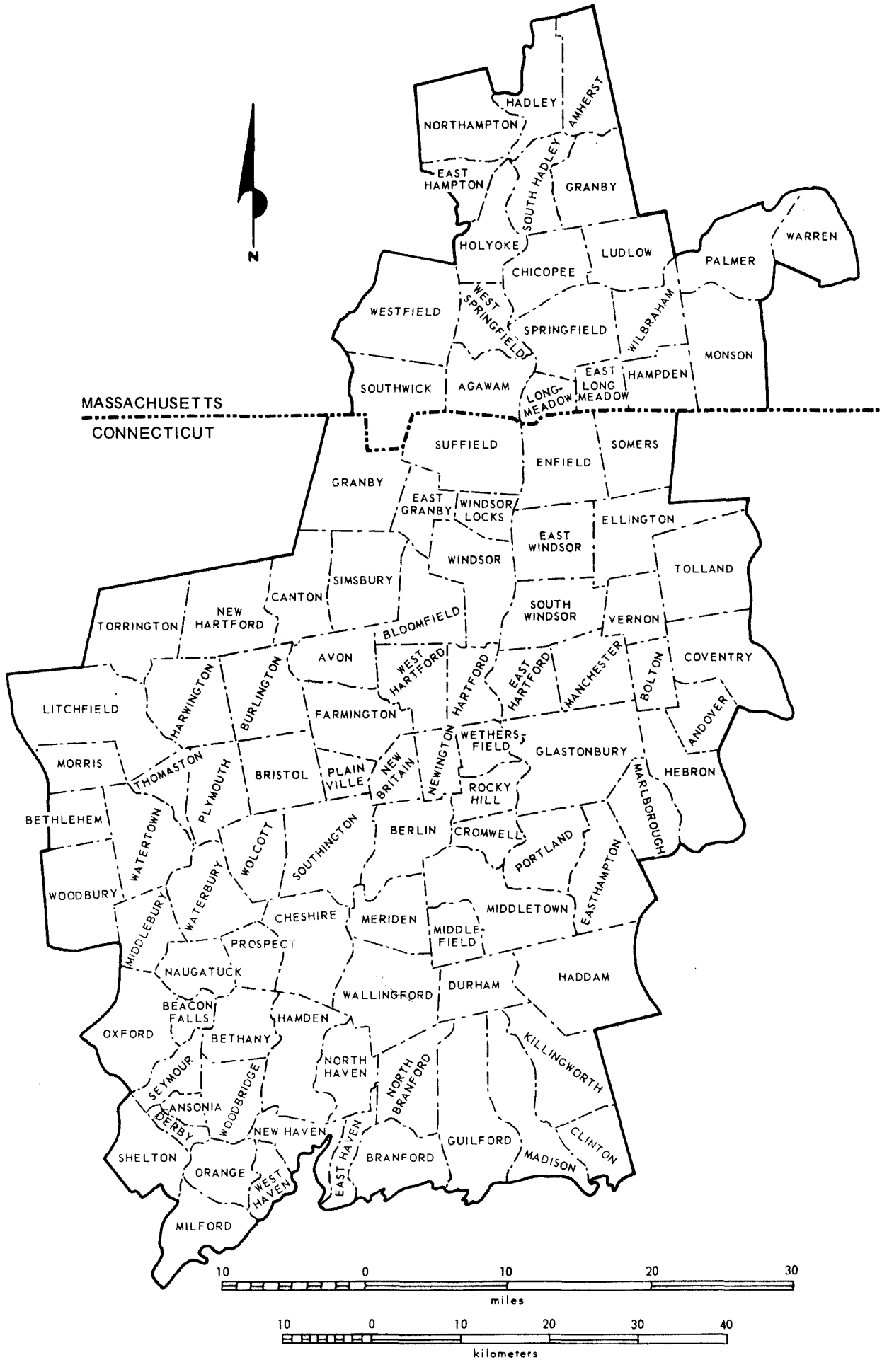

Figure 2. Detailed map of the Mid Connecticut-Lower Pioneer Valley study area.

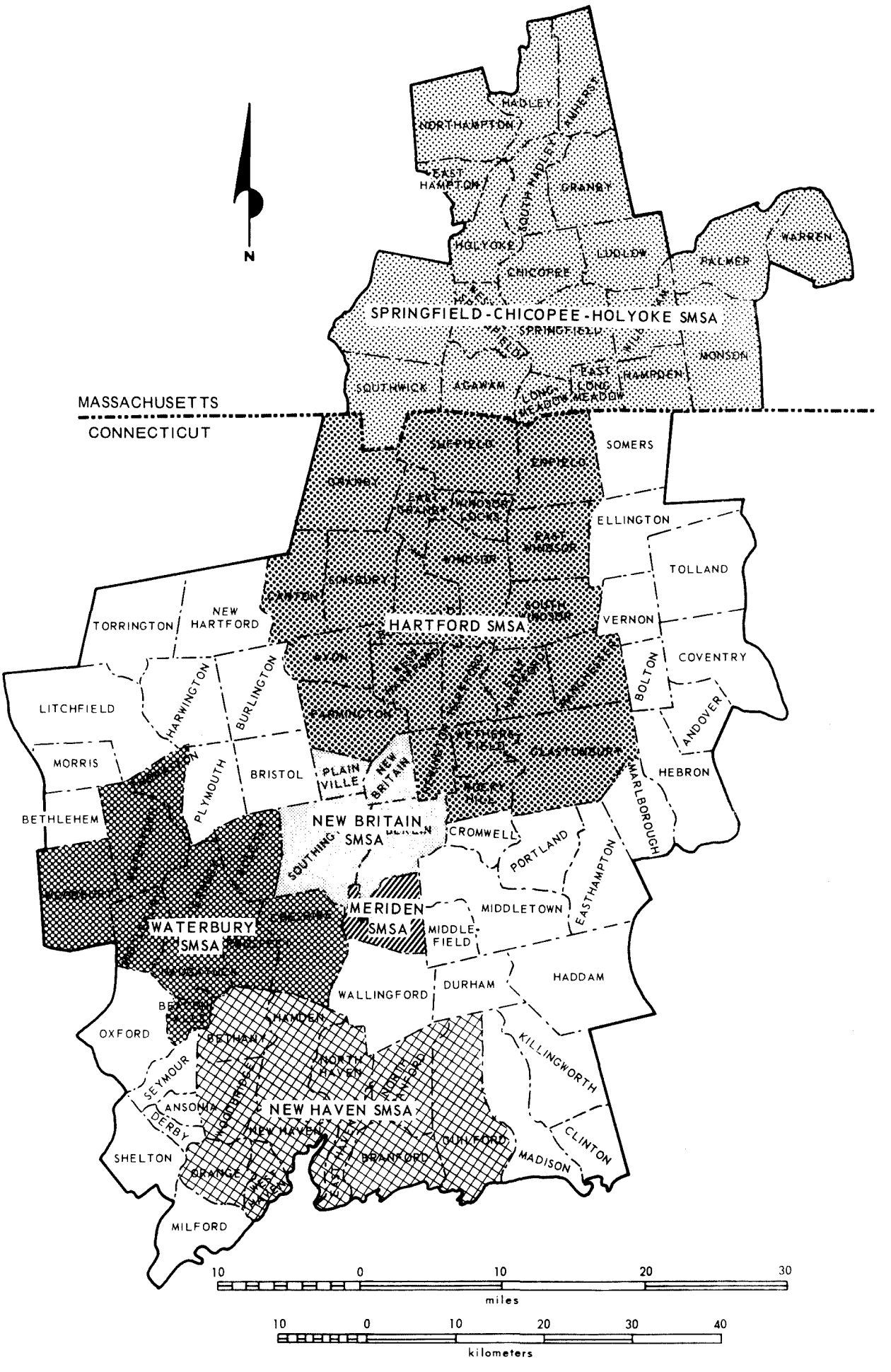

Figure 3. Standard Metropolitan Statistical Areas in the study area.

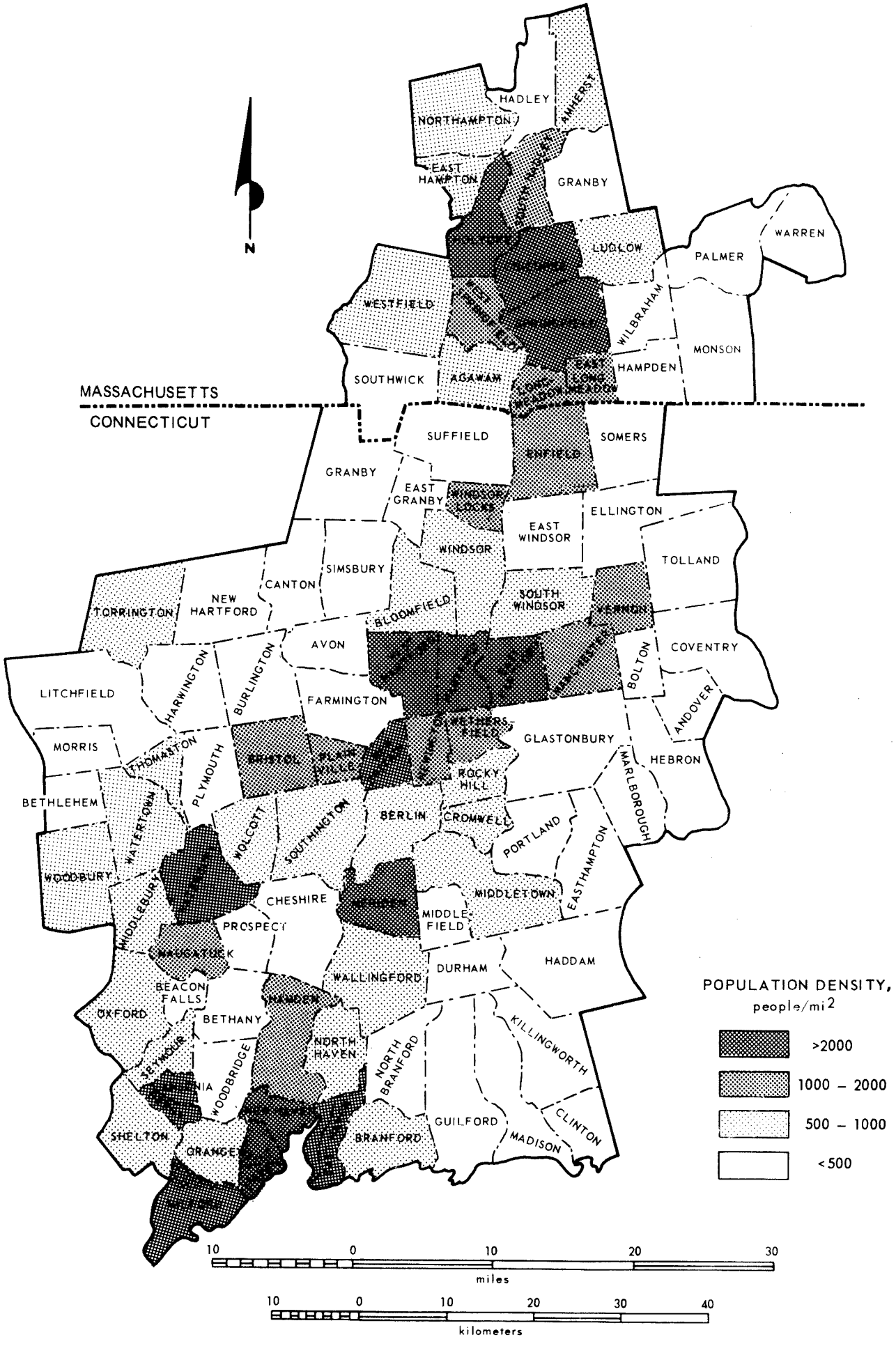

Figure 4. Population density by town, 1967.

TABLE 4 POPULATION AND LAND AREA CHARACTERISTICS

Area	Land Area (Sq. Mi.)	Population 1960	1967	% Increase
Massachusetts Portion				
Lower Pioneer Valley	534	494,000	533,700	8.0
Connecticut Portion				
Hartford SMSA	672	549,300	636,400	15.9
New Haven SMSA	245	320,800	360,700	12.4
New Britain SMSA	87	129,400	143,300	10.7
Meriden SMSA	24	51,900	56,100	8.1
Waterburn SMSA	217	185,500	201,100	8.4
Other Connecticut	874	--	361,400	--
Total Connecticut Portion	2,119	--	1,759,000	--
TOTAL AREA	2,653		2,293,000	--

GRID COORDINATE SYSTEM

A grid coordinate system based on the Universal Transverse Mercator Projection (UTM) was used in the Mid-Connecticut-Lower Pioneer Valley Study Area to show the geographical distribution of emissions. A map of this grid system is presented in Figure 5.

