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NORTHEAST CORRIDOR REGIONAL MODELING PROJECT ANNUAL EMISSION INVENTORY COMPILATION AND FORMATTING

Volume XVIII: Inventory Review And Evaluation

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NORTHEAST CORRIDOR REGIONAL MODELING PROJECT ANNUAL EMISSION INVENTORY COMPILATION AND FORMATTING

Volume XVIII: Inventory Review And Evaluation

by
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INTRODUCTION

On a nationwide basis, nonattainment of the National Ambient Air Quality Standards (NAAQS) for ozone is one of the most serious and widespread air pollution problems facing the air quality management community. The Northeast Corridor, a megalopolis of urban and suburban areas extending from Washington, D.C. to Boston, bears an especially large portion of this ozone nonattainment problem. The United States Environmental Protection Agency (USEPA), in cooperation with the northeastern states, local agencies, and Metropolitan Planning Organizations (MPOs), has undertaken the Northeast Corridor Regional Modeling Project (NECRMP) to develop regional and urban ozone control strategies through the use of photochemical air quality simulation models.

To employ a regional model, an inventory of point and area source emissions covering the entire NECRMP study area had to be assembled and placed into a common format. Unfortunately, exiting data bases were inadequate to either properly test or validate a regional model. To this end, USEPA's Office of Air Quality Planning and Standards retained GCA/Technology Division to complete an annual inventory for use in NECRMP. The study area, shown in Figure 1, includes the entire northeast quadrant of the United States from longitude 69 degrees to 82 degrees West and latitude 38 degrees to 45 degrees North, plus the Ohio Counties of Franklin, Licking, Perry, and Fairfield. To accommodate these additional counties, the NECRMP grid system extends West to 84 degrees longitude.

OBJECTIVES

The objective of the effort reported in this volume and summarized here was to compile and review the entire NECRMP emission inventory data base, evaluate its quality and comprehensiveness, and develop corrective measures in coordination with each state. Particular emphasis was placed on the suitability of the data for further temporal spatial, and species resolution for subsequent use in a photochemical model of the entire 15 state* area. This inventory review volume provides a summary of point and area source emission data from each state, including a discussion of their coverage and completeness and their agreement with 1982 ozone State Implementation Plan (SIP) data bases, and other inventory totals in use. Also included

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*For the purposes of this report, the District of Columbia is treated as a state equivalent.

is a description of ongoing data collection efforts in each state, and the current and future availability of additional data from individual state agencies.

The major pollutants of interest in the NECRMP study were Volatile Organic Compounds (VOC) and Oxides of Nitrogen (NO_x) with carbon monoxide (CO) being included as a potentially important tracer. Particulate (TSP) and Oxides of Sulfur (SO_x) emissions were also included as available, but quality assurance efforts focused on VOC and NO_x. Regarding the completeness and accuracy of data, the greatest emphasis was placed on point sources with emissions of VOC greater than 500 tons/year and NO_x above 750 tons/year, as these are generally found to be responsible for a large portion of the total point source emissions and are likely to have a distinct and identifiable impact on photochemical modeling results. Sources exceeding these cutoffs were considered "major" and will be handled as individual point sources by the Regional Model Data Handling System (RMDHS), although the NECRMP point source inventory generally includes all available data on point sources regardless of size. Point sources with emissions below the cutoff levels will be treated as area sources by the RMDHS system, their spatial allocation to grid cells based on UTM coordinates.

EMISSIONS SUMMARY

A summary of the NECRMP emissions data is provided in Section 2. Separate tables summarize emission totals for point and area sources by state and by type of emission category. Emissions for the entire NECRMP study area are as follows.

	VOC (tons/year)	NO_x (tons/year)
Area	2,981,759	2,795,288
Point	1,041,043	3,480,344
Total	4,022,802	6,275,632

EVALUATION TECHNIQUES AND DATA QUALITY REVIEW

Section 3 describes the techniques used to evaluate the quality of the NECRMP emissions data. It includes a discussion of how the NECRMP data were compared with inventories filed by each state in support of State Implementation Plan submittals and as well as with data contained in the National Emission Data System (NEDS). Also provided in Section 3 are tabular and graphic presentations of emission densities of VOC and NO_x expressed both in terms of population and land area. VOC/NO_x ratios are likewise presented for a number of emission categories by state to identify possible anomalies.

SIP Compatibility Review

All available 1982 ozone State Implementation Plans for ozone nonattainment areas within the NECRMP region were reviewed. In most instances, the NECRMP emission data were obtained directly from the same state agencies who were simultaneously developing the SIP inventories. Each state received special funding for NECRMP liaison activities, in addition to their regular program grants, and were required to keep GCA informed of any significant changes made to their emission inventories. In theory, the SIP and NECRMP inventories should agree for all ozone nonattainment areas within the study region; however, this is not always true. In some instances, certain states made significant changes to their SIP data either without notifying GCA or after the respective NECRMP inventory had been completed. In fact, as of this writing, some states are still actively modifying SIP inventory submittals. In other cases, entire area source categories were omitted by some states, and to maintain uniformity and completeness across the entire NECRMP region GCA developed its own emission estimates in these missing categories. Some states supplied GCA with computerized point source inventories which bore little or no resemblance to the point source data reported in the hard-copy SIP inventories.

While there is only one "correct" inventory for a given area, use of different methods, assumptions, and data sources can yield greatly differing results. To avoid inter-state biases introduced as a result of different inventory methods, the NECRMP inventories were compiled and verified using a single standard set of methods. Deviations from the standard methods or emission factors were brought to the attention of the appropriate state agency for reconsideration. While one objective of NECRMP was to ensure consistency from state to state, it was also an objective to achieve consistency between the SIP and NECRMP inventories for individual states. There were, of course, instances when these two priorities came into conflict. These situations were resolved case-by-case individually, with deviations from the standard methods documented in the individual state volumes.[2-16]

Because of their differing objectives, the SIP and NECRMP inventories are reported differently. The SIP requirements entailed reporting (hard copy) reactive VOC and NO_x emissions on a daily basis for a typical summer weekday to support SIP-required attainment demonstration (e.g., using EKMA). The NECRMP inventory required annual emissions reflecting total VOC and NO_x in computerized form appropriate for further temporal, spatial, and reactivity resolution in conjunction with EPA's Eulerian Regional Oxidant Model (ROM).

Thus, direct comparison between the SIP and NECRMP inventories was not possible within the time and resource limitations of this project. However, a limitted comparison was attempted by converting the SIP-reported emissions from kg/day to tons/year using a conversion factor based on 365 days/year. An exact match would not be expected since the SIP inventory totals reflect emissions on a typical summer weekday rather than an average annual basis, and because they include only reactive VOC emissions rather than total VOC. However, if adjusted totals were within approximately 10 percent of each

other, the SIP and NECRMP inventories were considered to "match." All known differences between the two are identified and evaluated in state-by-state review of data quality found in Section 4.

NEDS Compatibility Review

States are required annually to supply updated emissions data to EPA's National Emission Data System (NEDS), which is the national data repository upon which most air quality analyses are based. For a number of reasons, not all states have kept their NEDS files sufficiently detailed and up-to-date for use in modeling analyses as complex as NECRMP. Still, since the NECRMP, NEDS, and SIP inventories are all based on state supplied data, theoretically all three data bases should agree. However, since at EPA's urging each of the states in the study area provided assistance and assigned high priority to GCA's questions regarding compilation and quality assurance of the data base, it is resonable to assume that overall the NECRMP inventory represents the most suitable emissions data for the intended application. Unfortunately, the degree of cooperation extended by the various states in the NECRMP region was not uniformly high. Thus, for certain individual sources the data contained in NEDS may still be more representative of the actual level of emissions. It is useful, then, to compare data contained in NEDS with the SIP and NECRMP data to identify areas of disagreement for future resolution.

Section 3 presents a comparison, by SIP area and by state, of the NEDS, SIP, and NECRMP inventories. Regionwide totals are compared below for those 13 SIP areas which fall within the NECRMP study boundaries:

13 SIP area totals	VOC (tons/year)			NO_x (tons/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Point	850,548	505,741	590,672	789,584	974,144	1,339,483
Area	2,563,302	1,763,874	1,675,771	1,229,828	1,340,214	1,520,048
Total	3,413,850	2,269,615	2,266,443	2,019,412	2,314,358	2,859,567

The NECRMP VOC emission estimates generally agree with the SIP totals for the 13 SIP areas in the study region. The totals for all 13 SIP areas for NECRMP are within about 0.1 percent of the reported SIP values. The NEDS emission estimates for the same areas are 47 percent higher than those reported in the SIPs.

The NECRMP emission estimate for NO_x, across all 13 SIP areas, is approximately 25 percent higher than that reported in the SIPs. On the other hand the NEDS NO_x totals are approximately 13 percent lower than the corresponding figure compiled from the SIPs. The bulk of this latter difference can be attributed to the NECRMP point source inventory for New

York. As discussed in greater detail below, and again in Section 4, the reported NECRMP electric utility emissions for New York are higher than those reported in NEDS by a factor of 7. The utility emissions reported in NEDS are believed to be more accurate than those reported in NECRMP. Further, GCA recommends that the NEDS estimates for utilities be substituted for the NECRMP estimates in New York. With this adjustment, the NECRMP NO_x total for the 13 SIP areas would agree with the SIP totals within less than 3 percent.

	VOC (tons/year)		NO_x (tons/year)	
Entire NECRMP Region	NEDS	NECRMP	NEDS	NECRMP
Point	1,072,643	1,041,043	2,258,689	3,480,344
Area	4,367,962	2,981,759	2,299,300	2,795,288
Total	5,440,605	4,022,802	4,557,989	6,275,632

For area sources, the NEDS VOC estimates are consistently much higher than those provided in NECRMP, although there are a couple of exceptions. Nearly all of the difference in area source VOC emissions can be attributed to evaporative VOC losses from organic solvent use. This difference results primarily from the fact that GCA and the states utilized methodologies consistent with EPA Guidelines,[19] which do not consider all of the identified industrial end uses of organic solvent (given in Table 4 of End Use of Solvents Containing VOC (EPA-450/3-79-032))[20] as potentially being area sources, while NEDS does. In addition, when end use cannot be identified the organic solvent is all treated as area source emissions in NEDS. The assumption implicit in the Guidelines is that all industry end users classified as "other" or "unidentified" will be completely accounted for in the point source inventory. Thus, on a regionwide basis, it would be expected that NECRMP point source VOC emissions would exceed NEDS point source totals. As is shown in Section 3, this is clearly not the case. Either the methodology inherent in the Guidelines underestimates emissions from organic solvent use, or NEDS includes emissions estimates from sources that do not really exist. Because of the magnitude of this discrepancy, GCA recommends that the organic solvent data contained in End Use of Solvents Containing VOC be reexamined with respect to how the EPA Guidelines interpret these data.

Regionwide the NEDS and NECRMP NO_x emissions differ by over 1.7 million tons/year, with most of this difference atributable to point sources. Specifically, over 1.1 million tons can be accounted for by electric generation sources in New York. Since the NEDS data on electric generation

are updated annually based on DOE data (confirmed by E. H. Pechan estimates of SO_2 from electric utilities), independent of the states, it is likely that the NEDS estimates in this case are correct and should be substituted for those in NECRMP. The NEDS and NECRMP estimates for electric utility emission in New York are discussed further in Sections 3 and 4.

Emission Densities

Emission densities for VOC and NO_x were calculated for each state or region within the NECRMP study area, both in terms of emissions per capita and emissions per square mile. This analysis was performed primarily to identify potential anomalies in the emissions data. To identify "suspicious" values, the mean and standard deviation were calculated for VOC and NO_x for point, area, and total emissions. States whose per-capita emissions fell more than two standard deviations from the mean were singled out for further investigation. All state area source per-capita emissions estimates were found to fall within two standard deviations for the mean, indicating that no individual state values fall outside the range of values expected for this type of source.

One state value, for Delaware, falls more than two standard deviations (2.57) from the per-capita point source VOC mean. For point source NO_x emissions, only one value (for West Virginia) falls outside of the expected range. These state values are discussed in greater detail in Section 4.

Emission densities for each state were calculated as a function of land area, as were population densities. It would be expected that population densities and emission densities would correlate well. Regression analyses for VOC and NO_x emission densities versus population densities were performed, and as predicted, population and emission densities showed a very strong correlation ($r^2 > 0.98$) for both VOC and NO_x emissions.

Some area source categories (e.g., commercial/consumer solvent use, dry cleaning, etc.) are estimated based on population and a per-capita emission factor. Others are derived as a function of an activity rate (e.g., gasoline sales, vehicle miles of travel, etc.). One evaluation measure applied to the NECRMP area source inventory data was to calculate emissions on a per-capita basis for certain area source categories that were not originally derived using per-capita emission factors. The results of this analysis are presented in Section 3.

Point Source Inventory Comprehensiveness

Comprehensiveness of the point source emissions data was evaluated for each state by comparing facilities included in each state's inventory against those listed in the Directory of Volatile Organic Compound Sources Subject to Reasonably Available Control Technology Requirements (RACT Directory). This comparison was actually performed as a quality assurance measure during the point source compilation phase of NECRMP. The intention of this check was to identify and subsequently include VOC sources that had been omitted in the

individual state data bases. For the entire NECRMP study 548 sources were identified as being included in the RACT Directory but not in the state-supplied data. This exercise resulted in the addition of six facilities to the NECRMP data base (one in Rhode Island and five in Massachusetts) totaling over 9,000 tons of VOC. A state-by-state comparison of RACT coverage is presented in Section 3.

Area Source Inventory Comprehensiveness

Area source inventory comprehensiveness was evaluated in terms of geographic coverage, area source category coverage, and resolution of area source categories. Area source emission inventories were compiled for all areas within the NECRMP study boundaries. Some variations were found to exist between individual state components in terms of all three dimensions as discussed below in Section 3.

In certain instances, state agencies determined that some of the less significant categories did not contribute sufficient VOC and NO_x emissions to warrant their inclusion. In other cases emissions representing a number of the NECRMP categories were aggregated to form composite categories. For this latter situation, one of two courses of action were taken by GCA. When sufficient data were available from the states, or when national data were adequate to allow their independent disaggregation, GCA calculated category-specific estimates from the composite data. When such information was unavailable, GCA included the composite data in that state's EIS/AS master file and properly "commented" the composite category so as to identify its component constituents. These adjustments, unique to each state, are discussed individually in Section 4.

Point Source Inventory Quality

In general the NECRMP point source files are suitable for use in regional modeling, although some significant problems remain. Ongoing efforts in two states, New Jersey and West Virginia, should eventually result in significant improvements to the existing data. In New Jersey, the DEP is currently updating their APEDS file to reflect important changes in emissions estimates for a number of sources which resulted from field office reviews conducted in preparation for SIP revision. The DEP also recently addressed "bugs" in the conversion routine which had resulted in numerous conversion errors. When completed, the revised New Jersey data should be substituted for the point source file currently contained in the NECRMP annual inventory.

West Virginia's APCC is developing a new comprehensive point source inventory. Since the data currently in the NECRMP point source file for West Virginia are at least 7 years old, it should be used only as an interim file until the new state data are made available.

Three states, (Massachusetts, New York, Pennsylvania) and the District of Columbia, did not directly respond to GCA's specific QA question/problem

lists. Massachusetts and New York did supply revised NEDS tapes and additional data which addressed some of the more serious point source problems, although difficulties remain in both files, as described in Section 4. Except for "cleaning up" data errors that prohibited conversion to EIS/PS format, the Pennsylvania and District of Columbia files reflect data "as received."

The Maryland BAQNC has reinventoried two major facilities since completion of the NECRMP inventory for that state, namely Eastern Stainless and Bethlehem Steel. These revised data should replace the current NECRMP information for the two facilities.

By far the largest source of problems in the NECRMP inventory relates to data conversion. Since a regional scale inventory necessitates use of a common data format, all of the inventories had to undergo one or more data conversions. Most inventories had to be converted twice, once from the state's own unique systems to a common system and again to the system being used in the project. This double conversion was required since states with their own systems usually only had software to convert to one "common" system and this varied between NEDS, EIS/P&R, and EIS/PS. These conversions were expensive, often involving hundreds of dollars in computer time. Because the inventories had been inadequately checked for transcription and keypunching errors and the AEROS instructions were so often misinterpreted, the error listings resulting from the conversions were massive. Errors had to be prioritized before resolution despite the allocation of significant resources toward this end. For many states, the allocated resources were completely expended in identifying and resolving data "glitches" which prohibited conversion into EIS/PS. As a result, it was not always possible to verify that all of the states' emissions estimates were accurate.

It is unfortunate that this situation exists. A properly coded NEDS file will translate into EIS/PS format with very few if any problems. The NEDS system has been in existence long enough so that state agencies should be able to produce properly formatted "NEDS" data. However, many of the state-specific inventory systems are apparently not sufficiently compatible to allow complete and accurate conversion into NEDS format. Other systems which should be compatible appear to have a number of "bugs" in their conversion software. In still other instances, it appears that certain states have either misinterpreted or intentionally ignored the AEROS manual instructions.

The above problems have been addressed and the NECRMP point source inventory contains commonly formatted data for the entire study region. In most instances, these data were obtained directly from state air agencies and presumably represent the individual states' most current and accurate data. Thus, as a collective set, the NECRMP point source inventory should represent the most suitable data base available for the intended application. However, as described in this volume, there are some residual problems with the data. Since the data exists in a single commonly formatted, easily updatable data

base, these residual deficiencies should not be irreparable. Rather, the NECRMP point source inventory can be utilized as a continuously maintainable "working" file of point source data independent from NEDS and, thus, not bound by the same requirements. However, if the states follow through and update NEDS to reflect the data supplied for NECRMP, the two data bases should eventually be compatible.

Area Source Inventory Quality

In general, the NECRMP area source inventories are suitable for further use in NECRMP modeling, although some problems exist. The most significant residual problem with the area source inventories is the use of composite categories. Since the temporal and organic species allocations are category-specific, these will adversely affect the NECRMP modeling. Disaggregated data were sought from the appropriate agencies in all instances. Should this information be made available in the future, the NECRMP area source files should be appropriately updated. Similarly, the interim file for West Virginia should be superseded by West Virginia's 1980 area source inventory when it becomes available.

A number of differences between NECRMP and NEDS have been noted above. The largest single source of difference appears to relate to differing interpretations of solvent sales data used by OAQPS to develop the emission factors in Procedures for the Preparation of Emissions Inventories for Volatila Organic Compounds--Volume I, Second Edition[19] and by NADB to estimate emissions in NEDS. These differences should be resolved internally within EPA and the NEDS and/or NECRMP VOC estimates adjusted accordingly. Many other differences between NEDS and NECRMP will be resolved if the states file updates to NEDS, to reflect the data supplied for the SIPs and NECRMP.

SUMMARY

An emission inventory is only a compilation of estimates and as such does not allow one to compare actual versus predicted values. Nevertheless, if proven and standard procedures are followed and the resulting data are subjected to logical quality assurance and validation checks, one can develop reasonable assurance that an inventory data base is reliable for the purposes intended.

In general, GCA believes that the NECRMP emission inventory is complete as is practicable given the resources available and the current distribution of responsibilities between EPA and the individual states. Known problems with data from specific states are discussed in Section 4. Undoubtedly additional errors remain and some sources may be omitted. Since the data base is commonly formatted and capable of continuous updates using existing EPA software, it is likely that some additional corrections may be warranted in the future. For example, through the modeling process itself, peculiar results will often surface which result in the identification of a missing source, or erroneous information on an included source. Additionally, some states are still working on revisions to their ozone SIP inventories, presumably reflecting newer, better data. These updates should also eventually be reflected in NECRMP.

It should be reiterated that an emission inventory can never be proven precise and accurate. The NECRMP inventory however, has undergone rigorous checks and validation efforts and we believe it to be capable of driving the ROM. Any errors or inconsistence identified can be subsequently corrected and available new data incorporated.

SECTION 1

INTRODUCTION

BACKGROUND

On a nationwide basis, nonattainment of the National Ambient Air Quality Standards (NAAQS) for ozone is one of the most serious and widespread air pollution problems facing the air quality management community. The Northeast Corridor, a megalopolis of urban and suburban areas extending from Washington, D.C. to Boston, bears a large extent of the ozone problem. The United States Environmental Protection Agency (USEPA), in cooperation with the northeastern states, local agencies, and Metropolitan Planning Organizations (MPOs), has undertaken the Northeast Corridor Regional Modeling Project (NECRMP) to develop regional and urban ozone control strategies through the use of photochemical air quality simulation models.

To employ a regional model, an inventory of point and area source emissions covering the entire NECRMP study area had to be assembled and placed into a common format. Unfortunately, existing data bases were inadequate to either properly test or validate a regional model. To this end, USEPA's Office of Air Quality Planning and Standards retained GCA/Technology Division to complete an annual inventory for use in NECRMP. The study area, shown in Figure 1, includes the entire northeast quadrant of the United States from longitude 69 degrees to 82 degrees West and latitude 38 degrees to 45 degrees North, plus the Ohio Counties of Franklin, Licking, Perry, and Fairfield. To accommodate these additional counties, the NECRMP grid system extends West to 84 degrees longitude.

OBJECTIVES

The objective of the effort reported in this volume was to compile and review the entire NECRMP emission inventory data base, evaluate its quality and comprehensiveness, and develop corrective measures in coordination with each state. Particular emphasis is placed on the suitability of the data for further temporal, spatial, and species resolution for subsequent use in a photochemical model of the entire 15 state* area. This inventory review document includes a summarization of point and area source emissions from each state and includes discussion of coverage and completeness of area sources, agreement with 1982 ozone State Implementation Plan (SIP) data bases,

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*For the purposes of this report, the District of Columbia is treated as a state equivalent.

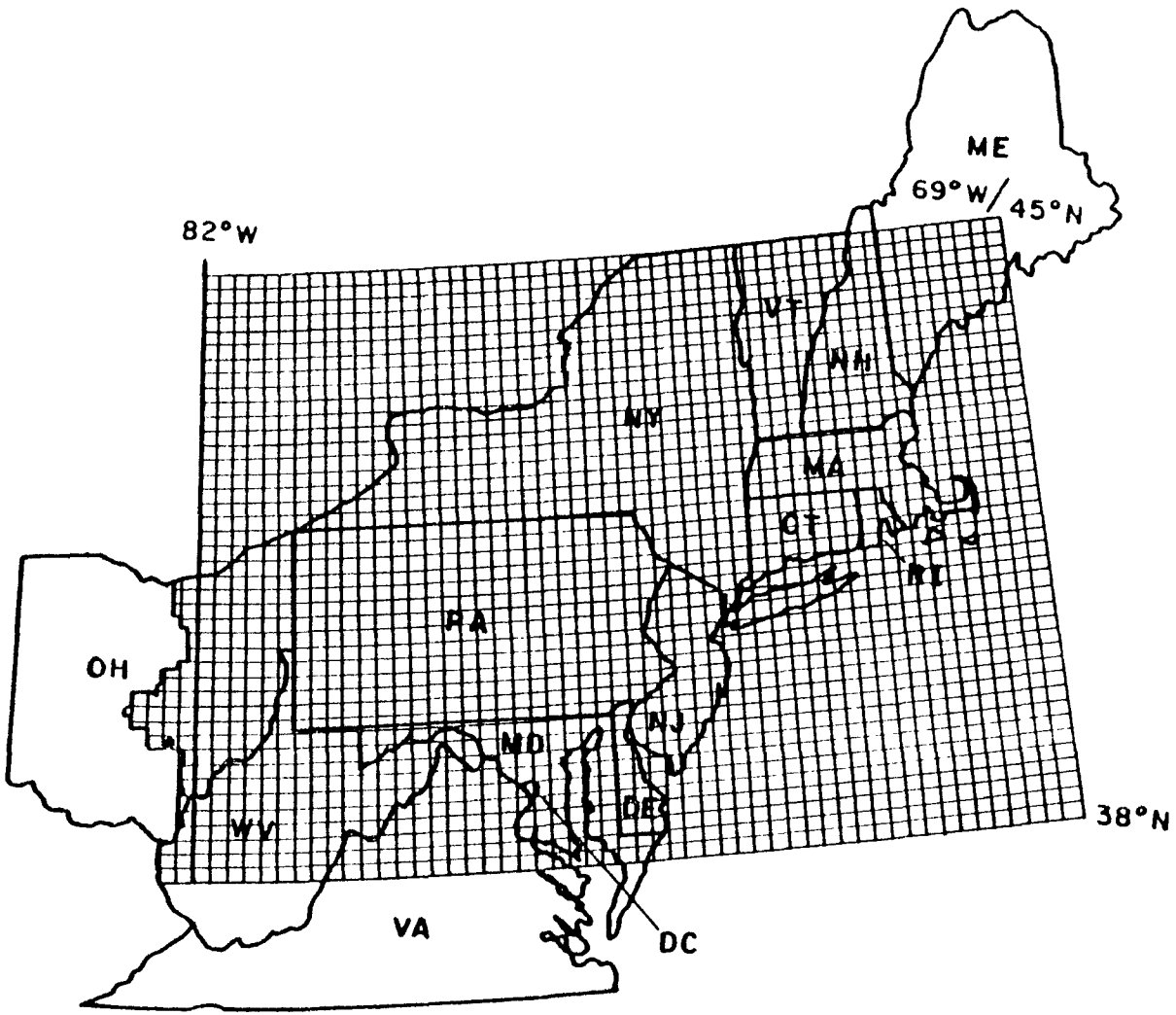

Figure 1. Boundaries of regional model grid system.

comprehensiveness and adequacy of point source data, and agreement with or deviation from other inventory totals in use. Included is a description of residual or ongoing data collection efforts occuring in each state, and the current and future availability of additional data from individual state agencies.

The major pollutants of interest were Volatile Organic Compounds (VOC) and Oxides of Nitrogen (NO_x) with carbon monoxide (CO) being included as a potentially important tracer. Particulate (TSP) and Oxides of Sulfur (SO_x) emissions were also included as available, but quality assurance efforts focused on VOC and NO_x. Thus, the quality of TSP, CO and SO_x emission data is generally undetermined. A higher emphasis for completeness and accuracy of data was placed on point sources with emissions of VOC greater than 500 tons/year and NO_x above 750 tons/year, as they are generally found to be responsible for a large portion of the total point source emissions and are likely to have a distinct and isolatable impact on photochemical modeling results. Sources exceeding the above cutoffs are considered "major" and will be handled as individual point sources by the Regional Model Data Handling System (RMDHS), although the NECRMP point source inventory generally includes all available data on point sources regardless of size. Point sources with emissions below the above cutoffs will be treated as area sources by the RMDHS system. Their spatial allocation to grid cells will be based on UTM coordinates.

AGENCY CONTACTS

Collection of raw emission inventory data is generally the responsibility of the individual states, who are required to annually supply data to EPA's National Emission Data System (NEDS), which is the national repository and data base upon which air quality analyses are performed. Due to conflicts in resources, priorities and differences in emphasis, not all states have kept their NEDS data files in a sufficiently detailed and up to date form for use in highly complex modeling exercises such as NECRMP. When it was determined that a data base of a more current and complete nature than available was required, it was necessary to identify the NECRMP effort as a state emphasis program. In addition to their regular grants, each state received funding for NECRMP emission inventory work and for responding to GCA's questions and comments relating to the inventory compilation and quality assurance efforts. In return, the states agreed to play a major role in the collection and correction of the data base.

Under previous work assignments,* EPA and GCA staff visited each of the involved EPA Regional Offices and the state agency offices. The objectives of the state meetings were to:

- determine state and local contacts who were to be actively involved in the regional emission inventory,

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*EPA Contract Number 68-02-3168, Work Assignments 1-3.

- determine if the needed data were available or the needed manpower, time, and resources for the states to provide EPA with a current, annual point and area source emission inventory in NEDS or EIS format had been committed, and

- determine if the manpower and costs associated with the liaison and assistance needed to support the NECRMP study were available and committed.

At the outset of this study, the EPA Project Officer provided agency contacts in the four EPA Regional Offices, 14 state agencies, and the District of Columbia, which resulted from the earlier meetings. These contacts, listed in Table 1, served as the source of initial inventory data in most instances, and assisted in a detailed review of the data for errors, inconsistencies, and missing elements.

REPORT ORGANIZATION

The results of the NECRMP annual emission inventory compilation effort are reported in an 18 volume set of documents. A directory of the NECRMP annual emission inventory reports is presented in Table 2. Volume I in this series describes the background of the program and discusses the methodologies used to compile and verify the annual emission inventory. Volumes II through XVI present a more detailed discussion of each state's inventory effort. Volume XVII describes the spatial, temporal, and species allocation factors developed to allow for the creation of modeler's tapes from the completed inventory. This volume, number XVIII, presents a summary of the point and area* source inventories for the entire study area. Also included is a detailed analysis of the overall quality of the data base and an assessment of the data's utility for photochemical modeling.

This volume consists of five sections plus an executive summary which preceeds this introduction. Section 2 summarizes point and area source emissions, by state, for the entire NECRMP study area. Section 3 discusses the techniques used to evaluate the quality of the emission data, and presents relative emission densities as a function of population and land area for VOC and NO_x. Section 4 presents a state by state review of the quality of the inventory data including identification of uncertainties, deficiencies, and recommendations for future improvements. All references cited in this volume are presented in Section 5.

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*For the purposes of this report, area sources include highway vehicles

TABLE 1. AGENCY CONTACTS FOR THE NECRMP ANNUAL EMISSION INVENTORY

EPA Region	State	Agency	Primary contact(s)
I	---	EPA/Region I	Besty Horne, John Courcier, Sarah Simon
	Connecticut	Department of Environmental Protection	Ron Freeto
	Maine	Department of Environmental Protection	Norm Anderson
	Massachusetts	Department of Environmental Quality Engineering	Robert Boiselle
	New Hampshire	Air Pollution Control Agency	Thomas Noel
	Rhode Island	Department of Environmental Management	Doug McVay
	Vermont	Agency of Environmental Protection	Harold Garabedian
II	---	EPA/Region II	George Kerr, Rob Predale
	New Jersey	Department of Environmental Protection	Raymond Dyba
	New York	Department of Environmental Conservation	Garry Neighmond
III	---	EPA/Region III	William Belanger, Neil Swanson, Israel Milner
	Delaware	Division of Environmental Control	Samuel Eaton
	Maryland	Bureau of Air Quality and Noise Control	Mario Jorquera
	Pennsylvania	Department of Environmental Resources	Dean Van Orden
	Virginia	State Air Pollution Control Board	William Erskine
	Washington, DC	Council of Governments	Kathy Bailey
	West Virginia	Air Pollution Control Commission	Ellen Shapiro
V	---	EPA/Region V	Ed Doty
	Ohio	Environmental Protection Agency	William Juris

TABLE 2. DIRECTORY OF THE NECRMP ANNUAL REGIONAL EMISSION INVENTORY REPORTS

Volume	Contents
I	Project Approach[1]
II	Connecticut Emission Inventory[2]
III	Delaware Emission Inventory[3]
IV	Maine Emission Inventory[4]
V	Maryland Emission Inventory[5]
VI	Massachusetts Emission Inventory[6]
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XIV	Virginia Emission Inventory[14]
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XVI	West Virginia Emission Inventory[16]
XVII	Development of Allocation Factors[17]
XVIII	Inventory Review and Evaluation

SECTION 2

EMISSIONS SUMMARY

INTRODUCTION

This section summarizes the Northeast Corridor Regional Modeling Project Annual Emission Inventory. Included are tables summarizing the original source of each state's emissions data and emission totals for point and area sources. Also included are summarizations of regionwide emissions by category.

