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Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

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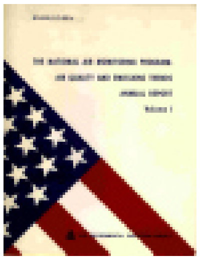
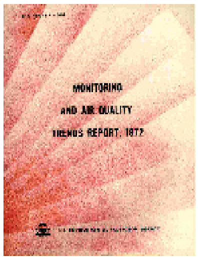
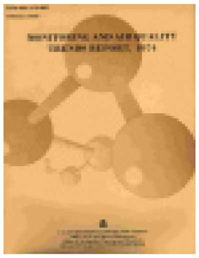
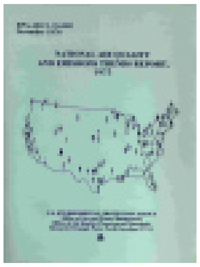
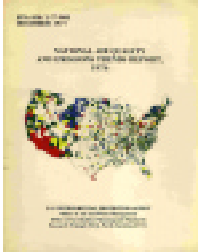
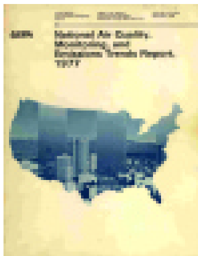
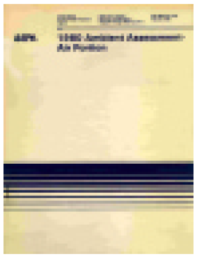
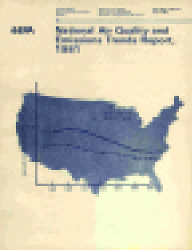
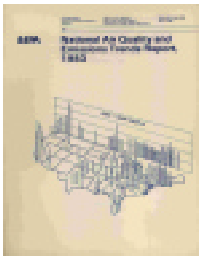
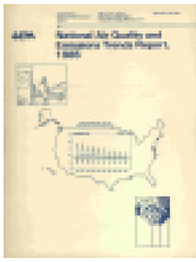
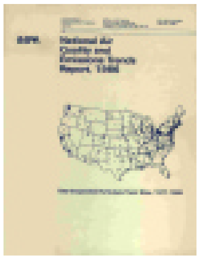
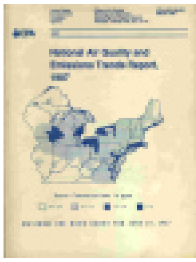
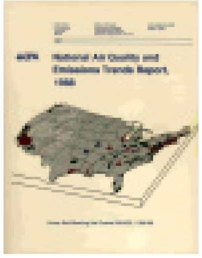
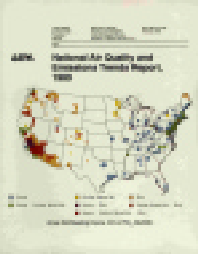
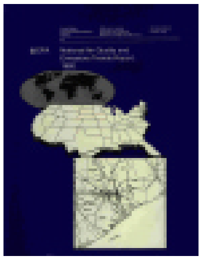
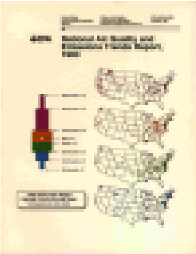
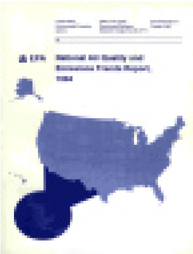
National Air Quality and Emissions Trends Report, 1997

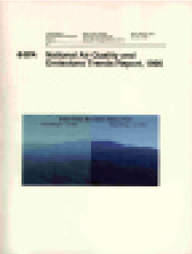







TRACKING THE
25th
ANNIVERSARY
REPORT
NATION'S AIR QUALITY

454/R-98-016

National Air Quality and Emissions Trends Report, 1997

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions Monitoring and Analysis Division
Air Quality Trends Analysis Group
Research Triangle Park, North Carolina 27711

December 1998

Disclaimer

This report has been reviewed and approved for publication by the U.S. Environmental Protection Agency's Office of Air Quality Planning and Standards. Mention of trade names or commercial products are not intended to constitute endorsement or recommendation for use.

Acknowledgments

The Trends Team would like to acknowledge the parties who peer reviewed this report prior to publication and the Trends Workgroup which includes the following members: Dr. Jane Caldwell, William Cox, Eric Crump, Laurel Driver, Shelly Eberly, Chebryll Edwards, Neil Frank, Nash Gerald, Yvonne Johnson, David Lutz, Melissa McCullough, Dr. David McKee, Brenda Millar, Dr. Deirdre Murphy, Annie Nikbakht, Sharon Nizich, Ted Palma, Anne Pope, Holly Reid, Joann Rice, Dr. Mary Ross, Vicki Sandiford, Dr. Roy Smith, Butch Stackhouse, Greg Stella, Susan Stone, and Chris Stoneman. Other persons who contributed to the report include John Bachmann, Rich Cook, and Emily Lada.

Preface

This is the twenty-fifth annual report on air pollution trends in the United States issued by the U.S. Environmental Protection Agency. The report is prepared by the Air Quality Trends Analysis Group (AQTAG) in Research Triangle Park, North Carolina and is directed toward both the technical air pollution audience and other interested parties and individuals.

The report, complete with graphics and data tables, can be accessed via the Internet at http://www.epa.gov/oar/aqtrnd97/. AQTAG solicits comments on this report and welcomes suggestions regarding techniques, interpretations, conclusions, or methods of presentation. Comments can be submitted via the Web site or mailed to:

Attn: Trends Team
AQTAG (MD-14)
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For additional air quality data, readers can access the Aerometric Information Retrieval System's (AIRS) executive software at http://www.epa.gov/oar/airs/aewin.

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Acronyms

AIRS	Aerometric Information Retrieval System
AIRMoN	Atmospheric Integrated Assessment Monitoring Network
AQRV	Air-Quality Related Values
BEIS	Biogenic Emissions Inventory System
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CARB	California Air Resources Board
CASAC	Clean Air Scientific Advisory Committee
CASTNet	Clean Air Status and Trends Network
CEMs	Continuous Emissions Monitors
CEP	Cumulative Exposure Project
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CMSA	Consolidated Metropolitan Statistical Area
DRI	Desert Research Institute
DST	Daylight Savings Time
EPA	Environmental Protection Agency
FRM	Federal Reference Method
GDP	Gross Domestic Product
HAPs	Hazardous Air Pollutants
IADN	Integrated Atmospheric Deposition Network
IMPROVE	Interagency Monitoring of PROtected Environments
LMOS	Lake Michigan Ozone Study
MACT	Maximum Achievable Control Technology
MARAMA	Mid-Atlantic Regional Air Management Association
MDN	Mercury Deposition Network
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NADP/NTN	National Atmospheric Deposition Program/National Trends Network
NAMS	National Air Monitoring Stations
NAPAP	National Acid Precipitation Assessment Program
NARSTO	North American Research Strategy for Tropospheric Ozone
NESCAUM	Northeast States for Coordinated Air Use Management
NET	National Emissions Trends Inventory
NMOC	Non-Methane Organic Compound
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NTI	National Toxics Inventory
O_3	Ozone
OTAG	The Ozone Transport Assessment Group
OTC	Ozone Transport Commission
PAHs	Polyaromatic Hydrocarbons
PAMS	Photochemical Assessment Monitoring Stations
Pb	Lead
PCBs	Polychlorinated Biphenyls
PM_{10}	Particulate Matter of 10 micrometers in diameter or less
$PM_{2.5}$	Particulate Matter of 2.5 micrometers in diameter or less
POM	Polycyclic Organic Matter
ppm	Parts Per Million
PSI	Pollutant Standards Index
RFG	Reformulated Gasoline
RVP	Reid Vapor Pressure
SAMI	Southern Appalachian Mountain Institute
SIP	State Implementation Plan
SLAMS	State and Local Air Monitoring Stations
SNMOC	Speciated Non-Methane Organic Compound
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SOS	Southern Oxidant Study
STP	Standard Temperature and Pressure
TNMOC	Total Non-Methane Organic Compound
TRI	Toxic Release Inventory
TSP	Total Suspended Particulate
UATMP	Urban Air Toxics Monitoring Program
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds
$\mu g/m^3$	Micrograms Per Cubic Meter

Foreword

It is my pleasure to provide the Foreword for this special 25th Anniversary Edition of the National Air Quality and Emissions Trends Report. A great deal has happened since I was involved with the publication of the first report. Twenty-five years ago, there were very limited ambient air pollution data. Today, there are thousands of air monitoring stations nationwide producing data of the highest quality. As a result, we can generate much better information on the status of air pollution problems and efforts to solve them. The state and local air pollution control agencies are to be applauded for the success of their monitoring programs.

On the occasion of this 25th report, I would like to acknowledge the following EPA staff who were responsible for producing the very first Trends Report - Bill Cox, Tom Curran, Bob Faoro, Neil Frank, Virginia Henderson, Alan Hoffman, Tom McMullen, and Willie Tiggs. Today, the report is produced by the new "Trends Team" consisting of the following members - Terence Fitz-Simons, Neil Frank, Warren Freas, Dave Guinnup, James Hemby, Vasu Kilaru, David Mintz, Sharon Nizich, Anne Pope, Mark Schmidt, Rhonda Thompson, and Miki Wayland.