The UTM system was chosen due to its advantages over other standard grid systems such as the Latitude-Longitude and State Plane Coordinate Systems. The major advantages of this system are that (1) it is continuous across the country and is not hindered by political subdivisions, (2) the grids are of uniform size throughout the country, (3) it has world-wide use, and (4) the grids are square in shape--a necessary feature for use in meteorological dispersion models.

The Universal Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid line, as illustrated in Figure 5, is identified by a coordinate number expressed in meters. Each point source and grid is identified by the horizontal and vertical coordinates of their geographical center to the nearest 100 meters.

As shown in Figure 5, the Study Area was divided into 101 grids of two different sizes--25 and 100 square kilometers. Grid zones of different sizes are used to limit the number of grid zones and yet allow a satisfactory definition of the geographical gradation of emissions. The majority of the emissions is usually concentrated in the populated and industrialized portions of a Study Area. Smaller grids are placed over these areas in order to reflect abrupt changes in emissions within short distances. The use of grid zones smaller than 25 square kilometers is not warranted because of the inherent inaccuracies in the data. Since only a small percentage of the total emissions occur in rural areas, larger grid zones are normally used to show the distribution of emissions in these lightly populated portions of a Study Area.

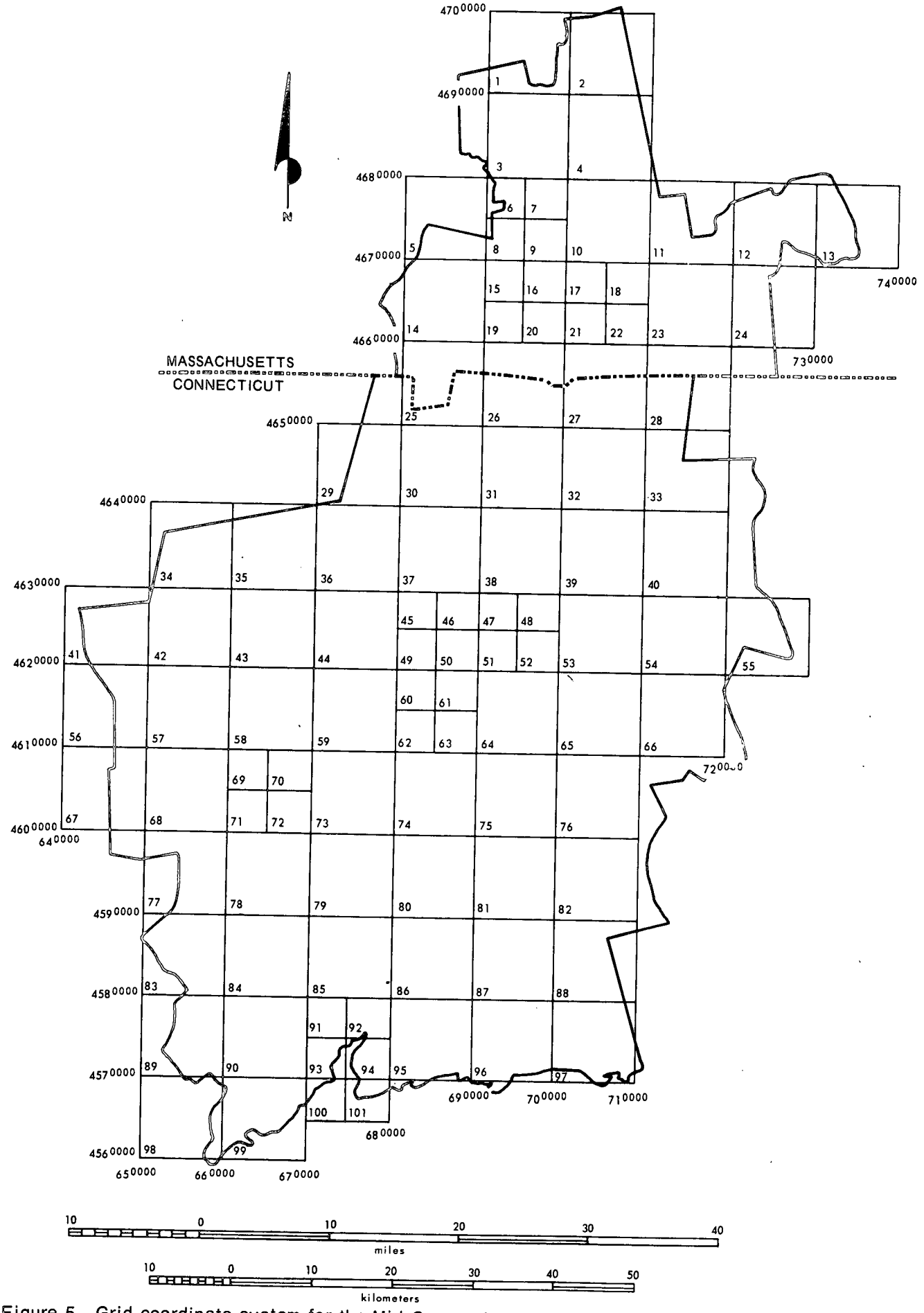

Figure 5. Grid coordinate system for the Mid Connecticut-Lower Pioneer Valley study area.

EMISSIONS BY SOURCE CATEGORY

For the purposes of compiling the basic data and emission estimates the sources of air pollutants were classified into the following four categories:

1. Transportation
2. Fuel combustion in stationary sources
3. Solid wastes disposal
4. Industrial process losses

Each of these categories are considered individually in this section. The data sources and necessary assumptions are presented with further breakdowns of emissions. Some of the estimates presented here are area-wide totals. The section on emissions by jurisdiction summarizes the emissions by source for each SMSA in the Study Area.

The estimates presented herein, especially in the industrial process loss category, are for the most part partial totals. The lack of emission factors and appropriate process and control data prevents a complete inventory of all sources and emissions. However, the major sources have been included and the sources not considered should be negligible. The results should be viewed with these limitations.

TRANSPORTATION

Two types of transportation sources are considered in this survey--motor vehicles and aircraft. Motor vehicles, which are by far the most significant source of air pollution in this category are further subdivided according to type of fuel used--gasoline and diesel.

Motor Vehicles

More than 10.2 billion miles were traveled by motor vehicles in the Study Area during 1967. In the process, 804 million gallons of gasoline and 54 million gallons of diesel fuel were consumed for

highway purposes. Table 3 indicates that most of the motor fuel was consumed in the Springfield-Chicopee-Holyoke, Hartford, and New Haven SMSA's.

Approximately 1.5 to 2.0 percent of gasoline is lost through evaporation from the gasoline tanks and carburetor, resulting in annual losses of about 12 million gallons. It was assumed that no diesel fuel was lost by evaporation. Since 1963, most new vehicles were equipped with positive crankcase ventilation(PCV) valves that reduce hydrocarbon emissions from the crankcase by about 90 percent. Due to a lag time in the automobile replacement rate, it was assumed that 20 percent of the automobiles were not equipped with PCV valves.

METHODOLOGY: The gallonages of motor fuel for the Connecticut portion of the Study Area were obtained from state totals. The total quantities of gasoline and diesel fuel consumed for highway purposes were apportioned to the cities and towns on the basis of vehicle registrations.[6] The gallonages were then converted to vehicle-miles of travel and apportioned onto the grids by population. For the Lower Pioneer Valley area, vehicle miles by city and town were available for 1965.[7] These mileages were updated to 1967 by assuming the same rate of increase in motor fuel consumption.[5] Appropiate speeds were assigned to each grid depending on the type of area and emissions were calculated on the basis of speed and vehicle miles.

RESULTS: The resulting air pollutant emissions from motor vehicles are shown in Table 7 along with emissions from aircraft. Motor vehicles are by far the most significant transportation source in the Study Area. Motor vehicles annually account for 4130 tons of sulfur oxides, 7190 tons of particulate matter, 784,000 tons of carbon monoxide, 105,000 tons of hydrocarbons, and 48,400 tons of oxides of nitrogen. Emissions from diesel powered vehicles are only significant for particulate matter, contributing 45 percent of the motor vehicle total.

TABLE 5 MOTOR VEHICLES FUEL CONSUMPTION AND REGISTRATIONS, 1967

SMSA	Gasoline (10^6 Gallons)	Diesel Fuel (10^6 Gallons)	Automobile Registrations	Trucks & Buses Registrations
Springfield-Chicopie Holyoke	168.5	18.2	218,000	26,800
Hartford	228.0	7.5	286,300	23,800
Meriden	17.9	0.7	22,500	2,100
New Britain	45.1	3.2	56,600	10,200
New Haven	150.4	8.7	188,800	28,000
Waterbury	63.5	4.6	79,700	14,700
Other	130.4	11.4	163,800	36,500
TOTAL	803.8	54.3	1,015,700	142,100

TABLE 6 VEHICLE-MILES OF TRAVEL IN THE STUDY AREA, 1967

(Vehicle-Miles/Day)

Area	Gasoline Vehicle Miles	Diesel Vehicle Miles	Total
Lower Pioneer Valley	5,420,100	121,900	5,542,000
Hartford SMSA	7,488,500	168,500	7,657,000
Meriden SMSA	652,300	14,700	667,000
New Britain SMSA	1,521,800	34,200	1,556,000
New Haven SMSA	5,268,500	118,500	5,387,000
Waterbury SMSA	2,277,800	51,200	2,329,000
Other Connecticut	4,222,000	95,000	4,317,000
TOTAL	26,851,000	604,000	27,455,000

TABLE 7 AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES, 1967

(Tons/Year)

SMSA	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Springfield-Chicopee Holyoke					
Motor Vehicles	1,080	2,150	126,500	20,000	11,100
Aircraft	N	80	3,850	1,260	290
Subtotal	1,080	2,230	130,400	21,200	11,400
Hartford					
Motor Vehicles	1,060	1,750	228,700	29,500	12,900
Aircraft	N	340	3,070	600	360
Subtotal	1,060	2,090	231,700	30,100	13,300
Meriden					
Motor Vehicles	90	170	19,900	2,570	1,130
Aircraft	N	N	N	N	N
Subtotal	90	170	19,900	2,570	1,130
New Britain					
Motor Vehicles	220	350	46,500	6,000	2,630
Aircraft	N	N	N	N	N
Subtotal	220	350	46,500	6,000	2,630
New Haven					
Motor Vehicles	750	1,240	160,900	20,800	9,100
Aircraft	N	N	N	N	N
Subtotal	750	1,240	160,900	20,800	9,100
Waterbury					
Motor Vehicles	320	530	69,500	8,970	3,940
Aircraft	N	N	N	N	N
Subtotal	320	530	69,500	8,970	3,940
Other					
Motor Vehicles	610	1,010	131,900	17,000	7,470
Aircraft	N	N	N	N	N
Subtotal	610	1,010	131,900	17,000	7,470
GRAND TOTAL					
Motor Vehicles	4,130	7,200	783,900	104,840	48,370
Aircraft	N	420	6,920	1,860	650
Subtotal	4,130	7,620	791,000*	107,000*	49,000*

* = Rounded

TABLE 8 AIR TRAFFIC ACTIVITY FOR THE CALENDAR YEAR, 1967

(Flights/Year)

Airport	Type of Flight	Number of Flights* Itinerant	Local
Windsor Locks (Connecticut)	Air Carrier	28,140	--
	General Aviation	25,218	20,176
	Military	3,540	4,725
	Subtotal	56,898	24,901
Westfield (Massachusetts)	Air carrier	346	--
	General Aviation	20,890	12,355
	Military	3,608	247
	Subtotal	24,844	12,602
TOTAL FOR STUDY AREA		81,742	37,503

*One flight equals a take-off and a landing.