DATA PROCUREMENT

Each state agency contact (see Table 1) was requested to provide that state's most current point source emission inventory in computer readable form. Data were accepted in NEDS, EIS/P&R, or EIS/PS format. A summary of the original procurements is presented in Table 3.

Two different approaches were used in compiling area source inventories, depending on whether the state had a current area source inventory (typically the case in ozone nonattainment areas) or not, in which case, GCA had to develop the inventory. Table 4 shows which states had a current area source inventory and for which states GCA developed the area source data.

EMISSIONS SUMMARY

Table 5 presents a summary of VOC and NO_x emissions, by state, for the entire NECRMP study area. Included in Table 5 are statewide summaries of point, area, and total emissions of VOC and NO_x. For Maine, Ohio, Virginia, and West Virginia, only the NECRMP study area portion of each state is reflected in the Table 5 emission levels.

For reporting purposes, regionwide point source emissions were aggregated into 70 emission categories. Aggregation of individual point sources was accomplished using a PL/1 computer routine which is described in Volume I.[1] The program screened each point source and allocated emissions into reporting categories based on the Source Classification Code (SCC) and Standard Industry Classification (SIC) associated with each point. The emission reporting categories include categories for which reasonably available control technology (RACT) requirements have been defined. In addition to "RACT" categories, the reporting categories include other source categories which were selected to facilitate reporting of emissions.

TABLE 3. SUMMARY OF POINT SOURCE DATA PROCUREMENT

State	Data source	Format	Date received (original submission)
Connecticut	Conn. Dept. of Environmental Protection	NEDS	10/81
Delaware	Delaware Div. of Environmental Control	EIS/P&R	5/81
Maine	Maine Dept. of Environmental Protection	NEDS	3/81
Maryland	Maryland Bureau of Air Quality and Noise Control	NEDS	8/81
Massachusetts	Mass. Dept. of Environmental Quality Engineering[a]	NEDS	9/81
New Hampshire	EPA/NADB	NEDS	5/81
New Jersey	New Jersey Dept. of Environmental Protection[b]	EIS/P&R	12/81
New York	New York Dept. of Environmental Conservation	NEDS	5/81
Ohio	GCA[c]	NEDS	1/82
Pennsylvania	Pennsylvania Dept. of Environmental Resources[b] and GCA (Allegheny County)[11]	EIS/P&R	9/81
Rhode Island	EPA/NADB	NEDS	3/81
Vermont	EPA/NADB	NEDS	5/81
Virginia	VA State Air Pollution Control Board	EIS/P&R	12/80
Washington, D.C.	D.C. Council of Governments	EIS/P&R	10/81
West Virginia	GCA[d]	NEDS	4/81[e]

[a]Through EPA/Region I.

[b]Via Engineering Science, Inc.

[c]Separate assignment, see Reference 10.

[d]From the Emissions Inventory for the SURE Region;[18] 1978 data.

[e]Reflects completion of the SURE Inventory,[18] which was utilized owing to the West Virginia Air Pollution Control Commission's inability to provide basic inventory data, despite earlier commitments. See Volume XVI.[16]

TABLE 4. SUMMARY OF AREA SOURCE INVENTORY DATA SOURCES

State	Source of Inventory
Connecticut	Connecticut Department of Environmental Protection
Delaware	GCA developed
Maine	Maine Department of Environmental Protection/GCA developed (category dependent)
Maryland	Maryland Bureau of Air Quality and Noise Control (nonattainment areas)/NUS Corp. (attainment areas)[a]
Massachusetts	Massachusetts Department of Environmental Quality Engineering
New Hampshire	GCA developed
New Jersey	New Jersey Department of Environmental Protection
New York	New York Department of Environmental Conservation
Ohio	GCA developed/Northeast Ohio Areawide Coordinating Agency (Cleveland area)
Pennsylvania	Pennsylvania Department of Environmental Resources
Rhode Island	Rhode Island Department of Environmental Management
Vermont	GCA developed
Virginia	Virginia State Air Pollution Control Board
Washington, D.C.	Washington Council of Governments[a]
West Virginia	GCA developed

[a]The area source data for the Maryland Counties of Montgomery and Prince George's were compiled by the Washington Council of Governments.

TABLE 5. STATEWIDE TOTALS OF AREA AND POINT SOURCE EMISSIONS OF VOC AND NO_x FOR THE NORTHEAST CORRIDOR STUDY REGION[a]

State	Emissions (tons/year)[b]					
	Area		Point		Total	
	VOC	NO_x	VOC	NO_x	VOC	NO_x
Connecticut	167,730	113,160	34,295	62,292	202,025	175,452
D.C.	21,309	15,684	1,952	6,345	23,261	22,029
Delaware	35,743	40,649	21,222	42,730	56,965	83,379
Maine	66,403	42,783	13,651	16,646	80,054	59,429
Maryland	197,699	156,845	77,557	138,095	275,256	294,940
Massachusetts	235,862	266,046	113,328	151,196	349,190	417,242
New Hampshire	59,187	45,306	21,041	49,206	80,228	94,512
New Jersey	415,035	348,568	158,228	204,844	573,263	553,412
New York	651,570	587,109	191,683	1,516,743	843,253	2,103,852
Ohio	379,588	432,098	85,452	310,576	465,040	742,674
Pennsylvania	465,776	491,114	264,054	538,019	729,830	1,029,133
Rhode Island	49,264	48,830	13,375	5,037	62,639	53,867
Vermont	33,551	25,791	4,921	1,595	38,472	27,386
Virginia	115,842	89,343	24,443	35,868	140,285	125,211
West Virginia	87,200	91,962	15,841	401,152	103,041	493,114
REGIONAL TOTALS	2,981,759	2,795,288	1,041,043	3,480,344	4,022,802	6,275,632

[a]Emission totals for Maine, Ohio, Virginia, and West Virginia reflect only the study area portion of each state.

[b]VOC emissions reflect totals reported by the respective states or MPOs. GCA made no adjustments to reported data to specifically reflect either total or reactive VOC. Generally evaporative sources reflect reactive VOC per EPA's policy summarized in Reference 19. Highway vehicle emissions generally consist of nonmethane VOC as generated by MOBILE1 or 2. Other combustion sources most often reflect total VOC emissions. State-specific deviations from the above are discussed in Section 4.

Table 6 presents a summary of regionwide point source emissions by reporting category. Summarization of each state's point source emissions into the same reporting categories as shown in Table 6 can be found in the individual state volumes of the NECRMP report.[2-16] For points with multiple SCCs, no attempt was made to split emissions into more than one category. In these instances, the primary SCC was used to account for all emissions at that point. It was further assumed that the first SCC listed in the point source record was the "primary" SCC.

The emission totals in Table 6 reflect 55,474 individual emission points representing more than 1,400 different source classifications (SCCs) at 12,657 facilities. However, a large portion of ozone precursor emissions occur within a few major categories as indicated in Table 7. These categories account for approximately 98 percent of the NO_x and 84 percent of the VOC emitted from point sources in the NECRMP region.

Table 8 presents area source emissions, by category, for the entire study region. Summaries of each state's area source emissions by category can be found in the individual state volumes of the NECRMP report.[2-16] As can be derived from Table 8, ten major classifications of area source emissions account for over 82 percent of the total area source VOC and over 86 percent of the NO_x in the NECRMP Study Region. These area source classifications are summarized in Table 9.

TABLE 6. NECRMP POINT SOURCE EMISSIONS BY REPORTING CATEGORY

	Category*	Emission points	Primary SCC Emissions (tons/year)				
			TSP	SO_2	NO_x	VOC	CO
1	Oil and Gas Production & Processing	0	0	0	0	0	0
2	Syn. Organic Chem. Storage & Transfer	54	9	0	0	70	0
3	Gasoline and Crude Oil Storage	534	0	0	100	16875	0
4	Ship and Barge Transfer of VOC	6	0	0	0	9549	0
5	Barge and Tanker Cleaning	14	0	0	0	883	0
6	Bulk Gasoline Terminals	438	51	0	0	25580	0
7	Gasoline Bulk Plants	54	0	0	0	937	0
8	Tank Truck Loading	252	655	0	4	22066	0
9	Service Station Loading (Stage I)	24	0	0	0	227	0
10	Service Station Unloading (Stage II)	3	7	0	6	16	0
11	Others-(Storage, Transp., Mkt of VOC)	1176	1508	0	7	17968	0
12	Lube Oil Manufacture	52	319	6306	51	2038	0
13	Petroleum Refineries	341	5945	77625	26422	76158	57871
14	Pharmaceutical Manufacture	274	4718	113	112	1107	188
15	Textile Polymers & Resin Manufacture	1386	44645	656	27	12937	6
16	Synthetic Fiber Manufacture	77	128	0	0	3564	1
17	Organic Chemical Manufacture	608	2924	4578	188	2570	1115
18	Inorganic Chemical Manufacture	777	43891	149336	1781	2543	7524
19	Fermentation Processes	36	74	27	5	131	0
20	Vegetable Oil Processing	0	0	0	0	0	0
21	Plastic Products Manufacture	308	180	0	6	3622	0
22	Rubber Tire Manufacture	242	245	0	0	2206	0
23	SBR Rubber Manufacture	59	257	0	0	889	0
24	Other Chemical Manufacture	3675	26048	33054	6535	35997	59239
25	Iron and Steel Manufacture	2438	103029	142038	27578	45470	842273
26	Tobacco Products	2	4	0	0	0	0
27	Food Products	944	10043	831	396	1326	22
28	Textile Mill Products	378	1639	0	10	9877	1
29	Lumber and Wood Products	452	3784	587	4	254	0
30	Paper and Allied Products	123	2498	2133	1394	120	9685
31	Stone, Clay, Glass, Concrete	5606	124716	146358	39657	10439	21553

(continued)

TABLE 6 (continued)

	Category*	Emission points	Primary SCC Emissions (tons/year) TSP	SO_2	NO_x	VOC	CO
32	Primary & Secondary Metals & Electrical	2047	23707	220877	3978	6112	4755
33	Fabricated Metal Products	1855	92841	39	68	3226	12
34	In-Process Fuel Use	1340	3997	17425	5729	133044	74212
35	Others - (Industrial Processes)	7312	62168	19747	15913	185793	35257
36	Adhesives	102	0	0	3	15430	0
37	Ind. Sfc. Coating-Large Appliances	5	4	0	0	42	0
38	Ind. Sfc. Coating-Magnet Wire	53	0	0	0	1177	0
39	Ind. Sfc. Coating-Automobile	238	659	0	0	22378	0
40	Ind. Sfc. Coating-Cans	201	66	0	5	23122	0
41	Ind. Sfc. Coating-Metal Coils	15	1	0	0	14733	0
42	Ind. Sfc. Coating-Paper	153	2	0	0	14310	0
43	Ind. Sfc. Coating-Fabric	81	954	0	0	11417	0
44	Ind. Sfc. Coating-Misc. Furniture	10	5	0	0	267	0
45	Ind. Sfc. Coating-Metal/Wood Products	297	28	0	0	10059	0
46	Plastic Parts Painting	42	32	0	0	3630	0
47	Large Ship Coating	18	133	0	0	1171	0
48	Large Aircraft Coating	38	0	0	0	273	0
49	Ind. Sfc. Coating-Misc. Metal Products	973	520	9	821	32092	6
50	Others - (Industrial Surface Coating)	644	236	1	14	44788	101
51	Degreasing	398	2	0	0	20851	0
52	Dry Cleaning	82	0	0	6	1278	0
53	Graphic Arts	358	81	0	0	50274	0
54	Other - (Solvent Use)	66	31	0	0	1244	0
55	Architectural Coatings	1	0	0	0	84	0
56	Auto Refinishing	12	13	0	0	149	0
57	Others-(Non-Industrial Surface Coating)	64	7	0	1	399	0
58	Ext. Comb. Boilers-Elec. Generation	809	387841	5828607	2769135	39595	162742
59	Ext. Comb. Boilers-Industrial	7431	178574	1319708	434892	45997	63037
60	Ext. Comb. Boilers-Comm/Inst	7698	57986	138651	60873	2604	9135
61	Ext. Comb. Space Heaters-Indust.	165	3515	36156	8184	1764	43315
62	Ext. Comb. Space Heaters-Comm.	26	366	4706	2591	145	718

(continued)

TABLE 6 (continued)

	Category*	Emission points	Primary SCC Emissions (tons/year) TSP	SO_2	NO_x	VOC	CO
63	Others-(Fuel Combustion)	442	3774	23645	9447	17389	10458
64	Solid Waste Disposal-Govt.	165	6936	2509	3274	2937	29957
65	Solid Waste Disposal-Comm/Inst	756	307	804	1067	1054	3482
66	Solid Waste Disposal-Industrial	346	1259	662	535	723	3862
67	Other Solid Waste Disposal	13	656	170	0	135	0
68	Waste Solvent Recovery Processes	218	6	0	6	19809	0
69	Stationary Internal Combustion Engines	565	9354	14382	59519	5379	29208
70	Not Classified	102	50	0	0	750	0
	Study Area Totals	55474	1213428	8191740	3480344	1041043	1469735

*In many cases, sources in these categories exist but are treated as area sources instead of point sources. This is particularly true for categories 2-11, 37-57, and 64-67. Under ideal circumstances, all sources would be considered as point sources.[19] It was GCA's policy to include all point source data available from the states regardless of how low the point source "cutoff level" was. Overlapping area source categories were carefully "balanced" against the point source totals to avoid double accounting of emissions (see References 1,19). The single exception to this approach was New Jersey.[8] NJDEP scaled up its 1982 SIP area source inventory to include emissions from <100 TPY VOC sources in SICs 20 to 39. Thus, the point and area source inventories reflect a "balance" (i.e., no double accounting of emissions) only if >100 TPY facilities are included in the point source inventory. To reflect this balance in the NECRMP inventory, GCA screened the point source inventory deleting <100 TYP sources of VOC. The point source data for New Jersey reflect the highest point source cutoff level in the NECRMP inventory.

TABLE 7. MAJOR CATEGORIES OF OXIDANT PRECURSOR EMISSIONS FROM POINT SOURCES IN THE NECRMP REGION

Emission Category	Percent of Point Source Oxidant Precursor Emissions	
	NO_x	VOC
Gasoline Handling	< 0.1	4.7
Petroleum Refinery	0.8	7.3
Misc. Chemical Manufacture	0.2	3.5
Iron & Steel Manufacture	0.8	4.4
Stone, Glass, Clay and Concrete	1.1	1.0
In-Process Fuel Use	0.2	12.8
Other Industrial Processes	0.5	17.8
Industrial Surface Coating	< 0.1	17.2
Degreasing	0.0	2.0
Graphic Arts	0.0	4.8
External Combustion Boilers		
- Electric Generation	79.6	3.8
- Industrial	12.5	4.4
- Commercial/Institutional	1.7	0.3

TABLE 8. NECRMP AREA SOURCE EMISSIONS BY CATEGORY

EIS/AS Category Number	Category Description	Annual Emissions (tons/year) VOC	Annual Emissions (tons/year) NO_x
001	Stage I Gasoline Evaporation	79,774	0
002	Stage II Gasoline Evaporation	121,240	0
003	Storage Tank Breathing	12,511	0
004	Gasoline Loading/Transit	44,561	0
005	Small Industrial/Commercial Degreasing	105,047	0
006	Dry Cleaning	40,848	0
007	Architectural Surface Coating	145,651	0
008	Auto Body Refinishing	57,235	0
009	Small Industrial Surface Coating	139,944	0
010	Graphic Arts	26,231	0
011	Commercial/Consumer Solvent Use	198,844	0
012	Cutback Asphalt Application	54,811	0
013	Pesticides	24,153	0
014	On-Highway Light Duty Vehicles	1,063,448	1,005,785
015	On-Highway Light Duty Trucks - Class I	112,544	102,675
016	On-Highway Light Duty Trucks - Class II	69,721	64,614
017	On-Highway Heavy Duty Gas Trucks	124,903	137,504
018	On-Highway Heavy Duty Diesel Trucks	57,103	421,473
019	On-Highway Motorcycles	11,905	6,472
020	Residential Anthracite Coal	6,284	7,138
021	Residential Bituminous Coal	678	498
022	Residential Residual Oil	246	11,817
023	Residential Distillate Oil	4,781	82,848
024	Residential Natural Gas	4,761	60,144
025	Residential LPG	134	1,437
026	Residential Wood	2,976	769
027	Commercial/Institutional Anthracite	300	8,678
028	Commercial/Institutional Bituminous	513	1,629

(continued)

TABLE 8 (continued)

EIS/AS Category Number	Category Description	Annual Emissions (tons/year) VOC	Annual Emissions (tons/year) NO_x
029	Commercial/Institutional Residual Oil	977	54,213
030	Commercial/Institutional Distillate Oil	1,167	40,861
031	Commercial/Institutional Natural Gas	1,630	29,266
032	Commercial/Institutional LPG	32	549
035	Industrial Bituminous	8,403	126,763
036	Industrial Residual Oil	368	22,253
037	Industrial Distillate Oil	560	14,951
038	Industrial Natural Gas	11,885	62,305
039	Industrial LPG	12	440
040	Industrial Wood/Other	17	500
041	Military Aircraft	12,117	6,123
042	Civil Aircraft	4,529	632
043	Commercial Aircraft	15,599	17,213
044	Railroad Locomotives	25,492	100,320
045	Gasoline Powered Vessels	63,372	16,994
046	Distillate Oil Powered Vessels	1,987	9,651
047	Residual Oil Powered Vessels	3,460	3,726
048	Off-Highway Vehicles - Gas	47,012	34,710
049	Off-Highway Vehicles - Diesel	20,582	219,166
050	On-Site Incineration	19,386	2,691
051	Open Burning	98,220	17,668
052	Structural Fires	15,855	3,274
053	Field/Slash Burning	8,308	1,380
054	Forest Fires	6,538	925
055	On-Highway Vehicles (composite)[a]	103,104	95,233
STUDY AREA TOTALS		2,981,759	2,795,288

[a]During development of the Connecticut Area Source inventory, vehicle class-specific emissions data were unavailable. Therefore, a composite category was utilized.

TABLE 9. MAJOR CATEGORIES OF OXIDANT PRECURSOR EMISSIONS FROM AREA SOURCES IN THE NECRMP REGION

Emission Category	Percent of Area Source Oxidant Precursor Emissions	
	NO_x	VOC
Gasoline Marketing	0.0	8.7
Degreasing	0.0	3.5
Architectural Surface Coating	0.0	4.9
Commercial/Consumer Solvent Use	0.0	6.7
Highway Vehicles	65.6	51.8
Residential Distillate Oil	3.0	0.2
Industrial Bituminous	4.5	0.3
Railroad Locomotive	3.6	0.9
Off Highway Vehicles	9.1	2.3
Open Burning	0.6	3.3

SECTION 3

EVALUATION TECHNIQUES

INTRODUCTION

This section describes the techniques used to evaluate the quality of the NECRMP emissions data. Included are discussions of how the NECRMP data were compared with inventories filed by each state in support of State Implementation Plan (SIP) submittals and data contained in the National Emission Data System (NEDS). Also provided in this section are tabular and graphic portrayals of emission densities of volatile organic compounds (VOC) and oxides of nitrogen (NO_x) expressed both in terms of population and land area. Ratios of emissions (VOC/NO_x) are also provided for a number of emission categories, by state, to identify possible anomalies.

SIP COMPATIBILITY REVIEW

A review was made of all 1982 ozone State Implementation Plans (SIP) available for ozone nonattainment areas within the NECRMP region. In most instances, the NECRMP emission data were obtained directly from the same state agencies who were simultaneously developing the SIP inventories. GCA reviewed the state-supplied data and, to the maximum extent possible, worked directly with each state to resolve problems. Further, each state received funding for NECRMP liaison activities, in addition to their regular grants, and were obligated to inform GCA of any changes made to their emission inventories after they were supplied to GCA. In theory, then, the SIP and NECRMP inventories should agree for all ozone nonattainment areas within the study region, however, this is not always true. In some instances, certain states made significant changes to their SIP data either without notifying GCA or after the respective NECRMP inventory had been completed. In fact, as of this writing, some states are still actively modifying SIP inventory submittals. In other cases, entire area source categories had been omitted by some states, and to maintain uniformity and completeness across the entire NECRMP region, GCA estimated emissions from these apparently omitted categories. Some states supplied GCA with computerized point source inventories which bore little or no resemblance to the point source data reported in the hard-copy SIP inventories.

While there is only one "correct" inventory for a given area, use of different methods, assumptions, and data sources can yield greatly differing results. To avoid inter-state biases introduced as a result of the employment of different inventory methods, the NECRMP inventories were compiled and verified using a single standard set of methods. Deviations from the standard

methods or emission factors were brought to the attention of the appropriate state agency for reconsideration. While one objective of NECRMP was to ensure consistency from state to state, it was also the objective to ensure consistency between the SIP and NECRMP inventories. There were, of course, instances when these priorities conflicted. These cases were resolved individually. Deviations from the standard set of methods are documented in the individual state volumes.[2-16]

The SIP requirements entailed reporting (hard copy) reactive VOC and NO_x emissions on a daily basis for a typical summer weekday to support SIP-required attainment demonstration (e.g., using EKMA). The NECRMP inventory required annual emissions reflecting total VOC and NO_x in computerized form for further temporal, spatial, and reactivity resolution to be used in EPA's Eulerian Regional Oxidant Model (ROM). Because of these differing requirements and issues of timing and availability, the SIP inventories were not directly used in NECRMP. However, the NECRMP inventories were compared with the SIP inventories to identify major differences for possible future resolution.

Since the SIP inventories seldom reported annual emissions and/or the temporal factors from which daily emissions were derived, direct comparisons with the NECRMP inventories were not possible within the time and resource limitations of this project. To attempt some comparison, the approach taken was to convert the SIP-reported emissions from kg/day to tons/year using a conversion factor based on 365 days/year. An exact match would not be expected since the SIP inventory totals were adjusted to reflect emissions on a typical summer weekday rather then an average annual basis. Also, no attempt was made to adjust the SIP-reported reactive VOC totals to reflect total VOC as is represented by the NECRMP totals. However, if the adjusted totals were within approximately 10 percent of each other, they were considered to "match". Regardless of how close the inventory totals are, all known differences are identified and evaluated in the state by state review of data quality that can be found in Section 4.

NEDS COMPATIBILITY REVIEW

States are required to annually supply updated emissions data to EPA's National Emission Data System (NEDS) which is the national repository and data base upon which many air quality analyses are based. Due to conflicts in resources, priorities, and differences in emphasis, not all states have kept their NEDS files sufficiently detailed and up-to-date for use in modeling analyses as complex as NECRMP. Since the NECRMP, NEDS, and SIP inventories are all based on state supplied data, in theory, all three data bases should agree. However, since EPA negotiated with each of the states in the study area to provide increased assistance and priority to GCA's questions and comments relating to the compilation and quality assurance of the data base, it is believed that overall the NECRMP inventory represents the most suitable emissions data for the intended application.

Unfortunately, the degree of cooperation of some of the states in the NECRMP region was less than ideal. Thus, for certain individual sources or area source categories, the data contained in NEDS may actually be more

representative of the actual level of emissions. It is useful, then, to compare data contained in NEDS with the SIP and NECRMP data to identify areas of disagreement for future resolution. Tables 10 and 11 present comparisons for each major SIP area of the NEDS, SIP, and NECRMP data bases for VOC and NO_x, respectively. Statewide or study area totals from NEDS are compared to the NECRMP data in Tables 12 and 13 for VOC and NO_x, respectively.

As shown in Table 10, the NECRMP VOC emission estimates generally agree with the SIP totals for the 13 SIP areas in the study region. The totals for all 13 SIP areas for NECRMP are within <1 percent of the reported SIP values. The NEDS emission estimates for the same areas are 47 percent higher than those reported in the SIPs.

As shown in Table 11, the NECRMP emission estimate for NO_x, across all 13 SIP areas, is approximately 25 percent higher than those reported in the SIPs, while the NEDS data are approximately 13 percent lower. The majority of this difference can be attributed to the NECRMP point source inventory for New York. As is discussed in greater detail in Section 4, the reported NECRMP electric utility emissions for New York are higher than those reported in NEDS by almost a factor of 7. For reasons discussed in Section 4, the utility emissions reported in NEDS are believed to be more accurate than those reported in NECRMP. Further, it is recommended that the NEDS estimates for utilities be substituted for the NECRMP estimates in New York. If so adjusted, the NECRMP NO_x total for the 13 SIP areas would agree within less than 3 percent.

As shown in Tables 12 and 13, a number of large differences exist between the NEDS and NECRMP estimates of emissions by state. Major differences, or differences that apply to all states in the study region are discussed below. Differences that apply to individual states are discussed in Section 4.

As shown in Table 12 on a regionwide basis, point source VOC emissions reported in NEDS and NECRMP are reasonably consistent (NECRMP point source VOC is 5.5 percent lower). However, on an individual state basis, some large differences occur; these are discussed in Section 4.

For area sources, the NEDS VOC estimates are consistently much higher than those provided for NECRMP, although there are a couple of exceptions. Nearly all of the difference in area source VOC emissions can be attributed to evaporative VOC emissions from organic solvent use. This occurs primarily because GCA and the states utilize methodologies consistent with the EPA Guidelines, which do not consider all of the identified industrial end uses of organic solvent given in Table 4 of End Use of Solvents Containing VOC (EPA-450/3-79-032)[20] as potentially being area sources, while NEDS does. In addition, the organic solvent when end use cannot be identified is all treated as area source emissions in NEDS. The assumption inherent in the Guidelines[19] is that all industry end users classified as "other" or "unidentified" will be completely accounted for in the point source inventory. Thus, on a regionwide basis, it would be expected that NECRMP point source VOC emissions would exceed NEDS point source totals. As shown in

TABLE 10. ANNUAL EMISSION (TONS) OF VOLATILE ORGANIC COMPOUNDS (VOC) FOR SELECTED SIP AREAS*

SIP Area	Annual Emissions (Tons) of VOC								
	Point			Area			Total		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Boston	76,883	41,039	68,901	312,231	177,311	145,867	389,114	218,350	214,768
Worcester	9,417	11,266	10,311	63,732	33,277	31,631	73,149	44,543	41,942
Springfield	20,981	17,703	20,987	56,163	33,647	34,583	77,144	51,350	55,570
Hartford	4,410	7,242	2,901	61,740	36,211	46,243	66,150	43,453	49,144
New Haven	28,317	10,058	22,934	57,530	30,176	37,826	85,847	40,234	60,760
Providence	14,613	16,094	13,375	87,594	51,500	49,264	102,207	67,594	62,639
New York	291,766	156,510	165,665	950,398	699,266	642,529	1,242,164	855,776	808,194
Allentown	6,869	6,035	7,444	39,201	17,703	18,897	46,070	23,738	26,341
Baltimore	62,231	49,890	72,691	152,793	78,054	90,806	215,024	127,944	163,497
Pittsburgh	29,405	24,543	28,750	152,299	124,726	122,448	181,704	149,269	151,198
Philadelphia	190,785	135,186	139,889	324,630	219,677	215,205	515,415	354,863	355,094
Washington, D.C.	3,923	4,023	7,056	141,962	119,093	120,230	145,885	123,116	127,286
Cleveland	110,948	26,152	29,768	163,029	143,233	120,242	273,977	169,385	150,010
ALL SIP AREAS	850,548	505,741	590,672	2,563,302	1,763,874	1,675,771	3,413,850	2,269,615	2,266,443

*SIP estimates converted to annual figures assuming 365 days per year. SIP numbers are subject to change. Data reflect latest information received by EPA as of 14 April 1983.

TABLE 11. ANNUAL EMISSIONS (TONS) OF NITROGEN OXIDES (NO_X) FOR SELECTED SIP AREAS

SIP Area	Annual Emissions (Tons) of NO_X								
	Point			Area			Total		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Boston	73,910	105,815	133,135	134,240	179,443	174,224	208,150	285,258	307,359
Worcester	2,050	80	2,662	24,622	26,957	28,972	26,672	27,037	31,634
Springfield	10,238	25,750	11,895	25,063	14,484	36,415	35,301	40,234	48,310
Hartford	7,843	8,047	5,219	27,988	27,761	31,483	35,831	35,808	36,702
New Haven	16,710	20,922	15,629	24,054	25,750	25,905	40,764	46,672	41,534
Providence	964	7,242	5,037	11,341	35,003	48,830	12,305	42,245	53,867
New York	201,619	236,576	689,888	403,084	479,588	501,710	604,703	716,164	1,191,598
Allentown	40,501	55,523	52,161	21,270	18,508	21,690	61,771	74,031	73,851
Baltimore	32,722	57,132	52,290	81,983	66,386	66,516	114,705	123,518	118,806
Pittsburgh	183,275	191,111	133,792	98,180	90,526	119,786	281,455	281,637	253,578
Philadelphia	105,864	146,049	141,759	199,241	179,443	208,303	305,105	325,492	350,062
Washington, D.C.	46,269	46,671	50,482	87,008	87,308	105,079	133,277	133,979	155,561
Cleveland	67,619	73,226	45,534	91,754	109,057	151,171	159,373	182,283	196,705
ALL SIP AREAS	789,584	974,144	1,339,483	1,229,828	1,340,214	1,520,084	2,019,412	2,314,358	2,859,567

TABLE 12. COMPARISON OF NEDS AND NECRMP EMISSIONS ESTIMATES FOR VOLATILE ORGANIC COMPOUNDS, BY STATE

State	Annual Emissions (Tons)					
	Point		Area		Total	
	NEDS	NECRMP	NEDS	NECRMP	NEDS	NECRMP
Connecticut	26,386	34,295	259,652	167,730	286,038	202,025
Washington, D.C.	901	1,952	43,284	21,309	44,185	23,261
Delaware	17,429	21,222	47,081	35,743	64,510	56,965
Maine*	12,718	13,651	54,172	66,403	66,890	80,054
Maryland	60,092	77,557	263,589	197,699	323,681	275,256
Massachusetts	101,681	113,328	445,041	235,862	546,722	349,190
New Hampshire	11,192	21,041	68,683	59,187	79,875	80,228
New Jersey	418,896	158,228	562,841	415,035	981,737	573,263
New York	34,264	191,683	989,101	651,570	1,023,365	843,253
Ohio*	163,460	85,452	474,441	379,588	637,901	465,040
Pennsylvania	182,428	264,054	830,342	465,776	1,012,770	729,830
Rhode Island	14,644	13,375	87,594	49,264	102,238	62,639
Vermont	4,171	4,921	35,562	33,551	39,733	38,472
Virginia*	17,157	24,443	115,775	115,842	132,932	140,285
West Virginia*	7,224	15,841	90,804	87,200	98,028	103,041
REGIONAL TOTALS	1,072,643	1,041,043	4,367,962	2,981,759	5,440,605	4,022,802

*Includes only study area portion of the state.