I would like to thank the Trends Team for developing the report and ensuring coordination among EPA's Air Offices. In addition, I would like to thank the peer reviewers who year-after-year help strengthen the report's content, the EPA offices (in particular, the Acid Rain Division and the Office of Mobile Sources) who provide data and coordinate with the Trends Team on various sections of the report, and the EPA staff who contribute to and maintain the Aerometric Information Retrieval System - EPA's largest source of ambient air quality data.

I would also like to acknowledge the feedback we have received over the years from our constituents which include many concerned citizens, the Congress, transportation and fuel industries, colleges and universities, foreign governments, and state and local air agencies. So that we can continue to provide a report relevant to the needs of our broad audience, I encourage you to continue communicating your reactions to us.

We have come a long way in the past 25 years. I hope you enjoy reading this report and learn more about air pollution issues - our successes, the problems still out there, and what more needs to be done. We have made tremendous strides towards cleaner air, but we still have a ways to go.

William F. Hunt Jr.

William F. Hunt
Director
Emissions, Monitoring,
and Analysis Division

Letter from the Administrator

The Environmental Protection Agency's (EPA) twenty-fifth report on the status and trends in our nation's air quality shows the progress we have made towards protecting public health and achieving clean air in the United States. EPA has worked in partnership with industries, state, local, and tribal governments, as well as concerned citizens on a wide variety of air quality issues. These partnerships have been invaluable in meeting air quality goals and protecting the nation's citizens. This annual Trends Report documents recent air quality improvements.

For example, emissions of the six principal pollutants (carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide) discussed in the Trends Report have decreased 31 percent since 1970. The Midwest, Northeast, and Mid-Atlantic regions, which have historically been affected by acid rain, have experienced reductions in rainfall acidity. We also have seen reductions in hazardous air pollutant emissions from cars and trucks.

The Trends Report shows there are still areas in the country where air pollution problems threaten public health and the environment. Many cities have levels of air pollution that exceed national health standards. Some of our most pristine areas, like national parks, are threatened with high levels of pollution that are harmful to breathe and reduce our ability to see great distances.

In 1997, EPA approved more protective health standards for the two most pervasive air pollutants, ozone (smog) and particulate matter (soot). At the same time, EPA proposed a new regional haze program to address visibility impairment in national parks and wilderness areas. In September 1998, EPA issued a rule that will significantly reduce the regional transport of ozone in 22 eastern states and help states meet the new national air quality standard for ozone. The Acid Rain Program's successful market-based trading approach assists industry in reducing emissions that contribute to acid rain. This trading program serves as a guide for future trading programs that will play an important role in implementing EPA's new ozone health standard and in cleaning the air we breathe.

In marking the 25th anniversary of EPA's National Air Quality and Emissions Trends Report, we acknowledge important improvements in our nation's air quality as we work to ensure public health and environmental protection for this generation as well as generations to come.

Carol M. Browner

Carol M. Browner

CHAPTER 1

Executive Summary

http://www.epa.gov/oar/aqtrnd97/chapter1.pdf

This is the twenty-fifth annual report documenting air pollution trends in the United States.[1-24] The scope of this report includes the criteria pollutants for which the United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS), hazardous air pollutants, known as air toxics, visibility impairment, and acid rain.

The six criteria pollutants - carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2) - are the focus of chapters 2 through 4. Chapters 2 and 3 present national, regional, and metropolitan area trends, while Chapter 4 summarizes how areas around the nation are doing with respect to meeting the NAAQS.

Air toxics, another set of pollutants regulated under the Clean Air Act (CAA), are discussed in Chapter 5. Both ambient toxics and the deposition of toxics are addressed in this chapter. Visibility impairment due to regional haze is discussed in Chapter 6, and acid deposition resulting from SO_2 and NO_x emissions is the topic of Chapter 7.

Discussions throughout this report are based on the recognition that many of the programs designed to reduce ambient concentrations of the criteria pollutants also aid in reducing pollution that contributes to air toxics pollution, visibility impairment, and acid rain. Likewise, requirements under the various air toxics, visibility, and acid rain programs can also help reduce emissions that contribute to ambient concentrations of the criteria pollutants.

CHAPTER 2 CRITERIA POLLUTANTS - NATIONAL TRENDS

National and regional air quality trends for the criteria pollutants are examined in Chapter 2, along with supporting emissions data. The air quality concentrations presented are based on actual measurements of pollutant concentrations in the air at selected monitoring sites across the country (see Appendix B for details on the monitoring networks). Emissions estimates presented are calculated from the total tonnage of these pollutants, or their precursors, released into the air annually.[25]

Table 1-1 summarizes the 10-year percent changes in national air quality concentrations and emissions between 1988 and 1997. Air quality has continued to improve during the past 10 years for all six pollutants. Nationally, the 1997 average air quality levels are the best on record for all six criteria pollutants, posting concentrations at or below last year's levels. Furthermore, all the years in the 1990s have had better average air quality levels than any of the years in the 1980s, showing a steady trend of improvement for each pollutant.

Emissions of all criteria pollutants have decreased as well, with the exception of NO_x. In September 1998, EPA issued a rule that will significantly reduce regional emissions of NO_x and, in turn, reduce the regional transport of ozone. This Regional Transport Rule is discussed in greater detail in the ozone section of Chapter 2.

Table 1-1. Percent Decrease in National Air Quality Concentrations and Emissions, 1988-1997.

	Air Quality Concentration % Decrease	Emissions % Decrease
CO	38	25
Pb	67	44
NO_2	14	1 (NO_x)
O_3	19(1-hr) 16(8-hr)	20 (VOC)
PM_{10}	26	12*
SO_2	39	12

*Includes only directly emitted particles. Secondary PM formed from SO_x, NO_x, and other gases comprise a significant fraction of ambient PM.

Trends relating to the revised ozone and PM NAAQS based on data currently available are also presented. In July 1997, EPA revised the ozone and particulate matter standards following a thorough scientific review process. Prior to this time, the PM standard applied to particles whose aerodynamic size is less than or equal to 10 micrometers, or PM_{10}. The NAAQS revision strengthened protection against particles in the smaller part of that range by adding an indicator for $PM_{2.5}$ (those whose aerodynamic size is less than or equal to 2.5 micrometers). The combination of the PM_{10} and $PM_{2.5}$ indicators provide protection against a wide range of particles in both size and composition. The revised ozone standard is now based on an 8-hour averaging time as opposed to 1-hour under the pre-existing standard. Since the pre-existing ozone and PM NAAQS still apply in some areas (see Chapter 2 for details), trends relating to the pre-existing NAAQS are also discussed in Chapter 2.

CHAPTER 3
CRITERIA POLLUTANTS - METROPOLITAN AREA TRENDS

Chapter 3 characterizes air quality on a more local level, using three different indicators. First, this chapter lists peak air quality concentrations for 1997 for each Metropolitan Statistical Area (MSA). Second, 10-year trends are assessed for each MSA using a statistical method to measure whether the trend is up or down. The results show that 15 MSAs had a statistically significant upward trend in ambient concentrations for at least one criteria pollutant, while 221 MSAs had a statistically significant downward trend for at least one criteria pollutant. Maps are used to show how these trends vary spatially. The third way in which local air quality is evaluated is by looking at the Pollutant Standards Index (PSI) in the nation's largest MSAs. The PSI analysis shows that between 1988 and 1997 the total number of "unhealthy" days decreased an average of 56 percent in southern California (which, for the purposes of this analysis, includes the Los Angeles, Riverside, Bakersfield, and San Diego MSAs) and an average of 66 percent in the remaining major cities across the United States.

CHAPTER 4
CRITERIA POLLUTANTS - NONATTAINMENT AREAS

Chapter 4 summarizes the current status of nonattainment areas, which are those areas not meeting the NAAQS for at least one of the six criteria pollutants. Under the Clean Air Act Amendments (CAAA) of 1990, there were 274 areas designated nonattainment for at least one ambient air quality standard. As of September 1998, 130 areas are still designated nonattainment. The current nonattainment area list is based on the pre-existing ozone and PM standards. In future years the nonattainment area list will reflect areas not meeting the revised ozone and particulate matter standards. The current nonattainment areas for each criteria pollutant are displayed on one map in this chapter, while a second map depicts the current ozone nonattainment areas alone, color-coded to indicate the severity of the ozone problem in each area. The condensed list of nonattainment areas as of September 1998 is presented in Table A-17. This table is also on the Internet at **http://www.epa.gov/airs/nonattn.html** and is updated as areas are redesignated.

CHAPTER 5
AIR TOXICS

Chapter 5 presents information on another set of air pollutants regulated under the CAA. Hazardous Air Pollutants (HAPs), commonly called air toxics, are pollutants known to cause or suspected of causing cancer or other serious human health effects or ecosystem damage. There are now 188 such pollutants. The National Toxics Inventory (NTI) estimates that 8.1 million tons of air toxics are released to the air annually from stationary, area, and mobile sources. This emissions inventory is now being substantially upgraded with input and review by the states.