TABLE 9 AIR POLLUTANT EMISSIONS FROM AIRCRAFT IN THE STUDY AREA, 1967

(Tons/Year)

Airport	Type of Flight	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Westfield (Mass.)	Air Carrier	N	6	6	2	4
	General Aviation and Military					
	Itinerant	N	7	263	48	23
	Local	N	8	1,689	315	79
	Subtotal	N	21	1,958	365	106
Windsor Locks (Conn.)	Air Carrier	N	288	301	85	198
	General Aviation and Military					
	Itinerant	N	38	56	13	34
	Local	N	16	2,708	506	130
	Subtotal	N	342	3,065	604	362
Westover Air Force Base		N	56	1,886	888	179
GRAND TOTAL*		N	420	6,910	1,860	650

* - Rounded

FUEL COMBUSTION IN STATIONARY SOURCES

All three of the major fuels (coal, fuel oil, and natural gas) are consumed in the Study Area. Fuel oil, the largest energy source produces 215 x 10^{12} BTU's of energy annually, while coal and natural gas produce 99 x 10^{12} BTU's and 44 x 10^{12} BTU's respectively. Tables 10, 11, 12, and 12A give fuel consumption by user category for each of the fuels (coal, natural gas, distillate oil and residual oil).

The largest consumer of residual fuel oil is steam-electric power generation. The several power plants in the Study Area use nearly 300 million gallons per year. The majority of distillate oil used is consumed for residential heating (560 million gallons per year). Coal is consumed primarily by steam-electric power plants (over 3 million tons annually). Natural gas is consumed primarily for residential heating and process use.

METHODOLOGY: Fuel consumption for residential and commercial-institutional users was obtained by multiplying the ratio of Study Area population to state population times state fuel consumption totals. Residential consumption was separated from the totals by calculating fuel use from the number of housing units in each town. The housing units were updated from the 1960 Census of Housing by 1967 estimates of population. These numbers are, therefore, approximations. Steam-electric power plants fuel consumptions were obtained from Steam-Electric Plant Factors.[8] Industry fuel use was obtained for Connecticut from the Traveler's Research Center, Incorporated report.[9] The local Lower Pioneer Valley Air Pollution Control District in Massachusetts supplied information on industrial fuel users in their area.

RESULTS: Table 14 summarizes emissions from the combustion of fuels in stationary sources. As the table shows, fuel oils produce approximately 190,000 tons of sulfur oxides (55% of the total from stationary fuel combustion sources). The majority of the emissions of the other four pollutants is the result of coal combustion.

TABLE 10 COAL CONSUMPTION BY USER CATEGORY FOR THE STUDY AREA, 1967

(Tons/Year)

Area	Steam-Electric Utilities	Industrial	Commercial-Institutional	Residential
Lower Pioneer Valley	1,081,000	100,000	20,000	52,400
Hartford SMSA	22,000	5,000	18,000	23,300
Meriden SMSA	--	800	--	3,210
New Britain SMSA	--	1,700	500	22,500
New Haven SMSA	--	2,000	14,000	17,700
Waterbury SMSA	--	64,000	7,500	8,860
Other Connecticut	2,269,000	2,700	16,000	36,500
TOTAL*	3,372,000	176,200	76,000	164,500

* - Rounded to nearest hundred.

TABLE 11 NATURAL GAS CONSUMPTION BY USER CATEGORY FOR THE STUDY AREA, 1967 (10^6 Cubic Feet/Year)

Area	Steam-Electric Utilities	Industrial	Commercial-Institutional	Residential
Lower Pioneer Valley	515	2,290	3,200	7,160
Hartford SMSA	--	1,940	4,340	5,930
Meriden SMSA	--	500	177	580
New Britain SMSA	--	1,410	567	1,870
New Haven SMSA	--	1,610	1,230	3,320
Waterbury SMSA	--	1,640	505	2,280
Other Connecticut	--	1,440	130	1,680
TOTAL*	500	10,800	10,200	22,800

* = Rounded to nearest hundred.

TABLE 12 DISTILLATE FUEL OIL CONSUMPTION BY USER CATEGORY FOR THE STUDY AREA, 1967 (Thousands of Gallons/Year)

Area	Steam-Electric Utilities	Industrial	Commercial-Institutional	Residential
Lower Pioneer Valley	--	13,900	30,000	108,400
Hartford SMSA	96	3,500	25,000	155,600
Meriden SMSA	--	400	2,500	14,180
New Britain	--	800	6,300	29,420
New Haven SMSA	--	1,500	15,500	87,190
Waterbury SMSA	--	1,300	8,700	44,560
Other Connecticut	1,420	3,700	18,000	121,000
TOTAL*	1,500	25,100	106,000	560,000

* - Rounded to the nearest hundred.

TABLE 12A RESIDUAL OIL CONSUMPTION BY USER CATEGORY FOR THE STUDY AREA, 1967 (Thousands of Gallons/Year)

Area	Steam-Electric Utilities	Industrial	Commercial-Institutional	Residential
Lower Pioneer Valley	9,780	60,000	36,000	--
Hartford SMSA	75,800	90,000	43,500	--
Meriden SMSA	--	12,000	4,200	--
New Britain SMSA	--	25,000	10,600	--
New Haven SMSA	54,100	65,000	26,800	--
Waterbury SMSA	--	41,000	14,800	--
Other Connecticut	133,500	55,000	30,500	--
TOTAL*	273,200	348,000	166,400	--

* - Rounded to the nearest hundred.

TABLE 13 AVERAGE CHEMICAL ANALYSIS OF FUELS CONSUMED IN THE STUDY AREA*

Fuel	Percent Sulfur	Percent Ash
Coal	2.4	8.0
Residual Fuel Oil	2.2	N
Distillate Fuel Oil	0.6	N
Natural Gas	0.008	N

* - Individual data were obtained for power plant fuels.

TABLE 14 AIR POLLUTANT EMISSIONS FROM THE COMBUSTION OF FUELS IN STATIONARY SOURCES, 1967 (Tons/Year)

User Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Coal					
Industrial	5,600	5,100	260	90	1,800
Steam-Electric	146,000	12,400	820	330	32,600
Commercial-Institutional	2,000	1,210	1,420	280	260
Residential	5,100	3,100	4,100	830	660
Subtotal	158,700	21,810	6,600	1,530	35,320
Residual Oil					
Industrial	68,200	3,900	330	340	12,700
Steam-Electric	68,400	1,750	10	560	18,100
Commercial-Institutional	31,800	1,910	160	160	5,900
Subtotal	168,400	7,560	500	1,060	36,700
Distillate Oil					
Industrial	1,400	200	20	20	1,000
Steam-Electric	N	10	N	N	70
Commercial-Institutional	3,100	800	100	100	3,700
Residential	15,700	2,200	560	850	3,360
Subtotal	20,200	3,210	680	970	8,130
Natural Gas					
Industrial	N	100	N	N	1,100
Steam-Electric	N	10	N	N	200
Commercial-Institutional	N	90	N	N	540
Residential	10	270	10	N	1,560
Subtotal	10	470	10	N	3,400
GRAND TOTAL*	347,300	33,000	7,800	3,600	83,600

* - Rounded to the nearest hundred.

SOLID WASTE DISPOSAL

METHODOLOGY: The total solid waste generation for the Connecticut portion of the Study Area was arrived at by combining the 4.5 lbs/day-capita rate with information of individual towns available from the State of Connecticut solid waste program. In Massachusetts total generation was arrived at using the same per capita rate as Connecticut and apportioning this total by method of disposal (municipal incineration, open burning, etc.). A solid waste balance for the Study Area is given in Table 15.

RESULTS: Table 16 summarizes emissions from solid waste disposal. Solid waste disposal accounts for approximately 17% of the total particulate emissions in the Study Area. Emissions of the other four pollutants from this source are small compared to other sources and the total for the Study Area.

INDUSTRIAL PROCESSES

The major cause of industrial pollution in the Study Area is from fuel combustion rather than process losses. This is especially true in the Connecticut portion.

In Massachusetts, process sources include: foundry operations, tire manufacturing, brass and bronze smelting, asphalt batching and concrete batching.

The Connecticut portion includes many metal fabricating operations and other similar operations which do not involve large process losses.

Emissions from process losses are given in Table 1, 2, and 3.

TABLE 15 SOLID WASTE BALANCE FOR THE STUDY AREA, 1967 (Tons/Year)

Area	Total Refuse Generated	Incineration		Landfills	Open Burning	
		Municipal	On-Site		Dumps	On-Site
Lower Pioneer Valley	460,400	18,000	160,700	137,700	16,500	127,500
Hartford SMSA	684,050	182,500	59,610	154,940	243,370*	43,630
Meriden SMSA	46,070	--	N	46,070	--	N
New Britain SMSA	387,530	32,000	N	223,060	109,780*	22,690
Waterbury SMSA	1,575,550	36,000	N	1,458,440	76,860*	4,250
New Haven SMSA	348,650	102,500	23,990	184,220	29,940*	8,000
Other Connecticut	449,990	22,500	N	346,230	57,100*	24,160
TOTAL	3,952,240	393,500	244,300	2,550,660	610,330*	230,230

* - O.F.D. - Open Face Dump where only a portion of the refuse is burned.

TABLE 16 AIR POLLUTANT EMISSIONS FROM SOLID WASTE DISPOSAL, 1967

(Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Incineration					
Municipal	390	3,340	200	60	390
On-Site	170	1,590	12,100	160	320
Subtotal	560	4,930	12,300	220	710
Open Burning					
Dumps	N	2,570	12,520	660	1,220
On-Site	N	1,840	9,780	580	1,270
Subtotal	N	4,410	22,300	1,240	2,490
GRAND TOTAL	560	9,340	34,600	1,460	3,200

EMISSIONS BY JURISDICTION

Tables 17 through 22 present air pollutant emissions by Standard Metropolitan Statistical Area. The previous sections of this report presented emissions primarily by source category. Note that numbers in these tables are rounded.

TABLE 17 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE WATERBURY SMSA
1967 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	250	330	69,400	5,230	3,530
Evaporation	--	--	--	3,490	--
Diesel Vehicles	70	200	110	250	410
Aircraft	--	--	--	--	--
Subtotal	320	530	69,510	8,970	3,940
Stationary Fuel Combustion					
Industry	10,050	3,760	130	70	2,380
Steam-Electric	--	--	--	--	--
Residential	1,510	370	270	110	440
Commercial-Institutional	3,430	410	210	60	900
Subtotal	14,990	4,540	610	240	3,720
Solid Waste Disposal					
Incineration	30	290	20	10	40
Open Burning	--	330	1,660	90	200
Subtotal	30	620	1,680	100	240
Industrial Process	1,260	940	1,880	3,180	20
GRAND TOTAL	16,600	6,600	73,700	12,500	7,900

TABLE 18 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE NEW HAVEN SMSA 1967 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	580	770	160,600	12,100	8,170
Evaporation	--	--	--	8,080	--
Diesel Vehicles	170	470	260	580	940
Aircraft	--	--	--	--	--
Subtotal	750	1,240	160,900	20,800	9,100
Stationary Fuel Combustion					
Industry	12,740	890	70	60	2,680
Steam-Electric	10,780	270	1	90	2,820
Residential	2,970	710	530	220	790
Commercial-Institutional	5,630	710	390	110	1,630
Solid Waste Disposal					
Incineration	130	1,160	910	30	180
Open Burning	--	240	1,080	90	100
Subtotal	130	1,400	1,990	120	280
Industrial Process	130	480	630	3,910	N
GRAND TOTAL	33,100	5,700	164,500	25,300	17,300

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE NEW BRITAIN SMSA, 1967 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	170	220	46,400	3,500	2,360
Evaporation	--	--	--	2,330	--
Diesel Vehicles	50	130	70	170	270
Aircraft	--	--	--	--	--
Subtotal	220	350	46,470	6,000	2,630
Stationary Fuel Combustion					
Industry	5,100	400	30	30	1,100
Steam-Electric	--	--	--	--	--
Residential	1,500	560	590	160	380
Commercial-Institutional	2,340	190	30	20	640
Subtotal	8,940	1,150	650	210	2,120
Solid Waste Disposal					
Incineration	30	270	20	10	30
Open Burning	--	1,080	5,340	300	620
Subtotal	30	1,350	5,360	310	650
Industrial Process	--	610	750	340	--
GRAND TOTAL	9,200	3,500	53,200	6,900	5,400

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE MERIDEN SMSA
1967 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	70	100	19,900	1,500	1,010
Evaporation	--	--	--	1,000	--
Diesel Vehicles	20	70	30	70	120
Aircraft	--	--	--	--	--
Subtotal	90	170	19,930	2,570	1,130
Stationary Fuel Combustion					
Industry	2,440	190	10	10	510
Steam-Electric	--	--	--	--	--
Residential	490	120	100	40	130
Commercial-Institutional	920	70	10	10	250
Subtotal	3,850	380	120	60	890
Solid Waste Disposal					
Incineration	N	N	N	N	N
Open Burning	N	N	N	N	N
Subtotal	N	N	N	N	N
Industrial Process	N	N	N	N	N
GRAND TOTAL	3,900	600	20,000	2,600	2,000