TABLE 13. COMPARISON OF NEDS AND NECRMP EMISSIONS ESTIMATES FOR NITROGEN OXIDES, BY STATE

State	Annual Emissions (Tons)					
	Point		Area		Total	
	NEDS	NECRMP	NEDS	NECRMP	NEDS	NECRMP
Connecticut	49,519	62,292	105,793	113,160	155,312	175,452
Washington, D.C.	6,363	6,345	21,682	15,684	28,045	22,029
Delaware	50,921	42,730	32,690	40,649	83,611	83,379
Maine*	11,462	16,646	31,010	42,783	42,472	59,429
Maryland	116,673	138,095	153,882	156,845	270,555	294,940
Massachusetts	89,621	151,196	183,930	266,046	273,551	417,242
New Hampshire	41,697	49,206	30,177	45,306	71,874	94,512
New Jersey	157,803	204,844	272,738	348,568	430,541	553,412
New York	336,563	1,516,743	426,567	587,109	763,130	2,103,852
Ohio*	301,615	310,576	290,622	432,098	592,237	742,674
Pennsylvania	626,011	538,019	503,869	491,114	1,129,880	1,029,133
Rhode Island	5,000	5,037	31,508	48,830	36,508	53,867
Vermont	866	1,595	43,023	25,791	43,889	27,386
Virginia*	30,354	35,868	79,858	89,343	110,212	125,211
West Virginia*	434,221	401,152	91,951	91,962	526,172	493,114
REGIONAL TOTALS	2,258,689	3,480,344	2,299,300	2,795,288	4,557,989	6,275,632

*Includes only study area portion of the state.

Table 12, this is clearly not the case. This result implies that either the methodology inherent in the Guidelines underestimates emissions from organic solvent use, or that NEDS includes emissions estimates from sources that do not really exist. Because of the magnitude of this discrepancy, it is recommended that the organic solvent data contained in End Use of Solvents Containing VOC[20] be reexamined with respect to the Guidelines[19] interpretation of these data.

As shown in Table 13, the NEDS and NECRMP NO_x emissions differ by over 1.7 million tons/year. Most of this difference is attributed to point sources. Specifically, over 1.1 million tons can be accounted for by electric generation sources in New York. Since the NEDS data on electric generation are annually updated based on DOE data (confirmed by E. H. Pechan estimates of SO_2 from electric utilities), independent of the states, it is most likely that the NEDS estimates, in this case, are correct and should be substituted for the NECRMP estimates for electric utility emissions. The NEDS and NECRMP estimates for electric utility emissions in New York are compared in Table 14.

TABLE 14. ELECTRIC UTILITY EMISSIONS IN NEW YORK

	Annual Emissions (1,000 tons) from Electric Utilities	
Pollutant	NECRMP	NEDS
TSP	81	112
SO_2	1,405	495
NO_x	1,340	188
VOC	21	1
CO	97	12

EMISSION DENSITIES

Emission densities for VOC and NO_x were calculated for each state or region within the NECRMP study area, both in terms of emissions per capita and emissions per square mile. Table 15 presents a summary of VOC and NO_x emissions per-capita for each state. Included are area source, point source, and total emissions expressed in tons per capita. Area source emissions would be expected to have little variability on a per-capita basis. As shown in Table 15, per-capita emissions for area sources of VOC range from 0.0334 tons/capita-year in the District of Columbia to 0.0744 tons/capita-year in Virginia, while per-capita emissions for area sources of NO_x range from 0.0246 tons/capita-year in the District of Columbia to 0.0738 tons/capita-year in Ohio.

TABLE 15. NECRMP STUDY AREA VOC AND NO_x EMISSIONS, BY STATE, AS A FUNCTION OF POPULATION (WITHIN STUDY AREA ONLY)

	Annual Emissions Per Capita (tons/capita-year)					
	Area		Point		Total	
State	VOC	NO_x	VOC	NO_x	VOC	NO_x
Connecticut	.0540	.0364	.0110	.0200	.0650	.0564
Washington, D.C.	.0334	.0246	.0031	.0100	.0365	.0345
Delaware	.0601	.0683	.0357	.0718	.0958	.1402
Maine	.0707	.0456	.0145	.0177	.0853	.0633
Maryland	.0471	.0374	.0185	.0329	.0656	.0703
Massachusetts	.0386	.0435	.0185	.0247	.0572	.0683
New Hampshire	.0644	.0493	.0229	.0535	.0873	.1028
New Jersey	.0564	.0473	.0215	.0278	.0778	.0751
New York	.0355	.0320	.0104	.0827	.0460	.1147
Ohio	.0648	.0738	.0146	.0530	.0794	.1268
Pennsylvania	.0393	.0414	.0223	.0453	.0615	.0867
Rhode Island	.0520	.0516	.0141	.0053	.0661	.0569
Vermont	.0656	.0504	.0096	.0031	.0752	.0536
Virginia	.0744	.0574	.0157	.0230	.0901	.0804
West Virginia	.0588	.0620	.0107	.2703	.0694	.3323
MEAN	.0543	.0481	.0162	.0494	.0705	.0975
STD. DEVIATION	$\pm$.0131	$\pm$.0134	$\pm$.0076	$\pm$.0655	$\pm$.0164	$\pm$.0712

As would be expected, when evaluated on a per-capita basis, point source emissions are somewhat more variable than area source emissions. Point source VOC emissions range from 0.0031 tons/capita-year in the District of Columbia to 0.0357 tons/capita-year in Delaware, while point source NO_x emissions range from 0.0031 tons/capita-year in Vermont to 0.2703 tons/capita-year in West Virginia.

The above analysis was performed primarily to identify potential anomolies in the emissions data. To identify "suspicious" values, the mean and standard deviation were calculated for VOC and NO_x for point, area, and total emissions. States whose per-capita emissions fell more than two standard deviations from the mean were identified for further investigation. All state area source per-capita emissions estimates were found to fall within two standard deviations from the mean indicating that no individual state values fall outside the range of values expected.

One state value, for Delaware, falls more than two standard deviations (2.57) from the per-capita point source VOC mean. For point source NO_x emissions, only one value for West Virginia falls outside of the expected range. These state values are discussed in greater detail in Section 4.

Emission densities were calculated as a function of land area, as presented in Table 16. Also shown in Table 16 are population densities for each state. It would be expected that population densities and emission densities would correlate well on a linear basis. Regression analyses for VOC and NO_x emission densities versus population densities were performed. As expected, population and emission densities showed a very strong correlation ($r^2 > 0.98$) for both VOC and NO_x emissions.

Emission densities, both as a function of population and land area are portrayed graphically in Figures 2 through 13.

PER CAPITA EMISSIONS FROM SELECTED AREA SOURCE CATEGORIES

Some area source categories (e.g., commercial/consumer solvent use, dry cleaning, etc.) are estimated based on population and a per-capita emission factor. Others are derived as a function of an activity rate (e.g., gasoline sales, vehicle miles of travel, etc). One evaluation measure applied to the NECRMP area source inventory data was to calculate emissions on a per-capita basis for certain area source categories that were not originally derived using per-capita emission factors. Three categories were selected for evaluation:

- residential fuel combustion,
- highway vehicles, and
- gasoline marketing.

TABLE 16. NECRMP STUDY AREA VOC AND NO_x EMISSIONS AS A FUNCTION OF LAND AREA (WITHIN STUDY AREA ONLY)

State	Annual Emissions (tons/square mile-year)						Population Density
	Area		Point		Total		
	VOC	NO_x	VOC	NO_x	VOC	NO_x	Capita/ sq. mi.
Connecticut	34.49	23.27	7.05	12.81	41.54	36.08	639
Washington, D.C.	349.33	257.11	32.00	104.02	381.33	361.13	9,788
Delaware	18.03	20.51	10.71	21.56	28.74	42.07	300
Maine	4.11	2.65	.85	1.03	4.96	3.68	58
Maryland	19.99	15.86	7.84	13.96	27.83	29.82	298
Massachusetts	30.13	33.99	14.48	19.32	44.62	53.31	781
New Hampshire	6.56	5.02	2.33	5.45	8.89	10.47	102
New Jersey	55.18	46.35	21.04	27.24	76.22	73.58	979
New York	13.62	12.27	4.01	31.71	17.63	43.99	384
Ohio	24.06	27.39	5.42	19.69	29.48	47.08	371
Pennsylvania	10.36	10.92	5.87	11.97	16.23	22.89	264
Rhode Island	46.96	46.55	12.75	4.80	59.71	51.35	903
Vermont	3.62	2.78	.53	.17	4.15	2.95	55
Virginia	8.93	6.89	1.88	2.77	10.81	9.65	120
West Virginia	4.37	4.60	.79	20.08	5.16	24.69	74

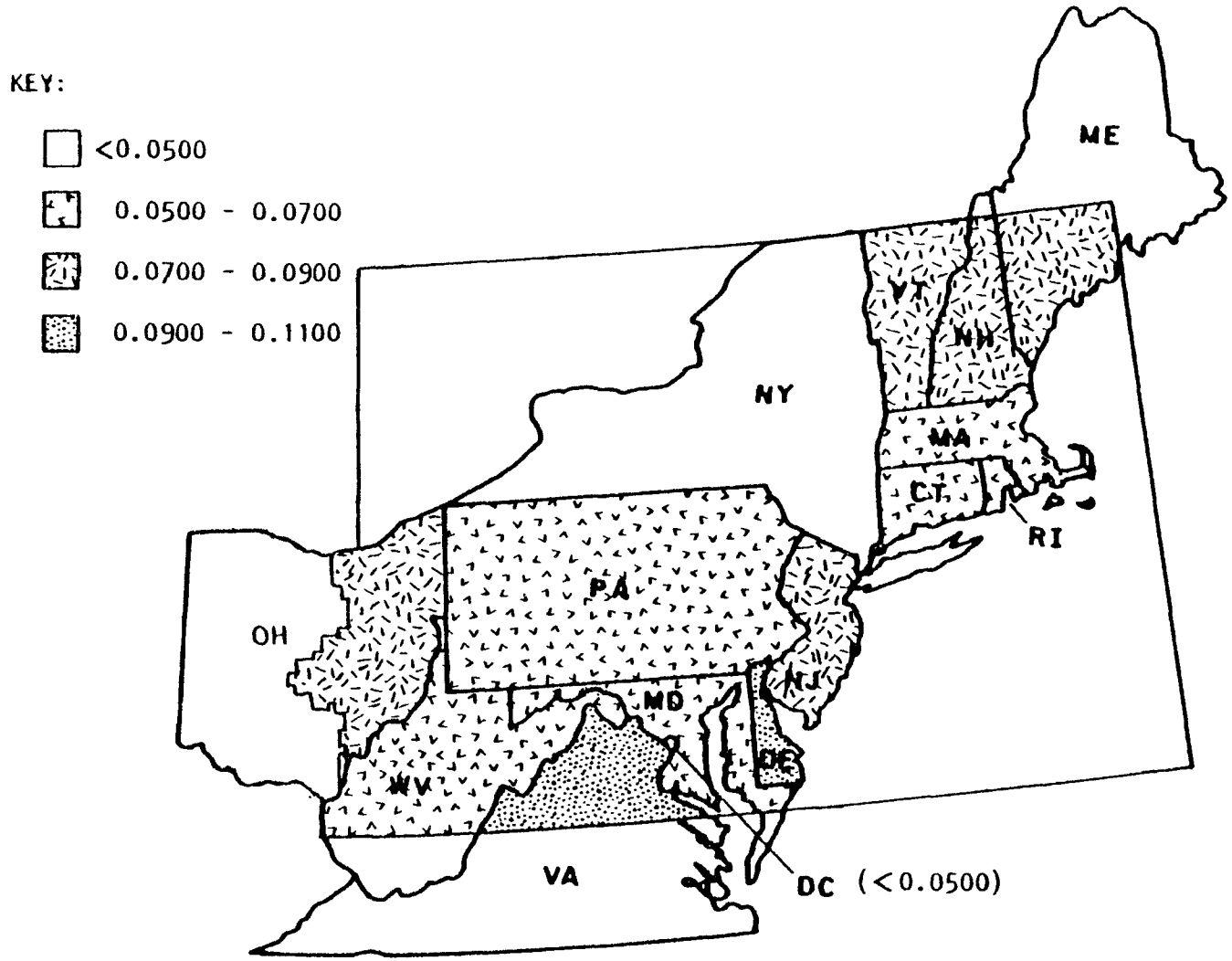

Figure 2. VOC point and area source emissions densities (tons/capita-year).

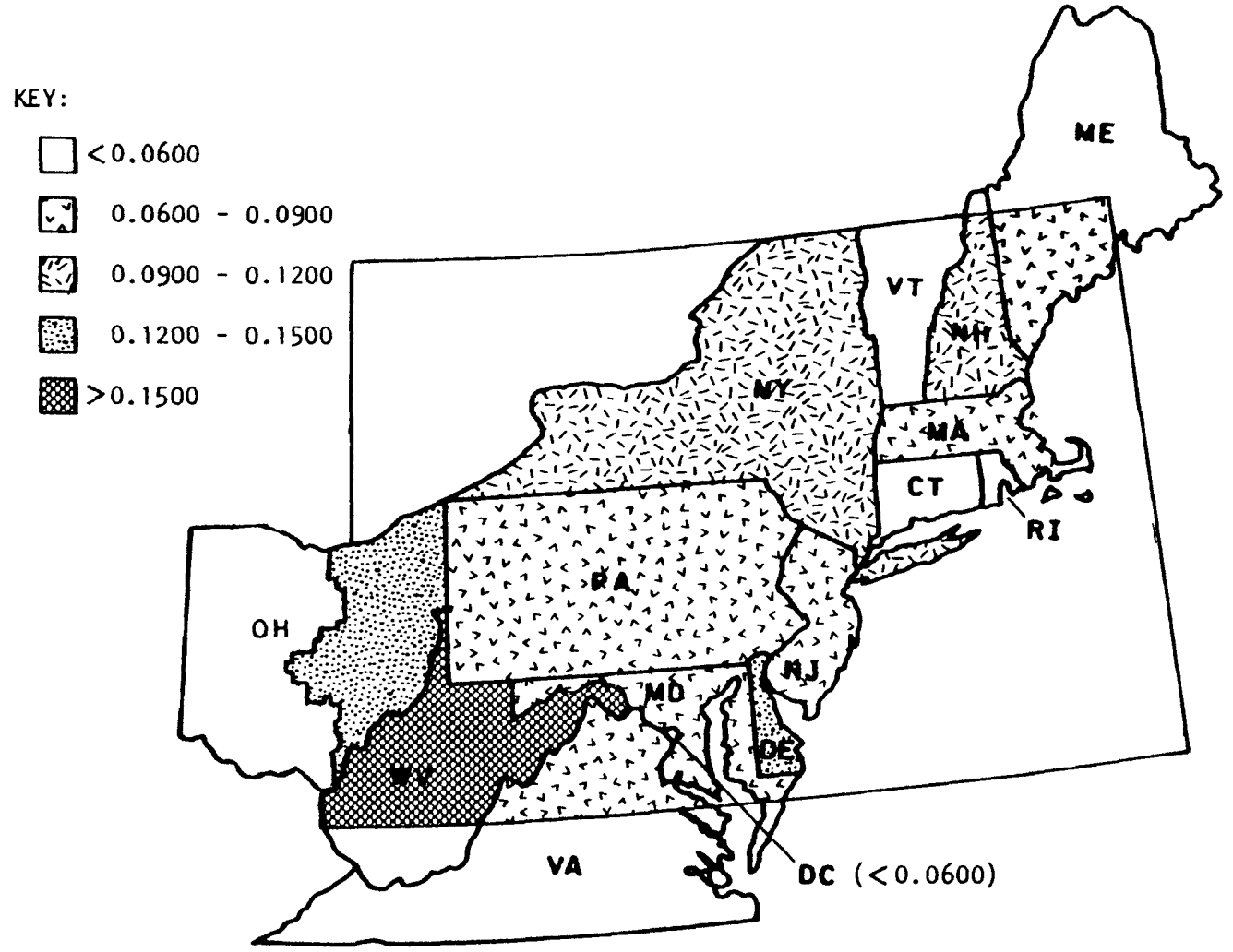

Figure 3. NO_x point and area source emission densities (tons/capita-year).

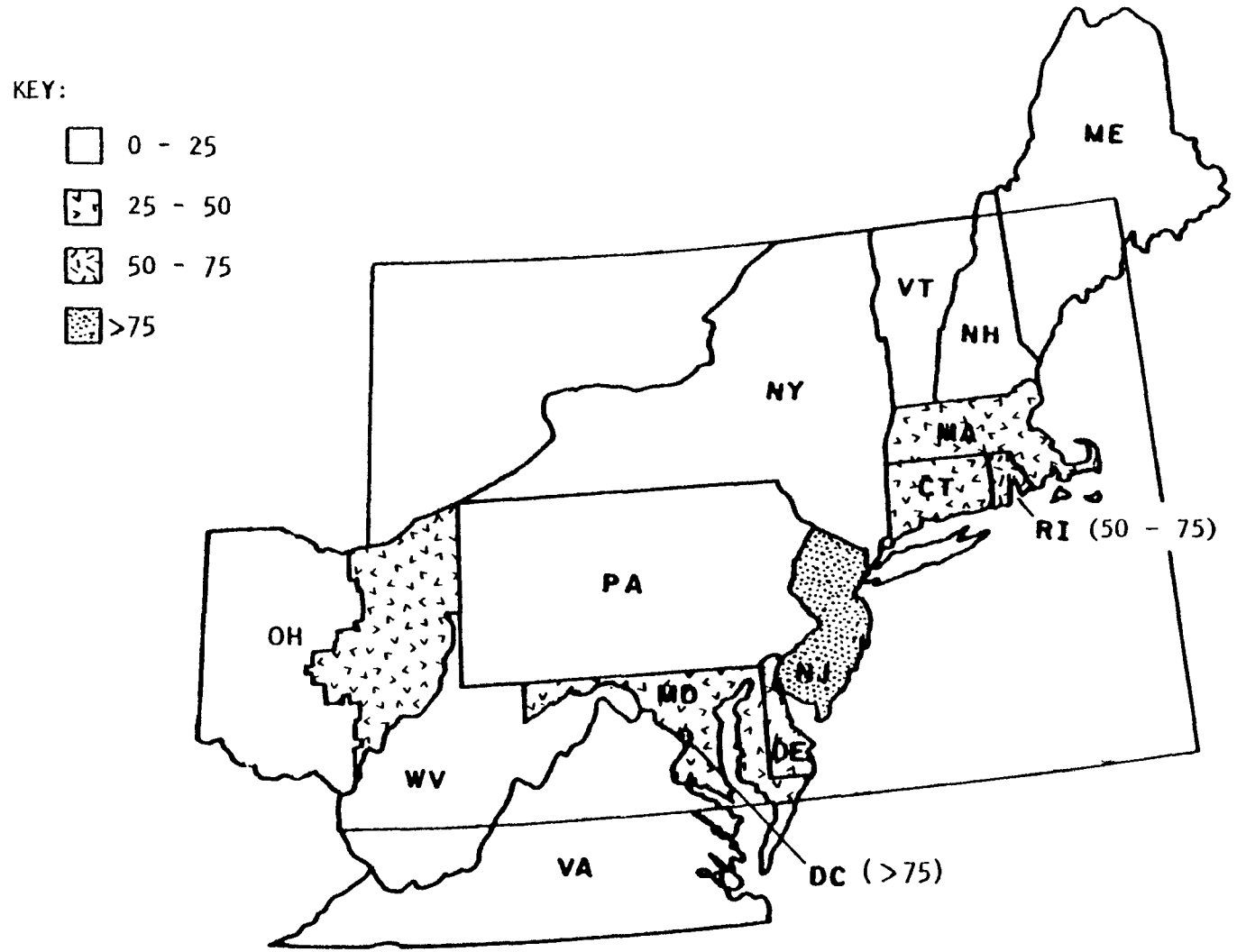

Figure 4. VOC point and area source emissions per area (tons/mi^2-year).

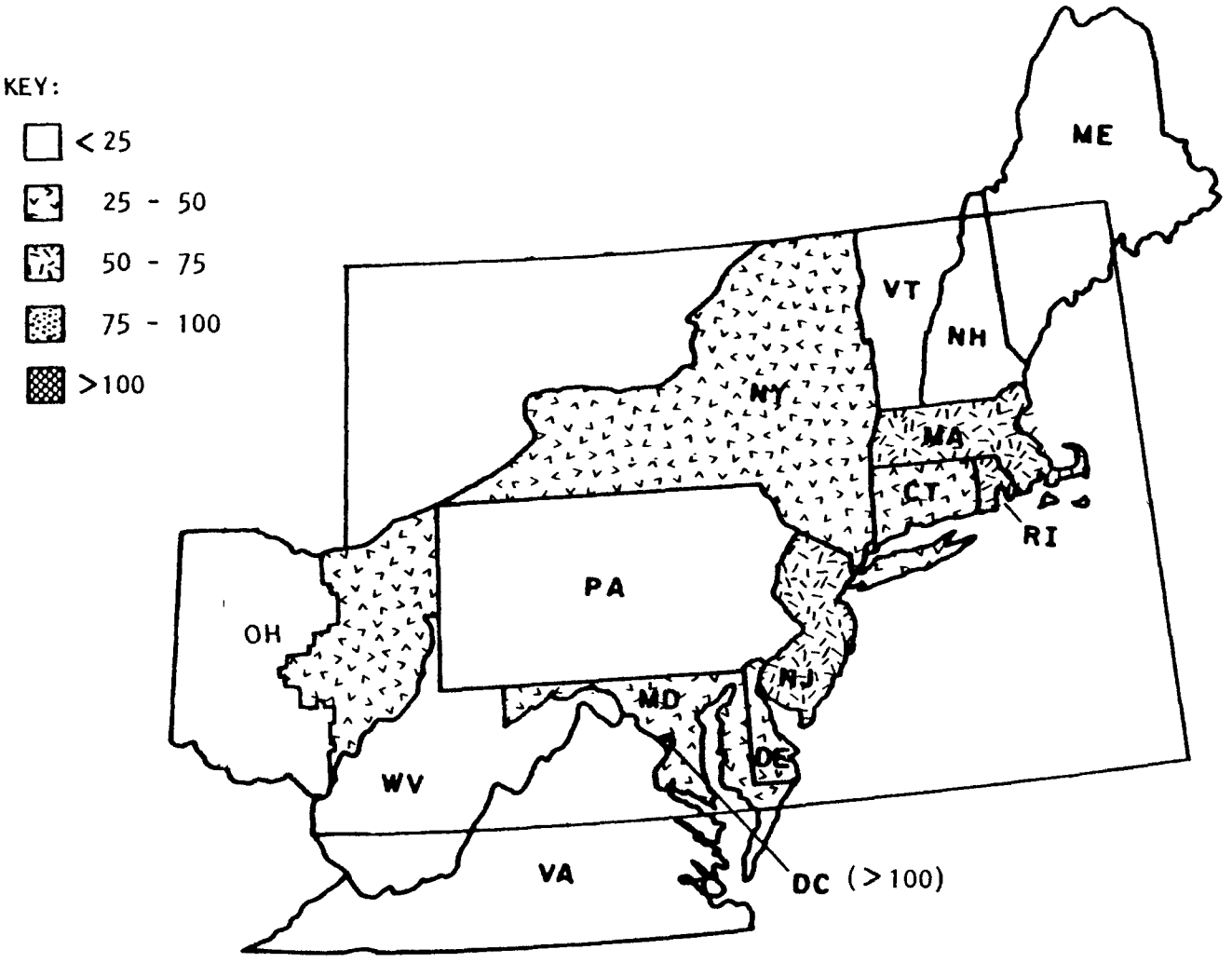

Figure 5. NO_x point and area source emissions per area (tons/mi^2-year).

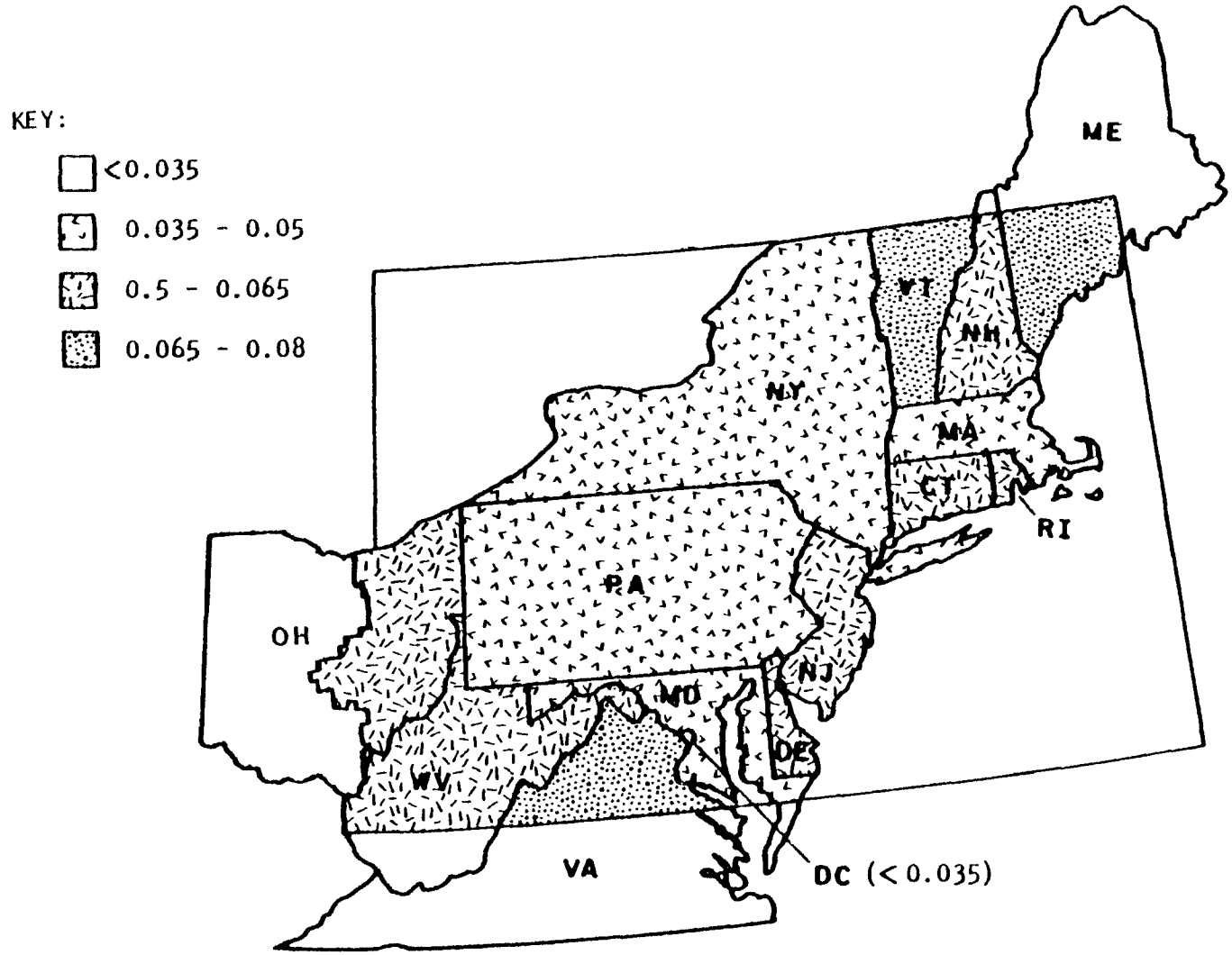

Figure 6. VOC area source emission densities (tons/capita-year).

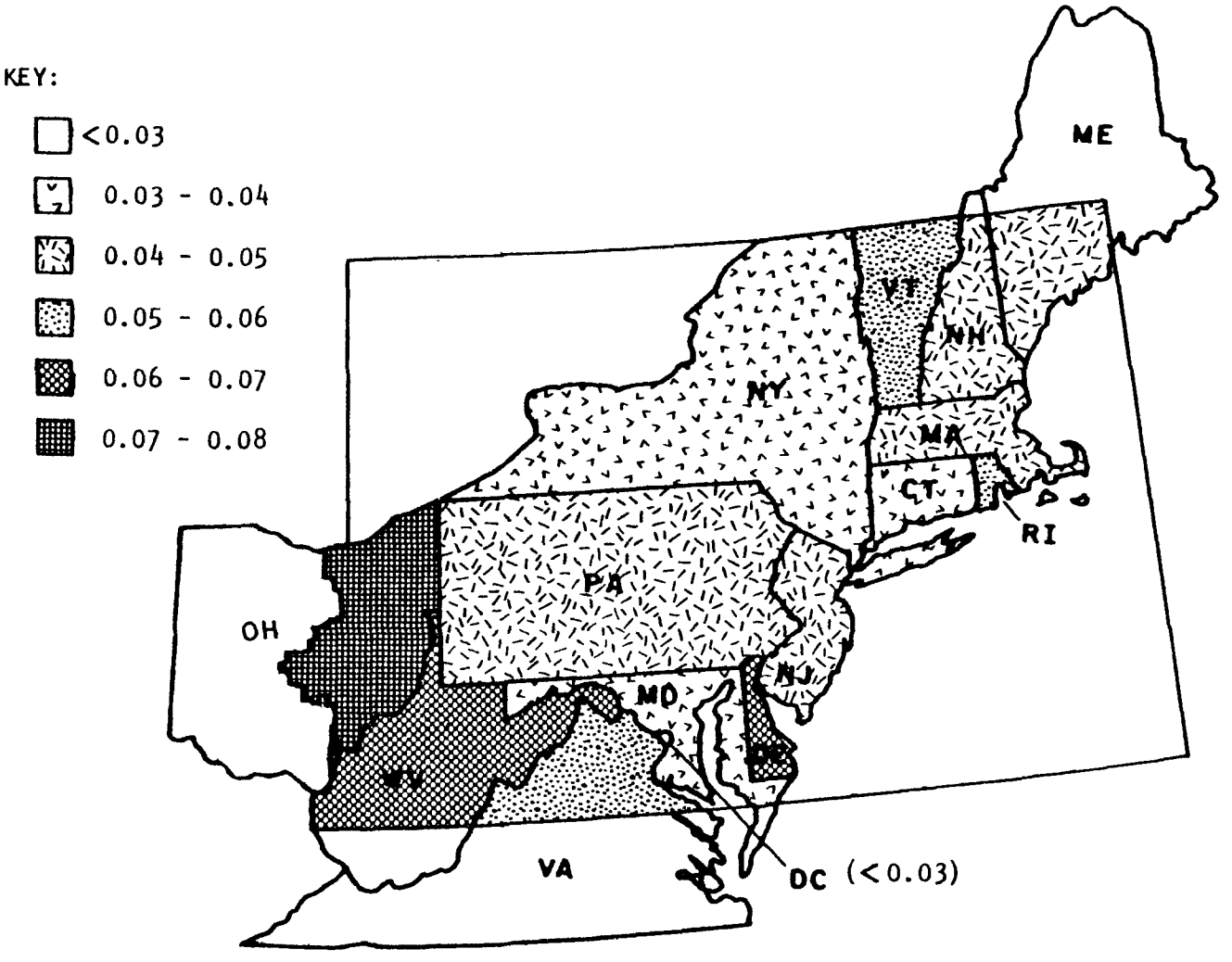

Figure 7. NOx area source emission densities (tons/capita-year).