While there is currently no national monitoring network designed to measure air toxics, EPA has several efforts underway which provide some information useful to assessing the toxics issue. For instance, the Agency's Photochemical Assessment Monitoring Stations (PAMS) program, which is designed to monitor ozone precursors in several major U.S. cities, provides ambient concentration data for 10 HAPs which are also ozone precursors. In addition to the PAMS program, EPA continues to administer and support voluntary programs through which states may collect ambient air quality measurements for a number of air toxics. Concurrent with these monitoring efforts, EPA has recently initiated a program to identify, compile, and catalogue all previously collected monitoring data for air toxics.

In addition to the emissions inventory and limited air quality monitoring information, EPA has developed a model to estimate air toxics concentrations nationwide based on emissions inventory and meteorological information. EPA has used this model to estimate air toxics concentrations for 1990, based on preliminary information on emissions and background concentrations as part of the Cumulative Exposure Project (CEP). EPA plans to upgrade and use this model periodically in future years to help track estimated air toxics concentrations and progress in efforts to address potential public health and environmental concerns associated with air toxics.

Because of their complex nature and sheer number, air toxics are regulated differently than the criteria pollutants. The approach is two-phased. The first phase consists of identifying the sources of toxic pollutants and developing technology-based standards to significantly reduce their emissions. This phase includes the MACT (Maximum Achievable Control Technology) program, as well as regulations under the specific pollutants and urban area source programs. Already, the MACT program has reduced HAP emissions across many of the source categories by more than half of the pre-MACT levels (see Table 5-1 for more details).

The second phase consists of strategies and programs for evaluating the remaining risks and ensuring that the overall program has achieved substantial reduction in risks to public health and the environment. This phase will involve additional reductions and incorporate information developed on remaining risks due to cumulative exposure to emissions from mobile as well as stationary sources. This work will be implemented primarily through the integrated urban air toxics strategy and residual risk programs, as well as utilizing information from special studies on atmospheric deposition, mercury, and utilities.

CHAPTER 6
VISIBILITY TRENDS

The CAA authorizes EPA to protect visibility, or visual air quality, through a number of programs. In 1987, the Interagency Monitoring of PROtected Environments (IMPROVE) visibility monitoring network was established as a cooperative effort between EPA, National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish & Wildlife Service, and state governments. The objectives of the network are to establish current conditions, to track progress toward the national visibility goal by documenting long-term trends, and to provide information for determining the types of pollutants and sources primarily responsible for visibility impairment.

The trends analyses presented in this chapter are based on data from the IMPROVE network. There were 37 sites having data adequate for assessing trends between 1988 and 1997. Because of the significant regional variations in visibility conditions, the trends are grouped into eastern and western regions, rather than a national aggregate. The trends are presented in terms of the annual average values for the clearest (“best”), middle, and haziest (“worst”) days monitored each year.

The results show that, in general, visibility is worse in the east than in the west. In fact, the worst visibility days in the west are only slightly more impaired than the best days in the east. The 10-year trends show that visibility in the west has improved slightly for all three ranges (best, middle, and worst days), while visibility in the east does not seem to be improving for any of the ranges.

In July 1997, EPA proposed a new regional haze program to address visibility impairment in national parks and wilderness areas caused by numerous sources located over broad regions. The proposed program takes into consideration scientific findings and policy recommendations from a number of sources. Because of the common precursors and the regional nature of the ozone, PM, and regional haze problems, EPA is developing these implementation programs together to integrate future planning and control strategy efforts to the greatest extent possible. Implementation of the NAAQS in conjunction with a future regional haze program is expected to improve visibility in urban as well as rural areas across the country.

Other air quality programs are expected to lead to emissions reductions that will improve visibility in certain regions of the country. The acid rain program will achieve significant regional reductions in SO_x emissions, which is expected to reduce sulfate haze particularly in the eastern United States. The recent NO_x State Implementation Plan (SIP) call to reduce emissions from sources of NO_x to reduce formation of ozone should also improve regional visibility conditions to some degree.

CHAPTER 7
ACID DEPOSITION

New to the report this year, the acid deposition chapter presents information concerning wet acidic deposition (commonly called acid rain) and dry acidic deposition. Wet deposition occurs when gaseous or particulate pollutants enter water droplets in the air, and fall as rain, snow, or other precipitation. Dry deposition occurs when particles settle by gravity or when gaseous pollutants are adsorbed by surface waters or bound chemically to soil surfaces.

The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) and the Clean Air Status and Trends Network (CASTNet), two monitoring networks described in detail in the chapter, monitor wet and dry acid deposition, respectively. NADP/NTN consists of nearly 200 sites nationwide, while CASTNet contains 72 sites. These sites monitor a number of compounds, including sulfates and nitrates, which are formed from sulfur oxides and nitrogen oxides reacting in the atmosphere.

Wet deposition data from the NADP/NTN show that sulfate concentrations in precipitation have decreased over the past two decades, with a particularly sharp decrease occurring since 1994 in the eastern United States. This recent reduction is directly related to large regional decreases in SO_2 emissions resulting from phase I of the Acid Rain program (see the SO_2 section in Chapter 2 for more details). Nitrate concentrations in recent years at the NADP/NTN sites are not appreciably different from historical levels.

Dry deposition data from the CASTNet sites show that sulfate concentrations decreased 26 percent between 1989 and 1995. During that same period, total nitrate concentrations decreased 8 percent. Nitrate concentrations should continue to decline due in part to the implementation of the Phase I Acid Rain NO_x Control Program, along with the Regional Transport rule, both of which are designed to reduce NO_x emissions. (NO_x is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. The criteria pollutant NO_2 is a common form of NO_x and is prevalent in NO_x emissions from the burning of fuels at high temperatures, as in a combustion process.)

In addition to the trends information in this chapter, maps of the 1997 wet and dry deposition data are also presented.

The Appendices

Finally, Appendix A provides expanded tables of the air quality concentrations and emissions data described throughout this report. Appendix B summarizes the methodology which is the basis for the trends analyses in Chapter 2, and also provides maps of the current monitoring network for each criteria pollutant.

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13. *National Air Quality and Emissions Trends Report*, 1985, EPA-450/4-87-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1987.

14. *National Air Quality and Emissions Trends Report*, 1986, EPA-450/4-88-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1988.

15. *National Air Quality and Emissions Trends Report*, 1987, EPA-450/4-89-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, March 1989.

16. *National Air Quality and Emissions Trends Report*, 1988, EPA-450/4-90-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, March 1990.

17. *National Air Quality and Emissions Trends Report*, 1989, EPA-450/4-91-003, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, February 1991.

18. *National Air Quality and Emissions Trends Report*, 1990, EPA-450/4-91-023, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, November 1991.

19. *National Air Quality and Emissions Trends Report*, 1991, EPA-450/R-92-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1992.

20. *National Air Quality and Emissions Trends Report*, 1992, EPA-454/R-93-031, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1993.

21. *National Air Quality and Emissions Trends Report*, 1993, EPA-454/R-94-026, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1994.

22. *National Air Quality and Emissions Trends Report*, 1994, EPA-454/R-95-014, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1995.

23. *National Air Quality and Emissions Trends Report*, 1995, EPA-454/R-96-005, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, October 1996.

24. *National Air Quality and Emissions Trends Report*, 1996, EPA-454/R-97-013, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, January 1998.

25. Emissions estimates are derived from many factors, including the level of industrial activity, technology changes, fuel consumption, vehicle miles traveled (VMT), and other activities that affect air pollution. In 1994, EPA began incorporating direct emissions measurements of sulfur dioxide and nitrogen oxides (NO_x) for the electric utility industry. Additional emissions information can be found at **http://www.epa.gov/oar/oaqps/efig.**

CHAPTER 2

Criteria Pollutants-National Trends

http://www.epa.gov/oar/aqtrnd97/chapter2.pdf

This chapter presents national and regional trends for each of the pollutants for which the United States Environmental Protection Agency (EPA) has established National Air Quality Standards (NAAQS). NAAQS are in place for the following six criteria pollutants: carbon monoxide (CO), lead, nitrogen dioxide, ozone, particulate matter (PM), and sulfur dioxide (SO_2). Table 2-1 lists the NAAQS for each pollutant in terms of the level and averaging time of the standard used to evaluate compliance.