TABLE 21 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE HARTFORD SMSA
1967 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	820	1,090	228,300	17,200	11,600
Evaporation	--	--	--	11,500	--
Diesel Vehicles	240	660	360	820	1,340
Aircraft	N	340	3,070	600	360
Subtotal	1,060	2,090	231,730	30,120	13,300
Stationary Fuel Combustion					
Industry	18,190	1,130	100	90	3,620
Steam-Electric	16,480	690	10	120	4,180
Residential	5,040	1,120	740	350	1,370
Commercial-Institutional	9,980	1,090	520	160	2,780
Subtotal	49,690	4,030	1,370	720	12,000
Solid Waste Disposal					
Incineration	190	2,040	6,540	90	220
Open Burning	N	1,260	6,580	330	660
Subtotal	190	3,300	13,120	420	880
Industrial Process	N	680	2,600	1,510	20
GRAND TOTAL	50,900	10,100	248,800	32,800	26,200

TABLE 22 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE REMAINDER OF THE CONNECTICUT STUDY AREA, 1967 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Gasoline Vehicles					
Exhaust	470	630	131,700	9,920	6,700
Evaporation	--	--	--	6,620	--
Diesel Vehicles	140	380	210	470	770
Aircraft	--	--	--	--	--
Subtotal	610	1,010	131,910	17,010	7,470
Stationary Fuel Combustion					
Industry	11,090	740	40	60	2,480
Steam-Electric	147,300	4,370	540	550	32,500
Residential	4,780	1,190	1,030	360	970
Commercial-Institutional	6,610	500	60	50	1,760
Subtotal	169,780	6,800	1,670	1,020	37,710
Solid Waste Disposal					
Incineration	40	320	20	10	40
Open Burning	--	350	1,500	70	120
Subtotal	40	670	1,520	80	160
Industrial Process	120	1,990	50	3,200	--
GRAND TOTAL	170,600	10,500	135,200	21,300	45,300

EMISSIONS BY GRID

For the purpose of defining the geographical variation of air pollutant emissions in the Study Area, the resulting emissions were apportioned onto the grid system. The emissions were divided into two source groups--point and area sources. The 87 point sources were identified individually with respect to location and emissions.

Figure 6 shows the location of most of the point sources in the area. Collectively, these sources account for 79 percent of the sulfur oxides (279,000 tons/year), 57 percent of the particulates (31,000 tons/year), 2 percent of the carbon monoxide (15,000 tons/year), 13 percent of the hydrocarbons (16,000 tons/year), and 48 percent of the nitrogen oxides (65,000 tons/year) emitted in the area.

Area sources are air pollutant sources that are insignificant by themselves, but as a group emit significant amounts of pollutant. Examples are motor vehicles, residential heating plants, light commercial and industrial establishments and backyard burning.

The emissions are presented for an annual average day, an average winter day (December, January, and February) and an average summer day (June, July, and August). The annual average daily emissions were arrived at by dividing yearly totals by 365. Seasonal variations were calculated by the use of space heating variations in fuel consumption and variations in motor vehicle traffic activity. This method is described in the appendix. Other sources are assumed to be constant throughout the year.

Tables 23 and 24 present point source emissions. Tables 26 and 27 present air pollutant emissions by grid for all sources (area and point sources).

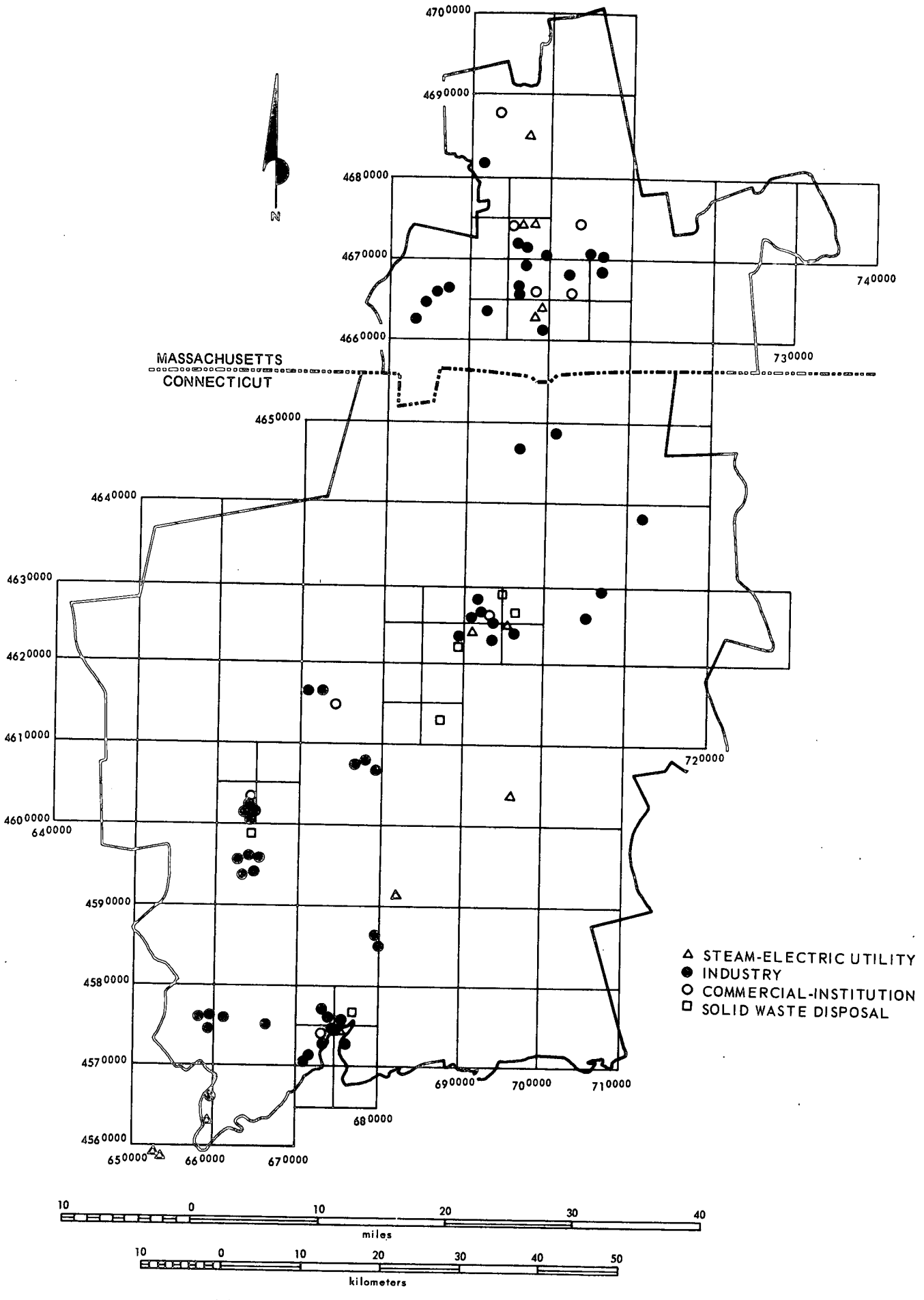

Figure 6. Point source locations in the study area.

TABLE 23 EMISSIONS FROM POINT SOURCES IN THE CONNECTICUT PORTION OF THE STUDY AREA, 1967

(Tons/Day)

Source	H.C.	V.C.	SO_x			PART.			CO			HC			NO_x	
			S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Industrial	7008	46485	1.22	1.95	1.72	0.07	0.11	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.22	0.35	0.31
Industrial	7122	46380	0.00	2.18	1.19	0.00	0.13	0.07	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.40	0.22
Commercial	6928	46257	1.87	2.46	2.26	0.11	0.14	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.34	0.45	0.41
Industrial	6943	46250	0.85	1.18	1.07	0.05	0.07	0.06	0.00	0.01	0.01	0.00	0.01	0.01	0.15	0.21	0.19
Industrial	6913	46255	0.25	2.15	1.24	0.01	0.13	0.07	0.00	0.01	0.01	0.00	0.01	0.01	0.05	0.40	0.23
Industrial	6924	46270	0.96	1.20	1.07	0.06	0.07	0.06	0.00	0.01	0.01	0.00	0.01	0.01	0.18	0.22	0.20
Industrial	6896	46234	0.91	2.52	1.79	0.05	0.15	0.10	0.00	0.01	0.01	0.00	0.01	0.01	0.17	0.46	0.32
Industrial	6958	46242	9.67	17.95	14.02	0.66	1.14	0.91	0.05	0.09	0.07	1.05	1.09	1.07	1.77	3.29	2.57
Industrial	7070	46299	1.43	1.98	1.79	0.08	0.11	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.26	0.36	0.32
Industrial	7050	46260	0.92	1.64	1.37	0.05	0.09	0.08	0.00	0.01	0.01	0.00	0.01	0.01	0.17	0.30	0.25
Commercial	6733	46150	0.23	3.42	2.32	0.02	0.23	0.15	0.00	0.02	0.01	0.00	0.02	0.01	0.05	0.70	0.48
Industrial	6715	46170	0.60	1.09	0.93	0.09	0.11	0.10	0.00	0.01	0.00	2.30	2.31	2.30	0.11	0.20	0.17
Industrial	6703	46168	1.95	3.52	3.00	0.13	0.23	0.20	0.01	0.02	0.02	0.01	0.02	0.02	0.44	0.79	0.67
Industrial	6630	46019	3.17	5.41	4.64	0.22	0.33	0.28	0.02	0.03	0.02	0.02	0.03	0.02	0.77	1.13	0.97
Industrial	6634	46010	2.65	3.10	2.94	0.15	0.18	0.17	0.01	0.02	0.01	0.01	0.02	0.01	0.48	0.56	0.53
Industrial	6642	46020	1.61	1.88	1.79	0.09	0.11	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.29	0.34	0.32
Industrial	6638	46025	3.58	4.18	3.97	0.21	0.24	0.23	0.02	0.02	0.02	0.02	0.02	0.02	0.65	0.76	0.72
Commercial	6641	46028	4.32	5.39	4.80	0.25	0.31	0.28	0.02	0.03	0.02	0.02	0.03	0.02	0.78	0.98	0.87
Industrial	6763	46076	3.44	3.71	3.62	0.20	0.21	0.21	0.02	0.02	0.02	0.02	0.02	0.02	0.62	0.67	0.66
Industrial	6767	46078	0.49	1.41	0.97	0.13	0.19	0.16	0.00	0.01	0.01	1.16	1.17	1.17	0.11	0.31	0.21
Industrial	6626	45938	6.36	7.44	7.07	11.25	13.16	12.50	0.33	0.39	0.37	0.11	0.13	0.12	2.23	2.61	2.48

TABLE 23 (Cont.)

Source	H.C.	V.C.	SO_X			PART.			CO			HC			NO_X		
			S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Industrial	6626	45960	2.21	2.59	2.46	0.13	0.15	0.14	0.01	0.01	0.01	0.01	0.01	0.01	0.40	0.47	0.45
Industrial	6631	45946	2.16	2.95	2.70	1.84	1.89	1.87	0.01	0.02	0.01	6.34	6.37	3.36	3.06	3.66	3.46
Industrial	6795	45850	2.31	2.80	2.57	0.14	0.17	0.15	0.01	0.01	0.01	2.66	2.66	2.66	0.46	0.56	0.51
Industrial	6799	45860	2.95	3.45	3.28	0.17	0.20	0.19	0.01	0.02	0.02	0.01	0.02	0.02	0.54	0.54	0.59
Industrial	6592	45763	1.66	2.41	2.07	0.10	0.14	0.12	0.01	0.01	0.01	0.01	0.01	0.01	0.30	0.44	0.37
Industrial	6591	45760	4.38	8.89	6.84	0.30	0.56	0.45	0.02	0.04	0.03	1.02	1.04	1.03	0.79	1.61	1.24
Industrial	6661	45745	5.33	6.86	6.27	0.34	0.43	0.39	0.03	0.04	0.04	0.03	0.04	0.04	1.15	1.48	1.35
Industrial	6588	45761	0.58	1.11	0.87	0.08	0.11	0.10	0.00	0.01	0.00	1.40	1.41	1.40	0.11	0.20	0.16
Industrial	6603	45758	0.79	0.79	0.79	2.55	2.55	2.55	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.16
Industrial	6732	45766	5.93	7.24	6.59	0.39	0.47	0.44	0.03	0.03	0.03	0.03	0.03	0.03	1.83	1.48	1.37
Industrial	6742	45756	9.35	9.92	9.74	0.54	0.57	0.56	0.05	0.05	0.05	0.05	0.05	0.05	1.69	1.80	1.76
Industrial	6753	45755	4.22	4.95	4.74	0.26	0.29	0.28	0.02	0.02	0.02	0.02	0.02	0.02	0.81	0.89	0.87
Commercial	6729	45742	4.32	6.62	5.40	0.33	0.50	0.41	0.03	0.04	0.04	0.03	0.04	0.04	1.03	3.33	2.11
Industrial	6710	45707	3.16	3.69	3.51	0.18	0.21	0.20	0.02	0.02	0.02	0.02	0.02	0.02	0.57	0.67	0.64
Industrial	6713	45713	2.56	2.76	2.68	0.41	0.42	0.41	0.01	0.01	0.01	10.41	10.41	10.41	0.55	0.60	0.58
Industrial	6728	45732	1.15	1.62	1.47	0.07	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01	0.21	0.29	0.27
Industrial	6743	45743	1.43	2.04	1.81	0.08	0.12	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.26	0.37	0.33
Industrial	6593	45667	0.94	2.78	2.15	0.10	0.21	0.17	0.00	0.01	0.01	1.40	1.40	1.40	0.17	0.50	0.39
Industrial	6970	46470	--	--	--	--	--	--	-0	--	-1	4.80	4.80	4.80	--	--	--

TABLE 23 (Cont.)