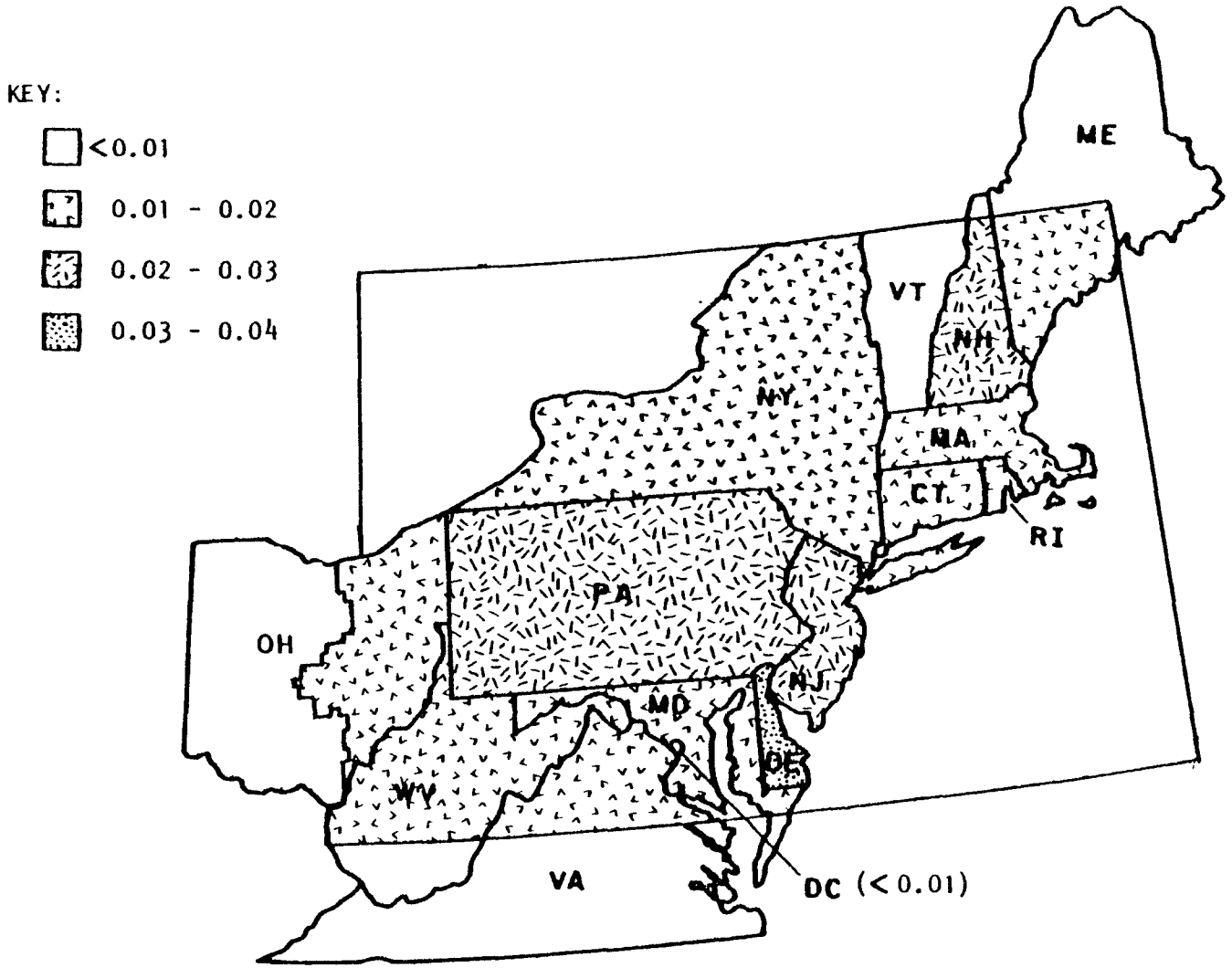

Figure 8. VOC point source emission densities(tons/capita-year).

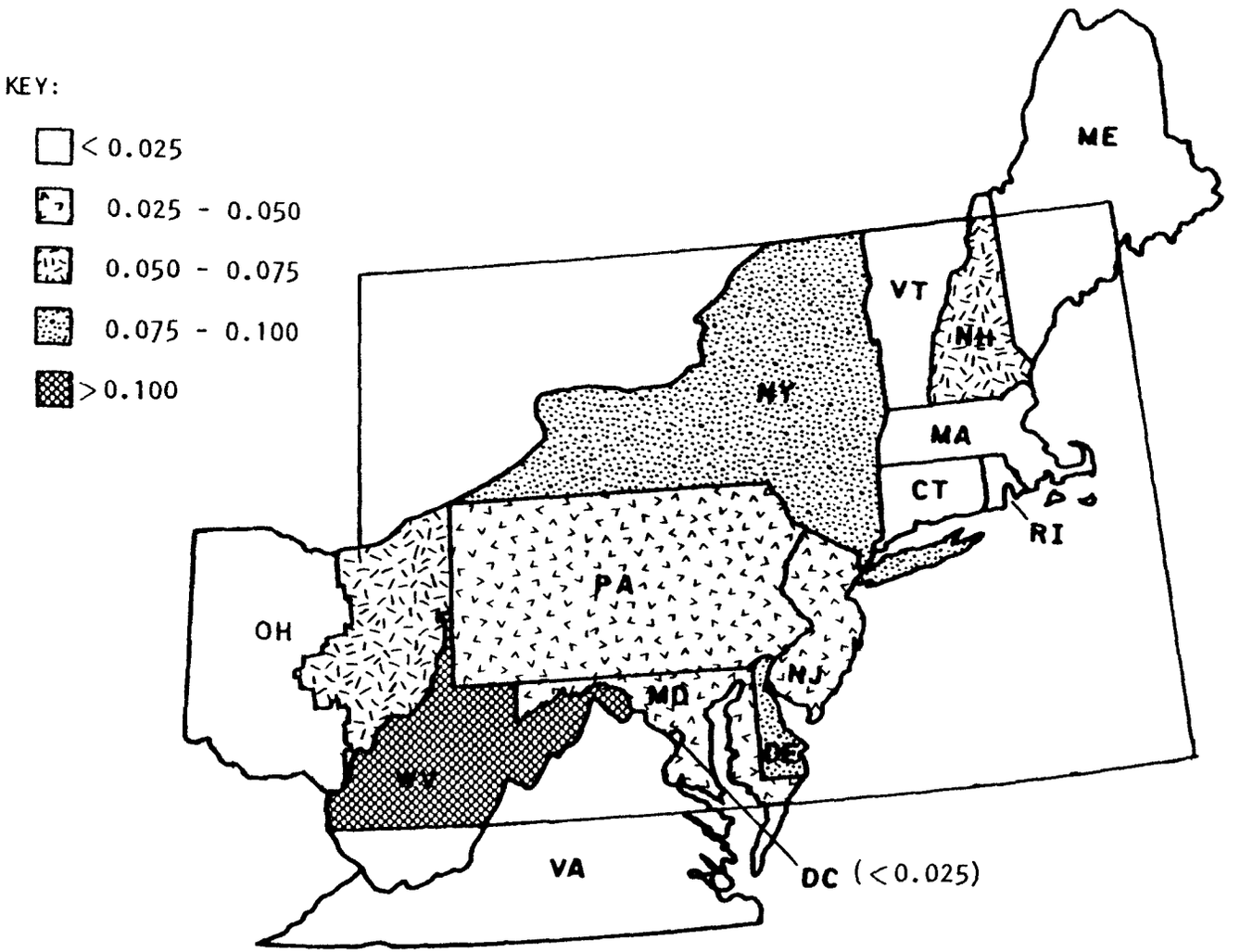

Figure 9. NO_x point source emission densities (tons/capita-year).

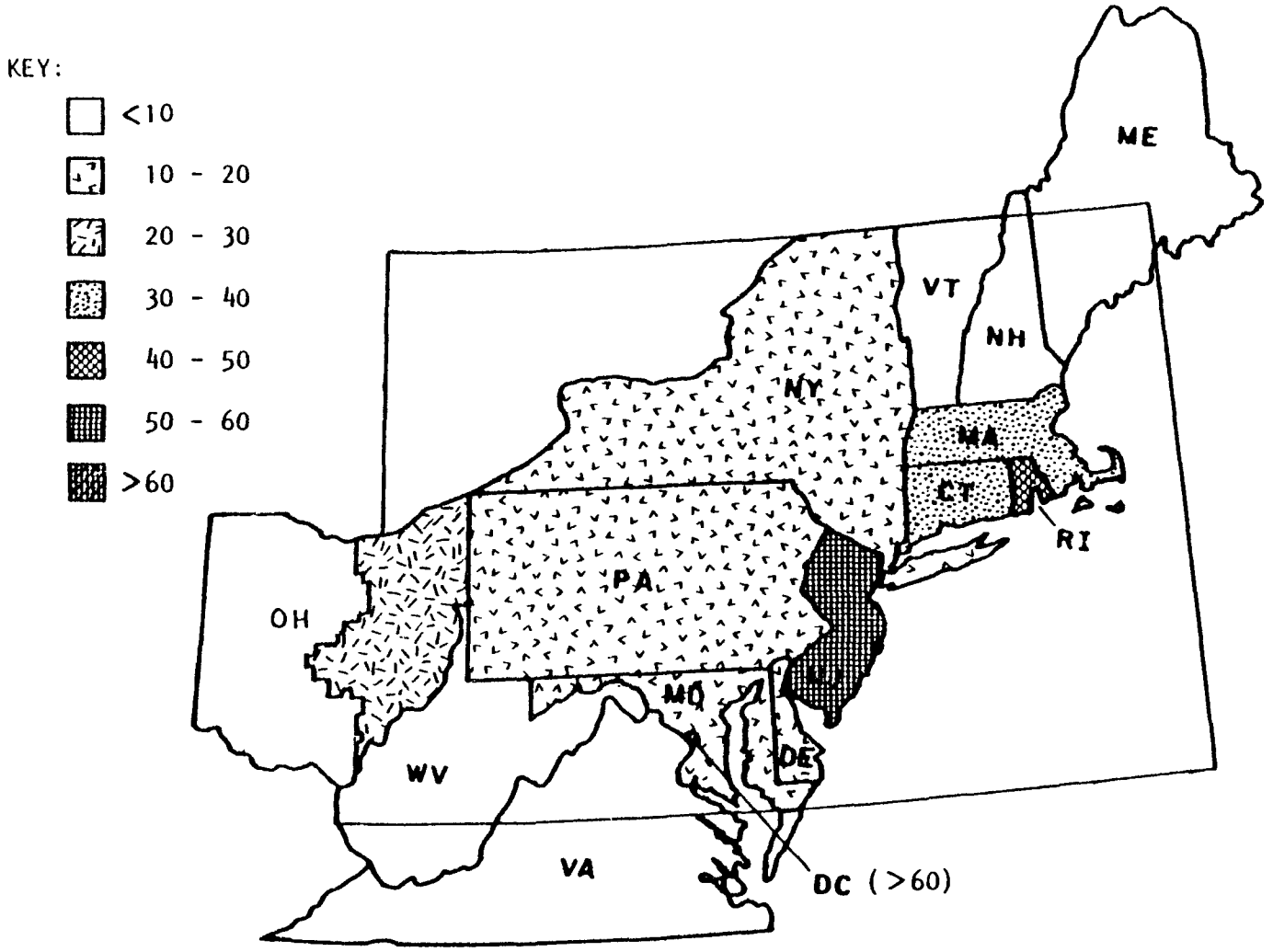

Figure 10. VOC area source emissions per area (tons/mi^2-year).

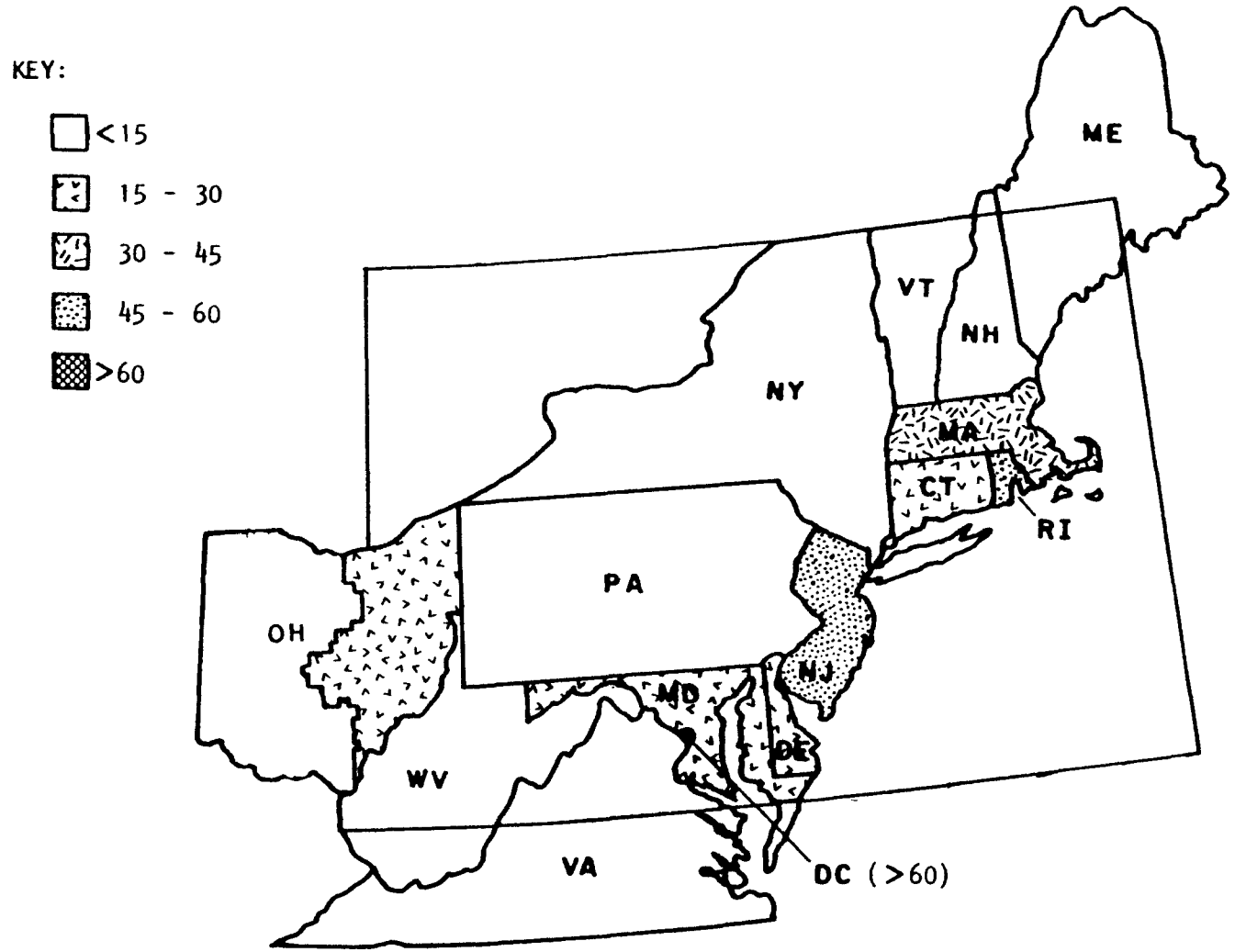

Figure 11. NO_x area source emissions per area (tons/mi^2-year).

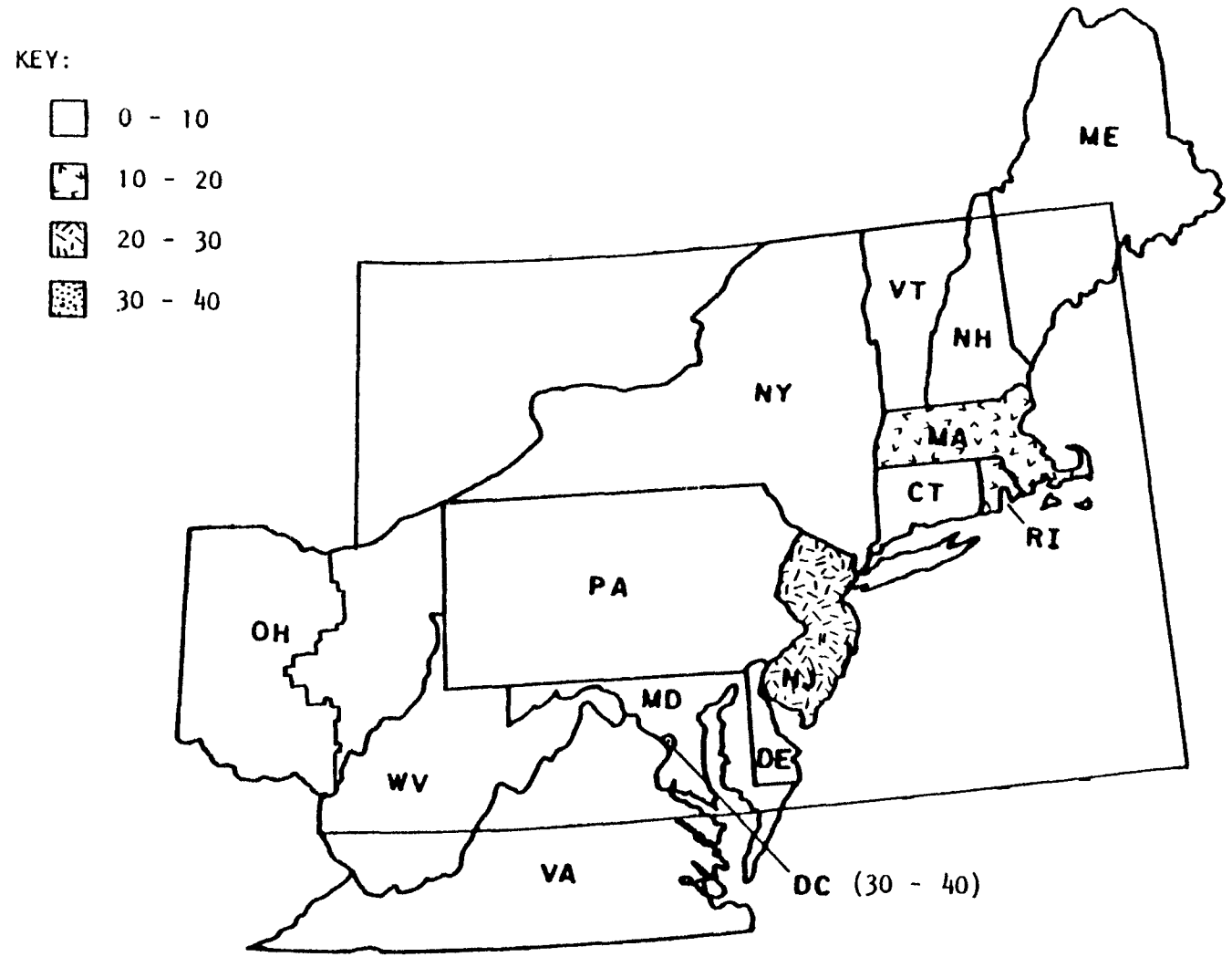

Figure 12. VOC point source emissions per area (tons/mi^2-year).

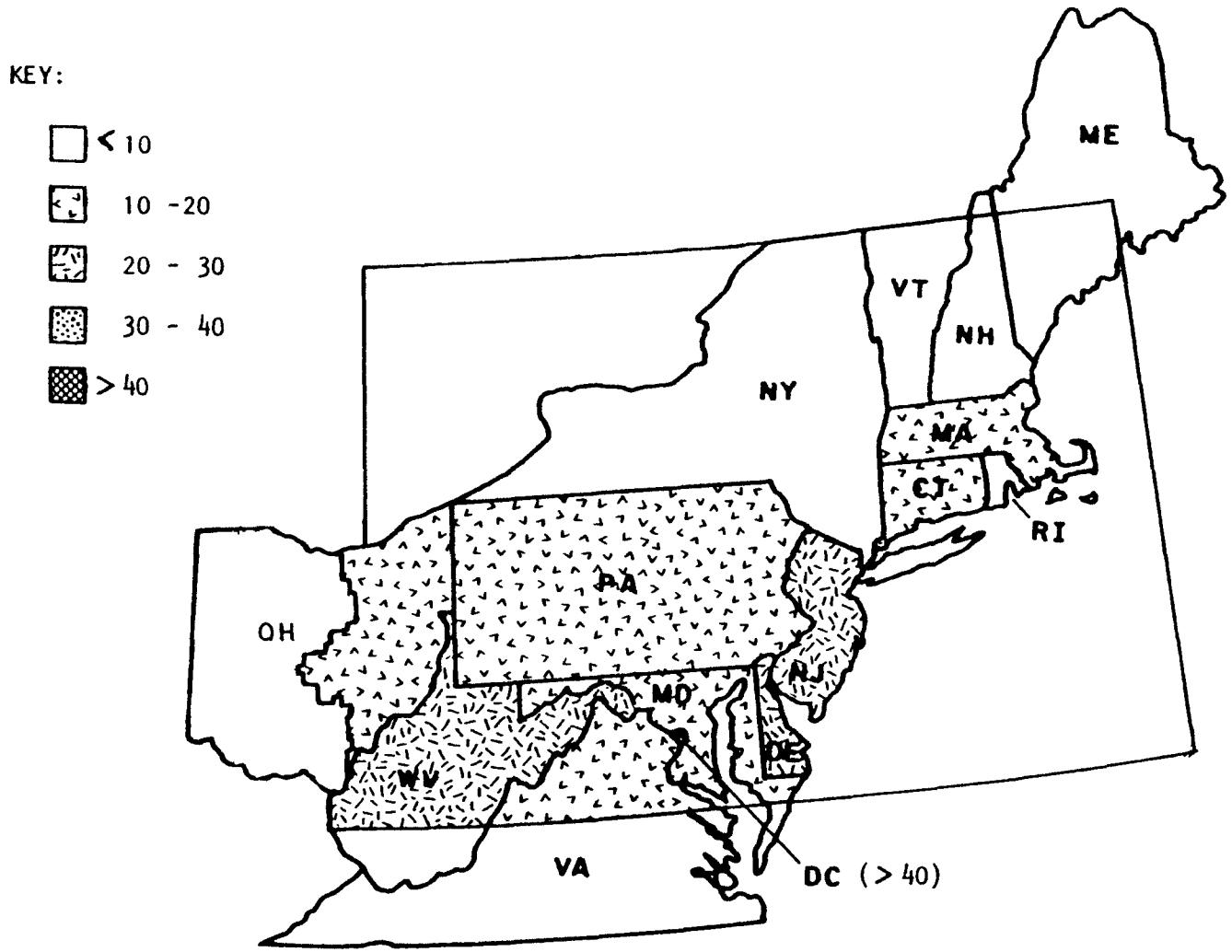

Figure 13. NO_x point source emissions per area (tons/mi^2-year).

The above categories were selected because they: (1) were not derived using per-capita emission factors; and, (2) would be expected to correlate with population. Emissions for the above three categories were expressed in terms of population and compared from state to state. The purpose of this comparison was to determine the degree of variability from state to state and identify potential anomolies with the data. Values which deviated significantly from the regionwide mean were examined in more detail to determine if the deviation was explainable, a result of differing methodology, or a probable error. Analyses for the above categories are discussed individually, as follows.

Residential Fuel Combustion

Residential fuel emissions were calculated on a per-capita basis for each state, as was the ratio of VOC/NO_x emissions, which are shown in Table 17. The per-capita emissions for VOC range from 0.25 lb/capita in Massachusetts to 2.48 lb/capita in Vermont while NO_x emissions range from 3.32 lb/capita in Virginia to 10.64 lb/capita in Vermont. The per capita emissions for Vermont are more than two standard deviations greater than the mean for VOC and nearly two standard deviations above the NO_x mean. Thus, the Vermont data were selected for further review. Since the Massachusetts VOC emissions, on a per capita basis, are one order of magnitude lower than Vermont, residential emissions from these two states were investigated in greater detail. The NEDS system residential emission totals for these two states are compared with the NECRMP estimates for these two states in Table 18.

TABLE 18. NEDS VS. NECRMP RESIDENTIAL EMISSIONS FOR MASSACHUSETTS AND VERMONT

	Annual Emissions from Residential Combustion (Tons)					
	VOC		NO_x		VOC/NO_x	
State	NEDS	NECRMP	NEDS	NECRMP	NEDS	NECRMP
Massachusetts	783	777	13,628	15,561	0.057	0.050
Vermont	306	633	1,414	2,721	0.216	0.233

As shown in Table 18, the NECRMP and NEDS data are in reasonable agreement for residential emissions in Massachusetts, while the NECRMP estimates for Vermont are approximately twice as great as the NEDS estimates. This difference can be attributed to differing methodologies. The NEDS residential emissions are estimated using annual Department of Energy (DOE) fuel use statistics while the NECRMP estimates were calculated by GCA by employing published housing and degree day information in the fuel use estimation equations contained in the EPA Guidelines.[19] The GCA

TABLE 17. PER-CAPITA EMISSIONS FROM RESIDENTIAL FUEL COMBUSTION

State	Annual Emissions (lb/capita)		Ratio VOC/NO_x
	VOC	NO_x	
Connecticut	0.35	4.59	0.076
Washington, D.C.	0.75	5.98	0.125
Delaware	0.83	6.63	0.125
Maine*	2.06	8.35	0.247
Maryland	0.86	6.56	0.131
Massachusetts	0.25	5.09	0.049
New Hampshire	1.51	8.93	0.169
New Jersey	0.40	5.39	0.074
New York	0.36	4.83	0.075
Ohio	0.60	4.12	0.146
Pennsylvania	0.95	4.66	0.204
Rhode Island	0.48	9.63	0.050
Vermont	2.48	10.64	0.233
Virginia	1.49	3.32	0.449
West Virginia	0.66	3.76	0.176
REGIONWIDE AVERAGE	0.62	4.68	0.132
MEAN OF STATE AVERAGES	0.93	6.17	0.151
STD. DEVIATION	$\pm$0.66	$\pm$2.26	---

*Residential fuel combustion emissions for Maine reflect a composite of residential, commercial/institutional, and industrial area source categories. See Volume IV.[4]

calculations were rechecked and verified to be accurate. Thus, in this instance, either all of the fuel used in Vermont was not reported by DOE or the Guidelines[19] algorithms overestimate fuel used. Since the Vermont data, on a per-capita basis, fall approximately two standard deviations from the mean, the later case is more likely true. (However, it is known that many Vermont residences that utilize a non-wood fuel as the primary heat source suppliment with wood that is either self-cut or purchased in such a manner that DOE will not have a record of its consumption).

Utilizing the NEDS data for Vermont in place of NECRMP still results in Vermont having five times the per-capita residential fuel combustion emissions experienced in Massachusetts. Some of the difference can be attributed to heating degree-days, which are compared below:

City	Heating Degree Days
Boston, MA	5,634
Worcester, MA	6,969
Burlington, VT	8,269

The remaining difference can be attributed to: (1) significantly different mixes of fuels used in the residential sector; and, (2) use of an "adjusted" VOC emission factor for natural gas combustion in Massachusetts.

A significantly greater percentage of homes in Massachusetts utilize natural gas for heating than in Vermont:

Fuel	Massachusetts	Vermont
Fuel Oil	65%	80%
Natural Gas	28%	5%
Electricity	4%	6%
Wood/Coal	0.5%	3.1%
LPG	1%	5%
All Others	1.5%	0.9%

The VOC emission factor utilized for residential natural gas combustion in Massachusetts had been adjusted by the Massachusetts DEQE to reflect reactive VOC only. A VOC emission factor of 3.2 lb/10^6 cu. ft. was employed in Massachusetts, whereas a factor of 8 lb/10^6 cu. ft. was utilized in Vermont and elsewhere in the NECRMP study area. The VOC emission factor used for all other residential fuels in Massachusetts are consistent with the remaining NECRMP states. The use of a reactive VOC emission factor in Massachusetts can be accounted for when the NECRMP inventory is speciated for input to the Regional Oxidant Model (ROM).