There are two types of standards: primary and secondary. Primary standards protect against adverse health effects, whereas secondary standards protect against welfare effects such as damage to crops, ecosystems, vegetation, buildings, and decreased visibility. There are primary standards for all of the criteria pollutants, and some pollutants (PM and SO_2) have primary standards for both long-term (annual average) and short-term (24 hours or less) averaging times. Short-term standards most directly protect people from any adverse health effects associated with peak short-term exposures to air pollution, while long-term standards can protect people from adverse health effects associated with short- and long-term exposures

Table 2-1. NAAQS in Effect in 1997

Pollutant	Primary (Health Related)		Secondary (Welfare Related)	
	Type of Average	Standard Level Concentration[a]	Type of Average	Standard Level Concentration
CO	8-hour[b]	9 ppm (10 mg/m^3)	No Secondary Standard	
	1-hour[b]	35 ppm (40 mg/m^3)	No Secondary Standard	
Pb	Maximum Quarterly Average	1.5 µg/m^3	Same as Primary Standard	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	Same as Primary Standard	
O_3	1-hour[c]	0.12 ppm (235 µg/m^3)	Same as Primary Standard	
	8-hour[d]	0.08 ppm (157 µg/m^3)	Same as Primary Standard	
PM_{10}	Annual Arithmetic Mean	50 µg/m^3	Same as Primary Standard	
	24-hour[e]	150 µg/m^3	Same as Primary Standard	
$PM_{2.5}$	Annual Arithmetic Mean[f]	15 µg/m^3	Same as Primary Standard	
	24-hour[g]	65 µg/m^3	Same as Primary Standard	
SO_2	Annual Arithmetic Mean	0.03 ppm (80 µg/m^3)	3-hour[b]	0.50 ppm (1,300 µg/m^3)
	24-hour[b]	0.14 ppm (365 µg/m^3)		

[a] Parenthetical value is an approximately equivalent concentration.

[b] Not to be exceeded more than once per year.

[c] Not to be exceeded more than once per year on average.

[d] 3-year average of annual 4th highest concentration.

[e] The pre-existing form is exceedance-based. The revised form is the 99th percentile.

[f] Spatially averaged over designated monitors.

[g] The form is the 98th percentile.

Source: 40 CFR Part 50.

to air pollution. Secondary standards have been established for each criteria pollutant except CO. Secondary standards are identical to the primary standard with the exception of SO_2.

On July 18, 1997, EPA issued the revised NAAQS for ozone and PM. The form of the revised ozone standard is the annual fourth highest 8-hour concentration averaged over 3 years. The level of the revised ozone NAAQS is 0.08 ppm. The form of the revised short-term PM_{10} standard is the 99th percentile 24-hour average concentration averaged over 3 years. The level of the revised short-term PM_{10} standard of 150 ug/m^3 was retained. The form and level of the long-term PM_{10} standard were retained. In addition, an indicator for $PM_{2.5}$ was introduced to protect against particulate matter in the smaller end of the particle range. The form of the $PM_{2.5}$ short-term standard is the 99th percentile 24-hour average concentration averaged over 3 years, and the associated level is 65 ug/m^3. The form of the $PM_{2.5}$ long-term standard is the annual arithmetic mean spatially averaged over designated monitors averaged over 3 years, and the associated level is 15 ug/m^3. The revised standards are listed in Table 2-1 and are discussed in greater detail within the ozone and PM sections of this chapter.

The pre-existing standards for ozone are still in effect for areas that did not meet them prior to the NAAQS revisions. The pre-existing NAAQS for PM_{10} are in effect until states take steps to remove them. Specifically, states must have a federally-approved State Implementation Plan (SIP) that shows how they can implement the revised PM NAAQS and all state adopted and implemented control measures. Both the pre-existing and the revised NAAQS are listed in Table 2-1 and trends associated with both are examined in this chapter.

Most of the trends information presented in this chapter is based on two types of data: ambient concentrations and emissions estimates. Ambient concentrations are measurements of pollutant concentrations in the ambient air from monitoring sites across the country. This year's report contains trends data accumulated from 1988 to 1997 on the criteria pollutants at 2,778 monitoring stations located throughout the United States. The trends presented here are derived from the composite average of these direct measurements. The averaging times and air quality statistics used in the trends calculations relate directly to the NAAQS.

The second type of data presented in this report reflects national emissions estimates. These are based largely on engineering calculations of the amounts and kinds of pollutants emitted by automobiles, factories, and other sources over a given period. In addition, some emissions estimates are based on measurements from continuous emissions monitors (CEMs) that have recently been installed at major electric utilities to measure actual emissions. This report incorporates data from CEMs collected between 1994 and 1997 for NO_x and SO_2 emissions at major electric utilities.

Changes in ambient concentrations do not always track changes in emissions estimates. There are four known reasons for this. First, because most monitors are positioned in urban, population-oriented locales, air quality trends are more likely to track changes in urban emissions rather than changes in total national emissions. Urban emissions are generally dominated by mobile sources, while total emissions in rural areas may be dominated by large stationary sources such as power plants and smelters.

Second, emissions for some pollutants are calculated or measured in a different form than the primary air pollutant. For example, concentrations of ozone are caused by VOC emissions as well as NO_x emissions.

Third, the amount of some pollutants measured at monitoring locations depends on what chemical reactions, if any, occur in the atmosphere during the time it takes the pollutant to travel from its source to the monitoring station.

Finally, meteorological conditions often control the formation and buildup of pollutants in the ambient air. For example, peak ozone concentrations typically occur during hot, dry, stagnant summertime conditions; CO is predominately a cold weather problem; and the amount of rainfall can affect particulate matter levels and the frequency of forest fires.

For a more detailed discussion of the methodology used to compute the trends estimates in this chapter, please refer to Appendix B.

THE NATIONAL PERSPECTIVE: PAST, PRESENT, AND FUTURE

Improvements in the face of Economic Growth

National reductions in air quality concentrations and emissions continue to occur in the face of economic growth. Since 1970, total U.S. population increased 31 percent, vehicle miles traveled increased 127 percent, and the gross domestic product (GDP) increased 114 percent.[1,2,3] During that same period, notable reductions in air quality concentrations and emissions took place. Aggregate criteria pollutant emissions decreased 31 percent. When examined individually, emissions for all criteria pollutants except NOx decreased between 1970 and 1997, the greatest improvement being a 98-percent decrease in lead emissions. Though air quality trends are not available back to 1970, in most cases they are available for the past 20 years. Reductions in air quality concentrations between 1978 and 1997 are impressive with CO, lead, and SO_2 decreasing by more than half.[4] These air quality improvements are a direct result of EPA working with states, industry, and other partners to effectively establish and implement clean air laws and regulations.

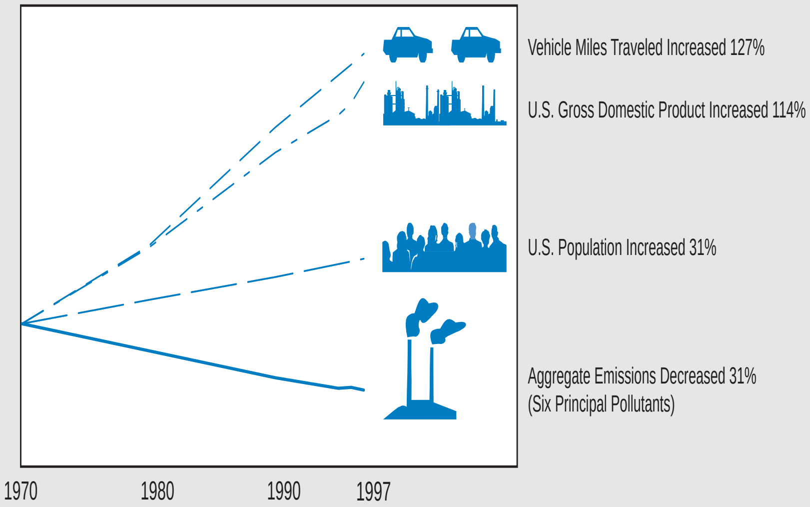
The Need for Continued Progress

While progress has been made, it is important not to lose sight of the air pollution problems that still remain. Though air quality trends are improving nationally, there are still areas, both urban and rural, with concentrations above the level of the national standard and even areas with worsening trends (in addition to Chapter 2, see Chapter 3 for more details on urban areas and Chapter 6 for more details on rural areas). Based upon monitoring data submitted to EPA's Aerometric Information Retrieval System (AIRS) data base, approximately 107 million people in the United States reside in counties that did not meet the air quality standard for at least one of the NAAQS pollutants for the single year 1997.[5,6]

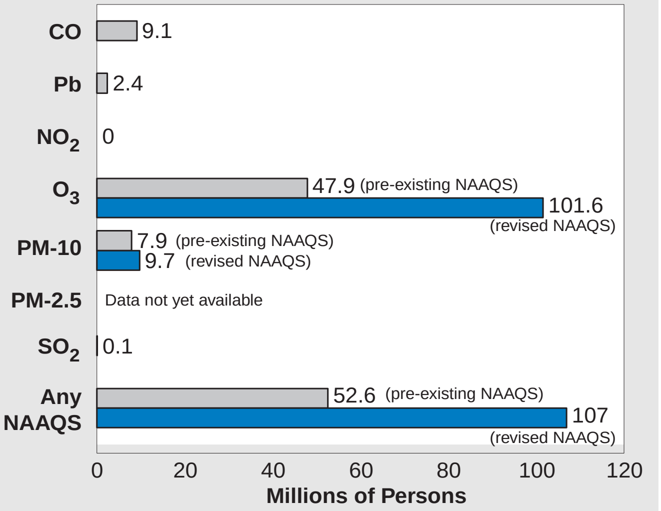
Long-term Percent Change in National Air Quality Concentration and Emissions

	Air Quality Concentration %Change 1978-1997	Emissions % Change 1970-1997
CO	-60%	-32%
Pb	-97%	-98%
NO_2	-25%	+11%
O_3	-30% (1hr)	-37%
PM_{10}	Data Not Available	-75%
SO_2	-55%	-35%

*Includes only directly emitted particles. Secondary PM formed from SO_x, No_x, and other gases comprise a significant fraction of ambient PM.