Source	H.C.	V.C.	SO_x			PART.			CO			HC			NO_x		
			S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Industrial	6920	46280	--	--	--	--	--	--	--	--	--	2.42	2.42	2.42	--	--	--
Industrial	6930	46230	--	--	--	0.35	0.35	0.35	5.50	5.50	5.50	--	--	--	--	--	--
Industrial	6790	46970	--	--	--	0.20	0.20	0.20	2.50	2.50	2.50	--	--	--	--	--	--
Industrial	6650	45960	5.00	5.00	5.00	1.00	1.00	1.00	--	--	--	6.00	6.00	6.00	--	--	--
Industrial	6640	45960	--	--	--	0.24	0.24	0.24	7.50	7.50	7.50	--	--	--	--	--	--
Industrial	6755	45730	0.50	0.50	0.50	1.00	1.00	1.00	2.50	2.50	2.50	1.00	1.00	1.00	--	--	--
Incinerator	6970	45269	0.15	0.15	0.15	1.28	1.28	1.28	0.08	0.08	0.08	0.02	0.02	0.02	0.15	0.15	0.15
Incinerator	6950	46286	0.38	0.38	0.38	3.23	3.23	3.23	0.19	0.19	0.19	0.06	0.06	0.06	0.38	0.38	0.38
Incinerator	6896	46225	0.20	0.20	0.20	1.70	1.70	1.70	0.10	0.10	0.10	0.03	0.03	0.03	0.20	0.20	0.20
Incinerator	6873	46127	0.13	0.13	0.13	1.09	1.09	1.09	0.07	0.07	0.07	0.02	0.02	0.02	0.13	0.13	0.13
Incinerator	6635	45992	0.14	0.14	0.14	1.21	1.21	1.21	0.07	0.07	0.07	0.02	0.02	0.02	0.14	0.14	0.14
Incinerator	6770	45770	0.42	0.42	0.42	3.58	3.58	3.58	0.21	0.21	0.21	0.06	0.06	0.60	0.42	0.42	0.42
Power Plant	6586	45635	118.30	118.30	118.30	5.64	5.64	5.64	0.69	0.69	0.69	0.39	0.39	0.39	31.10	31.10	31.10
Power Plant	6752	45747	28.76	29.96	29.55	0.72	0.75	0.74	0.00	0.00	0.00	0.23	0.24	0.24	7.52	7.84	7.73
Power Plant	6532	4559	88.81	148.98	83.49	1.95	3.30	1.85	0.22	0.36	0.20	0.54	0.91	0.51	23.08	39.06	21.09
Power Plant	6965	46032	157.48	164.04	161.80	3.63	3.78	3.73	0.57	0.60	0.59	0.37	0.39	0.38	27.50	28.64	28.25
Power Plant	6952	46244	43.95	45.78	45.15	1.83	1.91	1.88	0.02	0.02	0.02	0.33	0.34	0.34	11.14	11.60	11.44
Power Plant	6523	45597	29.01	37.14	29.4	.73	.93	.74	0.00	0.00	0.00	0.24	0.31	0.24	3.59	9.71	7.71
Power Plant	6817	45918	1.16	1.16	1.15	0.61	0.61	0.60	0.01	0.01	0.01	0.00	0.00	0.00	0.31	0.31	0.30

TABLE 24 EMISSIONS FROM POINT SOURCES IN THE MASSACHUSETTS PORTION OF THE STUDY AREA, 1967

(Tons/Day)

Source	H.C.	V.C.	SO_x			PART.			CO			HC			NO_x		
			S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Industrial	6920	46817	.74	1.18	1.05	.16	.25	.23	.01	.02	.02	.01	.01	.01	.15	.25	.22
~~Industrial~~	6937	46871	0	3.08	1.45	0	.44	.21	0	.36	.17	0	.08	.09	0	.56	.26
Industrial	6994	46702	4.18	6.90	5.97	.24	.40	.35	.02	.03	.03	.02	.03	.03	.76	1.26	1.09
Industrial	6972	46720	.68	1.63	1.36	.04	.10	.08	.00	.01	.01	0	.01	.01	.13	.30	.25
Institutional	6956	45740	0	3.02	1.42	0	.17	.08	0	.02	.01	0	.02	.01	0	.55	.26
Industrial	7050	46703	5.19	6.42	5.76	.40	.50	.45	.03	.04	.04	.03	.04	.03	1.65	2.04	1.83
Governmental	7030	46745	.23	4.68	2.32	.08	1.53	.76	.08	1.68	.83	.02	.35	.17	.05	.94	.40
Industrial	6857	46644	1.08	1.42	1.27	.07	.09	.08	.01	.01	.01	.01	.01	.01	.20	.27	.24
Industrial	6845	46724	7.61	7.61	7.61	2.00	2.00	2.00	.30	.30	.30	.10	.10	.10	2.01	2.01	2.01
Industrial	6973	46688	.96	1.56	1.37	.06	.09	.08	.01	.01	.01	.01	.01	.01	108	.29	.26
Industrial	6972	46665	.49	1.81	1.39	.05	.17	.13	0	.02	.01	0	.02	.01	.20	.74	.57
Institutional	6982	46658	0	1.15	.54	0	.07	.03	0	0	0	0	0	0	0	.08	.04
Commercial	7027	46654	0	1.17	.55	0	.07	.03	0	.01	0	0	01	0	0	.21	.10
Industry	7065	46700	2.03	2.55	2.39	0.12	.15	.14	.01	.01	.01	.01	.01	.01	.37	.46	.43
Industrial	6926	46630	1.59	2.00	1.82	.09	.11	.10	.01	.01	.01	.01	.01	.01	.28	.35	.32
Industrial	6990	46614	.70	3.18	2.33	.15	.68	.50	.01	.05	.04	.01	.02	.02	.15	.67	.49
Industrial	6870	46652	.20	.89	.67	.30	1.35	1.01	.02	.10	.08	.01	.03	.03	.15	.67	.50
Industrial	7024	46676	0	0	0	.36	.36	.36	5.28	5.28	5.28	0	0	0	0	0	0
Industrial	6879	46664	0	0	0	.01	.01	.01	1.07	1.07	1.07	0	0	0	0	0	0

TABLE 24 (Cont.)

Source	H.C.	V.C.	SO_x S	SO_x W	SO_x A	PART. S	PART. W	PART. A	CO S	CO W	CO A	HC S	HC W	HC A	NO_x S	NO_x W	NO_x A
Industrial	7064	46683	0	0	0	.11	.11	.11	1.64	1.64	1.64	0	0	0	0	0	0
Industrial	6862	46655	0	0	0	.30	.30	.30	4.28	4.28	4.28	0	0	0	0	0	0
Industrial	6975	46717	0	0	0	.36	.36	.36	5.14	5.14	5.14	0	0	0	0	0	0
Power Plant	6987	46632	77.82	77.8 2	77.82	13.45	13.45	13.45	.42	.42	.42	.17	.17	.17	16.86	16.86	16.86
Power Plant	6992	46635	1.03	1.03	1.02	1.20	1.20	1.18	.01	.01	.01	.01	.01	.01	.49	.49	.48
Power Plant	6974	46836	34.43	34.43	34.43	8.71	8.71	8.71	.30	.30	.30	.12	.12	.12	12.08	12.08	12.08
Power Plant	6971	46746	2.59	2.59	2.59	.26	.26	.26	.01	.01	.01	.02	.02	.02	1.04	1.04	1.04
Power Plant	6984	46744	3.14	3.14	3.14	.08	.08	.08	0	0	0	.03	.03	.03	.82	.82	.82

TABLE 25 EMISSIONS BY GRID FOR ALL SOURCES IN THE CONNECTICUT PORTION OF THE STUDY AREA, 1967

(Tons/Day)

Grid	H.C.	V.C.	Area	SOx S	SOx W	SOx A	PART. S	PART. W	PART. A	CO S	CO W	CO A	HC S	HC W	HC A	NOx S	NOx W	NOx A
25	6850	46550	100	0.21	1.06	0.60	0.07	0.19	0.13	4.14	3.56	3.81	0.48	0.44	0.46	0.27	0.47	0.35
26	6950	46550	100	0.26	1.38	0.78	0.16	0.32	0.24	14.85	12.54	13.57	1.87	1.62	1.72	0.88	1.05	0.93
27	7050	46550	100	1.13	5.72	3.32	0.46	1.09	0.76	25.52	21.86	23.46	3.11	2.74	2.89	1.63	2.70	2.07
28	7150	46550	60	0.01	0.19	0.10	0.03	0.07	0.04	04.04	3.42	3.70	0.52	0.44	0.47	0.22	0.22	0.21
29	6750	46450	60	0.21	1.13	0.63	0.07	0.21	0.14	3.51	3.04	3.25	0.41	0.37	0.39	0.23	0.46	0.33
30	6850	46450	100	0.45	2.36	1.33	0.19	0.33	0.32	12.17	10.30	11.17	1.49	1.30	1.39	0.76	1.18	0.93
31	6950	46450	100	1.01	5.19	3.02	1.48	2.05	1.75	51.74	45.13	48.04	7.10	6.36	6.67	3.60	4.35	3.87
32	7050	46450	100	0.46	2.95	1.58	0.17	0.57	0.36	9.65	8.37	8.91	1.16	1.08	1.11	0.62	1.18	0.85
33	7150	46450	80	0.41	2.27	1.23	0.13	0.39	0.26	4.07	3.61	3.80	0.44	0.42	0.44	0.30	0.76	0.50
34	6550	46350	70	0.76	6.24	3.57	0.34	0.98	0.65	24.07	20.55	22.09	3.09	2.74	2.86	1.62	2.52	2.06
35	6650	46350	90	0.07	1.34	0.67	0.08	0.27	0.17	6.56	5.62	6.05	0.84	0.74	0.78	0.41	0.62	0.50
36	6750	46350	100	0.46	2.42	1.37	0.22	0.50	0.35	15.14	12.87	13.87	1.87	1.63	1.73	0.93	1.33	1.10
37	6850	46350	100	1.17	5.50	3.16	0.54	1.11	0.81	35.87	30.46	32.85	4.44	3.85	4.10	2.21	3.23	2.62
38	6950	46350	100	1.30	6.03	3.55	0.50	1.09	0.79	31.01	26.40	28.43	3.82	3.31	3.52	1.98	3.09	2.45
39	7050	46350	100	1.17	5.76	3.27	0.52	1.16	0.83	33.89	28.85	31.08	4.20	3.64	3.87	3.11	3.20	2.56
40	7150	46350	100	1.13	5.50	3.14	0.50	1.09	0.78	35.23	30.22	30.27	4.40	3.82	4.06	2.18	3.11	2.55
41	6450	46250	70	0.05	0.01	0.51	0.05	0.16	0.10	2.60	2.24	2.40	0.33	0.29	0.30	0.19	0.37	0.26
42	6550	46250	100	0.15	1.54	0.81	0.21	0.40	0.30	22.31	18.82	20.36	2.87	2.45	2.64	1.30	1.40	1.32
43	6650	46250	100	0.05	1.13	0.56	0.06	0.19	0.11	2.87	2.50	2.66	0.36	0.34	0.34	0.20	0.42	0.29
44	6750	46250	100	1.01	4.80	2.76	0.34	0.81	0.57	13.72	11.84	12.67	1.62	1.45	1.52	0.96	1.97	1.39
45	6825	46275	25	0.65	3.41	1.91	0.24	0.63	0.43	11.19	9.66	10.33	1.34	1.21	1.26	0.75	1.49	1.06

TABLE 25 (Cont.)