Highway Vehicles

Highway vehicle emissions were calculated for each state in the study region, as shown in Table 19. VOC emissions range from 99.96 lb/capita in Virginia to 39.32 lb/capita in Pennsylvania. The regionwide averages are

TABLE 19. PER CAPITA EMISSIONS FOR HIGHWAY VEHICLES

	Annual Emission Factor (lb/capita)													
	LDV		LDT1		LDT2		HDG		HDD		MC		Total	
	VOC	NO_x	VOC	NO_x	VOC	NO_x	VOC	NO_x	VOC	NO_x	VOC	NO_x	VOC	NO_x
Connecticut	-	-	-	-	-	-	-	-	-	-	-	-	66.36	61.29
Washington, D.C.	39.64	25.55	2.86	1.79	.95	.60	1.25	4.67	.56	2.07	-	-	45.25	34.68
Delaware	42.92	40.26	4.73	4.62	2.94	2.98	6.36	7.58	1.35	12.33	.90	.09	59.20	67.86
Maine	50.16	36.54	8.65	6.01	8.65	6.01	8.25	8.13	8.25	8.13	-	-	83.97	64.81
Maryland	39.65	33.95	5.14	4.05	.27	.25	5.23	8.94	.47	2.88	.17	.01	50.92	50.08
Massachusetts	32.40	36.80	5.16	4.96	1.10	1.05	4.56	6.09	.87	9.34	.69	.05	44.78	58.30
New Hampshire	50.34	47.10	5.58	5.38	4.15	3.91	7.09	7.79	1.36	11.96	1.07	.07	69.58	76.21
New Jersey	38.96	53.55	4.11	5.65	2.33	3.20	2.08	2.86	1.64	2.25	.45	.60	49.56	68.12
New York	28.16	18.96	2.74	1.83	2.14	1.43	4.19	2.77	2.15	13.49	.25	.018	39.59	38.50
Ohio	39.29	39.85	2.85	2.73	3.19	3.15	3.63	4.76	2.55	28.46	.44	.04	51.96	79.00
Pennsylvania	29.88	29.95	1.97	1.80	2.36	2.40	2.75	3.59	1.97	21.56	.39	.60	39.32	59.89
Rhode Island	56.24	52.75	2.46	2.40	2.46	2.50	8.26	9.85	1.29	11.59	.31	.03	71.00	79.12
Vermont	42.89	45.69	8.05	8.74	.75	.87	3.34	4.46	.35	3.77	5.14	.56	60.54	64.08
Virginia	72.71	55.64	6.24	4.26	7.39	7.02	11.98	10.81	1.66	13.51	-	-	99.96	91.25
West Virginia	28.25	24.01	5.88[a]	5.95[a]	5.88[a]	5.95[a]	4.62	4.87	2.01	17.50	-	-	46.64	58.27
REGIONWIDE AVERAGE	---	---	-	-	-	-	-	-	-	-	-	-	47.82	56.92
MEAN	42.25	38.61	-	-	-	-	-	-	-	-	-	-	58.57	63.43
STD. DEVIATION	±12.18	±11.12	-	-	-	-	-	-	-	-	-	-	±17.16	±15.04

[a]Both LDT1 and LDT2 vehicles were reported as a single LDT category. For comparison purposes, these emissions were evenly divided into LDT1 and LDT2 categories.

47.82 lb VOC/capita and 56.92 lb NO_x/capita. Means of the individual state values are 58.57 lb VOC/capita and 63.43 lb NO_x/capita. Since the majority of highway vehicle emissions are generated by light-duty vehicles (LDV), means and standard deviations were examined separately for LDVs.

For both light-duty vehicles and total vehicles, emissions for Virginia are generally two standard deviations higher than the means. All other state values fell within two standard deviations of the mean. To determine why the values for Virginia are so high, light-duty vehicle emission factors are compared in Table 20. As shown in Table 20, the Virginia light-duty vehicle emission factors fall within the expected range. Thus, the anomolies in the Virginia per capita highway vehicle emissions occur as a result of the implied VMT per capita.

Emissions reported in NECRMP were compared with those published by the Virginia State Air Pollution Control Board[21] and were found to be consistent. Since the relationship of VMT per capita in Virginia is much higher than observed elsewhere, the VMT estimates for Virginia should be further investigated.

Ratios of VOC/NO_x emissions are compared from state to state and by vehicle class in Table 21. Results in Table 21 for New Jersey appear anomolous because New Jerseys' VOC and NO_x emissions were forcefully disaggregated into vehicle classes soley on the basis of VMT distribution, thus the same VOC/NO_x ratio applies to all vehicle classes.

Highway vehicle emissions were calculated by the individual states using various versions of EPA's mobile source emission factor model. Some states utilized MOBILE1 while others used MOBILE2. Following completion of most of the NECRMP inventory, serious errors were detected in the MOBILE2 emission model prompting the release of MOBILE2.5. Additional corrections are currently underway and MOBILE3 is expected to be released in the fall of 1983.

Since highway vehicles account for a significant percentage of total emissions in the NECRMP region, the inconsistency of emission models used and the uncertainty introduced by the known errors in the version of MOBILE2 used in several states raises serious questions about both the accuracy of mobile source emission in the NECRMP inventory as well as the likely impact on model results. Recalculation of highway vehicle emissions following the release of MOBILE3 should be considered.

Gasoline Handling

VOC emissions from various gasoline handling activities are shown in Table 22 on a per-capita basis. State to state variations in gasoline handling emissions occur as a result of differing gasoline consumption rates (on a per-capita basis), and the use of differing emission factors owing to different percentages of splash, submerged and balance loading and the implementation of Stage II RACT controls in some areas.

TABLE 20. AVERAGE LIGHT-DUTY VEHICLE EMISSION FACTORS, BY STATE

State	VOC	NO_x
Connecticut	---	---
Washington, D.C.	11.00	7.09
Delaware	7.99	7.49
Maine	9.70	7.08
Maryland	10.17	8.71
Massachusetts	6.69	7.60
New Hampshire	9.27	8.68
New Jersey	7.38	10.14
New York	9.02	6.07
Ohio	7.57	7.68
Pennsylvania	7.57	7.59
Rhode Island	10.56	9.90
Vermont	9.72	10.35
Virginia	10.54	8.07
West Virginia	7.63	6.49
MEAN	8.92	8.07
STD. DEVIATION	$\pm$1.42	$\pm$1.33

TABLE 21. VOC/NO_x RATIOS FOR HIGHWAY VEHICLE EMISSIONS

State	LDV	LDT1	LDT2	HDG	HDD	MC	Total
Connecticut	--	--	--	--	--	--	1.08
Washington, D.C.	1.55	1.59	1.59	.27	.268	--	1.30
Delaware	1.07	1.03	.99	.84	.110	10.32	0.87
Maine	1.37	1.44	1.44	.98	.985	--	1.30
Maryland	1.17	1.27	1.11	.59	.163	14.95	1.02
Massachusetts	.88	1.04	1.04	.75	.094	12.51	0.77
New Hampshire	1.07	1.04	1.06	.91	.114	14.78	0.91
New Jersey	.73	.73	.73	.73	.73	0.73	0.73
New York	1.49	1.50	1.50	1.51	.159	11.63	1.03
Ohio	.99	1.04	1.01	.76	.090	10.03	0.66
Pennsylvania	1.00	1.09	.98	.77	.091	0.66	0.66
Rhode Island	1.07	1.02	.98	.84	.111	11.15	0.90
Vermont	.94	.92	.87	.75	.093	9.19	0.94
Virginia	1.31	1.46	1.05	1.11	.123	--	1.10
West Virginia	1.18	.99	--	.95	.115	--	0.80

TABLE 22. PER CAPITA EMISSIONS FOR GASOLINE HANDLING (POINT AND AREA SOURCES)

State	Annual Emissions (lb/capita)				
	Stage I gasoline evaporation	Stage II gasoline evaporation	Storage tank breathing	Gasoline loading/ transit	Total
Connecticut	3.20	4.25	.44	0.33	8.22
Washington, D.C.	.08	2.65	.27	1.87	4.88
Delaware	4.12	4.66	.49	3.38	12.65
Maine	5.55	4.68	.49	7.25	17.95
Maryland	1.20	2.76	.29	1.95	6.23
Massachusetts	1.28	3.67	.38	0.73	6.06
New Hampshire	3.63	4.18	.44	2.98	11.23
New Jersey	.58	4.58	.47	3.71	9.34
New York	2.22	2.95	.30	1.12	6.58
Ohio	4.45	5.13	.53	3.74	13.86
Pennsylvania	3.42	3.67	.41	1.79	9.29
Rhode Island	2.85	3.79	.39	5.85	12.88
Vermont	3.99	4.63	.48	3.28	12.38
Virginia	2.86	5.78	.35	3.75	12.74
West Virginia	3.63	4.22	.43	2.99	11.26
REGIONWIDE AVERAGE	---	---	---	---	8.73
MEAN	---	---	---	---	10.37
STD. DEVIATION	---	---	---	---	±3.58

As shown in Table 22, per capita emissions from stage I evaporation appear quite low for the District of Columbia and New Jersey and quite high for Maine. These differences can be attributed to different assumed mixes of splash, submerged, and balance filling. The District of Columbia Council of Governments assumed that all service station loading was performed using balance filling (0.3 lb/thousand gallons). Similiarly, a considerable portion of New Jersey (AQCRs 043 and 045) also reflects balance filling only. Conversely, the Maine Department of Environmental Protection assumed all service station loading was performed using splash filling (11.5 lb/thousand gallons). These factors account for most of the differences in Stage I emissions. The remaining differences can be attributed to varying gasoline consumption rates.

Gasoline loading/transit losses were examined on a per-capita basis. As shown in Table 22, values for Connecticut and Massachusetts appear quite low, while values for Maine and Rhode Island appear high. The Maine and Rhode Island loading losses come primarily from large point sources. Both states house large gasoline terminals which serve as major transfer points for areas that go beyond the state boundaries. This could, in part, also account for the low values in Connecticut and Massachusetts. Further, gasoline loading losses that were supplied for the metropolitan Boston area were calculated assuming 100 percent balance filling. The Connecticut area source inventory covered only transit losses for the category, with loading losses assumed to be adequately covered in the point source inventory. With the exception of Maine, discussed above, total emissions from gasoline marketing for all states, on a per-capita basis, fall within two standard deviations from the mean.

POINT SOURCE INVENTORY COMPREHENSIVENESS

Numbers of facilities and individual emission points covered in each state component of the NECRMP inventory are provided in Table 23. Comprehensiveness of the point source emissions data was evaluated for each state by comparing facilities included in each state's inventory against those listed in the Directory of Volatile Organic Compound Sources Subject to Reasonably Available Control Technology Requirements (RACT Directory). This comparison was actually performed as a quality assurance measure during the point source compilation phase of NECRMP. The intention of this check was to identify and subsequently include VOC sources that had been omitted in the individual state data bases. For the entire NECRMP study, over 548 sources were identified as being included in the RACT Directory, but not in the state-supplied data. This exercise resulted in the addition of six facilities to the NECRMP data base (one in Rhode Island and five in Massachusetts) totaling over 9,000 tons of VOC.

GCA fowarded, to each state agency contact, a list of potential omissions based on a comparison of the state-supplied data with the RACT Directory. State agency contacts who responded to GCA's lists of potential emissions usually indicated that the apparent omissions were for one or more of the following reasons:

TABLE 23. NUMBERS OF FACILITIES AND INDIVIDUAL POINT SOURCES COVERED IN THE NECRMP[2-16] INVENTORIES

State	NECRMP (1979/1980)[2-16]		
	Facilities	Points	Points/facility
Connecticut	3,342	10,239	3.1
Delaware	472	1,277	2.7
Maine[a]	487	713	1.5
Maryland	131	1,477	11.3
Massachusetts	1,274	4,363	3.4
New Hampshire	316	459	1.5
New Jersey	331[b]	13,329	17.6
New York	1,145	2,564	2.2
Ohio[a]	731	2,980	4.1
Pennsylvania	2,137	13,590	9.7
Rhode Island	90	319	3.5
Vermont	162	331	2.0
Virginia[a]	1,628	2,641	1.6
Washington, D.C.	102	207	2.0
West Virginia[a]	309	985	3.2
REGION TOTALS	12,657	55,474	5.4

[a]The NECRMP data include only a portion of this state.

[b]NEDS "Card 1" data were provided for 14,643 facilities while complete records were provided for 1,749 facilities, reflecting 30,742 emission points. Further, to properly "balance" with the New Jersey area source inventory, only facilities emitting more than 100 TPY are included in the NECRMP point source inventory.

- the facility has ceased operation or transferred ownership,
- the facility was listed in the inventory under a different name,
- the facility emitted less VOC than the state's minimum source size cutoff,
- the source was incorrectly listed in the RACT Directory.

Nevertheless, since some states had nearly perfect "RACT coverage", it is believed that relative coverage of "RACT" sources is a reasonable measure of the comprehensiveness of the point source inventories.

The RACT Directory[22] attempts to list all VOC sources subject to RACT regardless of size. Many of the point source files supplied by the NECRMP states reflected a minimum source size cutoff and therefore would not have included small VOC emitters listed in the RACT Directory.[22] This explains the apparant low coverage of sources in New York, for example. Also, many of the facilities listed in the RACT Directory[22] as Industrial Perchloroethylene Drycleaners are questionable. This suspicion was confirmed at least for Massachusetts, by GCA staff members familiar with industrial perchloroethylene drycleaners in Massachusetts. On the other hand, some sources listed in the RACT Directory[22] but not in individual state point source files are suspected to be significant emitters. Thus, while a very low percentage of RACT facility coverage does not guarantee that major VOC sources have been omitted, it does cast some uncertainty on the comprehensiveness of the states' point source data. Conversely, a very high percentage of RACT sources in a state inventory does provide some assurance of the comprehensiveness of the data for these states.

Table 24 provides a comparison of the relative coverage of RACT sources in the NECRMP inventory. As shown in Table 24, two states, Virginia and Delaware had virtually 100 percent coverage of these sources in their inventories. It is the author's opinion that these states' inventories were outstanding in terms of comprehensiveness.

AREA SOURCE INVENTORY COMPREHENSIVENESS

Area source inventory comprehensiveness can be defined in terms of geographic coverage, area source category coverage, and resolution of area source categories. Area source emission inventories were compiled for all areas within the entire NECRMP study area. However, some variations exist between individual state components in terms of category coverage and resolution, and in one instance, geographic resolution.

The primary objectives of the area source inventory development were:

- to ensure all VOC and NO_x emissions had been accounted for, and were adequately resolved into individual source categories to enable proper temporal and organic species disaggregation to support photochemical modeling, and

TABLE 24. COVERAGE OF "RACT" SOURCES IN THE NECRMP DATA BASE[a]

	Facilities listed in the "RACT" directories[22]	"RACT" directory sources omitted in NECRMP (after resolution)	Percent coverage
Connecticut	79	14	82
Delaware	30	1	97
Maine	35	4	89
Maryland	69	31	55
Massachusetts	123	44	64
New Hampshire	11	4	64
New Jersey	336	44	87
New York[b]	232	159	31
Ohio	233	62	73
Pennsylvania[b]	245	138	44
Rhode Island	43	19	56
Vermont	10	4	60
Virginia	90	1	99
Washington, D.C.[b]	3	2	33
West Virginia[b]	49	15	69
Region Totals	1,588	542	66

[a]Does not include sources identified as having been closed or included under a different name. Individual facilities are identified in specific state volumes.

[b]Some states did not respond to lists of potential omissions forwarded by GCA as part of the quality assurance review and therefore may not actually have as poor a coverage as indicated above since facilities that may have been closed or had their ownership transferred were not identified.

- to ensure complete geographical coverage and adequate spatial resolution to enable further disaggregation to grid cells.

Spatial Resolution

The area source inventories for NECRMP were compiled on a county level for all but one state within the NECRMP study area. The single deviation involves the Commonwealth of Massachusetts, whose Department of Environmental Quality Engineering utilizes Air Pollution Control Districts (APCD) for virtually all aspects of air quality management, including emission inventories. The Massachusetts APCDs, and the relationship to counties is portrayed in Figure 14. As shown in Figure 14, the Massachusetts APCDs do not adhere to country boundaries. To accomodate Massachusetts' deviation from the other NECRMP states, the following steps were taken: (1) the Massachusetts point and area source inventories were compiled on an APCD basis, and (2) spatial allocation factors[17] for Massachusetts were altered to enable spatial resolution to NECRMP grids from APCDs rather than counties. Since the Massachusetts spatial allocation factors have been based on APCDs, this deviation should not adversely impact the use of the Massachusetts data in photochemical modeling.

Area Source Category Coverage and Category Resolution

One objective of the area source inventory development was to ensure sufficient resolution of area source emissions into categories to enable detailed temporal and spatial resolution for photochemical modeling. A total of 54 unique area source categories were defined for use in NECRMP. These categories are shown in Table 25. Not all of the Table 25 categories were covered in all 15 state inventories. In some instances, certain state agencies determined that some of the less significant categories did not contribute sufficient VOC and NO_x emissions to warrant their inclusion. In other instances, emissions representing a number of the Table 25 categories were aggregated to form composite categories. For these latter cases, two courses of action were taken by GCA. First, when sufficient data were available from the states or when national data were adequate to allow their independent disaggregation, GCA calculated category-specific estimates from the composite data. When such information was unavailable, GCA included the composite data in that state's EIS/AS masterfile and properly "commented" the composite category so as to identify its component constituents. Since these adjustments were unique to each state, they are discussed individually, by state, in Section 4.

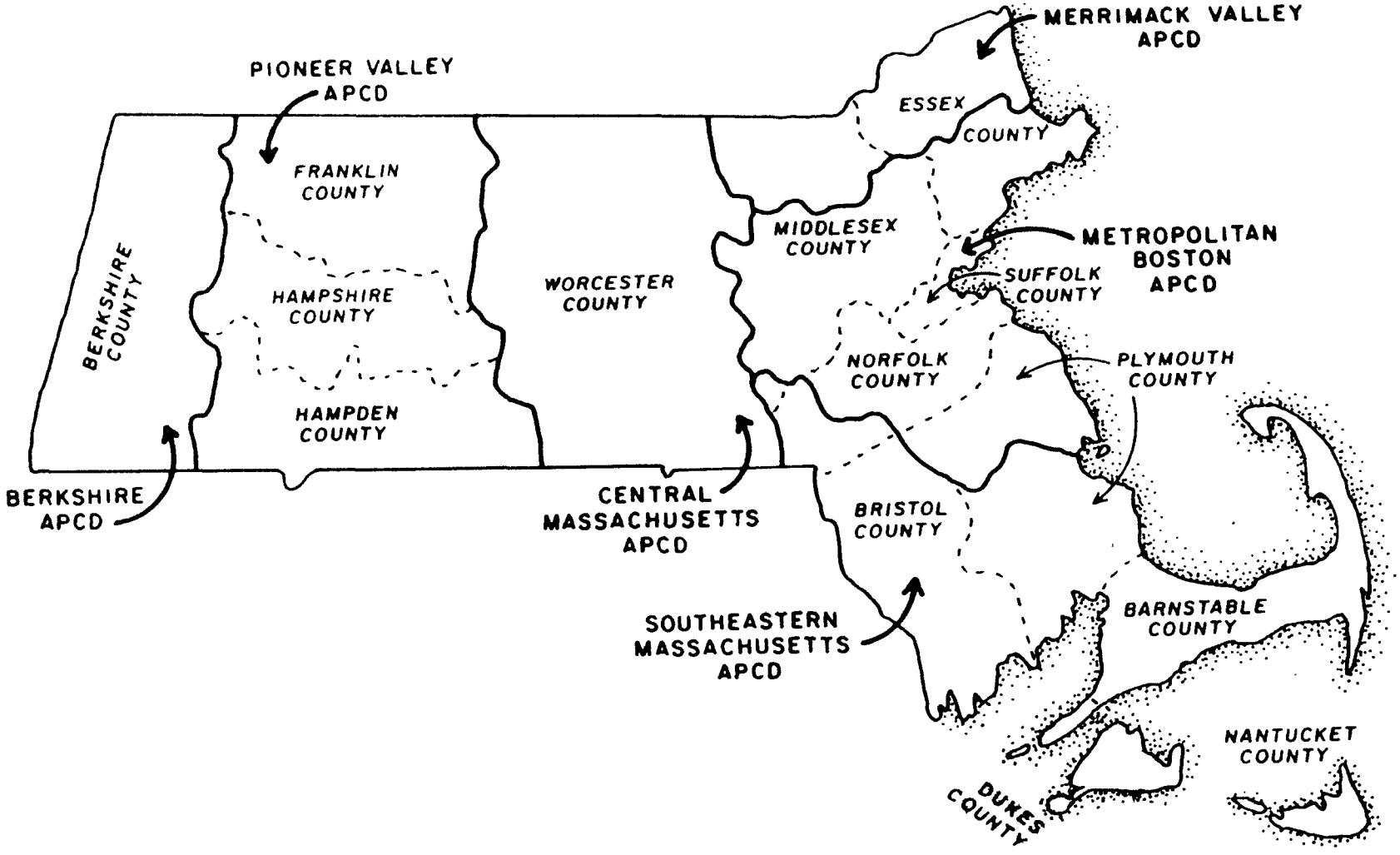

Figure 14. Massachusetts air pollution control districts and counties.

TABLE 25. AREA SOURCE CATEGORIES INVENTORIED FOR THE NECRMP STUDY

Category number	Category description
001	Stage I Gasoline Evaporation
002	Stage II Gasoline Evaporation
003	Storage Tank Breathing
004	Gasoline Loading/Transit
005	Small Industrial/Commercial Degreasing
006	Dry Cleaning
007	Architectual Surface Coating
008	Auto Body Refinishing
009	Small Industrial Surface Coating
010	Graphic Arts
011	Commercial/Consumer Solvent Use
012	Cutback Asphalt
013	Pesticides
014	On-Highway Light Duty Vehicles
015	On-Highway Light Duty Trucks - Class I
016	On-Highway Light Duty Trucks - Class II
017	On-Highway Heavy Duty Gas Trucks
018	On-Highway Heavy Duty Diesel Trucks
019	On-Highway Motorcycles
020	Residential Anthracite Coal
021	Residential Bituminous Coal
022	Residential Residual Oil
023	Residential Distillate Oil
024	Residential Natural Gas
025	Residential LPG
026	Residential Wood
027	Commercial/Institutional Anthracite
028	Commercial/Institutional Bituminous
029	Commercial/Institutional Residual Oil
030	Commercial/Institutional Distillate Oil
031	Commercial/Institutional Natural Gas
032	Commercial/Institutional LPG
033	Commercial/Institutional Wood
034	Industrial Anthracite
035	Industrial Bituminous
036	Industrial Residual Oil
037	Industrial Distillate Oil
038	Industrial Natural Gas
039	Industrial LPG
040	Industrial Wood
041	Military Aircraft
042	Civil Aircraft
043	Commercial Aircraft
044	Railroad Locomotives
045	Gasoline Powered Vessels
046	Distillate Oil Powered Vessels
047	Residual Oil Powered Vessels
048	Off-Highway Vehicles - Gas
049	Off-Highway Vehicles - Diesel
050	On-Site Incineration
051	Open Burning
052	Structural Fires
053	Field/Slash Burning
054	Forest Fires

SECTION 4

DATA QUALITY REVIEW

INTRODUCTION

This section presents a state-by-state review of the overall quality of the NECRMP inventory data. It includes a discussion of the results of the evaluation techniques presented in Section 3 as they relate to each state. Also included are lists of uncertainties, deficiencies, and recommendations for future corrective actions. Commentary on the overall suitability of the NECRMP data base for use in photochemical modeling is offered.

The quality of the NECRMP point source inventories were evaluated in terms of currency (year represented by the data), missing data elements, residual problems, and apparent completeness for other pollutants (TSP, SO_x and CO). Although the point source inventories were subjected to considerable quality assurance checks and subsequent corrections, not all problems identified were fully rectified due to time and resource limitations. Error corrections were prioritized based on source size, severity of the error, and likely impact photochemical modeling results.

The quality of the NECRMP area source inventories were evaluated in terms of consistency with the EPA-prescribed methodologies,[19] age of the data, and deviations from generally accepted emission factors. Area source inventories were also examined in terms of comprehensiveness, which addresses both geographical coverage and area source category coverage and resolution.

The NECRMP point and area source emissions were previously compared to NEDS and the 1982 Ozone SIPs in Section 3. Differences identified in that comparison are examined on a state-by-state basis in the remainder of this section.

CONNECTICUT

The Connecticut Department of Environmental Protection (DEP) provided the input data used in the NECRMP point and area source inventories for Connecticut and assisted in the quality assurance review of the data by supplying required corrections and additional data as was necessary.

Point Source Inventory Quality

The NECRMP point source inventory for Connecticut reflects 1979 and 1980 data and was supplied in NEDS format as converted from Connecticut's STARTER

system. A number of data formatting problems were addressed by GCA prior to incorporation of the data into the NECRMP inventory. These included elimination of repetitive NEDS Card 1 records for each point, correction of erroneous hexidecimal bit patterns (internal computer formatting) for alphabetic point IDs, and duplicate point ID assignments. Also, a large number of incomplete and/or incorrect SCC codes were corrected with the assistance of the DEP. Since the inventory, as received, was virtually incapable of conversion into EIS format, the corrections in this regard represent a considerable improvement. However, some problems remain. One "generic" correction undertaken involved seasonal emissions distribution percents. Many of these fields, as received, were blank or zero filled. These fields were changed to reflect an equal seasonal distribution, i.e., four 25 percent values. This may impact the temporal allocation of the emissions data since temporal factors for most point source categories are derived from the operating rate data contained on the point source records. However, for power plants, the largest point source NO_x emission category, the percent annual throughput fields will be overridden by the temporal allocation factors reported in Volume XVII.[17]

Area Source Inventory Quality

The Connecticut area source inventory, representing a 1979* base year, was supplied in hard copy format by the Connecticut DEP. The inventory reflected county summaries of emissions of all five criteria pollutants from 52 area source categories. However, these categories did not correspond well with the 54 NECRMP area source categories. Two major groups of area source emissions, gasoline handling and highway vehicles, had been aggregated, and six categories had been omitted. Most of these problems were resolved with the assistance of the DEP. The major residual problem with the Connecticut data is the aggregation of on-highway vehicle emissions. Vehicle type specific emissions were reportedly unavailable. All highway vehicle emissions were reported in a single composite category. For the remaining categories, the DEP data conformed resonable well with the EPA-prescribed methodologies.[19]

One deviation from the EPA-prescribed methods relates to VOC emissions from dry cleaning. The DEP estimated dry cleaning solvent usage using a 3 lb solvent/capita factor. Emissions were derived with an emission factor of 210 lb VOC/ton of solvent. The EPA-recommended factor of 1.5 lb VOC/capita would have resulted in an increase in the VOC emissions estimate of approximately 1,900 tons/year. Since the DEP believed their methodology to be more consistent with actual conditions in Connecticut, their estimates were maintained in NECRMP.

The Connecticut DEP indicated that pesticide usage data were unavailable and, therefore, did not supply an estimate of VOC emissions from this

*Except per-capita based emissions, which were recalculated by GCA using data from the 1980 census.

category. For the purposes of NECRMP, GCA calculated emissions from the application of pesticides assuming an emission rate of 3.5 lbs/harvested acre. Also, the DEP emissions estimate from off-highway vehicles accounts for diesel fuel only.

Comparisons with the NEDS and SIP Inventories

The NECRMP emissions data for Connecticut are compared to NEDS and SIP inventory estimates in Table 26.

As shown in Table 26, NECRMP VOC estimates are somewhat higher than those reported in the SIP but lower than that reported in NEDS. NECRMP NO_x emissions compare reasonably well with the SIP and NEDS estimates for the SIP areas, but are about 13 percent higher than the statewide estimate in NEDS.

Virtually all of the VOC difference is related to area sources of organic solvent evaporation. For area sources, NEDS shows 130,628 tons VOC/year, while NECRMP shows 31,690 tons VOC/year from solvent evaporation. The reason for this difference relates to different interpretations of organic solvent sales data[20] between the EPA Guidelines[19] and those employed in NEDS, as discussed earlier in Section 3.

Most of the NO_x difference between the reported NEDS and NECRMP estimates relates to electric generation emissions, NEDS shows 25,745 tons NO_x/year while NECRMP shows 44,157 tons NO_x/year. Some of this difference may relate to different years of record between NEDS (1981/82) and NECRMP (1979/80). Electric generation emissions are updated in NEDS using DOE data, independent of the states, whereas the NECRMP estimates are believed to be consistent with the DEP estimates for 1979.

Apparent Completeness for Other Pollutants

The Connecticut point source inventory also contains data on TSP, SO_2 and CO emissions, which are compared to the NEDS system totals below. NECRMP data correction efforts did not focus on these pollutants, but rather, emphasized VOC and NO_x.

	TSP (tons/year)	SO_2 (tons/year)	CO (tons/year)
NECRMP point	16,231	51,492	14,268
NEDS point	57,977	48,346	71,281
	(41,746)	3,146	(51,013)

A complete discussion of the Connecticut inventory is presented in Volume II.[2]

TABLE 26. COMPARISON OF NEDS, SIP AND NECRMP EMISSIONS FOR CONNECTICUT

	VOC (tons/year)			NO_x (tons/year)		
SIP area	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Hartford						
Point	4,410	7,242	2,901	7,843	8,047	5,219
Area	61,740	36,211	46,243	27,988	27,761	31,483
Total	66,150	43,453	49,144	35,831	35,808	36,702
New Haven						
Point	28,317	10,058	22,934	16,710	20,922	15,629
Area	57,530	30,176	37,826	24,054	25,750	25,905
Total	85,847	40,234	60,760	40,764	46,672	41,534
Statewide						
Point	26,386	-	34,295	49,519	-	62,292
Area	259,652	-	167,730	105,793	-	113,160
Total	286,038	-	202,025	155,312	-	175,452

DELAWARE

The Delaware Division of Environmental Control (DEC) provided the input data used in the Delaware point source inventory. The area source inventory for Delaware was developed primarily by GCA using the EPA Guideline[19] methodologies. The DEC assisted in this process by supplying much of the input data utilized, reviewing the GCA-developed inventory, and suggesting some changes which were subsequently carried out.

Point Source Inventory Quality

The Delaware point source inventory was obtained from the Delaware DEC in EIS/P&R format and reflected 1980 data. In general, the Delaware inventory was found to be complete and exceptionally well prepared. Problems that were detected primarily related to duplicate SCC's at single points and UTM coordinate errors. The former errors were completely corrected as EIS/PS will reject duplicate SCCs at single points, thus assuring their identification. All UTM coordinates that fell "out of range" were addressed since these were identified in the EIS edit checking program. All suspicious UTMs at large facilities were also addressed since these sources were subjected to a manual review. There is little assurance, however, that UTM coordinates on minor facilities that did not fall "out of range" were all identified. However, since 95 percent of all point source NO_x emissions and 97 percent of all VOC emissions are represented by "major" facilities (these emitting more than 100 tons per year of VOC and/or NO_x), resulting errors in photochemical modeling are expected to be insignificant.

Area Source Inventory Quality

When contacted in December 1980, the Delaware DEC had indicated that they intended to utilize projections of a 1976 base year inventory for their 1982 State Implementation Plan submittal.[3] Since one of the program objectives was to avoid data older than 1978,[3] GCA developed a 1980 area source inventory of VOC and NO_x emissions using state-supplied and published activity data, AP-42 and other EPA-approved emission factors, and methodologies generally consistent with the Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds--Volume I.[19]

For some area source categories, the methodologies described in Volume I[19] had to be slightly modified to accommodate the source activity data available for Delaware. Additionally, the quality of existing activity data necessitated making certain assumptions or adjusting older data to reflect 1980. These assumptions, adjustments, and deviations from the Volume I[19] methodologies are discussed in detail in Volume III.[3]

Comparisons with NEDS and SIP Inventories

The NECRMP emissions data for Delaware are compared to the NEDS and SIP inventory estimates in Table 27.