Total U.S. Population, vehicle miles traveled, U.S. gross domestic product, and aggregate emissions, 1970-1997.



Number of people living in counties with air quality concentrations above the level of the NAAQS in 1997.

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1. Statistical Abstract of the United States, 1996, U.S. Department of Commerce, U.S. Bureau of Census.
2. E.H. Pechan & Associates, Sprinfield, VA, October 1998.
3. The Bureau of Economic Analysis, Department of Commerce, website at **http://www.bea.doc.gov/bea/**.
4. Because of evolving monitoring networks, these long-term changes in air quality concentrations are not as certain as the more recent 10-year assessment.
5. The population estimates are based upon only a single year of data, 1997, and only consider counties with monitoring data for each pollutant. They are intended to provide a relative measure of the extent of the problem for each pollutant in 1997. An individual living in a county that had a measured concentration above the level the NAAQS may not actually be exposed to unhealthy air.
6. The number of people living in formally designated nonattainment areas as of September 1998 was approximately 113 million. These population estimates differ because formal nonattainment designations are based on multiple years of data rather than a single year and generally do not follow county boundaries. For a pollutant such as ozone, nonattainment areas typically compose the entire metropolitan area, which may include additional counties that do not contain monitors. Also, designations have not yet been made for the revised ozone and PM NAAQS. Therefore, the nonattainment area population does not reflect the revised NAAQS.

CARBON MONOXIDE

- **Air Quality Concentrations**

1988–97	38%	decrease
1996–97	7%	decrease

- **Emissions**

1988–97	25%	decrease
1996–97	3%	decrease

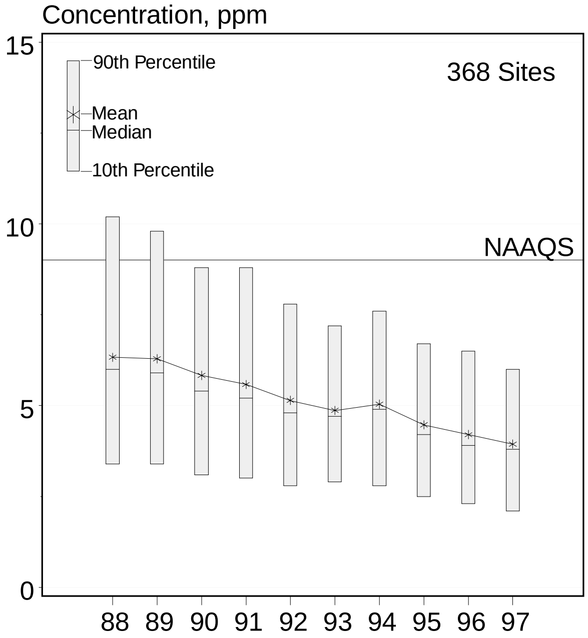
Nature and Sources

CO is a colorless, odorless, and at much higher levels, a poisonous gas formed when carbon in fuels is not burned completely. It is a product of motor vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide. High concentrations of CO generally occur in areas with heavy traffic congestion. In cities, as much as 95 percent of all CO emissions may emanate from automobile exhaust. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires. Woodstoves, cooking, cigarette smoke, and space heating are sources of CO in indoor environments. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater and nighttime inversion conditions are more frequent.

Health Effects

Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. The health threat from lower levels of CO is most serious for those who suffer from cardiovascular disease, such as angina pectoris. At much higher levels of exposure, CO can be poisonous, and healthy individuals may also be affected. Visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks are all associated with exposure to elevated CO levels.

Figure 2-1. Trend in second maximum non-overlapping 8-hour average CO concentrations, 1988-1997.



Primary Standards

There are two primary NAAQS for ambient CO, a 1-hour average of 35 ppm and an 8-hour average of 9 ppm. These concentrations are not to be exceeded more than once per year. There currently are no secondary standards for CO.

National 10-Year Trends

The use of a moving 10-year trends window maximizes the number of sites that meet the minimum data completeness requirement of 8 years of ambient monitoring data. The 10-year trend in ambient CO concentrations is graphically shown in Figure 2-1. Air quality improvement is clear given the decreases shown in CO concentrations for "peak" sites, "typical" sites, and "clean" sites (i.e., the 90th percentile, the composite mean, and the 10th percentiles.) Nationally, CO concentrations decreased 38 percent during the past 10 years as measured by the composite average of the annual second highest 8-hour concentration. Between 1996 and 1997, national composite average CO concentrations decreased 7 percent. Nationally, the 1997 composite average 8-hour ambient CO concentration is the lowest level recorded during the past 10 years.

Figure 2-2 presents diurnal patterns in hourly CO concentrations averaged across all sites for the 10-year period, 1987–96. The figure shows that reductions in CO concentrations are not limited to the peak hours, but are found at all hours throughout the day.[1]

Reductions in ambient CO concentrations also occurred across all monitoring environments—urban, suburban, and rural sites. Figure 2-3 shows that urban monitoring sites record higher CO concentrations on average, than suburban sites, with the lowest levels found at 12 rural CO sites. During the past 10 years, composite mean CO 8-hour concentrations decreased 39 percent at 208 urban sites, 35 percent at 145 suburban locations, and 46 percent at 12 rural monitoring sites.

Emissions Trends

Figure 2-4 shows that national total CO emissions have decreased 25 percent since 1988. Emissions from all transportation sources have decreased 22 percent during the past 10 years, despite a 25 percent increase in vehicle miles traveled (VMT). Because the urban CO monitoring sites are primarily mobile-source oriented, the 38 percent reduction in CO concentrations more closely tracks the estimated 29 percent reduction in emissions from highway vehicles. Figure 2-6 shows that the transportation category, composed of on-road and off-road sources, accounts for 77 percent of the nation's total CO emissions in 1997. Total CO emissions decreased 2 percent since 1996, with CO emissions from highway vehicles recording a 6-percent decline since last year, while VMT increased by 2 percent since 1996.

Table 2-2 lists some of the major milestones in the control of emissions from automobiles starting with the Clean Air Act (CAA) of 1970. At the national level, these measures include establishing national standards for tailpipe emissions, new vehicle technologies, and clean fuels programs. These measures have led to reductions in emissions of CO as well as

Figure 2-2. Diurnal plot of mean winter (December-February) hourly CO concentrations, 1987-1996.

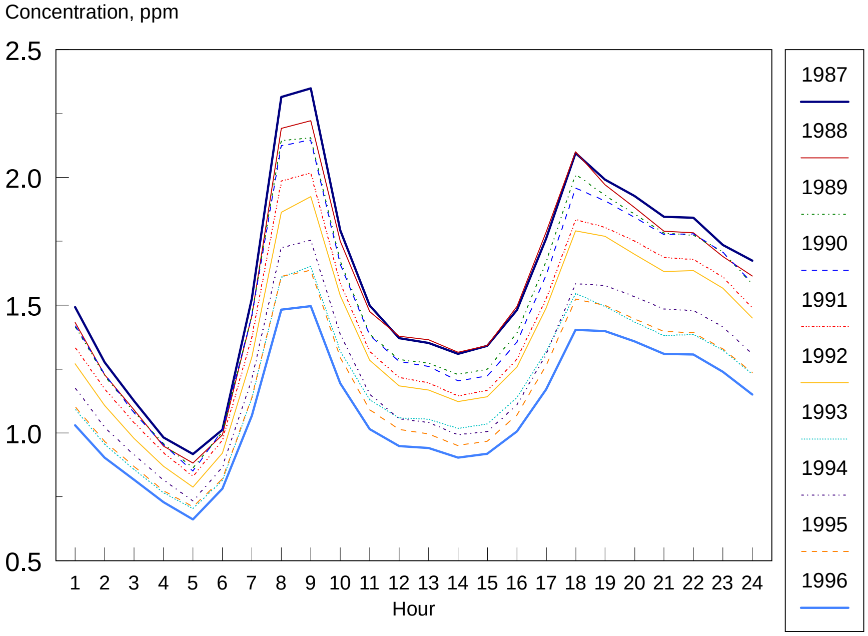


Figure 2-3. Trend in second maximum non-overlapping 8-hour average CO concentrations by type of location, 1988-1997.

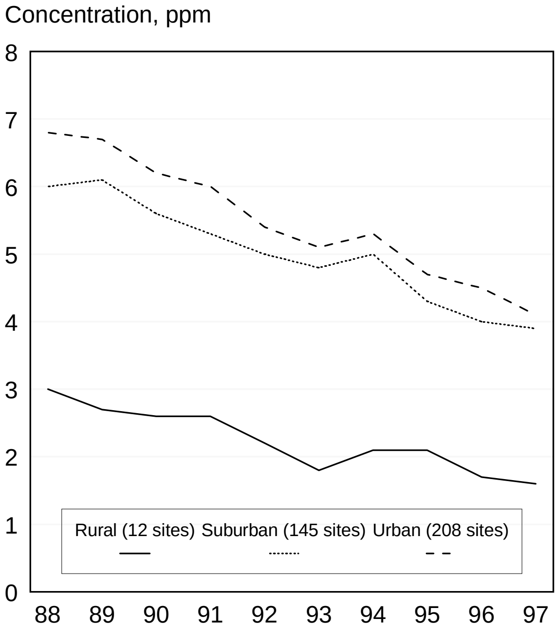


Figure 2-4. Trend in national total CO emissions, 1988-1997.