Grid	H.C.	V.C.	Area	SO_x			PART.			CO			HC			NO_x		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
46	6825	46275	25	1.41	6.78	3.86	0.64	1.36	0.98	42.28	35.95	38.74	5.23	4.55	4.83	2.62	2.88	3.13
47	6925	46275	25	2.18	11.03	6.30	0.88	1.66	1.24	68.92	58.00	62.85	8.78	7.37	7.94	4.23	5.81	4.88
48	6975	46275	25	2.29	7.62	4.75	0.70	1.34	1.00	42.02	35.65	38.46	5.20	4.49	4.79	2.76	3.98	3.15
49	6825	46225	25	.83	3.79	2.19	.27	.84	.45	8.59	7.48	7.97	.96	.87	.91	.63	1.47	.99
50	6875	46225	25	1.37	6.37	3.66	.76	1.41	1.07	34.99	29.05	32.09	4.82	4.27	4.51	2.21	3.43	2.70
51	6925	46225	25	1.61	10.21	5.53	.89	2.01	1.41	64.24	53.80	58.80	8.07	7.04	7.46	3.91	5.68	4.62
52	6975	46225	25	.97	4.74	2.69	.45	1.00	.72	35.59	30.19	32.57	5.45	3.85	4.11	2.17	2.99	2.48
53	7050	46250	100	1.40	7.79	4.41	1.39	2.31	1.66	59.37	50.37	54.33	7.53	6.44	6.91	3.62	4.52	3.95
54	7150	46250	100	.43	1.92	1.12	.17	.37	.26	8.93	7.62	8.20	1.07	.93	.99	.58	1.01	.76
55	7250	46250	50	.42	2.08	1.19	.15	.38	.27	6.50	5.63	6.01	.76	.68	.71	.44	.85	.61
56	6450	46150	40	.05	.88	.44	.80	1.12	.83	2.42	2.06	2.22	.31	.27	.28	.18	.35	.25
57	6550	46150	100	.64	2.38	1.38	.19	.52	.35	7.41	6.51	6.90	.92	.86	.89	.57	1.13	.79
58	6650	46150	100	1.23	4.54	2.81	2.34	.98	.67	26.22	22.53	24.13	3.37	3.26	3.39	2.38	2.38	2.03
59	6750	46150	100	5.01	12.67	8.57	2.74	4.11	3.36	77.19	66.08	70.93	10.89	9.71	10.20	5.40	7.04	4.91
60	6825	46175	25	2.64	11.66	5.05	1.87	4.07	2.51	36.10	32.06	34.40	4.58	4.37	4.34	2.75	5.31	3.35
61	6875	46175	25	2.88	8.78	5.50	1.41	2.14	1.51	33.92	29.57	31.43	4.11	3.69	3.85	2.59	4.53	3.24
62	6825	46125	25	1.85	5.57	3.50	.93	1.42	.99	20.21	17.72	18.79	2.45	2.21	2.30	1.59	2.88	2.02
63	6875	46125	25	1.62	5.17	3.20	.84	1.37	.94	20.81	18.22	19.32	2.54	2.29	2.39	1.57	2.73	1.96
64	6950	46150	100	.64	3.55	1.96	.49	.95	.70	49.97	42.15	45.60	6.37	5.46	5.85	2.91	3.32	2.04
65	7050	46150	100	.44	2.34	1.32	.16	.45	.31	8.21	7.09	7.58	.98	.88	.92	0.54	1.03	.74
66	7150	46150	100	.05	1.13	.57	.06	.19	.12	3.14	2.71	2.91	.49	.37	.37	.22	.43	.30

TABLE 25 (Cont.)

Grid	H.C.	V.C.	Area	SO S	SO W	SO A	PART. S	PART. W	PART. A	CO S	CO W	CO A	HC S	HC W	HC A	NO S	NO W	NO A
67	6450	46050	50	.28	.95	.57	.11	.24	.17	5.80	4.99	5.35	.72	.64	.68	.39	.62	.47
68	6550	46050	100	1.18	2.55	1.76	.36	.63	.50	16.51	14.07	15.14	2.24	1.98	2.09	1.19	1.51	1.30
69	6625	46075	25	.76	2.47	1.47	.31	.65	.56	16.49	14.32	15.92	2.53	1.81	1.93	1.13	1.75	1.35
70	6675	46075	25	.72	2.23	1.35	.25	.55	.41	9.50	8.26	8.79	1.18	1.06	1.11	.73	1.35	.96
71	6625	46025	25	1.56	6.49	4.03	1.11	1.85	1.49	41.00	34.54	37.54	5.43	4.75	5.03	2.70	3.87	2.14
72	6625	46025	25	.95	3.37	1.97	.42	.95	.71	31.01	26.42	28.43	3.95	3.44	3.66	1.98	2.73	2.25
73	6750	46050	100	1.38	5.26	3.11	.87	1.58	1.07	35.96	31.12	33.19	4.46	3.98	4.16	2.33	3.23	2.61
74	6850	46050	100	1.58	13.09	8.54	2.61	3.29	2.72	45.88	39.18	42.10	5.88	5.11	5.41	2.75	5.81	4.35
75	6950	46050	100	6.67	11.84	9.13	1.10	2.54	1.76	48.32	41.02	44.22	6.25	5.47	5.81	4.86	5.68	5.19
76	7050	46050	100	.09	1.44	.73	.11	.30	.20	9.35	7.98	8.58	1.20	1.06	1.11	.57	.77	.65
77	6550	45950	80	.31	1.13	.66	.14	.30	.22	9.40	8.03	8.63	1.19	1.04	1.10	.60	.82	.68
78	6650	45950	100	1.09	4.33	2.49	.72	1.43	1.08	53.96	45.77	49.36	7.11	6.17	6.58	3.30	4.09	3.56
79	6750	45950	100	.40	2.15	1.17	.20	.49	.35	18.40	15.63	16.85	2.35	2.04	2.18	1.12	1.44	1.23
80	6850	45950	100	3.49	11.00	7.16	.89	2.10	1.45	24.97	21.94	23.13	3.31	3.10	3.16	2.22	4.32	2.97
81	6950	45950	100	.09	1.39	.71	.12	.30	.20	10.70	9.10	9.80	1.38	1.20	1.27	.67	.85	.72
82	7050	45950	100	.08	1.12	.57	.10	.22	.16	9.15	7.68	8.31	1.17	1.01	1.07	.55	.71	.62
83	6550	45850	80	.43	1.67	1.03	.08	.20	.12	4.13	3.53	3.80	.53	.46	.49	.37	.72	.48
84	6650	45850	100	2.36	5.86	4.09	.56	.97	.83	20.93	18.18	19.25	2.72	2.41	2.54	1.67	2.44	2.01
85	6750	45850	100	1.02	5.17	2.91	1.15	1.85	1.51	60.67	51.24	55.39	7.91	6.92	7.37	3.65	3.85	3.89
86	6850	45850	100	.58	3.00	1.64	.88	1.58	1.29	10.65	9.33	9.89	1.39	1.26	1.31	.80	1.53	1.10
87	6950	45850	100	.51	2.46	1.35	.31	.57	.46	3.71	3.39	3.52	.48	.46	.36	.96	.62	
88	7050	45850	70	.05	.90	.46	.06	.14	.09	3.68	3.13	3.37	.47	.40	.43	.25	.41	.31

TABLE 25 (Cont.)

Grid	H.C.	V.C.	Area	SOx			PART.			CO			HC			NO_x		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
89	6550	45750	70	.45	6.76	3.45	.55	1.30	.88	44.78	37.99	40.97	6.43	5.67	6.01	2.79	3.80	3.20
90	6650	45750	100	2.72	10.96	6.47	1.76	2.85	2.31	81.63	69.73	74.91	11.31	9.92	9.53	5.21	6.71	5.78
91	6725	45775	25	1.76	10.53	5.79	2.07	3.76	2.90	184.15	155.36	168.04	23.77	20.42	21.87	10.75	11.57	10.95
92	6775	45775	25	1.00	8.30	2.94	.88	1.66	1.31	32.51	27.71	29.81	4.21	3.71	3.92	2.52	3.58	2.55
93	6725	45775	20	1.27	5.83	3.33	1.50	2.40	1.93	30.35	25.92	27.76	3.93	3.49	3.67	2.90	4.02	3.39
94	6775	45775	20	.79	4.22	2.31	.74	1.34	1.06	33.85	28.74	30.98	4.38	3.83	4.05	2.12	2.86	2.42
95	6850	45750	100	.49	2.82	1.54	.50	.93	.72	30.87	26.12	28.21	3.99	3.46	3.69	1.87	2.28	2.02
96	6950	45750	100	.41	2.12	1.18	.35	.79	.55	16.70	14.08	15.25	2.15	1.87	2.00	1.06	1.41	1.19
97	7050	45750	90	.12	1.71	.87	.25	.42	.27	15.65	13.31	14.34	2.01	1.76	1.86	.93	1.10	1.02
98	6550	45650	10	.67	4.00	2.23	.24	.61	.41	14.06	11.99	12.90	1.88	1.57	1.66	1.02	1.57	1.20
99	6650	45650	80	1.53	8.49	4.63	.93	1.84	1.38	49.16	42.62	45.44	6.65	5.92	6.23	3.18	4.70	3.80
100	6710	45690	10	.35	1.89	1.03	.28	.55	.43	2.52	2.27	2.38	.33	.37	.33	.26	.72	.45
101	6775	45690	10	.35	1.89	1.00	.28	.55	.43	2.07	1.90	1.97	.27	.29	.28	.23	.70	.43

TABLE 26 EMISSIONS FROM ALL SOURCES BY GRID FOR THE MASSACHUSETTS PORTION OF THE STUDY AREA, 1967

(Tons/Day)

Grid	I.C.	V.C.	Area	S	SO_x W	A	S	PART. W	A	S	CO W	A	S	HC W	A	S	NO_x W	A
1	6950	46950	100	.13	.69	.40	.20	.31	.25	5.22	4.50	4.81	.95	.84	.88	.63	.68	.64
2	7050	46950	100	.18	1.72	.92	.20	.59	.38	2.01	2.17	2.07	.24	.31	.27	.25	.61	.43
3	6950	46850	100	1.36	8.31	7.54	1.07	2.17	1.90	27.19	24.09	25.69	4.77	4.32	4.58	3.27	4.77	4.55
4	7050	46850	100	.14	1.26	.60	.17	.43	.31	5.48	4.85	5.12	.98	.89	.93	.66	.85	.78
5	6850	46750	100	.22	.93	.56	.16	.26	.21	3.07	3.21	3.23	.57	.57	.57	.41	.41	.39
6	6925	46775	25	.16	.85	.49	.05	.19	.12	2.46	2.14	2.28	.36	.33	.35	.24	.46	.34
7	6975	46775	25	1.52	4.30	2.71	.75	1.17	.98	18.81	16.46	17.48	2.54	2.26	2.37	1.80	2.45	2.12
8	6925	46725	25	.18	1.62	.66	.05	.21	.13	1.75	1.52	1.62	.25	.23	.24	.22	.54	.32
9	6975	46725	25	3.18	8.22	5.89	1.39	2.28	1.79	33.60	28.93	30.96	4.85	4.27	4.51	3.37	4.43	3.89
10	7050	46750	100	.58	2.81	1.63	.51	.97	.73	17.95	16.23	16.97	4.53	4.29	4.39	1.91	2.51	2.16
11	7150	46750	100	.34	1.45	.87	.15	.31	.22	4.53	3.87	4.16	.85	.74	.80	.64	.95	.78
12	7250	46750	100	.20	1.09	.62	.42	.60	.50	4.44	3.97	4.17	.72	.66	.68	.55	.73	.63
13	7350	46750	100	.17	.73	.43	.11	.20	.14	2.07	1.82	1.93	.35	.31	.33	.29	.45	.37
14	6850	46650	100	1.61	6.16	4.82	.97	1.75	1.43	24.05	21.44	22.65	4.34	3.89	4.08	3.05	4.09	3.63
15	6925	46675	25	.22	.96	.57	.03	.14	.08	.45	.41	.43	.06	.06	.07	.11	.37	.24
16	6975	46675	25	1.41	6.76	4.22	1.17	2.21	1.71	44.14	38.14	40.75	6.27	5.52	5.84	3.82	4.96	4.38
17	7025	46675	25	.85	5.37	2.97	1.49	2.06	1.72	39.42	34.09	36.43	5.34	4.63	4.95	3.34	4.16	3.74
18	7075	46675	25	.57	2.16	1.33	.53	.78	.64	28.15	23.77	25.71	4.09	3.48	3.75	2.33	2.55	2.41
19	6925	46625	25	.51	2.31	1.37	.45	.79	.60	19.00	16.24	17.45	2.71	2.35	2.50	1.62	2.04	1.81
20	6975	46625	25	.68	4.45	2.70	1.16	1.86	1.51	44.53	38.13	40.93	6.36	5.51	5.87	3.63	4.32	3.99

TABLE 26 (Cont.)