TABLE 27. COMPARISON OF NEDS, SIP AND NECRMP EMISSIONS FOR DELAWARE

SIP area	VOC (tons/year)			NO_x (tons/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
New Castle Co.[a]						
Point	16,664	21,026	20,041	16,338	27,117	24,709
Area	30,585	20,576	19,612	18,793	29,421	26,809
Total	47,249	41,602	39,653	35,131	56,538	51,518
Statewide						
Point	17,429	-	21,222	50,921	-	42,730
Area	47,081	-	35,743	32,690	-	40,649
Total	64,510	-	56,965	83,611	-	83,379

[a]Part of Philadelphia SIP.

As shown in Table 27, the NECRMP and NEDS area source inventories differ by approximately 11,000 tons VOC/yr. Essentially all of this deviation results from a single NEDS area source category, solvent evaporation loss. The reasons for this difference, as previously discussed, involve differing interpretations of solvent use data between those used to estimate emissions in NEDS and those used to develop the per-capita factors reported in the the EPA Guidelines.[19] The SIP and NECRMP inventories appear to be in reasonable agreement for New Castle County while the NEDS inventory is somewhat higher for VOC and lower for NO_x in that County. Statewide NO_x totals between NEDS and NECRMP also appear to be in reasonable agreement overall although the distribution between point and area source emissions differ.

Apparent Completeness for Other Pollutants

The Delaware point source inventory also contains data on TSP, SO_2 and CO emissions, which are compared to the NEDS system totals below.

	TSP (tons/year)	SO_2 (tons/year)	CO (tons/year)
NECRMP point	42,066	132,463	9,126
NEDS point	38,973	125,198	2,605
Deviation	3,093	7,265	6,521

A complete discussion of the Delaware inventory is presented in Volume III.[3]

MAINE

The Maine Department of Environmental Protection (DEP) provided the input data used in the NECRMP point and area source inventories for Maine and assisted in the quality assurance review of the data by supplying required corrections and additional data as necessary.

Point Source Inventory Quality

The Maine point source inventory reflecting 1979, was obtained from the Maine DEP in NEDS format. The most frequently encountered problems detected were missing UTM coordinates and exhaust flow rates. The Maine DEP provided all missing UTM coordinates, and flow rates for all major sources were either supplied by the DEP or calculated by GCA using agreed upon default equations, which are presented in Volume I.[1] Known remaining problems with the Maine point sources include missing flow rates for minor sources. Since these will be modeled as area sources in NECRMP, and not as individual point sources, their omission is of little consequence.

Area Source Inventory Quality

The Maine 1979 area source inventory was supplied by the Maine DEP. A portion of the inventory was supplied in hard copy format several months before the complete inventory was supplied in EIS/AS format. The Maine EIS file did not conform to the category numbering scheme selected for NECRMP. Rather, the Maine DEP utilized the NEDS numbering system. The Maine EIS file was renumbered to match the NECRMP category codes and was merged with the previously supplied data which had been coded into EIS/AS format by GCA. For a number of categories, the Maine EIS/AS files reported only emission totals. The emission factors, in these instances, were obtained from the hard copy documentation of the area source inventory. In turn, the process rates for these categories were derived by GCA from the DEP reported emissions and emission factors. The Maine area source inventory did not address architectural surface coating, autobody refinishing, and small industrial surface coating. Emissions from these categories were inventoried by GCA using the methods presented in Volume I.[1]

For several area source categories, the Maine DEP's inventory reflected methodologies that differed from those recommended in Volume I.[1] These are highlighted as follows.

Degreasing--

Rather than employ the per-capita method recommended in Volume I,[19] the Maine DEP utilized data obtained from an inventory questionnaire. All degreasers emitting less than 10 tons/yr were considered area sources. As a result, the Maine DEP estimate of VOC emissions from degreasing operations is approximately 3,000 tons/yr less than would have been estimated had the per-capita method been employed. Apparently, the Maine DEP felt that the questionnaire survey was comprehensive enough to justify the deviation.

Dry Cleaning--

Rather than utilize the per-capita approach suggested in Volume I,[19] the Maine DEP relied on survey data to develop the VOC emissions estimate for dry cleaning. Use of the per-capita method would have resulted in a 260 ton/yr increase (approximately 60 percent higher) in emissions from this source category. The DEP believes the survey to be more accurate for Maine than the national average per-capita factor.

Commercial/Consumer Solvent Use--

The Maine DEP utilized solvent sales data obtained from three companies to estimate VOC emissions from this category. The DEP estimate may not have adequately accounted for household use of cleaners, etc. Had the per-capita approach been employed, the VOC emissions estimated for this category would be approximately 2,300 tons/yr higher. However, the DEC believes the national per-capita approach to be less accurate for Maine.

Fuel Combustion--

The Maine area source inventory reported emissions from fuel combustion by fuel type, but not by user sector. As a result, all area source fuel combustion emissions were included under residential use, except LPG, for which use-specific data were available. This will impact temporal distribution of the emissions, but not speciation, which is based primarily on fuel type.

Civil Aircraft--

The Maine DEP concluded that emissions from LTOs of civil aircraft were insignificant, based on survey data. Therefore, emissions from this category were not included.

Comparison with the NEDS Inventory

The NECRMP emission data for the study area portion of Maine are compared to the NEDS inventory on Table 28.

TABLE 28. COMPARISON OF NEDS AND NECRMP EMISSIONS FOR THE NECRMP STUDY AREA PORTION OF MAINE

	VOC (tons/year)		NO_x (tons/year)	
	NEDS	NECRMP	NEDS	NECRMP
Point	12,718	13,651	11,462	16,646
Area	54,172	66,403	31,010	42,783
Total	66,890	80,054	42,472	59,429

As shown in Table 28, point source emissions from VOC are in reasonable agreement, while the NECRMP NO_x estimate is somewhat higher than NEDS. The bulk of this difference can be attributed to industrial boiler emissions. Much of the area source difference can be attributed to highway vehicles. Differences in the year of record between NEDS (1981/82) and NECRMP (1979) may account for this difference. the NECRMP highway vehicle estimates were obtained directly from the Maine DEP and are believed to accurately represent 1979 highway vehicle emissions.

Apparent Completeness for Other Pollutants

The Maine point source inventory includes data on TSP, SO_2 and CO emissions, which are compared to the NEDS system totals, below, for the NECRMP study area portion of Maine.

	TSP (tons/year)	SO_2 (tons/year)	CO (tons/year)
NECRMP point	10,811	60,578	22,530
NEDS point	11,733	75,692	29,026
Deviation	(922)	(15,114)	(6,496)

A complete discussion of the Maine inventory is presented in Volume IV.[4]

MARYLAND

The Maryland Bureau of Air Quality and Noise Control (BAQNC) provided the input data used in the NECRMP point and area source inventories for Maryland and assisted in the quality assurance review of the data by supplying required corrections and additional data as necessary.

Point Source Inventory Quality

The Maryland point source data were supplied by the Maryland BAQNC in NEDS format, as converted from the Maryland Premise Files. The data reflect 1980.

A number of "generic problems" resulted from the conversion of the Premise File data into NEDS format. These included redundant NEDS card 1 records and dropped trailing zeros in NEDS fields with implied decimal points. These generic problems were addressed using GCA-developed computer routines.[5] In addition to these problems, the most frequent errors encountered were incomplete or missing SCC codes, stack parameters, and UTM coordinates. A number of "out of range" UTM-Y coordinates were detected as well.

All of the incomplete or missing SCC codes were addressed. Due to the EIS system's handling of these problems (card rejection), their complete correction is reasonably ensured. However, missing stack data were not sought

for minor point sources and, therefore, remain incomplete. Since these point sources will not be modeled as individual points in NECRMP, these remaining problems will be of little consequence in that regard. All missing UTMs were obtained from the BAQNC and are incorporated in the final data base. Similarly, "out of range" Y coordinates were corrected with the assistance of the BAQNC. However, since Maryland crosses a UTM zone boundary, virtually any UTM-X coordinate would pass the EIS edit check, therefore no UTM-X "out of range" errors were detectable by the EIS system edit checks. During the manual review of major sources, inconsistencies in UTMs between points within any facility were identified. However, if all points within a facility had the same set of incorrect UTM-X coordinates they were not likely noticed. Since there were a number of Y-coordinate errors, it must be assumed that some incorrect X-coordinates could exist, particularly among small sources. Since the overwhelming majority of point source VOC and NO_x emissions in Maryland are attributable to major sources (over 99 percent), this potential problem will be of minor consequence in photochemical modeling.

The BAQNC, when responding to GCA's error list, indicated that two major facilities, Eastern Stainless and Bethlehem Steel, were being reinventoried. These new data were not received by GCA in time for their inclusion in the Maryland point source inventory. When completed, these data should replace the current information for these two sources.

Area Source Inventory Quality

The 1980 Maryland area source inventory was supplied in hard copy format by the Maryland BAQNC. The inventory for portions of Maryland that are in attainment of the National Ambient Air Quality Standard (NAAQS) for ozone was completed by NUS Corporation, under contract to the BAQNC. For nonattainment areas, the BAQNC developed the inventory.

Although the methodologies reported by NUS and the BAQNC were generally consistent with those recommended in Volume I[19], annual emission totals, activity rates, and emission factors on a county-specific basis had not been provided for all categories. Also, a number of categories had been omitted. The BAQNC supplied most, but not all, of the data requested by GCA as a result of the data review. Some deviations from the EPA Guidelines[19] are identified below.

Small Industrial/Commercial Degreasing--

According to the BAQNC, all degreasing emissions for the nonurban portions of Maryland are accounted for in Maryland's point source inventory. Therefore, area source emissions from this category were assumed to be zero in the nonurban areas. This resulted in a VOC estimate that is approximately 2,800 tons/yr lower than would have been estimated by the Volume I[19] method.

Small Industrial Surface Coating--

According to the BAQNC, all surface coating emissions are covered in the point source inventory. Area source emissions from this category were assumed to be zero.

Fuel Combustion--

The BAQNC was unable to disaggregate fuel combustion emissions by fuel type. Composite categories were utilized for residential and commercial/ institutional fuel combustion. This will have a significant impact on VOC speciation since species profiles are fuel-specific.

According to the BAQNC, all industrial fuel combustion emissions are covered by the Maryland point source inventory. Therefore, area source emissions from these categories were assumed to be zero. The Maryland emission totals for all fuel combustion categories exceed these reported in NEDS, which gives some weight to this assumption, even though NEDS shows over 5,000 tons/yr of NO_x and close to 1,200 tons/yr of VOC from area source industrial fuel combustion.

Other Composite Categories--

The Maryland area source inventory also fails to disaggregate emissions from the following composite categories: aircraft (civil, commercial, military), oil-powered vessels* (distillate, residual), off-highway vehicles (gasoline, diesel), and on-highway light-duty trucks (classes I and II). Use of composite categories will adversely affect VOC and NO_x speciation. Temporal factors will not seriously be affected by these aggregations, except aircraft, for which separate hourly patterns were derived for civil, commercial, and military aircraft operations.

Comparison with NEDS and SIP Inventories

The NECRMP emissions data for Maryland are compared to the NEDS and SIP inventory estimates in Table 29.

For the Baltimore SIP area, the NEDS, SIP, and NECRMP estimates for VOC are quite variable, while agreement for NO_x is significantly better. In both instances, the NECRMP estimates fall almost midway between the SIP and NEDS estimates.

Area source emissions reported in the (December, 1981 version) Maryland SIP do not include four categories that are included in the NECRMP inventory; Degreasing, Dry Cleaning, Autobody Refinishing, and Graphic Arts, which account for much of the VOC difference. The SIP VOC point source data are more than 30 percent lower than NECRMP, and should be further investigated.

On a statewide basis, the NEDS and NECRMP estimates for NO_x are within less than 10 percent of each other. For VOC, however, the NEDS system totals are significantly higher. Much of the difference occurs as a result of the organic solvent evaporation differences between NEDS and the EPA Guidelines, as previously discussed in Section 3. For point sources, much of the difference between NEDS and NECRMP can be attributed to two categories: in-process fuel use and unclassified fuel combustion.

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*In nonurban areas, the composite category also includes pleasure craft (gasoline-powered).

TABLE 29. COMPARISON OF NEDS, SIP, AND NECRMP EMISSIONS FOR MARYLAND

SIP area	VOC (tons/year)			NO_x (tons/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Baltimore						
Point	62,231	49,890	72,691	32,722	57,132	52,290
Area	152,793	78,054	90,806	81,983	66,386	66,516
Total	215,024	127,944	163,497	114,705	123,518	118,806
Statewide						
Point	60,092	-	77,557	116,673	-	138,095
Area	263,589	-	197,699	153,882	-	156,845
Total	323,681	-	275,256	270,555	-	294,940

Apparent Completeness for Other Pollutants

The NECRMP point source inventory for Maryland includes estimates for TSP SO_2 and CO emissions, which are compared to the NEDS system totals, below.

	TSP (tons/yr)	SO_x (tons/year)	CO (tons/year)
NECRMP point	87,313	447,997	39,139
NEDS point	29,137	297,743	52,176
Deviation	58,176	150,254	(13,037)

A complete description of the Maryland inventory is presented in Volume V.[5]

MASSACHUSETTS

The Massachusetts Department of Environmental Quality Engineering (DEQE) provided the input data used in the NECRMP point and area source inventories for Massachusetts and assisted in the quality assurance review of the data by supplying a revised point source tape reflecting corrections to problems identified by GCA and supplying required corrections for area source data as necessary.

Point Source Inventory Quality

The Massachusetts point source inventory was obtained from the Massachusetts DEQE, through EPA. The inventory reflected 1979 data and was supplied in NEDS format as converted from the DEQE's, EIS/P&R file. A number of generic problems existed throughout the Massachusetts NEDS file which were addressed using GCA-developed computer routines.[6] This included inconsistent coding of the emission control device and efficiency fields, incorrect common stack fields, and incorrectly entered "action" codes. In addition, the following problems were frequently encountered: emissions estimation methods reported as "3" (i.e., computer calculated), but fields needed for calculation were missing; missing stack data; illegal SCC codes; and duplicate SCCs at single points. A comprehensive list of specific problems was forwarded to the Agency. However, the DEQE chose not to respond to the error list directly, rather, the DEQE updated the Massachusetts NEDS file, reportedly using the GCA error list as a guide. Updates were reportedly based on source size and error severity. Although the revised data reflected considerable improvements, numerous problems persisted. These included missing stack data and duplicate SCCs at single points. The former problems were addressed using a computer routine which inserted data reflecting ground level plumes at ambient temperature (77°F) for the missing stack data. The duplicate SCC problems had to be manually corrected by GCA, since they frequently occurred when the emissions estimation method of "3" was used. In these instances process rates were added and sulfur and ash contents were averaged, weighed by relative process rates.

In addition to the stack data problem, there were a significant number of incorrect UTM coordinates that were identified during the QA review. While many of these were addressed by the DEQE in the revised inventory, all UTM-X coordinate errors may not have been identified since Massachusetts falls within two UTM zones making virtually all X coordinates "in range." Based on the number of "out of range" Y coordinates it would not be surprising if a number of X coordinate errors exist within the Massachusetts data.

Upon review of the initial NECRMP report for Massachusetts,[6] the DEQE noted discrepancies in VOC emissions for a number of facilities. The problem was traced back to conversion of the Massachusetts data from EIS/P&R format to NEDS format. Apparently, for a number of major facilities, DEQE had stored reactive VOC data in a separate, "sixth" pollutant field in their EIS/P&R file. These data were subsequently "lost" in the conversion to NEDS format. A follow-up meeting was held at EPA/Region I offices to determine the most efficient approach to restore the missing VOC data.

The DEQE subsequently supplied listings of VOC emissions data, which included the reactive VOC data stored in the above mentioned separate pollutant field, to EPA/Region I. Update transactions to enable the appropriate corrections were coded and keypunched by EPA/Region I and forwarded to GCA, who updated the EIS/PS master file, accordingly. GCA also took this opportunity to correct the SCC codes of several lime manufacturing point sources which had previously been miscoded as a result of a typographical error in the 11/78 version of the NEDS SCC listing (on page C-59 of AP-42).[24]

Area Source Inventory Quality

The Massachusetts DEQE supplied area source data, reflecting 1979, in hard copy format. The area source inventory was reviewed for comprehensiveness and consistency with the Volume I[1] area source methodologies. The documentation supplied provided only the VOC and NO_x emissions in kg/day. Activity or process rates, emission factors, and annual emissions in tons/year were not provided. Additionally, a few categories had not been addressed, and a few others required further disaggregation to maintain conformity with the NECRMP requirements.

GCA was also unable to duplicate DEQE's emission calculations for gasoline handling, architectural surface coating, and autobody refinishing. Additional information was requested. The DEQE estimate for small industrial/commercial degreasing included only cold cleaning. GCA asked DEQE to verify that all open-top vapor and conveyorized degreasing had been covered in the point source inventory's 8665 tons VOC/year (covering 112 emission points). The DEQE estimate for structural fires included VOC emissions only; GCA requested NO_x data as well. All of the above were subsequently resolved except that the DEQE did not disaggregate emissions for three categories: vessels (gasoline, distillate, residual), aircraft (civil, commercial, military), and off-highway vehicles (gasoline, diesel). Composite categories were used in these instances. As is the case for other states which used composite categories, speciation and temporal resolution will be adversely affected.

Comparison with NEDS and SIP Inventories

The NECRMP emissions data for Massachusetts are compared to the NEDS and SIP inventory estimates in Table 30.

With the exception of the Worcester SIP area, NECRMP point source VOC totals are somewhat higher than the SIP estimates. Some of this difference is related to the DEQE's handling of nonreactive VOC for point sources. As discussed above, the DEQE had stored reactive VOC emissions in "sixth" pollutant field in their EIS/P&R file which were not supplied in Massachusetts original NECRMP submittal. Adding these emissions into the NECRMP data base resulted in a statewide increase in VOC point source emissions of approximately 51,000 tons/year. For the Springfield area the NEDS and NECRMP estimates for point source VOC are in good agreement. The NEDS point source VOC estimates are approximately 10 percent higher than NECRMP for the Boston area and 10 percent lower for the Worcester area.

The Massachusetts SIP and NECRMP area source inventory totals deviate significantly from NEDS. The bulk of the VOC difference can be attributed to solvent evaporation. Reasons for deviations in estimates for this category have previously been addressed.

For NO_x, the NECRMP inventory shows over 80,000 tons/yr more than NEDS (approximately 30 percent higher). Nearly half of this deviation is attributable to highway vehicle emissions (32,000 tons/yr). The NECRMP annual totals for highway vehicles were derived from the Massachusetts supplied kg/day values using the temporal adjustment factors from Volume XVII.[17] This will ensure that when temporally resolved to a typical summer weekday, the NECRMP emissions will match the Massachusetts SIP values. Thus, a deviation in annual totals may not necessarily be a major problem in this instance. The remaining difference can be attributed to commercial/institutional oil combustion. For these categories (distillate, residual), GCA utilized the DEQE supplied fuel use estimates and emission factors to calculate emissions. Although the distribution to sectors varies, the total area source distillate oil use was found to be in good agreement (less than one percent difference) with the 1978 NEDS Fuel Use Report,[32] yet the NO_x emissions estimates from commercial/institutional distillate oil combustion differ by an order of magnitude. Some of this difference appears to be related to emission factors utilized. The DEQE used a factor of 60 $lb/10^3$ gallons, which is somewhat higher than the emission factor used by GCA in other NECRMP states (22 $lb/10^3/gal$).

Apparent Completeness for Other Pollutants

The Massachusetts NECRMP point source inventory includes emission data on TSP, SO_2, and CO, which are compared to the NEDS system totals below.

TABLE 30. COMPARISON OF NEDS, SIP, AND NECRMP EMISSIONS ESTIMATES FOR MASSACHUSETTS

SIP area	VOC (tons/year)			NO_x (tons/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Boston						
Point	76,883	41,039	68,901	73,910	105,815	133,135
Area	312,231	177,311	145,867	134,240	179,443	174,224
Total	389,114	218,350	214,768	208,150	285,258	307,359
Worcester						
Point	9,417	11,266	10,311	2,050	80	2,662
Area	63,732	33,277	31,631	24,622	26,957	28,972
Total	73,149	44,543	41,942	26,672	27,037	31,634
Springfield						
Point	20,981	17,703	20,987	10,238	25,750	11,895
Area	56,163	33,647	34,583	25,063	14,484	36,415
Total	77,144	51,350	55,570	35,301	40,234	48,310
Statewide						
Point	101,681	-	113,328	89,621	-	151,196
Area	445,041	-	235,862	183,930	-	266,046
Total	546,722	-	349,190	273,551	-	417,242

	TSP (tons/yr)	SO_x (tons/year)	CO (tons/year)
NECRMP point	13,368	320,261	18,541
NEDS point	11,975	301,229	10,057
Deviation	1,393	19,032	8,484

A complete description of the Massachusetts emission inventory can be found in Volume VI.[6]

NEW HAMPSHIRE

Point source data for New Hampshire were obtained from the NEDS system following an update in a previous contractual effort by GCA.[23] The area source data were developed by GCA using the procedures recommended by EPA in the Guidelines[19] document. The New Hampshire Air Pollution Control Agency (NHAPCA) assisted in this effort by supplying required corrections and additional data as needed for the point source inventory, and providing much of the input data used in the area source inventory development.

Point Source Inventory Quality

The New Hampshire point source inventory, reflecting 1979 data, was obtained from the NEDS system. The data had been updated in a previous assignment by GCA.[23] The majority of the problems corrected as a result of the QA review entailed missing UTM coordinates, inconsistent use of blanks and zeros in the control equipment and efficiency fields, and missing exhaust flow rates. These were corrected through the cooperation of the New Hampshire APCA. An erroenous emission total for one facility was detected by EPA and subsequently addressed. No serious remaining problems are known.

Area Source Inventory Quality

GCA developed a 1980 area source inventory of emissions of VOC and NO_x using state supplied activity data and methodologies generally consistent with the Procedures for the Preparation of Emission Inventory for Volatile Organic Compounds--Volume I.[19] Due to data availability, some minor deviations from the Volume I[19] methods were necessary. These are explained in Volume VII.[7]

One such modification to the Guidelines[19] methodologies involves residential fuel combustion. Fuel used in the residential sector was estimated using the equations presented in Volume I.[19] The number of housing units using each individual fuel type was determined using the following equation:

$$H_{i\ 80} = H_{i\ 70} \left(\frac{H_{T\ 80}}{H_{T\ 70}} \right)$$

where $H_{i\ 80}$ = Number of housing units using fuel type i in 1980

$H_{i\ 70}$ = Number of housing units using fuel type i in 1970 (from the 1970 Census of Housing)

$H_{T\ 80}$ = Number of total housing units in 1980 (from the 1980 Census)

$H_{T\ 70}$ = Number of total housing units in 1970 (from the 1970 Census)

This method, used in lieu of fuel-specific data for 1980, assumes an insignificant change in fuel mix from 1970 to 1980. The emission factor for LPG was derived assuming a 1:1 ratio of propane to butane. Emission factors for the remaining fuels were obtained directly from AP-42.[24]

Comparison with the NEDS Inventory

The NECRMP emissions data for New Hampshire are compared to the NEDS inventory estimates in Table 31.

TABLE 31. COMPARISON OF NEDS AND NECRMP EMISSIONS FOR NEW HAMPSHIRE

	VOC (tons/year)		NO_x (tons/year)	
	NEDS	NECRMP	NEDS	NECRMP
Point	11,192	21,041	41,697	49,206
Area	68,683	59,187	30,177	45,306
Total	79,875	80,228	71,874	94,512

As shown in Table 31, NECRMP point source VOC emissions are nearly twice those contained in NEDS. This is primarily due to recent updates in NEDS (current as of January 1983). (The July 1982 version of NEDS data for New Hampshire contained 18,461 tons/year from VOC point sources).

The NECRMP area source estimates of both VOC and NO_x differ from the NEDS system. As was the case in other states, the NEDS system shows higher VOC emissions from solvent evaporation. The reasons for this deviation have been previously discussed. For NO_x, the NECRMP inventory shows over 30 percent more emissions from area sources than does NEDS. Most of this deviation can be attributed to higher NO_x emissions estimates for light-duty highway vehicles and residential distillate oil combustion. The NECRMP estimate of emissions from highway vehicles was calculated based on VMT data from the NHDOT and MOBILE2. The NECRMP residential fuel combustion emissions estimate was derived using the volume I[19] methodology.

Apparent Completeness for Other Pollutants

The NECRMP point source inventory includes data on TSP, SO_2 and CO which are compared to the NEDS inventory, below.

	TSP (tons/year)	SO_2 (tons/year)	CO (tons/year)
NECRMP point	4,829	68,015	5,875
NEDS point	6,489	102,088	11,143
	(1,660)	(34,073)	(5,268)

A complete discussion of the New Hampshire inventory is presented in Volume VII.[7]

NEW JERSEY

The New Jersey Department of Environmental Protection (DEP) was the original source of the point and area source emissions data used in NECRMP. For the New Jersey counties included in the Philadelphia SIP area, Engineering-Science, Inc. conducted an extensive update and quality assurance effort prior to incorporation of the data into the NECRMP inventory. The New Jersey DEP also assisted in the quality assurance review of the NECRMP data by supplying updates and corrections as required and additional data as needed.

Point Source Inventory Quality

The NECRMP point source inventory data, reflecting 1980, were obtained in EIS/P&R format from Engineering-Science, Inc., who had previously converted the inventory data from NJDEP's Air Pollution Emission Inventory Data System (APEDS). There were numerous significant problems with the data, which were traced back to conversion of the APEDS data into EIS/P&R format. These included dropped digits in stack diameter fields, occasional incorrect conversion of emissions from lb/hr to tons/year, invalid and/or missing emission control equipment and efficiencies, blank UTM zones, "garbage" data in various fields and asterisks in several process rate fields.

Due to resource limitations, the above problems were generically addressed using a computer routine, which is further discussed in Volume VIII.[8]

After completion of the above computerized corrections, a number of discrepancies were noted between the NECRMP data and the New Jersey SIP inventory. The EIS file for the involved facilities was compared to the New Jersey APEDS file, the NJDEP field office reports, and the operating permit files. Inconsistencies generally fell into two categories:

- The APEDS to EIS conversion resulted in uncontrolled emissions being reported for certain points, thus creating a discrepancy.

- The APEDS file matched the EIS file, but emissions reported in the SIP reflected the more recent field office reports which superseded the APEDS data.

The APEDS file reflects emissions by pollutant species rather than total VOC, SO_x, NO_x, etc. It was noted when reviewing the APEDS data that in some instances water vapor (H_2O) had been erroneously included as hydrocarbon emissions in the APEDS to EIS conversion. Since at that point the objective was primarily to reach agreement between the SIP and NECRMP inventories, no attempt was made to correct these problems.

In many instances, the SIP facility emission totals resulted from the NJDEP field offices' reports. For some field offices, only plant totals were provided prohibiting matching of individual emission points. In these instances, "new" emission totals were allocated to individual points based on the distribution of the "old" emission totals. Since pollutant speciation in preparation for photochemical modeling will be tied to point-specific SCC codes, considerable error in speciation is inevitable.

Area Source Inventory Quality

The 1980 New Jersey area source emission inventory was supplied in hard copy format by the New Jersey DEP. The EPA Project Officer also made available an area source inventory covering the New Jersey portion of the Philadelphia AQCR that was developed by Engineering-Science, Inc.

The above area source inventories were reviewed for comprehensiveness and consistency with the area source methodologies presented in Volume I.[1] In general, the NJDEP area source inventory was very well prepared and was determined to be preferable to the Engineering-Science inventory. The results of this review and comparison were documented and forwarded to the EPA Project Officer. The primary problem with the Engineering-Science data reflected the fact that the inventory had been developed prior to the release of the Procedures for Preparation of Emission Inventories for Volatile Organic Compounds, Volume I, Second Edition[19] and, therefore, reflected older methodologies in many instances. The EPA Project Officer indicated concurrence with GCA's recommendation to utilize the NJDEP inventory for all of New Jersey in the NECRMP inventory. Some minor modifications were made to the NJDEP data prior to computerization, primarily to ensure consistency with the other NECRMP states' data. These involved those area source categories whose emissions are based on population: degreasing, dry cleaning, architectural surface coating, autobody refinishing, graphic arts, and commercial/consumer solvent use. Since the DEP had completed calculation of the area source inventory prior to release of the 1980 Census, they had relied on population projections for estimating emissions using per-capita factors. To maximize consistency with the other NECRMP states, GCA recalculated emissions for the above categories using the 1980 Census of Population.

Comparison with NEDS and SIP Inventories

GCA prepared its first draft of the New Jersey inventory report[8] in May, 1982. In August of 1982, the NJDEP submitted a revised ozone SIP inventory. Differences between the August 1982 version and the December 1981 SIP inventory utilized by GCA are highlighted below.

- Eight major point sources of VOC were added to the August 1982 SIP inventory and one was deleted, totaling an increase of 3,612 TPY of VOC. One of the added sources was already contained in NECRMP, the other seven are not; the deleted source is in the NECRMP inventory.

- Non-highway vehicle area source emissions were unchanged and are generally in good agreement with NECRMP. Some minor differences exist because GCA used 1980 Census data for per-capita area source emissions calculation, while the NJDEP used earlier population projections.

- Highway vehicle emissions have been modified to reflect an error in MOBILE2, ostensibly involving I/M credits. This results in VOC emissions adjusted upward, across-the-board, by about 15.3 percent. Total summer weekday VOC emissions, which were 454 Mg/day in the December 1981 SIP, are now 517 Mg/day in the August 1982 revision. Extrapolating to annual rates, the NECRMP VOC totals for highway vehicles should be increased from about 182,458 TPY to about 208,000 TPY, an increase of about 25,000 TPY.

- A source-by-source comparison was made of facility totals between the New Jersey SIP and NECRMP inventories. These are summarized below:

  - 77 facilities emitting $\geq$ 100 TPY of VOC are included in the NECRMP inventory but not in the SIP inventory, totaling 20,307 TPY. The NJDEP has acknowledged that some of these sources do emit 100 TPY or more.[25]

  - 37 facilities emitting $\geq$ 100 TPY of VOC are in the New Jersey SIP inventory but not in the NECRMP inventory, totaling 13,199 TPY.

  - 33 sources are present in both the NECRMP and SIP inventories but differ in VOC emissions by $\geq$ 100 TPY of VOC. The SIP sources falling in this category total 7105 TPY more than the NECRMP sources.

  - 35 sources emitting $\geq$ 100 TPY of NO_x are in the NECRMP inventory, but not in the SIP inventory, totaling 19,322 TPY. The NJDEP has acknowledged that some of these sources emit 100 TPY.[25]

- 19 sources emitting $\geq$ 100 TPY of NO_x are in the New Jersey SIP inventory but not in the NECRMP inventory totaling 6,412 TPY.