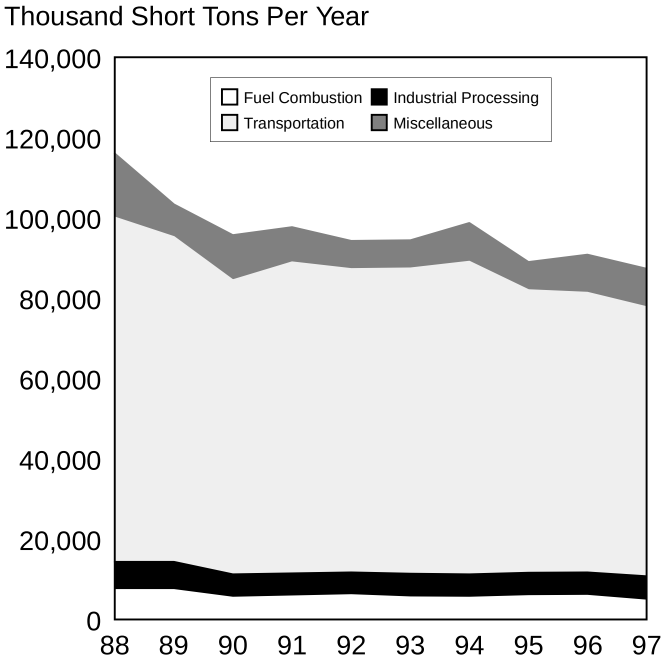
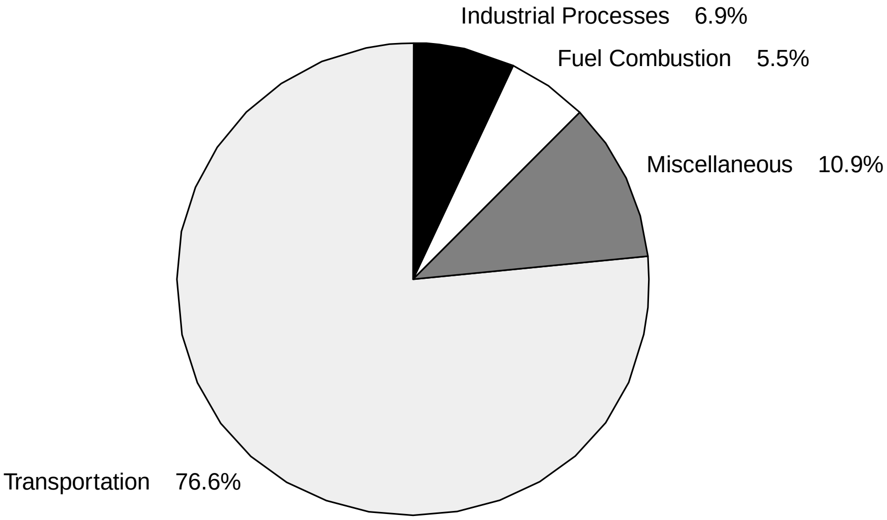


Figure 2-5. CO emissions by source category, 1997.



other pollutants. State and local emissions reduction measures include inspection and maintenance (I/M) programs and transportation management programs.

Table 2-2. Milestones in Auto Emissions Control

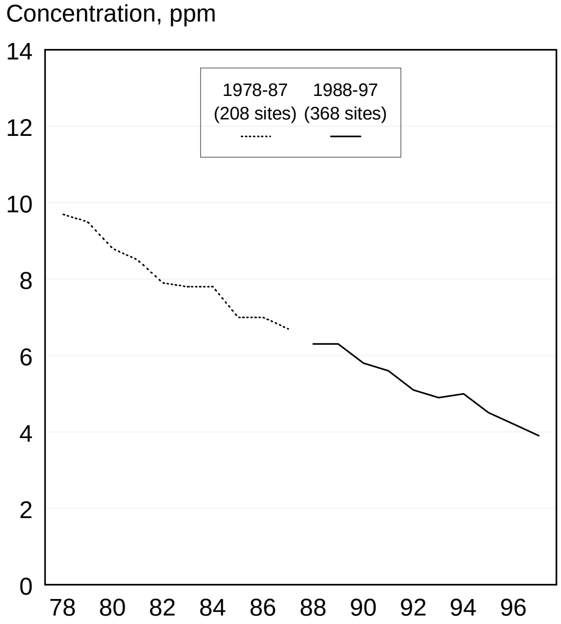
1970	New Clean Air Act sets auto emissions standards.
1971	Charcoal canisters appear to meet evaporative standards.
1972	EGR valves appear to meet NO_x standards.
1974	Fuel economy standards are set.
1975	The first catalytic converters appear for hydrocarbon, CO.
	Unleaded gas appears for use in catalyst equipped cars.
1981	3-way catalysts with on-board computers and O_2 sensors appear.
1983	I/M programs are established in 64 cities.
1989	Fuel volatility limits are set for RVP.
1990	CAAA set new tailpipe standards.
1992	Oxyfuel introduced in cities with high CO levels.
1993	Limits set on sulfur content of diesel fuel.
1994	Phase-in begins of new vehicle standards and technologies.

In the area of clean fuels, the 1990 Clean Air Act Amendments (CAAA) require oxygenated gasoline programs in several regions during the winter months. Under the program regulations, a minimum oxygen content (2.7 percent by weight) is required in gasoline to ensure more complete fuel combustion.[2,3] Of the 36 nonattainment areas that initially implemented the program in 1992, 25 areas continue to use oxygenated fuels. An analysis of the oxygenated fuels program in several cities with winter oxygenated gasoline programs showed reductions in ambient CO concentrations of about 10 percent.[4] Other studies estimated that the oxyfuel effect was an average total reduction in ambient CO concentrations of 7 to 14 percent overall for the eight winter seasons from 1986 through 1994.[5,6]

National 20-Year Trends

Because of the annual loss and replacement of ambient monitoring sites, too few sites are able to meet a 20-year data completeness criteria. Thus, long-term trends are assessed by piecing together two separate 10-year trends data bases. Because the number of monitoring sites nationwide can vary greatly over a 20-year period, two 10-year periods are used to capture a common set of sites for each period. Although there are differences in the mix of trend sites for the two periods (208 vs. 367 sites), Figure 2-6 shows a consistent decline in CO concentrations during the past 20 years. Nationally, the 1997 composite average ambient concentration is 60 percent lower than 1978 and the lowest level recorded during the past 20 years of monitoring.

Figure 2-6. Long-term trend in second maximum non-overlapping 8-hour average CO concentrations, 1978-1997.



Regional Trends

The map in Figure 2-7 shows the regional trends in ambient CO concentrations during the past 10 years, 1988–1997. All 10 EPA Regions recorded 10-year declines in CO levels as measured by the regional composite mean concentrations. The largest concentration reductions are in the Northcentral, Rocky Mountain and Northwest states. Smaller reductions can be seen in the West, South and Midwest regions. Only the Southeast (Region 4) saw an upturn between 1996 and 1997 (an increase of 3 percent).

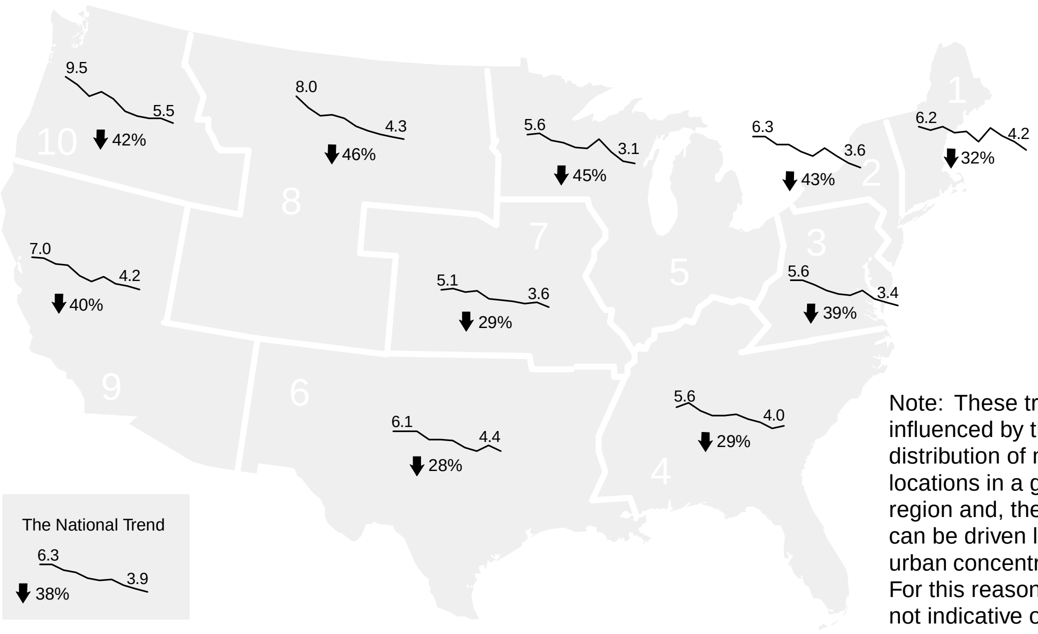
1997 Air Quality Status

The map in Figure 2-8 shows the variations in CO concentrations across the country in 1997. The air quality indicator is the highest annual second maximum 8-hour concentration measured in each county. The bar chart to the left of the map displays the number of people living in counties within each concentration range. The colors on the map and bar chart correspond to the colors of the concentration ranges displayed in the map legend. Only 6 of the 537 monitoring sites reporting ambient CO data to AIRS failed to meet the CO NAAQS in 1997. These six sites were located in three counties with a total population of 9 million people—Los Angeles County, CA; Fairbanks, AK; and Imperial County, CA (Calexico, CA). The site in this latter area is located 1/4 mile north of the border crossing with Mexicali, Mexico. This is an improvement over the 1996 totals of seven counties with a total population of 13 million people.