Grid	H.C.	V.C.	Area	SO_x			PART.			CO			HC			NO_x	
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
21	7025	46625	25	1.11	8.17	4.48	1.76	5.04	2.66	42.97	38.63	40.38	5.64	5.26	5.37	3.68	7.28	5.03
22	7075	46625	25	.58	2.98	1.84	.47	.91	.69	12.72	11.12	11.82	1.74	2.03	1.62	1.19	1.87	1.51
23	7150	46650	100	.22	1.29	..74	.24	.47	.35	7.57	6.60	7.02	1.21	1.07	1.13	.79	.95	.86
24	7250	46650	100	.13	.86	.49	.19	.36	.27	5.45	4.79	5.08	.97	.86	.90	.65	.74	.68
25	6850	46550	100	.33	1.42	.81	.17	.39	.26	3.26	2.93	3.07	.56	.52	.53	.47	.74	.58
26	6950	46550	100	.18	1.83	1.09	.18	.42	.32	9.42	7.99	8.62	1.59	1.37	1.46	.95	1.36	1.17
27	7050	46550	100	.33	2.59	1.58	.23	.58	.40	10.97	9.41	10.08	1.87	1.63	1.72	1.16	1.63	1.40
28	7150	46550	100	.30	1.11	.65	.09	.23	.15	1.31	1.19	1.23	.22	.37	.21	.25	.49	.35

EMISSION DENSITIES

In order to provide a visual representation of the emissions of pollutants by grid, emission density maps have been provided. Figures 6 through 10 show variation in emission densities for the respective grids throughout the Study Area. As expected the emissions generally follow the pattern and degree of urbanization. Emission densities are higher in grids with high populations and correspondingly high vehicular and industrial activity.

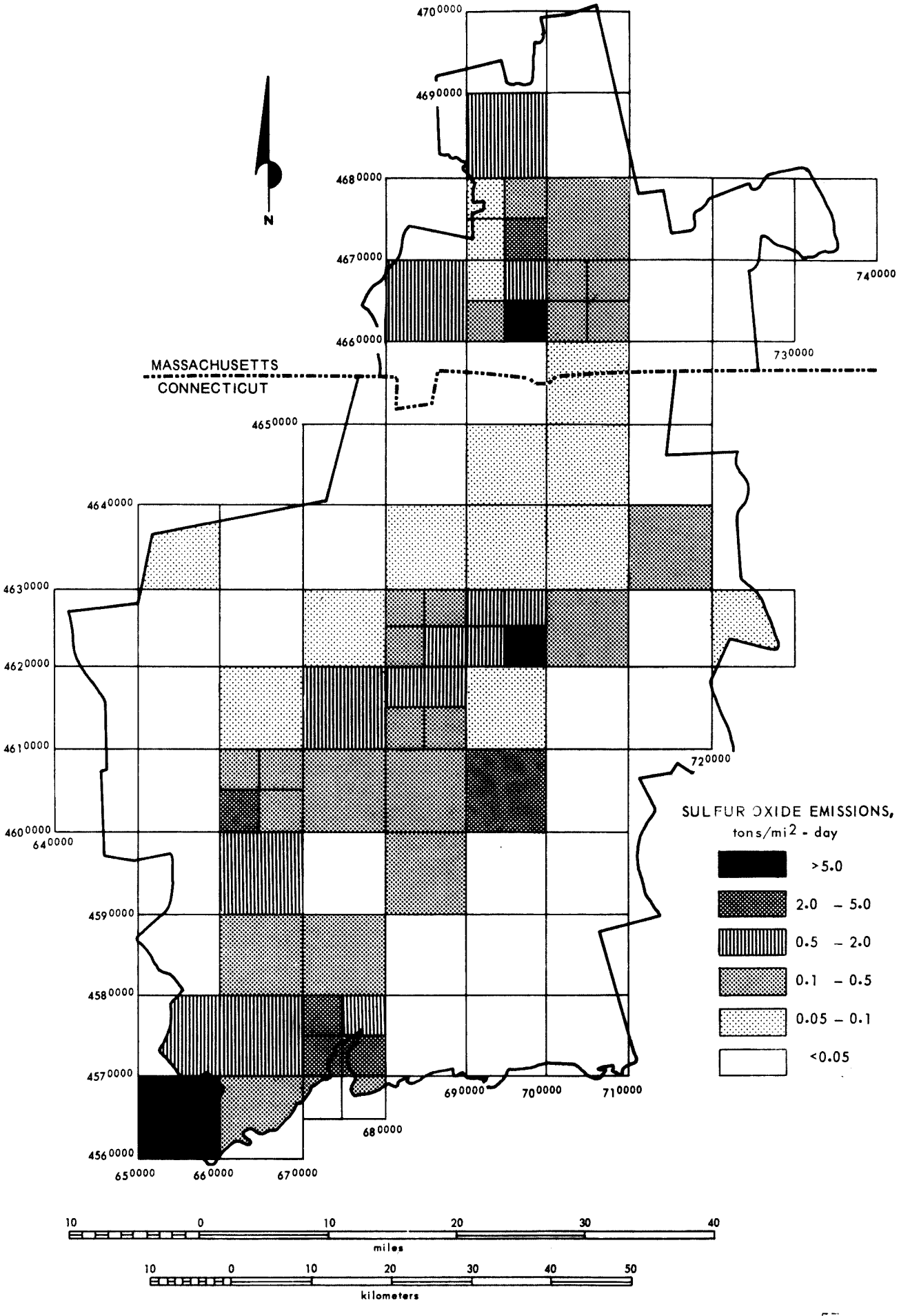

Figure 7. Sulfur oxide emission density map.

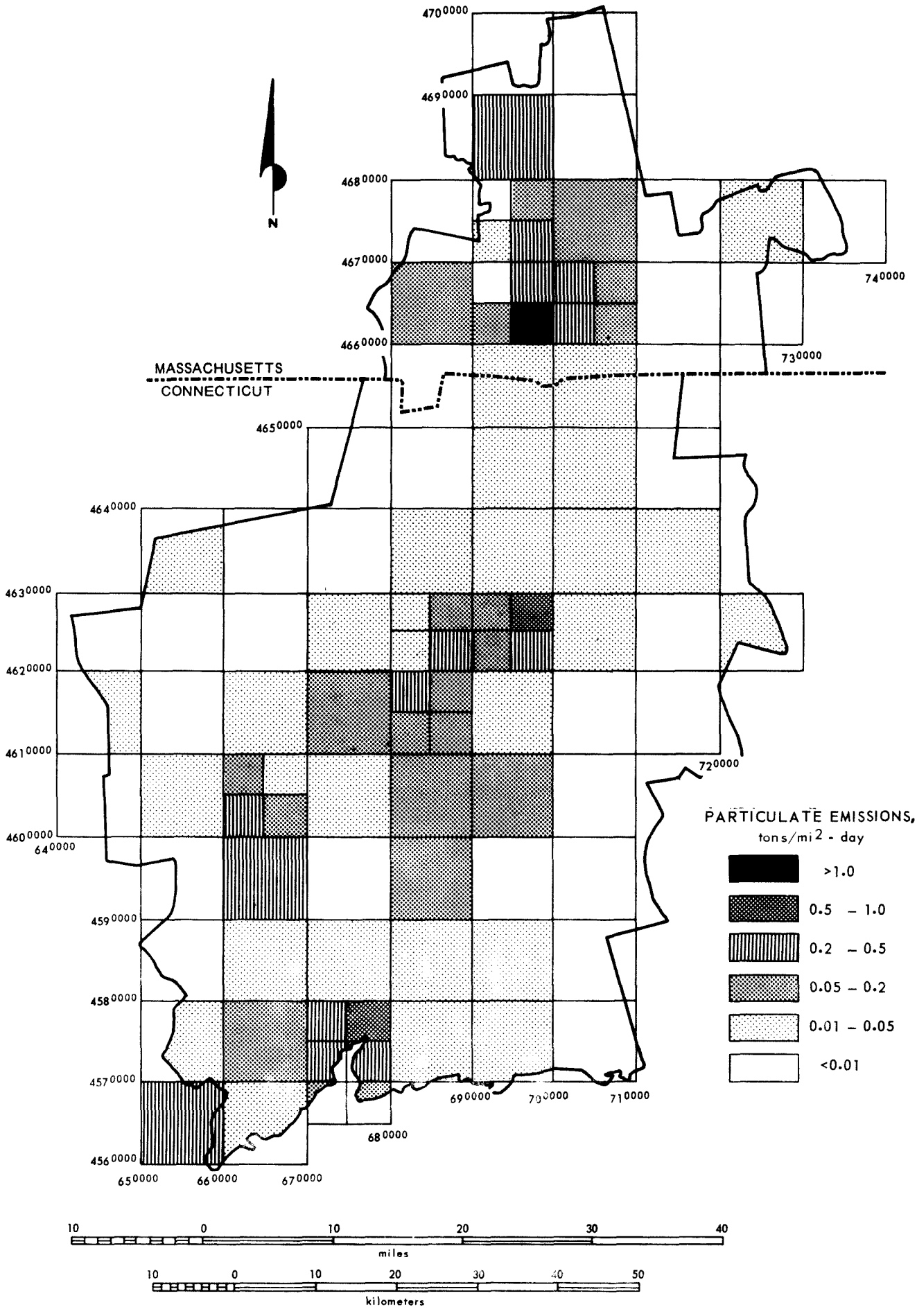

Figure 8. Particulate emission density map.

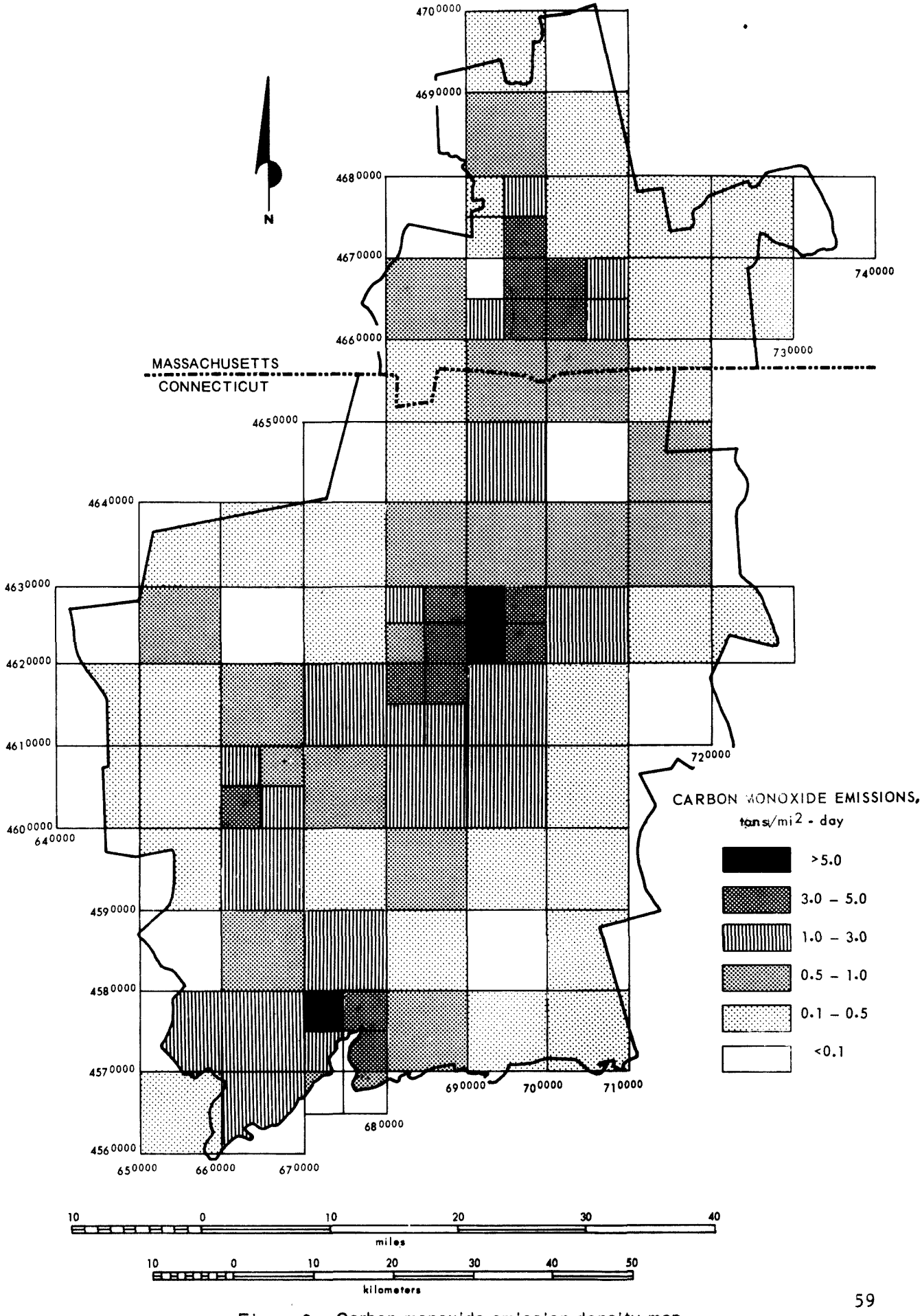

Figure 9. Carbon monoxide emission density map.