- 17 sources present in both the NECRMP and SIP inventories, but differ in NO_x emissions by $\geq$ 100 TPY. The SIP sources account for 13,249 TPY of NO_x more than the same sources in the NECRMP inventory.

A source by source review of the above differences can be found in Appendix D of Volume VIII.[8]

The New Jersey NECRMP emissions estimates are compared to the NEDS system totals in Table 32.

TABLE 32. COMPARISON OF THE NEDS AND NECRMP INVENTORIES FOR NEW JERSEY

	VOC (tons/year)		NO_x (tons/year)	
	NEDS	NECRMP	NEDS	NECRMP
Point	418,896	158,228	157,803	204,844
Area	562,841	415,035	272,738	348,568
Total	981,737	573,263	430,541	553,412

As shown in Table 32, the NEDS system estimates for VOC emissions from both point and area sources are considerably higher than NECRMP. Changes in the NJDEP SIP inventory are not believed to be reflected in NEDS because, despite the above differences between the NEDS and SIP inventories, it was found that the cumulative errors, for both VOC and NO_x, almost exactly (and coincidentally) cancel each other.

The differences between the NEDS and NECRMP estimates for point source VOC can primarily be attributed to chemical manufactuing, organic solvent evaporation, and petroleum storage transport. For NO_x, NECRMP point sources in NECRMP total 47,000 TPY higher than NEDS. Virtually, all of this difference can be attributed to electric generation.

Area source VOC totals in NEDS are nearly 150,000 TPY higher than NECRMP. Much of the difference can be attributed to organic solvent evaporation. Reasons for this deviation have previously been discussed. The NECRMP NO_x emissions estimate from area sources is approximately 21 percent higher than NEDS. Most of this difference can be attributed to highway

vehicles - LDVs. The NECRMP highway vehicles emissions, and most likely the NEDS highway vehicle emissions as well, do not reflect the August 1982 update made by the NJDEP.

Because of the large number of differences between NEDS, NECRMP, and the revised ozone SIP inventories for New Jersey, it is recommended that, if not already accomplished, the latest set of SIP estimates be incorporated into the New Jersey APEDS file. Since the errors which hindered conversion from APEDS to EIS format have reportedly been corrected, the revised APEDS file should be converted into EIS format for replacement of the current NECRMP file for New Jersey point sources. Similarly, highway vehicle emissions for New Jersey (as well as other affected areas) should be updated to reflect corrections to MOBILE2.

Apparent Completeness for Other Pollutants

The New Jersey point source inventory also includes data on TSP, SO_2, and CO emissions, which are compared to the NEDS system totals below:

	TSP (ton/year)	SO2 (ton/year)	CO (ton/year)
NECRMP points	160,027	588,276	113,773
NEDS points	351,017	273,589	94,925
Deviation	(190,990)	314,687	18,848

A complete discussion of the New Jersey emission inventory can be found in Volume VIII.[8]

NEW YORK

The New York Department of Environmental Conservation (DEC) provided the input data used in the NECRMP point and area source inventories for New York. The DEC assisted in the quality assurance review of the data by supplying a revised point source tape reflecting corrections to many errors identified by GCA, and supplying additional data as needed, most notably a cross-reference file which enabled GCA to "match up" New York's unique process codes with the most closely corresponding EPA SCC codes.

Point Source Inventory Quality

The New York point source emission inventory was supplied by the New York Department of Environmental Conservation (DEC). The data were supplied in NEDS format and represented 1980 data. The first NEDS formatted tape sent by New York had considerable problems apparently relating to the conversion of the point source data from New York's data system into NEDS format. Most notably, no NEDS Card 6 records were provided for nonboiler sources, thus, no process rates, SCC codes, design rates, or process descriptions were included. Other problems related to the emissions control device and efficiency fields. Further, a large number of sources had reported stack temperatures of 80°F.

The most significant problem entailed SCC codes. New York utilizes their own unique process codes which are not directly compatible with EPA's SCC codes. The DEC did send a cross reference list of New York process codes to SCCs, matching the "closest" SCC to the appropriate New York process code. This, combined with a revised NEDS file which contained the previously missing Card 6's which now contained the New York process codes, enabled GCA to "match" approximately half of the SCC codes for processes. Process codes that could not be "matched" with an appropriate SCC were assigned an "unidentified" code of 3-99-999-99. This SCC accounts for 38 percent of the VOC emission but only 0.2 percent of the NO_x emissions from point sources in New York.

Since the VOC species allocation factors are SCC-specific, 38 percent of the New York point source VOC will not be able to be properly speciated, seriously affecting the data's suitability for photochemical modeling.

Area Source Inventory Quality

The New York DEC supplied separate inventories for the Metropolitan New York City area and for "upstate" New York. GCA reviewed the DEC-supplied data and identified numerous data gaps and a few emission factor inconsistencies which were brought to the attention of the DEC. A number of composite area source categories needed to be disaggregated to conform to the list of area source categories being used in NECRMP. Emission factors and activity rates were not provided for the majority of categories. GCA also identified discrepancies with some of the emission factors that were provided by the NYDEC.

Some of the missing data for the "downstate" inventory was contained in the DEC's ozone SIP inventory which was later supplied by EPA/Region II. NYDEC supplied VOC composite category disaggregation data, through EPA, and the New York Department of Transportation supplied VMT data enabling disaggregation of highway vehicle emissions data into the appropriate vehicle classes.

GCA eventually chose not to utilize the upstate NO_x emissions summary for the following reasons. First, the emissions were aggregated into composite categories. Although the NYDEC later disaggregated the VOC emissions summaries into the appropriate NECRMP categories, no information was provided to enable proper disaggregation of the NO_x emissions. Additionally, the inventory was reportedly based on Part 208 Water Quality Management Program population projections, which were determined to vary significantly from the 1980 Census data which was used in all other NECRMP states.

In some instances, GCA had to develop emission factors, activity rates, and/or emissions for various categories to supplement the New York DEC supplied data. This was necessary to meet the requirements of the EIS/AS system and, in some cases, to be more consistent with Volume I[1] methodologies. The specific categories to which this applies are discussed in detail in Volume IX.[9]

Comparison with the NEDS and SIP Inventories

The NECRMP inventory for New York is compared to the SIP and NEDS emission totals in Table 33.

As shown in Table 33, the VOC totals for the New York State portion of the New York City (NYC) Metropolitan Area agree within 5 percent. Closer examination, however, shows significant differences in individual point source totals, which are outlined in detail in Appendix E of Volume IX.[9] More than 99 percent of the difference in NO_x emissions in the Metro NYC area can be attributed to two power plants, whose NECRMP NO_x emission totals are shown below, that are not present in the New York SIP:

- E. F. Barrett (105,481 TPY)
- Bowline Point (325,045 TPY)

Despite the known VOC emission total differences for specific point source in New York and New Jersey, VOC emission totals for the entire New York City SIP area agree within less than 6 percent. Differences in NO_x emissions are roughly equal to that reported for the two NYC area power plants identified above.

Statewide totals of point source VOC emissions are considerably higher in NECRMP than in NEDS. The majority of NECRMP VOC emissions fall into two categories, in-process fuel use and not-classified industrial point sources, which are not readily comparable to the NEDS reporting categories. Area source VOC emissions reported in NEDS are considerably higher than those shown for NECRMP area sources. Most of this difference can be attributed to organic solvent evaporation. Reasons for this difference have previously been discussed.

Statewide NO_x emissions in NECRMP are approximately 1.3 million tons/year higher than shown in NEDS. About 1.1 million ton/year of this difference relates to electric generation sources, which account for most of the NO_x discrepancy between NECRMP and NEDS in the entire 15-state NECRMP study area. As discussed in Section 3, NEDS emissions for power plants are independently updated by NADB annually using DOE published activity data. Yet, much of the difference between NECRMP and the SIP relates to power plants which are not included in the SIP inventory, and may be omitted in NEDS as well. Thus, the NECRMP NO_x emissions from power plants in New York should be reinvestigated.

Apparent Completeness for Other Pollutants

The New York Point Source inventory includes point source emissions data for TSP, SO_2, and CO, which are compared to the latest NEDS totals below:

TABLE 33. COMPARISON OF THE NEDS, SIP, AND NECRMP INVENTORIES FOR NEW YORK

SIP area	VOC (ton/year)			NO_x (ton/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
New York portion of Metro NYC						
Point	-	18,148	53,793	-	90,173	555,122
Area	-	344,023	325,073	-	246,339	245,211
Total	-	362,171	378,866	-	336,512	800,333
Entire NYC Metro[a]						
Point	291,766	156,510	165,665	201,619	236,576	689,888
Area	950,398	699,266	642,529	403,084	479,588	501,710
Total	1,242,164	855,776	808,194	604,703	716,164	1,191,598
Statewide						
Point	34,264	-	191,683	336,563	-	1,516,743
Area	989,101	-	651,570	426,567	-	587,109
Total	1,023,365	-	843,253	763,130	-	2,103,852

[a]Includes northern New Jersey and Fairfield County, Connecticut

	TSP (ton/year)	SO_2 (ton/year)	CO (ton/year)
NECRMP points	272,343	1,769,409	203,972
NEDS points	225,320	989,761	92,996
Deviation	47,023	779,648	110,976

A complete discussion of the New York emission inventory is presented in Volume IX.[9]

OHIO

The Ohio Environmental Protection Agency (OEPA) worked with GCA* in updating their point source inventory data for use in NECRMP. Since Ohio does not maintain an area source inventory of the detail required for NECRMP, GCA developed the Ohio area source inventory for NECRMP using methods generally as prescribed by the EPA Guidelines[19] document. The Ohio EPA assisted in this process by supplying much of the input data used by GCA in developing the area source inventory.

Point Source Inventory

The Ohio point source inventory was obtained from the Ohio EPA, following the GCA update work, in NEDS format as converted from the Ohio EIS system, and represents 1980 data. The most prevalent problems identified in the quality assurance review entailed missing SCC codes, SIC codes, and stack parameters. Also a number of sources contained multiple discharge points† for which stack parameters needed for modeling were unavailable. The majority of the missing data was supplied by the Ohio EPA in response to GCA's request for those data. For multiple discharge points, the Ohio EIS to NEDS conversion routine substitutes 77°F, 49 foot plumes for the multiple "stack" data. Since this substitution would have adversely affected modeling, the following method was used to determine the most appropriate parameters to include in the source record. Where several discharge points had different stack parameters but met the criteria of AEROS Volume II for combining into a single point, the following method (suggested in AEROS Volume II) was used to determine the most appropriate parameters to code. A "K" value was calculated for each discharge point as:

$$K = HVT/Q$$

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*Contract 68-02-3510, Work Assignment 10.

†The Ohio EIS system maintains parameters for each discharge point individually even though they are contained in a single emission "point". NEDS and EIS/PS, however, can contain only one set of stack parameters for each "point".

where H = individual stack height

V = individual gas flow rate

T = individual stack temperature

Q = individual emission rate for VOC if present, NO_x otherwise.

Stack parameters were coded for the discharge point with the lowest "K" value.

Some residual problems remain with the Ohio point source data. The most important of which relates to 96 source records which have missing data (primarily SCC codes) owing to confidentiality. Missing SCCs were coded as "other chemical manufacture" or "other industrial processes." Although VOC speciation for modeling is based on SCC codes and omission of these SCCs will adversely affect the photochemical modeling, these categories account for only 7.5 percent of the total VOC emissions from Ohio point sources. Therefore the impact is not expected to be severe.

Area Source Inventory Quality

Since Ohio did not maintain a VOC/NO_x area source inventory of the detail required for NECRMP, the 1980 area source inventory for the Ohio portion of the NECRMP study area was developed by GCA using methods generally consistent with the Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds--Volume I, Second Edition,[19] and includes estimates for all 54 NECRMP area source categories. The Northeast Ohio Areawide Coordinating Agency (NOACA) was concurrently preparing a VOC/NO_x area source inventory for use in the 1982 ozone SIP for the Cleveland area. With a few exceptions, the emissions estimates used in NECRMP for the Ohio Counties of Cuyahoga, Lake, Lorain, and Medina reflect the NOACA estimates. A comparison of the NOACA versus NECRMP estimates can be found below. A more comprehensive discussion of the differing methods used is presented in Volume X.[10]

Comparison with SIP and NEDS Inventories

The NECRMP point and area source emission totals are compared to the SIP and NEDS totals for the Ohio portion of the NECRMP study area in Table 34.

The Northeast Ohio Areawide Coordinating Agency (NOACA) prepared a VOC/NO_x area source inventory for the Cleveland area, consisting of Cuyahoga, Lake, Lorain, and Medina Counties, for the 1982 State Implementation Plan (SIP) submittal. GCA also calculated emissions for the four NOACA counties in order to compare the results of the different methodologies and data sources. The results of this comparison appear in Table 35 which shows the emissions calculated by both GCA and NOACA for each area source category. A ratio of the sum of all four counties' emissions as calculated by GCA divided by the sum of emissions as calculated by NOACA is included as an indicator of comparison for each category. If this ratio is nearly equal to 1.0, the calculation differences are small. A sum over all counties was used for this ratio so that differences in distributing emissions to the different counties were smoothed out and the ratio indicates primarily differences in methodology and data sources. The entire table shows calculations before any

TABLE 34. COMPARISON OF THE NEDS, SIP, AND NECRMP INVENTORIES FOR THE OHIO PORTION OF THE NECRMP STUDY AREA

SIP area	VOC (ton/year)			NO_x (ton/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Cleveland						
Point	110,948	26,152	29,768	67,619	73,226	45,534
Area	163,029	143,233	120,242	91,754	109,057	151,171
Total	273,977	169,385	150,010	159,373	182,283	196,705
Regionwide						
Point	163,460	-	85,452	301,615	-	310,576
Area	474,441	-	379,588	290,622	-	432,098
Total	637,901	-	465,040	592,237	-	742,674

TABLE 35. COMPARISON OF GCA AND NOACA AREA SOURCE EMISSION CALCULATIONS FOR THE FOUR CLEVELAND AREA COUNTIES

	Category	Pollutant	Cuyahoga		Lake		Lorain		Medina		GCA total / NOACA total
			GCA	NOACA	GCA	NOACA	GCA	NOACA	GCA	NOACA	
01	Tank truck unloading	VOC	3,069	3,294	500	436	634	475	274	218	1.01
02	Vehicle refueling	VOC	3,527	3,765	574	538	728	538	315	269	1.01
03	Tank breathing	VOC	368	388	60	55	76	55	33	28	1.02
04	Tank truck transit	VOC	2,525	82	411	12	521	12	226	6	19.25
05	Degreasing	VOC	5,686	4,028	808	509	1,043	405	429	212	1.55
06	Drycleaning	VOC	1,124	1,366	160	154	206	183	85	54	0.90
07	Architectural surface coating	VOC	3,446	3,446	589	589	632	632	260	260	1.00
08	Auto refinishing	VOC	1,423	1,015	202	272	261	312	107	117	1.16
09	Small industrial surface coat.	VOC	7,310	--	1,038	--	1,343	--	553	--	--
10	Graphic arts	VOC	599	959	85	41	110	55	45	38	0.77
11	Commercial/consumer solvent use	VOC	4,720	4,720	670	670	866	866	356	356	1.00
12	Cutback asphalt	VOC	5,150	3,155	731	118	945	360	389	378	1.80
13	Pesticide application	VOC	8	15	23	47	179	264	119	175	0.66
14-19	On Highway		No NOACA data provided								
20	Res. anthracite	VOC	1	3	4	0	0	1	0	0	--
		NO_x	1	4	9	0	0	1	0	0	--
21	Res. bituminous	VOC	30	0	0	0	11	0	11	0	--
		NO_x	60	0	0	0	21	0	21	0	--
22	Res. residual oil	VOC	0	0	0	0	0	0	0	0	--
		NO_x	0	0	0	0	0	0	0	0	--
23	Res. distillate oil	VOC	8	53	11	7	4	9	6	3	0.40
		NO_x	150	955	200	121	75	154	101	61	0.41
24	Res. natural gas	VOC	213	77	31	10	39	12	17	5	2.88
		NO_x	2,126	772	306	197	395	125	166	50	2.62
25	Res. LPG	VOC	3	4	0	1	1	1	1	0	0.83
		NO_x	32	4	4	1	15	1	5	0	9.33
26	Res. wood	VOC	0	--	0	--	0	--	0	--	--
		NO_x	0	--	0	--	0	--	0	--	--
27	C/I anthracite	VOC	0	0	0	0	0	0	0	0	--
		NO_x	14	48	1	7	1	9	0	4	0.24
28	C/I bituminous	VOC	0	0	0	0	0	0	0	0	--
		NO_x	0	0	0	0	0	0	0	0	--
29	C/I residual oil	VOC	27	4	2	1	3	1	1	0	5.5
		NO_x	1,600	255	129	36	155	47	57	19	5.4
30	C/I distillate oil	VOC	0	0	0	0	0	0	0	0	--
		NO_x	0	8	0	1	0	1	0	1	--
31	C/I natural gas	VOC	250	32	18	4	22	6	7	2	6.75
		NO_x	3,755	474	271	67	327	87	106	36	6.72

(continued)

TABLE 35 (continued)

	Category	Pollutant	Cuyahoga		Lake		Lorain		Medina		GCA total / NOACA total
			GCA	NOACA	GCA	NOACA	GCA	NOACA	GCA	NOACA	
32	C/I LPG	VOC	0	4	0	1	0	1	0	0	--
		NO_x	0	56	0	8	0	10	0	4	--
33	C/I wood	VOC	0	--	0	--	0	--	0	--	--
		NO_x	0	--	0	--	0	--	0	--	--
34	Industrial anthracite	VOC	0	0	0	0	0	0	0	0	--
		NO_x	2	0	0	0	0	0	0	0	--
35	Industrial bituminous	VOC	5,959	541	647	63	1,051	97	222	19	10.9
		NO_x	89,386	8,115	9,703	951	15,768	1,462	3,333	290	10.9
36	Industrial residual oil	VOC	28	21	4	2	3	4	1	1	1.29
		NO_x	1,699	1,237	215	145	192	229	67	44	1.31
37	Industrial distillate oil	VOC	132	9	17	0	25	2	6	0	16.36
		NO_x	2,911	208	374	24	544	38	121	7	14.26
38	Industrial natural gas	VOC	64	63	8	7	8	11	2	2	0.99
		NO_x	3,747	3,669	475	430	459	661	131	131	0.98
39	Industrial LPG	VOC	4	1	0	0	1	0	0	0	5.00
		NO_x	162	38	19	4	28	7	6	1	4.30
40	Industrial wood	VOC	0	--	0	--	0	--	0	--	--
		NO_x	0	--	0	--	0	--	0	--	--
41	Military aircraft	VOC	48	0	0	0	0	0	0	0	--
		NO_x	16	0	0	0	0	0	0	0	--
42	Civil aircraft	VOC	68	140	13	15	16	24	15	14	0.58
		NO_x	5	51	1	2	1	8	1	2	0.13
43	Commercial aircraft	VOC	892	2,106	0	0	0	0	0	0	0.42
		NO_x	783	1,665	0	0	0	0	0	0	0.47
44	Railroads	VOC	288	1,226	96	174	223	225	110	93	0.42
		NO_x	1,132	4,827	377	686	878	886	432	365	0.42
45	Vessels--gas	VOC	510	625	141	3,692	160	2,174	67	0	0.14
		NO_x	24	590	7	889	7	136	3	0	0.03
46	Vessels--distillate oil	VOC	39	44	23	5	22	16	0	0	1.29
		NO_x	171	195	99	22	97	73	0	0	1.27
47	Vessels--residual oil	VOC	2	6	0	1	1	2	0	0	0.33
		NO_x	59	73	8	8	25	27	0	0	0.85
48	Off-highway gas	VOC	1,063	1,691	147	282	208	456	92	291	0.56
		NO_x	149	707	20	153	43	271	24	153	0.18
49	Off-highway diesel	VOC	447	501	53	75	71	136	34	80	0.76
		NO_x	5,591	4,735	654	941	784	848	338	649	1.03

(continued)

TABLE 35 (continued)

	Category	Pollutant	Cuyahoga		Lake		Lorain		Medina		GCA total / NOACA total
			GCA	NOACA	GCA	NOACA	GCA	NOACA	GCA	NOACA	
50	On-site incineration	VOC	4,285	743	598	97	785	136	307	43	5.86
		NO_x	265	266	36	36	49	49	16	17	0.99
51	Open burning	VOC	10,848	1,102	1,528	409	1,990	651	798	472	5.76
		NO_x	2,065	183	290	65	379	34	152	107	7.42
52	Structural fires	VOC	205	--	17	--	27	--	11	--	--
		NO_x	33	--	3	--	4	--	2	--	--
53	Field/slash burning	VOC	0	--	0	--	0	--	0	--	--
		NO_x	0	--	0	--	0	--	0	--	--
54	Forest fires	VOC	2	--	1	--	2	--	2	--	--
		NO_x	0	--	0	--	0	--	0	--	--

balancing with point sources was done. Area source categories for which large differences occur were reexamined. In some instances, the NOACA estimates reflected survey or other local data believed to be more accurate than national per-capita factors reflected in the EPA Guideline[19] methods. In these instances, the NOACA numbers were used in NECRMP. In other instances, GCA concluded that the NOACA inventory had omitted or improperly estimated emission from certain other area source categories. In these instances, GCA estimates were used. A complete discussion of which estimates were used for which category is presented in Volume X.[10]

A number of categories had not been completed by NOACA in time for inclusion in the Ohio NECRMP inventory.[10] These categories are:

- Small Industrial Surface Coating (09)
- On-Highway Light Duty Vehicles (14)
- On-Highway Light Duty Trucks--Class I (15)
- On-Highway Light Duty Trucks--Class II (16)
- On-Highway Heavy Duty Gas Trucks (17)
- On-Highway Heavy Duty Diesel Trucks (18)
- On-Highway Motorcycles (19)
- Structural Fires (52)
- Forest Fires (54)

GCA estimates, therefore, were used for the above categories. Other categories for which NOACA and GCA estimates differ significantly, and resolution of these differences are summarized below.

Tank Truck Loading/Transit--

The NOACA inventory did not include tank truck loading emissions. To maintain consistency with the other NECRMP states, the emissions calculated by GCA were used for this category.

Degreasing--

The NOACA estimate for degreasing was based on a comprehensive survey in the Cleveland area. Since the GCA method reflected a national average and the NOACA survey appeared to be comprehensive and reasonable, the NOACA estimates were used for this category.

Pesticide Application--

GCA estimated emissions from pesticide application using the per-harvested acre emission factor prescribed in the EPA Guidelines,[19] and harvested acreage data from the Census Bureau's County and City Data Book. NOACA used a similar procedure but utilized different acreage estimates derived from the respective county conservation services. Since the acreage data used by NOACA were more current than those reported by the Census Bureau, the NOACA estimates were used for this category.

Cutback Asphalt--

GCA utilized state totals of asphalt application, apportioned to counties on the basis of population, to address this category. NOACA performed a survey to determine asphalt application in the Cleveland area. Since the NOACA survey was believed to be reasonably comprehensive, the NOACA estimates were used for this category.

Stationary Source Fuel Combustion

The methods used by NOACA for these categories were similar to those used for the NECRMP inventory, except for the data sources used. Table 36 compares the NECRMP and NOACA data sources. A large discrepancy occurred in the emissions computed by GCA and those used by NOACA for Industrial Bituminous (GCA's calculations were greater by more than an order of magnitude). NOACA used both the industrial point and area source bituminous use reported in NEDS Fuel Use Report. Thus, electric generation bituminous use was excluded from the NOACA calculations. However, when balancing this category with the Ohio point source inventory, GCA subtracted all point source use, including electric generation fuel use. Therefore, GCA's calculations were used for all 32 counties for Industrial Bituminous emissions.

TABLE 36. DATA SOURCES FOR COMMERCIAL/INSTITUTIONAL AND INDUSTRIAL FUEL CATEGORIES USED IN THE NECRMP AND NOACA ANNUAL EMISSION INVENTORIES

Fuel	NECRMP data source	NOACA data source
Anthracite coal	EPA's NEDS Fuel Use Report	EPA's NEDS Fuel Use Report
Bituminous coal	DOE's Bituminous and Sub-bituminous Coal and Lignite Distribution	EPA's NEDS Fuel Use Report
Residual oil	API's Basic Petroleum Data Book	Petroleum Encyclopedia
Distillate oil	API's Basic Petroleum Data Book	ODOE Energy Review
Natural gas	AGA's Gas Facts	ODOE Reports
LPG	DOE's Sales of LPG and Ethane	DOE's Sales of LPG and Ethane
Wood	EPA's NEDS Fuel Use Report	Not included in the NOACA inventory

Further comparison of the NOACA and NECRMP estimates, on a category-by-category basis can be found in Volume X.[10]

On a regionwide basis, the NEDS system totals for VOC are somewhat higher than NECRMP. Most of this difference is related to organic solvent evaporation. The reasons for this discrepancy have previously been discussed. For NO_x, the NECRMP estimates are considerably higher than NEDS. Most of this difference can be attributed to area sources of NO_x from bituminous coal combustion. The NECRMP estimate for this category reflects coal usage reported by DOE when balanced with point source totals in this category.

Apparent Completeness for Other Pollutants

The NECRMP point source inventory for Ohio includes data on TSP, SO_2, and CO, which we compared to the NEDS system totals for the Ohio portion of the NECRMP study area below:

	TSP (ton/year)	SO_2 (ton/year)	CO (ton/year)
NECRMP points	206,391	1,459,530	211,165
NEDS points	231,664	1,545,934	425,854
Deviation	(25,273)	(86,404)	(214,689)

A complete discussion of the NECRMP inventory for Ohio is presented in Volume X.[10]

PENNSYLVANIA

The Pennsylvania Department of Environmental Resources (DER) provided most of the input data used in the NECRMP point and area source inventories for Pennsylvania. The DER further assisted in the quality assurance review of the inventory by supplying some additional area source data where required. Unfortunately, the DER did not respond to GCA's questions concerning the point source inventory. Thus, except for corrections to generic problems that were needed to enable conversion into EIS/PS format, the point source data for most of Pennsylvania reflect the data essentially as received from the DER.

Point source data, and subsequent corrections, for the Philadelphia area (except Philadelphia County) were obtained from Engineering-Science, Inc. (ESI), who had conducted an extensive QA review of those data. Data for Philadelphia County were obtained from the Philadelphia Air Management Services (PAMS), through ESI. Point source data for Allegheny County (Pittsburgh) were developed by GCA under a separate assignment[26] to fulfill the requirements of both the 1982 ozone SIP for the Pittsburgh area, and the NECRMP annual inventory.

Point Source Inventory Quality

The original data source and year of record for the various components of the Pennsylvania point source emission data are summarized below:

Area	Source	Year of data
Allegheny County (Pittsburgh)	GCA[26]	1980
Philadelphia County	PAMS	1979
Remaining Philadelphia area[a]	ESI	1979/80
Remainder of Pennsylvania	PADER	1978

[a]Bucks, Chester, Delaware, and Montgomery Counties

The above data were merged into a single file and subjected to the quality assurance procedures reported in Volume I.[1] The quality assurance review of the Pennsylvania data revealed a number of duplicate SCCs at single points, a considerable number of points with questionable stack data, and a number of sources with suspiciously high SO_2 and CO emission levels. A detailed list of questions was forwarded to the Pennsylvania DER in January, 1982. No responses were received from the DER. Engineering-Science supplied data on changes affecting four facilities in the Philadelphia area, which were incorporated into the NECRMP inventory as appropriate. For the remaining portion of the State, however, the NECRMP inventory reflects the point source data, as received, from the PADER.

As discussed above, to enable conversion into EIS/PS format, some "generic" problems had to be addressed using a computer routine which is discussed in detail in Volume XI.[11]

Area Source Inventory Quality

The 1980 Pennsylvania area source inventory was obtained in hard copy format from the DER. GCA identified several area source categories which were not included in the Pennsylvania inventory. A number of composite categories which had to be further disaggregated were identified. Subsequently, GCA received the PADER responses to the GCA review, via EPA/Region III. Not all of the issues identified by GCA were resolved, although the PADER did supply responses to the questions concerning the aircraft and gasoline marketing categories. GCA was able to disaggregate the remaining composite categories based on information from neighboring states' area source emission inventories, and utilized NEDS 1980 emissions data for the omitted categories. In some instances, GCA had to back calculate activity rates from reported emissions, using AP-42 emission factors, to enable coding in EIS/AS format. Specific adjustments performed by GCA in this regard are discussed in detail in Volume XI.[11] More significant categories are summarized below.

Gasoline Marketing--

The PADER provided activity rates, emissions estimates and emission factors for the Stage I and Stage II gasoline evaporation categories. The PADER estimate for Stage I evaporation included storage tank breathing. GCA disaggregated the emissions for Stage I and storage tank breathing into

separate categories. An AP-42 emission factor of 0.12 lb/10^3 gal was used to cover evaporative losses during transport by tanker trucks. GCA reviewed the Pennsylvania point source inventory and verified that emissions for tank truck loading were completely covered.

Degreasing, Dry Cleaning, Architectural Surface Coating, Graphic Arts, Commercial Consumer Solvent Use--

GCA calculated VOC emissions (ton/year) using the 1980 Census of Population and the per capita emission factors provided by the PADER, which agreed with those recommended in the EPA Guidelines.[19]

Highway Vehicles--

Combined emission totals (for both VOC and NO_x) for the six on-highway vehicle categories were available for each county in kg/day for a typical summer weekday. GCA multiplied daily emissions by 365 to convert the emissions to tons/year consistent with Volume XVII.[17] The emission totals were distributed to specific vehicle classes based on the ratios derived from the Ohio Area Source inventory.[10] Emission factors from the Ohio Inventory[10] were used to back-calculate VMT.

Fuel Use--

The PADER did not supply data on area source fuel combustion. Therefore, 1980 emissions from the NEDS system were used. The statewide emissions estimates were distributed to counties based on the 1980 Census of Population. Activity rates were back calculated using the appropriate AP-42 emission factors.

Comparison with the NEDS and SIP Inventories

The NEDS, SIP and NECRMP emission totals for Pennsylvania are compared in Table 37.

As shown in Table 37, the NEDS, SIP, and NECRMP estimates for NO_x are generally in good agreement. Similarly, the SIP and NECRMP VOC totals are in reasonable agreement, while VOC totals in NEDS are consistently higher. As is the case throughout the NECRMP region, the NEDS system estimates are higher primarily as a result of organic solvent evaporation estimates. The reasons for these differences have previously been discussed in Section 3. A comprehensive comparison of the SIP and NECRMP inventories can be found in Appendix D of Volume XI.[11]

Apparent Completeness for Other Pollutants

The NECRMP point source inventory for Pennsylvania includes data on TSP, SO_2, and CO emission, which are compared to the latest NEDS system totals, below.