Data Sources

The CO ambient trends plotting points and emissions totals by source category are listed in Tables A-1 and A-2. The plotting points for the 20-year trend charts are listed in Table A-9. The 1997 county maximum second-highest non-overlapping 8-hour CO concentrations are listed in Table A-11.

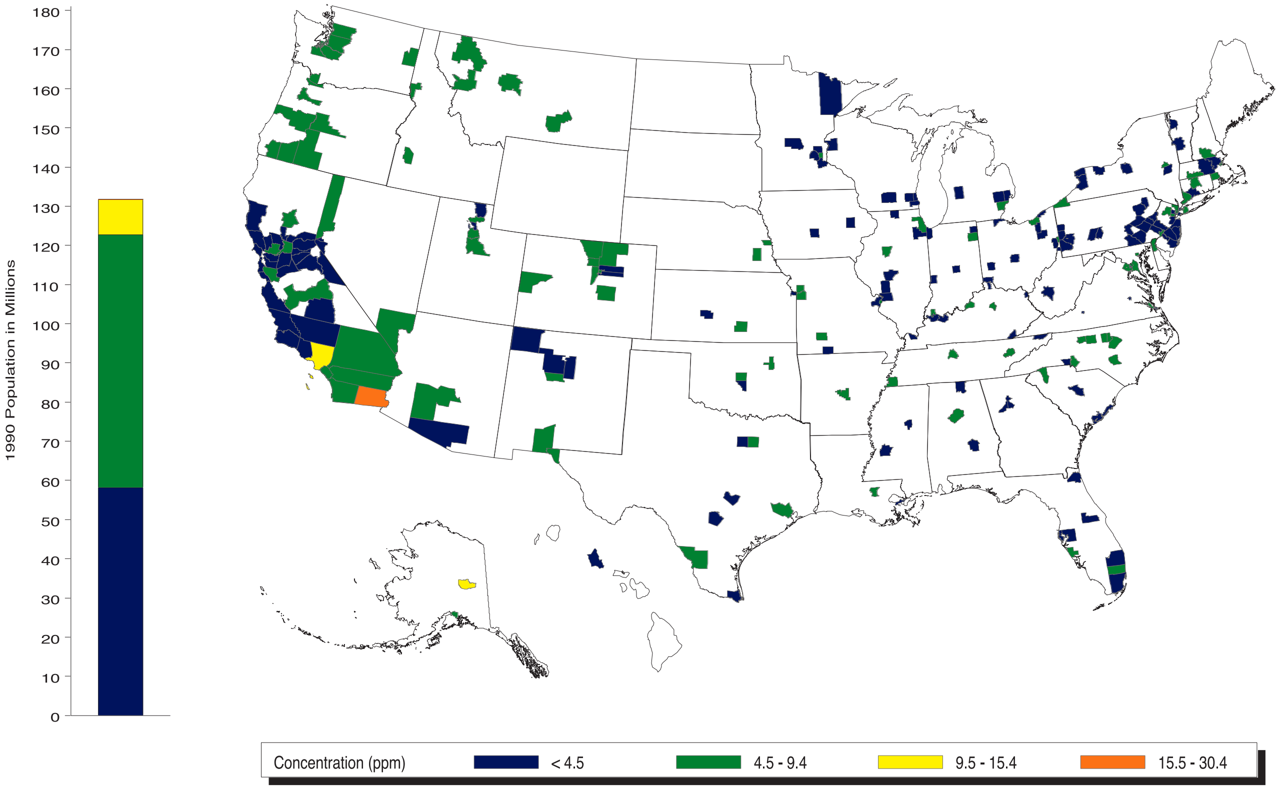
Figure 2-7. Trend in CO second maximum 8-hour concentrations by EPA Region, 1988-97.



Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Figure 2-8. Highest second maximum non-overlapping 8-hour average CO concentration by county, 1997.



LEAD

- **Air Quality Concentrations**

1988–97	67% decrease
1996–97	no change

- **Emissions**

1988–97	44% decrease
1996–97	no change

Nature and Sources

Twenty years ago, automotive sources were the major contributor of lead emissions to the atmosphere. As a result of EPA's regulatory efforts to remove lead from gasoline, the contribution from the transportation sector has dramatically declined. Today, metals processing is the major source of lead emissions to the atmosphere. The highest ambient air concentrations of lead are found in the vicinity of ferrous and nonferrous smelters, battery manufacturers, and other stationary sources of lead emissions.

Health and Environmental Effects

Exposure to lead occurs mainly through inhalation and ingestion of lead in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues. Lead also can adversely affect the kidneys, liver, nervous system, and other organs. Excessive exposure to lead may cause neurological impairments such as seizures, mental retardation, and/or behavioral disorders. Even at low doses lead exposure is associated with changes in fundamental enzymatic, energy transfer, and homeostatic mechanisms in the body. At low doses fetuses and children may suffer from central nervous system damage. Recent studies show that lead may be a factor in high blood pressure and subsequent heart disease. Recent studies also indicate that neurobehavioral changes may result from lead exposure during the child's first years of life.

Airborne lead also can have adverse impacts on the environment. Wild and domestic grazing animals may ingest lead that has deposited on plant or soil surfaces or that has been absorbed by plants through leaves or roots. Animals, however, do not appear to be more susceptible or more sensitive to adverse effects from lead than humans. For this reason, the secondary standard for lead is identical to the primary standard. At relatively low concentrations (2–10 μg/m^3), lead can inhibit plant growth and lead to a shift to more tolerant plant species near roadsides and stationary source emissions.

In spite of the fact that the majority of soil lead becomes bound so that it is insoluble, immobile, and biologically unavailable, elevated soil lead concentrations have been observed to cause shifts in the microbial community (fungi and bacteria), reduced numbers of invertebrates, reduced decomposition and nitrification rates, and alterations in other soil parameters. Because lead remains in the soil, soil concentrations continue to build over time even when deposition rates are low. Thus, another concern is that acid precipitation may be increasing the mobility and bioavailability of soil lead in some places.

Lead enters water systems mainly through urban runoff and sewage and industrial effluents. Most of this lead is readily complexed and bound in the sediment. However, water lead concentrations can reach levels that are associated with increased mortality and impaired reproduction in aquatic invertebrates and blood and neurological changes in fish. Given the above effects, there continue to be implications for the long-term impact of lead on ecosystem function and stability. [See also Chapter 5: Air Toxics and the December 1990 *OAQPS Staff Paper* (EPA-450/2-89-022)].

Primary and Secondary Standards

The primary and secondary NAAQS for lead is a quarterly average concentration not to exceed 1.5 μg/m^3.

National 10-Year Trends

The statistic used to track ambient lead air quality is the maximum quarterly mean concentration of each year. A total of 195 ambient lead monitors met the trends data completeness criteria. Point source-oriented monitoring data were excluded from all ambient trends analyses presented in this section so as not to mask the underlying urban trends. Figure 2-9 indicates that between 1988 and 1997, maximum quarterly average lead concentrations decreased 67 percent at population-oriented monitors. The decline was fairly similar at rural, suburban, and urban locations as seen in Figure 2-10. Between 1996 and 1997, national average lead concentrations (approaching the minimum detectable level) remained unchanged.

Emissions Trends

Figure 2-11 shows that total lead emissions decreased 44 percent between 1988 and 1997. The large ambient and emissions reductions are a waning result of the phase-out of leaded gasoline. Table A-3, which lists lead emissions by major source category, shows that on-road vehicles accounted for 82 percent of the 10-

Figure 2-9. Trend in maximum quarterly average Pb concentrations (excluding source-oriented sites), 1988-1997.