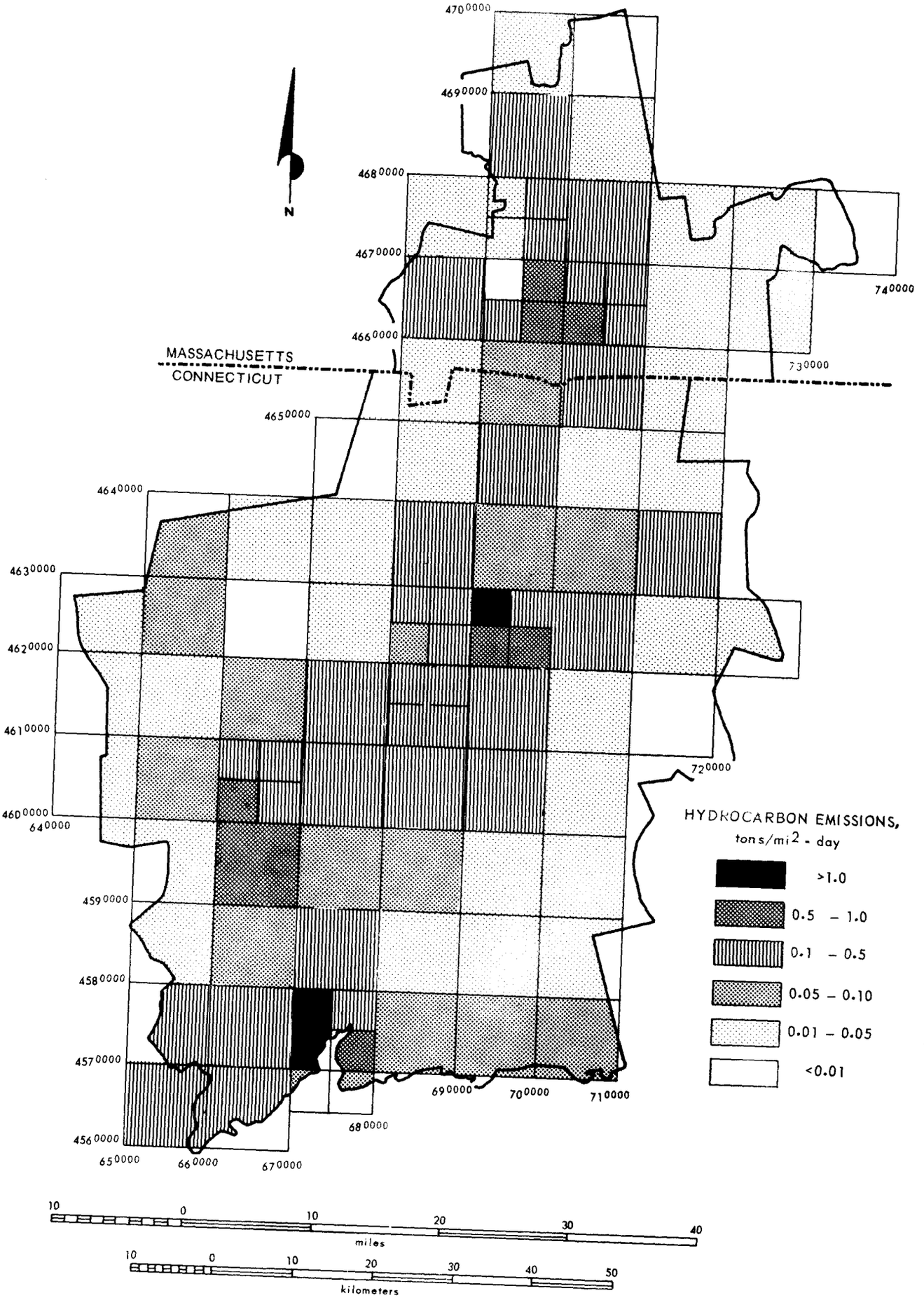

Figure 10. Hydrocarbon emission density map.

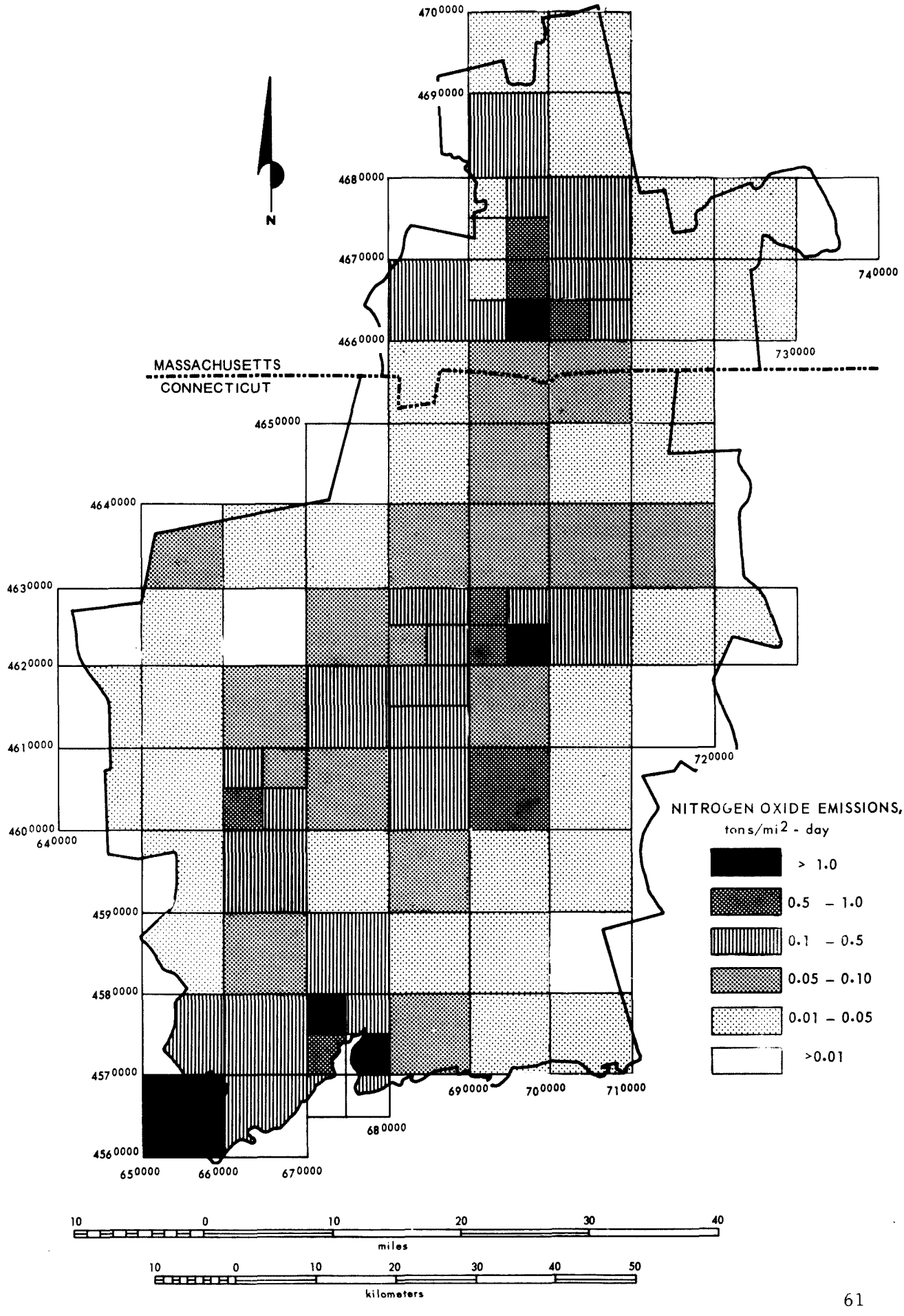

Figure 11. Nitrogen oxide emission density map.

REFERENCES

1. Ozolins, G. and Smith, R., Rapid Survey Technique for Estimating Community Air Pollution, USDHEW, PHS, October 1966.

2. Duprey, R. L., Compilation of Air Pollutant Emission Factors, USDHEW PHS, April 1967.

3. Register and Manual, State of Connecticut, 1967.

4. Local Climatological Data, Annual Summary, U.S. Department of Commerce, ESSA

5. Highway Statistics, 1967, U.S. Department of Transportation, Bureau of Public Roads.

6. Unpublished Information, State of Connecticut, Motor Vehicle Board.

7. Wilbur Smith and Associates, Report to the Lower Pioneer Valley Regional Planning Commission.

8. Mineral Industry Surveys, U.S. Department of Interior, Bureau of Mines, 1967.

9. Steam-Electric Plant Factors, 1967, National Coal Association.

10. Development of a Simulation Model for Air Pollution over the State of Connecticut, Volume I., Traveler's Research Center, Inc.

APPENDIX A

METHOD FOR CALCULATING SUMMER, WINTER AND ANNUAL AVERAGE EMISSIONS FOR FUEL CONSUMPTION IN STATIONARY SOURCES

YEARLY AVERAGE (A)

$$A = \frac{\text{Fuel Consumed} \times \text{Emission Factor (E. F.)}}{\text{Days of Operation}}$$

e.g. A plant consumed 100,000 tons of coal in 1967 while operating 365 days. The total degree days for the area was 4,800 and 2,800 for the three winter months. The plant was estimated to use 15 percent of the fuel for space heating and 85 percent for process heating. From this information, the annual average emission for carbon monoxide would be the following:

$$A = \frac{100{,}000 \text{ tons/year} \times 3 \text{ lbs. CO/Ton coal}}{365 \text{ Days/year} \times 2{,}00 \text{ lb/ton}}$$

$$A = 0.41 \text{ Ton/Day}$$

WINTER AVERAGE (W)

$$W = \frac{\text{Fuel Consumed} \times \text{E. F.}}{\text{Days of Winter Operation}} \times \frac{\text{Winter Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E. F.}}{365} \times \text{\% Fuel used for process heating}$$

$$W = \left[\frac{100{,}000 \times 2{,}800}{90 \times 4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$W = 0.49 \text{ Ton/Day}$$

SUMMER AVERAGE (S)

$$S = \frac{\text{Fuel Consumed} \times \text{E. F.}}{\text{Days of Summer Operation}} \times \frac{\text{Summer Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel used for Space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E. F.}}{365} \times \text{\% Fuel used for process heating}$$

$$S = \left[\frac{100{,}000}{90} \times \frac{0}{4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$S = 0.35 \text{ Ton/Day}$$

APPENDIX B

METRIC CONVERSION FACTORS

Multiply	By	To Obtain
Feet	0.3048	Meters
Miles	1609	Meters
Square Feet	0.0920	Square meters
Square Miles	2.59	Square kilometers
Pounds	453.6	Grams
Pounds	$453.6/10^4$	Tons (metric)
Tons (metric)	1.103	Tons (short)
Tons (short)	907.2	Kilograms
Tons (short)	.9072	Tons (metric)

To Obtain	By	Divide