TABLE 37. COMPARISON OF NEDS, SIP, AND NECRMP INVENTORIES FOR PENNSYLVANIA

	VOC (tons/year)			NO_x (tons/year)		
SIP area	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Allentown						
Point	6,869	6,035	7,444	40,501	55,523	52,161
Area	39,201	17,703	18,897	21,270	18,508	21,690
Total	46,070	23,738	26,341	61,771	74,031	73,851
Pittsburgh						
Point	29,405	24,543	28,750	183,275	191,111	133,792
Area	152,299	124,726	122,448	98,180	90,526	119,786
Total	181,704	149,269	151,198	281,455	281,637	253,578
Philadelphia[a]						
Point	190,785	135,186	139,889	105,864	146,049	141,759
Area	324,630	219,677	215,205	199,241	179,443	208,303
Total	515,415	354,863	355,094	305,105	325,492	350,062
Statewide						
Point	182,428	-	264,054	626,011	-	538,019
Area	830,342	-	465,776	503,869	-	491,114
Total	1,012,770	-	729,830	1,129,880	-	1,029,133

[a]Includes Southern New Jersey and New Castle County, Delaware.

	TSP (ton/year)	SO2 (ton/year)	CO (ton/year)
NECRMP points	248,622	2,027,142	754,852
NEDS points	261,867	2,000,221	546,463
Deviation	(13,245)	26,921	(208,389)

A complete discussion of the NECRMP inventory for Pennsylvania is presented in Volume XI.[11]

RHODE ISLAND

The Rhode Island Department of Environmental Management (DEM) provided the basic input data used for both the NECRMP point and area source inventories for Rhode Island. The DEM further assisted in the quality assurance checking of the inventory by working directly with GCA to resolve point source problems and providing additional data as needed to complete the area source inventory compilation effort.

Point Source Inventory Quality

The Rhode Island point source data were obtained from the Rhode Island DEM (through EPA Region I). The inventory was provided in NEDS format, and reflects 1979 data. When received, the Rhode Island data suffered from missing UTM coordinates, incomplete stack data, missing maximum design rates, and the omission of a major VOC emitting facility. All of these problems were resolved through the cooperation of the Rhode Island DEM. There are no significant residual problems with the Rhode Island point source inventory of which GCA is aware.

Area Source Inventory Quality

The Rhode Island DEM provided a 1980 area source inventory in hard copy format. The initial submittal provided only statewide VOC totals for 17 composite categories. GCA subsequently received some of the information needed to disaggregate the composite categories and allocate them to counties. Still, the lack of comprehensive information required GCA make certain assumptions to enable computerization of the inventory in EIS/PS format. These cases are discussed individually in Volume XII.[12] Some of the more significant categories are discussed below.

Highway Vehicles--

VMT in miles per day and VOC emissions were supplied by the Rhode Island DEM. The NO_x emissons were estimated by GCA by utilizing the average ratios of VOC emissions to NO_x emissions from other NECRMP highway vehicle inventories for each vehicle type and then applying those percentages to the Rhode Island VOC emissions estimates.

Gasoline Marketing--

The statewide 1980 Gasoline Sales total of 370,355 x 10^3 gallons was distributed to counties based on population. Emissions and emission factors

were supplied by the Rhode Island DEM for Stage I and II Gasoline Evaporation and Storage Tank Breathing. Emissions from Gasoline Loading/Transit had not been accounted for, therefore, GCA applied an emission factor of 6.87 lb VOC/10^3 gallons.* Point source emissions were subtracted from the area source emissions as described in Volume I.[1]

Fuel Combustion--

VOC emission factors for all of the fuel combustion categories and composite VOC emission totals for each county were provided by the Rhode Island DEM. Based on the distribution of VOC emissions found in the 1978 NEDS Fuel Use Report,[23] the 333 tons per year of VOC emissions in Rhode Island were distributed to the Residential, Commercial/Institutional and Industrial Sectors, by fuel types. The activity rates were then back calculated using the VOC emissions and emission factors. The appropriate AP-42 emission factors were used with the back-calculated fuel usages to derive NO_x emissions.

Railroad Locomotives--

The Rhode Island DEM provided a statewide VOC emission estimate. Using a railroad transportation map,[28] GCA calculated the percentage of track mileage in each county in order to distribute the emissions. Using the appropriate AP-42 VOC emission factor, the activity rates were back calculated. By applying the corresponding AP-42 NO_x emission factor, NO_x emissions were calculated.

Aircraft and Vessels--

The Rhode island DEM supplied statewide composite VOC emissions for both aircraft and vessels. GCA distributed the emissions to counties based on population. NO_x emissions were determined by applying the corresponding ratios of VOC emissions to NO_x emissions from the Massachusetts Inventory[6] to the Rhode Island VOC emissions. A 2,000 lb/ton VOC emission factor was employed to enable coding in EIS/AS.

Comparison to the NEDS and SIP Inventories

The NECRMP emission inventory for Rhode Island is compared to the NEDS and SIP inventory totals in Table 38.

As shown in Table 38, the SIP and NECRMP estimates for VOC agree within less than 10 percent, although the NEDS estimate is 50 percent higher. Most of this difference is attributable to organic solvent evaporation, the reasons for which have previously been addressed in Section 3.

The NECRMP estimate for NO_x is more than 25 percent higher than the SIP estimate. At the time of preparation of the Rhode Island[12] inventory, NO_x data for many area source categories had not been provided, most notably, highway vehicles and residential combustion of fossil fuels. NO_x

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*Derivation of this emission factor is discused in Volume I.[1]

TABLE 38. COMPARISON OF NEDS, SIP, AND NECRMP INVENTORIES FOR RHODE ISLAND

	VOC (tons/year)			NO_x (tons/year)		
SIP area	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Providence						
Point	14,613	16,094	13,375	964	7,242	5,037
Area	87,594	51,500	49,264	11,341	35,003	48,830
Total	102,207	67,594	62,639	12,305	42,245	53,867
Statewide						
Point	14,644	-	13,375	5,000	-	5,037
Area	87,594	-	49,264	31,508	-	48,830
Total	102,238	-	62,639	36,508	-	53,867

emissions from these categories in NECRMP were calculated using the Rhode Island supplied VOC estimates and ratios of the appropriate NO_x versus VOC emission factors.

Apparent Completeness for Other Pollutants

The Rhode Island point source inventory includes estimates of TSP, SO_2 and CO emissions, which are compared to the latest NEDS system totals, below.

	TSP (ton/year)	SO2 (ton/year)	CO (ton/year)
NECRMP points	3,441	6,055	2,096
NEDS points	3,315	6,115	2,994
Deviation	126	(60)	(898)

A complete discussion of the Rhode Island emission inventory can be found in Volume XII.[12]

VERMONT

Point source data for Vermont were obtained from the NEDS system following an update in a previous contractual effort by GCA.[23] The area source data were developed by GCA using the procedures recommended by EPA in the Guidelines[19] document. The Vermont Agency of Environmental Protection (VAEP) assisted in this effort by supplying required corrections and additional data as necessary for the point source inventory, and providing much of the input data used in the area source inventory development.

Point Source Inventory Quality

The Vermont point source inventory was obtained from EPA's NEDS system and reflect 1979 data. Since an extensive update of the Vermont data had previously been completed,[23] relatively few problems were detected as a result of the quality assurance review. Those problems that were encountered entailed missing SIC codes, exhaust gas flow rates, and missing or incorrect UTM coordinates, which were subsequently corrected through the cooperation of the Vermont Agency of Environmental Protection. There are no known residual problems with the NECRMP point source inventory for Vermont.

Area Source Inventory Quality

The 1980 Vermont area source inventory was developed by GCA using data supplied by various Vermont state agencies and methods generally consistent with the Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds--Volume I, Second Edition.[19] Estimates of emissions of VOC and NO_x were derived for all 54 NECRMP area source categories. The Vermont area source inventory is believed to reflect the most current data available at the time of its preparation, and follows the EPA-prescribed methods[19] as closely as the available data allowed.

Comparison with the NEDS Inventory

The NECRMP and NEDS inventories for Vermont are compared in Table 39.

TABLE 39. COMPARISON OF NEDS AND NECRMP INVENTORIES FOR VERMONT

	VOC (tons/year)		NO_x (tons/year)	
	NEDS	NECRMP	NEDS	NECRMP
Statewide				
Point	4,171	4,921	866	1,595
Area	35,562	33,551	43,023	25,791
Total	39,733	38,472	43,899	27,386

As shown in Table 39, VOC emissions from NEDS and NECRMP are, overall, in good agreement. For NO_x, however, the NECRMP point source totals are approximately 700 tons/year higher than those shown in NEDS. Over 300 TPY of this difference can be attributed to the Beld Moran Plant in Burlington. The NEDS data for this facility shows 304 TPY of NO_x, reflecting a 1975 year of record, while the NECRMP inventory, reflecting the 1979 update,[23] shows 621 tons/year. The bulk of the remaining point source difference can be attributed to industrial external combustion, for which NECRMP shows 670 tons/year (across 119 individual emission points) while NEDS shows 334 tons/year. Some, but most likely not all, of this deviation could be related to use of the AP-42 Supplement 13 emission factors in NEDS. The emission factors in NECRMP reflect modifications made through Supplement 12, as Supplement 13 was released (August 1982) after completion of the point source inventory for Vermont.

The NEDS system area source NO_x totals are 40 percent higher than those reported in NECRMP. Virtually all of this difference can be attributed to off-highway diesel vehicles. The NECRMP estimate was derived using the 1978 NEDS Fuel Use Report[27] to obtain off-highway diesel usage. Emissions were calculated by distributing off-highway diesel fuel to equipment categories (e.g., agriculture, construction, recreational vehicle, etc.) using survey data summarized in the EPA Guidelines[19] and applying the appropriate AP-42 emission factors. The NEDS estimates reflect more recent DOE fuel use

estimates, however, it is doubtful that this alone could account for the magnitude of emissions difference in this category. Evidently NEDS assumes a different vehicle mix.

Across the entire NECRMP study region, off-highway diesels account for approximately eight (8) percent of the total NO_x emissions from area sources in NECRMP.* The NEDS system totals for Vermont show more than 52 percent of the area source NO_x as being emitted from off-highway diesels while the NECRMP data for Vermont show off-highway diesels as being responsible for 15 percent of the area source NO_x emissions. In this instance, the NECRMP NO_x estimate is believed to be more accurate.

Apparent Completeness for Other Pollutants

The NECRMP point source inventory for Vermont includes data on TSP, SO_2 and CO, which are compared to the latest NEDS system totals below.

	TSP (ton/year)	SO2 (ton/year)	CO (ton/year)
NECRMP points	2,887	2,508	303
NEDS points	2,014	2.867	445
Deviation	873	(359)	(142)

A complete description of the Vermont emission inventory can be found in Volume XIII.[13]

VIRGINIA

The Virginia State Air Pollution Control Board (VSAPCB) provided the input data used in both the NECRMP point and area source inventories. The VSAPCB further assisted in this process by working closely with GCA in a review of the data and by supplying required corrections, as needed.

Point Source Inventory Quality

The Virginia point source emission inventory was supplied by the Virginia State Air Pollution Control Board (VSAPCB). The inventory reflects 1979 data, which were supplied in NEDS format, as converted from EIS/P&R by the VSAPCB. Although the inventory was generally found to be complete and well prepared, some minor problems were encountered. All estimated emissions based on stack tests (estimation Method = 1) were apparently "lost" in the State's conversion from EIS/P&R to NEDS. These data were subsequently supplied by the VSAPCB. Other problems addressed included out of date SCC codes and missing UTM coordinates. All deficiencies identified were addressed, and were corrected in the final EIS/PS master file.

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*Nationwide, NEDS also shows this category as contributing 8 percent of the total area source NO_x.

Data Confidentiality--

Under the Air Pollution Control Law of Virginia, the VSAPCB cannot release point-specific process information. In order to obtain Virginia's point source inventory, GCA had to consent to a confidentiality agreement prohibiting the release of the process data considered confidential by the Commonwealth of Virginia.

Originally, the VSAPCB indicated that the following fields would have to be deleted from the inventory data prior to release to EPA (and, hence, made public information):[29]

SPACES	NEDS CARD NO. 6 DATA ITEM	CONTENTS
18-25	Source Classification Code	(Process Description)
26-32	Annual Fuel or Process Volume	(Process Volume)
33-39	Maximum Hourly Design Rate	(Process Capacity)
51-70	Comments	(Equipment Description)

Withholding of the SCC would have seriously affected the further use of the Virginia data in the NECRMP study. Temporal and pollutant species patterns will be determined by SCC in developing modeling files from the inventory data. Further, application of various control scenarios in the modeling portion of the study will likely be dependent on the SCC.

EPA and the Commonwealth of Virginia were able to work out a solution that enabled release of the SCC without compromising any provision of the Air Pollution Control Law of Virginia. This entailed deleting the following fields from each EIS point source record:[29]

- boiler capacity (columns 65 to 69 on card 11)
- emission estimation method (column 64 on card 13)
- fuel, process, solid waste operating rate (columns 37 to 43 on card 21)
- maximum design rate (columns 44 to 50 on card 21)
- emission factor origin (column 32 on card 23)
- emission factor (columns 38 to 46 and 54 to 62 on card 23)

The above fields were deleted prior to delivery of the final data base to EPA. The above deletions should not seriously affect the data's utility in photochemical modeling.

Area Source Inventory Quality

The 1979 Virginia area source inventory was supplied in hard copy format by the Virginia State Air Pollution Control Board. The inventory reflected county summaries of area source emissions for all five criteria pollutants that covered most of the 54 NECRMP area source categories. However, for

reporting purposes, many of the categories had been aggregated together and, therefore, did not conform with the NECRMP categories. Also, five categories were determined to have been excluded from the inventory.

The documentation supplied with the inventory summary was reviewed for consistency with the Volume I[19] recommended procedures and the EPA-approved emission factors. In general, the methodologies used by Virginia were consistent with those recommended as the standard in Volume I.[19] The basic problem with the inventory provided was the aggregation of categories for reporting purposes. The information needed to disaggregate emissions into all 54 area source categories was subsequently supplied by the VSAPCB.

Comparison to the NEDS Inventory

The NECRMP inventory for Virginia is compared to the latest NEDS system totals in Table 40.

TABLE 40. COMPARISON OF THE NEDS AND NECRMP INVENTORIES FOR VIRGINIA

	VOC (tons/year)		NO_x (tons/year)	
	NEDS	NECRMP	NEDS	NECRMP
Regionwide				
Point	17,157	24,443	30,354	35,868
Area	115,775	115,842	79,858	89,343
Total	132,932	140,285	110,212	125,211

As shown in Table 40, area source VOC totals between NEDS and NECRMP are in good agreement, while NECRMP point source totals are more than 7,000 TPY higher than NEDS. Approximately half of this difference can be attributed to three facilities (for which NEDS shows a 1977 year of record versus a 1979 year of record in NECRMP):

	VOC (tons/year)	
	NECRMP	NEDS
Allied Aviation - Arlington County	1535	Not listed
DuPont - Augusta County	2075	41
Reeves Brothers - Rockbridge County	2246	1860
	5856	1901

Similarly, for NO_x point sources, NECRMP totals are more than 5,000 TPY (18 percent) higher than NEDS. Over 4,400 TPY of this difference can be attributed to the VEPCO Possum Pt. Power Plant, for which NEDS shows a 1978 year of record). The NECRMP inventory, reflecting 1979, is believed more current for the above facilities.

Apparent Completenes for Other Pollutants

The NECRMP point source inventory for Virginia includes data on TSP, SO_2 and CO emissions, which are compared to the latest NEDS system totals, below.

	TSP (ton/year)	SO_2 (ton/year)	CO (ton/year)
NECRMP points	29,696	78,867	6,423
NEDS points	30,395	93,986	4,363
Deviation	(699)	(15,119)	2,060

A complete description of the Virginia emission inventory can be found in Volume XIV.[14]

WASHINGTON, D.C.

The Washington, D.C. Council of Governments (WASHCOG) provided the basic input data used for the NECRMP point and area source inventories. The Agency also assisted in the area source inventory development by supplying more detailed documentation of the emissions estimates supplied, when requested by GCA. GCA forwarded a comprehensive list of suspected errors and questions concerning the WASHCOG-supplied point source data, but a response was not received. The implications of this lack of response are discussed below.

Point Source Inventory Quality

Point source data for the District of Columbia, reflecting 1980, were provided in EIS/P&R format by the Metropolitan Washington Council of Governments (WASHCOG). The point source inventory also contained data covering five Virginia and two Maryland Counties. At the time of receipt of these data, GCA had already obtained point source data covering those Virginia and Maryland Counties from the Virginia SAPCB and the Maryland BAQNC, respectively. The state supplied data were used in preference to WASHCOG's data for the following reasons:

- At the time of receipt of the WASHCOG data, work on the Virginia point surce data had been completed and work on the Maryland data was well under way;
- The Council of Governments did not formally respond to GCA's lists of questions/problems concerning the D.C. point source data; and
- GCA noted the obvious omission of major powerplants in the WASHCOG data for Virginia and Maryland and, in general, was more confident of the accuracy of the data supplied by the Virginia and Maryland Agencies.

GCA completed a QA audit of the WASHCOG-supplied data and forwarded a list of suspected errors and questions to that Agency.

After awaiting a response from the agency for several months, GCA corrected the obvious errors (dropped zeros) and determined that the remaining problems were not sufficiently serious to warrant further delay. These were primarily missing maximum design rates and in a few cases, seasonal throughput percents.

Area Source Inventory Quality

The 1980 area source emission inventory was provided by the Washington Council of Governments (WASHCOG). The data provided included emission summaries for the District of Columbia, five surrounding Virgina counties and two Maryland counties. Area source emissions for the Virginia counties had already been inventoried by the Virginia State Air Pollution Control Board, and had been reviewed by GCA and found to be comprehensive and reasonable. Therefore, the WASHCOG data covering Virginia were not used in NECRMP. However, although the Maryland Bureau of Air Quality and Noise Control provided point source data for the entire State, the Maryland area source inventory did not address the Washington, D.C. area counties of Montgomery and Prince George's. Therefore, the District of Columbia area source inventory provided by WASHCOG was utilized in NECRMP for those two Maryland counties.

The area source data were reviewed for comprehensiveness and consistency with the prescribed procedures. The most notable deficiency was the lack of process or activity data and emission factors. GCA requested this information from WASHCOG and subsequently received sufficient information to enable GCA to complete the District of Columbia area source inventory. For many categories, only emission factors and emission levels were provided. In these instances, GCA back calculated process rates from the WASHCOG supplied data.

Some deviations from EPA prescribed procedures and emission factors were noted, and are discused below.

WASHCOG employed some emission factors which deviated from the factors recommended by GCA[1] or prescribed by EPA in Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds--Volume I, Second Edition.[19] These primarily involved categories for which per-capita factors are typically used. For degreasing, the WASHCOG inventory accounts for VOC emissions from cold metal degreasing only, and presumes all open top vapor and conveyorized degreasing emissions have been accounted for in the point source inventory.

For architectural surface coating, the WASHCOG inventory documentation indicates that the EPA-prescribed VOC emission factor of 4.6 lb/capita was felt to overstate emissions in the Metropolitan Washington area. Based on data derived from the National Paint and Coating Association's 1979 Data Bank Program, a factor of 1.76 lb/capita was determined to be a more accurate estimate of VOC emissions from architectural surface coating in the District of Columbia area.

The WASHCOG inventory employed a 0.4 lb/capita factor to account for VOC emissions from graphic arts establishments. While the EPA prescribed value is 0.8 lb VOC/capita, WASHCOG indicated that the lower value was employed as a result of an extensive survey of local graphic arts facilities.

WASHCOG discarded both the EPA per-capita and per-employee factors as resulting in unrealistically high emission estimates for autobody refinishing. WASHCOG conducted a survey of 24 autopainting businesses to determine average numbers of full and partial paint jobs performed on a typical summer day by a single shop. WASHCOG derived a VOC emission estimate using the above derived average shop workload; a 6 lb VOC/total paint job emission factor; a 3 lb VOC/partial paint job factor; and the total number of shops listed in the yellow pages. The above deviation from the recommended methods were identified and justified in the WASHCOG documentation.

Comparison with the NEDS and SIP Inventories

The NECRMP inventory for the District of Columbia is compared with the NEDS and SIP inventory totals in Table 41.

Overall the SIP and NECRMP inventory totals are in reasonable agreement, within about 10 percent. There are, however, substantial differences for individual source categories which are summarized in Tables 42 and 43 for VOC and NO_x, respectively.

Highway vehicles, most notably trucks, exhibit the greatest differences in both VOC and NO_x emissions. Part of this difference is due to using a tons/day to tons/year conversion factor of 365 for SIP comparison. In NECRMP, to ensure proper temporal allocation when creating modeler's tapes for use in the Regional Oxidant Model (ROM), the NECRMP temporal allocation factors[17] were utilized to convert the WASHCOG tons/day data into tons per year. For the District of Columbia and the Maryland counties of Montgomery and Prince George, when the NECRMP temporal allocation factors are applied, on-highway VOC and NO_x emissions match exactly. The NECRMP highway vehicle emission estimates for the Virginia counties were obtained from the Virginia State Air Pollution Control Board (VSAPCB) for reasons discussed previously. Vehicle emissions for these counties, particularly for trucks, differ significantly even though WASHCOG reportedly obtained Virginia and Maryland data from the respective state agencies.

VOC estimates for gasoline evapoation losses are significantly higher in NECRMP than the SIP since NECRMP added an area source component (per the EPA Guidelines methodology[19]) to account for loading of tank trucks at gasoline terminals and bulk plants.

The category having the largest NO_x discrepancy--residential, commercial, institutional fuel use--is actually of less consequence than indicated by the large difference in emissions, since very little of this total is allocated to the oxidant season. This category also accounts for a significant difference in annual VOC emissions.

TABLE 41. COMPARISON OF THE NEDS, SIP, AND NECRMP INVENTORIES FOR WASHINGTON, D.C.

SIP area	VOC (ton/year)			NO_x (ton/year)		
	NEDS	SIP	NECRMP	NEDS	SIP	NECRMP
Metro D.C. SIP area[a]						
Point	3,923	4,023	7,056	46,269	46,671	50,482
Area	141,962	119,093	120,230	87,008	87,308	105,079
Total	145,885	123,116	127,286	133,277	133,979	155,561
D.C. Only						
Point	901	672	1,952	6,363	2,789	6,345
Area	43,284	22,412	21,309	21,682	16,724	15,684
Total	44,185	23,084	23,261	28,045	19,513	22,029

[a]Includes Arlington, Fairfax, Loudoun, and Prince William Counties in Virginia and Montgomery and Prince George Counties in Maryland.

TABLE 42. MAJOR VOC DISCREPANCIES IN D.C. AREA, SIP VERSUS NECRMP

Source category	State/County	SIP total (TPY)	NECRMP total (TPY)	Comments
Autos (LDV)	All	71,313	63,381	SIP = 64,182, if NECRMP temporal factors used
LDT	All	6,268	8,154	SIP = 5,641, if NECRMP temporal factors used
HDT	All	3,992	7,167	SIP = 3,593, if NECRMP temporal factors used
Gasoline handling losses	All	175	3,408	NECRMP includes terminal and bulk plant losses not covered as point sources
Controlled/burning/ structural fires	All VA	493	3,260	
Degreasing	All Va	1,695	0	NECRMP assumed all covered as point sources
Allied Aviation	Arlington (WA National)	0	1,535	
	Loudoun (Dulles)	0	122	
Res./comm./inst. fuel use	All MD	0	1,348	Little allocated to summer season
Washington Post and Star Newspapers	DC	0	1,264	
Off-highway vehicles	Fairfax, VA	192	1,016	
Auto painting	All	1,095	1,852	COG used local survey data
Arch. surface coating	Fairfax, VA	686	1,373	COG developed lower per capita factors
Commercial/consumer solvent	Fairfax, VA	2,464	1,880	Both used 6.3 lb/cap-yr
VA heating and refrigerating	Arlington, VA	12	276	

TABLE 43. MAJOR NO_x DISCREPANCIES IN D.C. AREA, SIP VERSUS NECRMP

Source category	State/County	SIP total (TPY)	NECRMP total (TPY)	Comments
Res./comm./inst. fuel use	Arlington, Fairfax Prince Williams	8,652	1,430	Little allocated to summer season
Autos (LDV)	All	54,385	49,393	SIP = 48,947 if NECRMP temporal factors used
Point Sources	Prince Williams, VA	9,636	14,280	Individual NO_x sources not listed in SIP
	Prince George, MD	13,677	17,575	
	Washington, DC	2,789	6,345	
Off-highway	Arlington, Fairfax Prince Williams	1,797	5,231	
HDT	All	15,184	17,713	
LDT	All	5,201	7,010	
Railroads	Fairfax	580	101	

Several point sources, namely Allied Aviation at the two main airports, and the two Washington newspapers, contribute significantly to the NECRMP VOC totals, but are not represented at all in the SIP, even though NECRMP data for these sources were obtained directly from WASHCOG.

No area source degreasing losses were included in the NECRMP inventory for Virginia because all such activities were claimed to have been handled as point sources, per Virginia's APCB. Nevertheless, WASHCOG included an area source degreasing component, using the EPA[19] suggested 3 lb/capita-yr factor.

Auto painting and architectural surface coating emissions are considerably lower in the SIP. WASHCOG developed lower factors for these two source categories through contacts with the National Paint and Coating Association (NPCA) and various local autobody shops. GCA used the EPA-suggested factors in the NECRMP inventory.

Apparent Completeness for Other Pollutants

The NECRMP point source inventory for Washington, D.C. includes data on TSP, SO_2 and CO emissions, which are compared to the latest NEDS system totals below.

	TSP (ton/year)	SO2 (ton/year)	CO (ton/year)
NECRMP points	1,398	11,082	4,295
NEDS points	2,533	14,519	6,249
Deviation	(1,135)	(3,437)	(1,954)

A complete discussion of the Washington, D.C. emission inventory can be found in Volume XV.[15]

WEST VIRGINIA

The EPA Project Officer provided an agency contact in the West Virginia Air Pollution Control Commission (WVAPCC). The WVAPCC received EPA liaison funding and were to have been responsible for confirming data, supplying required corrections or additional data, interfacing with individual sources as necessary, and concurring on the comprehensiveness and accuracy of the final data base. However, during the period of performance of the project, the WVAPCC were unable to provide the basic input data needed for the inventory. Therefore, as an interim measure while the WVAPCC completes their inventory, alternative data sources were agreed upon.

Point Source Inventory Quality

The West Virginia Air Pollution Control Commission (WVAPCC) did not complete their point source inventory in sufficient time to be used in the initial applications of the NECRMP inventory. As an interim measure, while

the WVAPCC completes their in-house comprehensive inventory, GCA accessed West Virginia emissions data from the Emissions Inventory for the SURE Region.[18] Since these data are to be used only as an interim measure, a significant degree of data correction effort was not expended. Rather, efforts focused on correcting only those data problems that prohibited conversion of the NEDS formatted data into EIS/PS format. One such problem related to data within the West Virginia file that had been claimed confidential. For previous use in SURE,[18] the boiler design capacities, process rates, emission estimation methods, hourly design rates, and percent space heat fields for certain facilities had been "masked out" with alphabetic characters. Since EIS/PS would not permit nonnumeric or blank characters in these fields, they had to be changed to numeric characters to enable conversion. The emissions estimation fields were changed to "5" (special emission factor) and the remaining fields were changed to zeros. The most significant problem with the interim West Virginia point source data is its age. Although the base year of the SURE[18] inventory is 1978, most of the data actually represent 1975.

Area Source Inventory Quality

The West Virginia APCC did not complete their area surce inventory in sufficient time to be used in the initial applications of the NECRMP inventory. As an interim measure, while the WVAPCC completes this inventory, GCA assessed the West Virginia area source inventory from the Emissions Inventory for the SURE Region.[18] A few categories were not sufficiently disaggregated in SURE to conform with the 54 NECRMP area source categories. In these instances, data from NEDS were obtained and coded directly into EIS/AS format. All population based categories were recomputed by GCA using the per-capita factors from Volume I of the Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Second Edition[19] and the 1980 Census of Population.

The interim area source inventory should be adequate for use in NECRMP until West Virgina APCC completes their area source inventory.

Comparison with the NEDS Inventory

The NECRMP and NEDS inventory data for the NECRMP study area portion of West Virginia is presented in Table 44.

Overall, the NEDS and NECRMP data for West Virginia are in good agreement particularly for area sources. Some differences in point source totals exist, however, even though SURE utilized NEDS point source data. Changes made to the West Virginia point source data for SURE were not made in the NEDS system. Similarly, NEDS annual updates of powerplant and Federal government-owned facilities data are not reflected in NECRMP.

However, since total emissions match reasonable well, the NECRMP inventory should be adequate for interim use until the WVAPCC completes their emissions inventory update.

TABLE 44. COMPARISON OF NEDS AND NECRMP INVENTORIES FOR THE WEST VIRGINIA PORTION OF THE NECRMP STUDY AREA

	VOC (tons/year)		NO_x (tons/year)	
	NEDS	NECRMP	NEDS	NECRMP
Point	7,224	15,841	434,221	401,152
Area	90,804	87,200	91,951	91,962
Total	98,028	103,041	526,172	493,114

Apparent Completeness for Other Pollutants

The NECRMP point source inventory from West Virginia includes data on TSP, SO_2, and CO emissions, which are compared to the latest NEDS system totals below.

	TSP (ton/year)	SO2 (ton/year)	CO (ton/year)
NECRMP points	128,625	1,219,811	92,953
NEDS points	128,510	1,023,192	170,510
Deviation	115	196,619	(77,557)

A complete discussion of the West Virginia point source inventory can be found in Volume XVI.[16]

SUMMARY

A summary of the NECRMP inventory review and evaluation is presented in the Executive Summary of this Volume.

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16. ABSTRACT

This report discusses the development of the Northeast Corridor Regional Modeling Project (NECRMP) annual regional emission inventory. The inventory reflects 1979/1980 data and focuses on point, area and mobile source emissions of Volatile Organic Compounds (VOC) and Nitrogen Oxides (NO_x), although particulate, sulfur oxides and carbon monoxide emissions were also compiled for point sources. The study area includes the entire northeast quadrant of the United States from longitude 69° to 82° West, and latitude 38° to 45° North. The Volume presents a summary of emissions for the entire study area. Also included is a detailed analysis of the overall quality of the data base and an assessment of the data's utility for photochemical modeling.

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