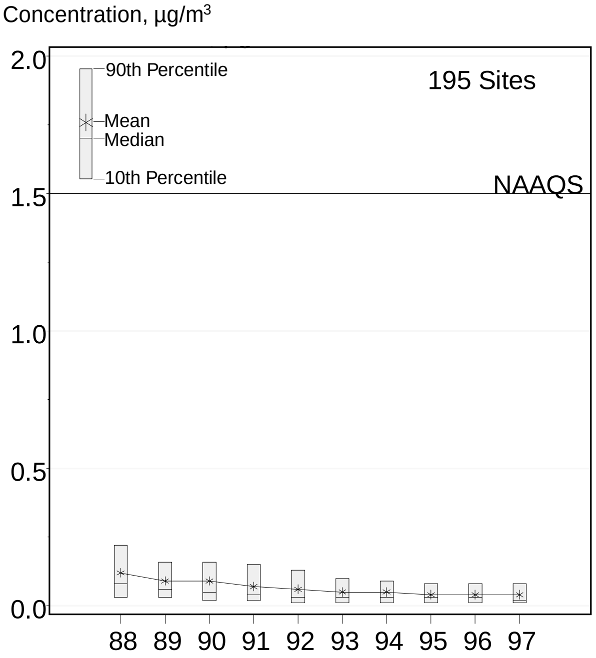
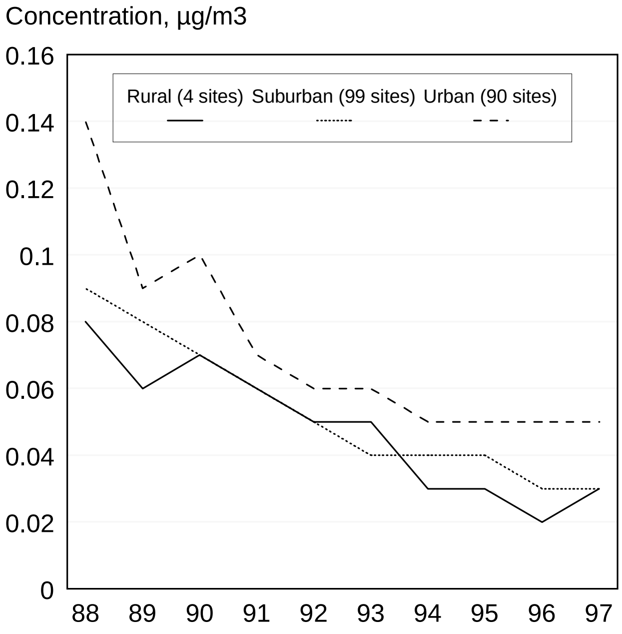


Figure 2-10. Pb maximum quarterly mean concentration trends by location (excluding source-oriented sites), 1988-1997.



year emissions decline. Between 1996 and 1997, lead emissions did not change substantially. Figure 2-12 shows that industrial processes were the major source of lead emissions in 1997, accounting for 74 percent of the total. The transportation sector (on-road and non-road sources) now accounts for only 13 percent of total 1997 lead emissions; on-road vehicles account for only one-half of a percent.

National 20-Year Trends

The effect of the conversion to unleaded gasoline usage on ambient lead concentrations is most impressive when viewed over a longer period, such as illustrated in Figure 2-13. Between 1978 and 1997, ambient concentrations of lead declined 97 percent. This large decline tracks well with the overall emissions trend, which shows a decline of 98 percent between 1975 and 1997.

Regional Trends

Figure 2-14 segregates the ambient trend analysis by EPA region. Although all regions showed large concentration reductions between 1988 and 1997, there were some intermittent upturns. Many of the latter year upturns and dips can be attributed to the inherent variability associated with data reported near the instrument's lower limit of detection.

1997 Air Quality Status

The large reductions in long-term lead emissions from transportation sources has changed the nature of the ambient lead problem in the United States. Because industrial processes are now responsible for all violations of the lead standard, the lead monitoring strategy now focuses on these emissions point sources. The map in

Figure 2-15 shows the lead monitors oriented in the vicinity of major sources of lead emissions. In 1997, four lead point sources had one or more source-oriented monitors that violated the NAAQS. These four sources are ranked in Figure 2-15 according to the site with greatest maximum quarterly mean. Various enforcement and regulatory actions are being actively pursued by EPA and the states for these sources.

The map in Figure 2-16 shows the highest quarterly mean lead concentration by county in 1997. Four counties, with a total population of 2.4 million and containing the point sources identified in Figure 2-15, did not meet the lead NAAQS in 1997.

Monitoring Status

Because of the shift in ambient air monitoring focus from mobile source emissions to stationary point sources of lead air pollution, EPA has taken action to revise the lead air monitoring regulations. This action is being taken at the direct request of numerous State and local agencies whose on-road mobile source-oriented lead monitors have been reporting peak lead air pollution values that are many times less than the quarterly lead NAAQS of 1.5 µg/m^3 for a number of consecutive years. EPA published a direct final rule for ambient air quality surveillance for lead on November 5, 1997 in the *Federal Register*. However, due to adverse comments received, the rule was withdrawn on December 23, 1997. It is anticipated that the final rule will be published in late December 1998. The previous (current) regulation requires that each urbanized area with a population of 500,000 or more operate at least two lead National Air

Figure 2-11. National total Pb emissions trend, 1988-1997.

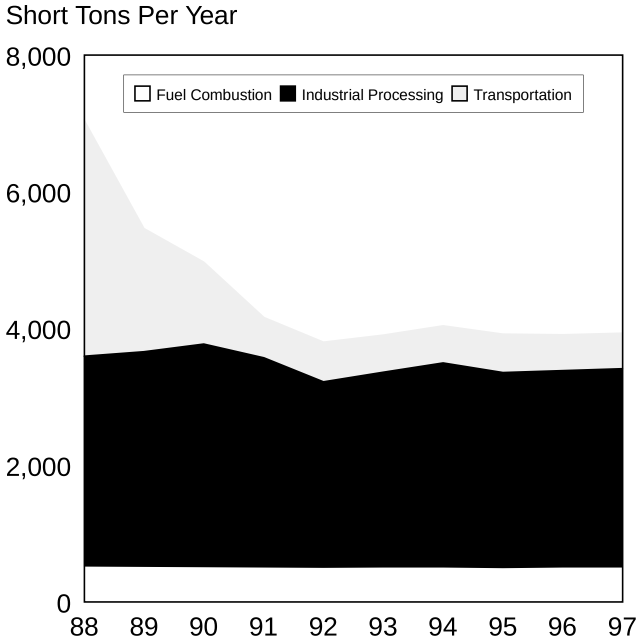
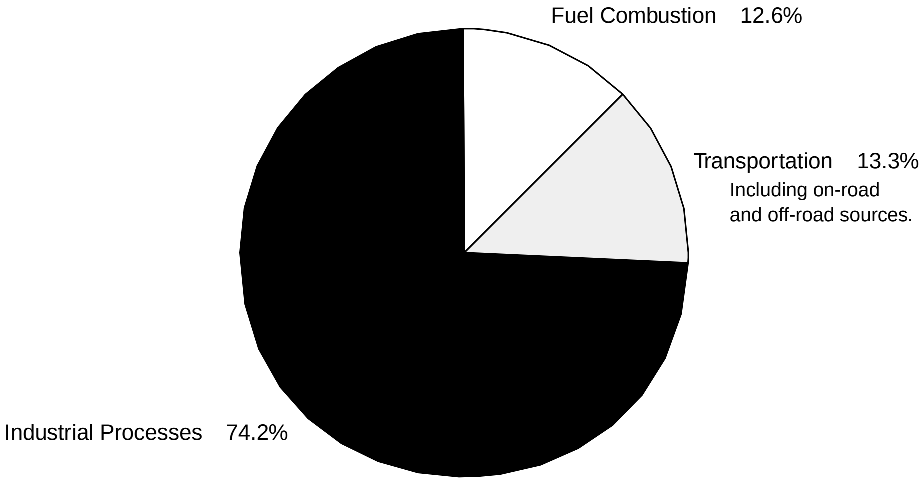


Figure 2-12. Pb emissions by source category, 1997.



Monitoring Stations (NAMS). The new lead monitoring rule maintains a minimum number of traditional types of lead monitoring sites in the largest metropolitan areas, and it refocuses available monitoring resources into areas with industrial sources.

Figure 2-13. Long-term ambient Pb trend, 1977-1997.

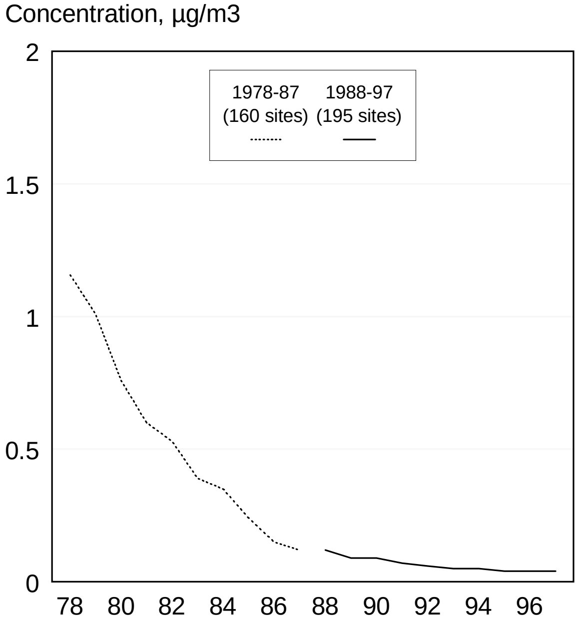
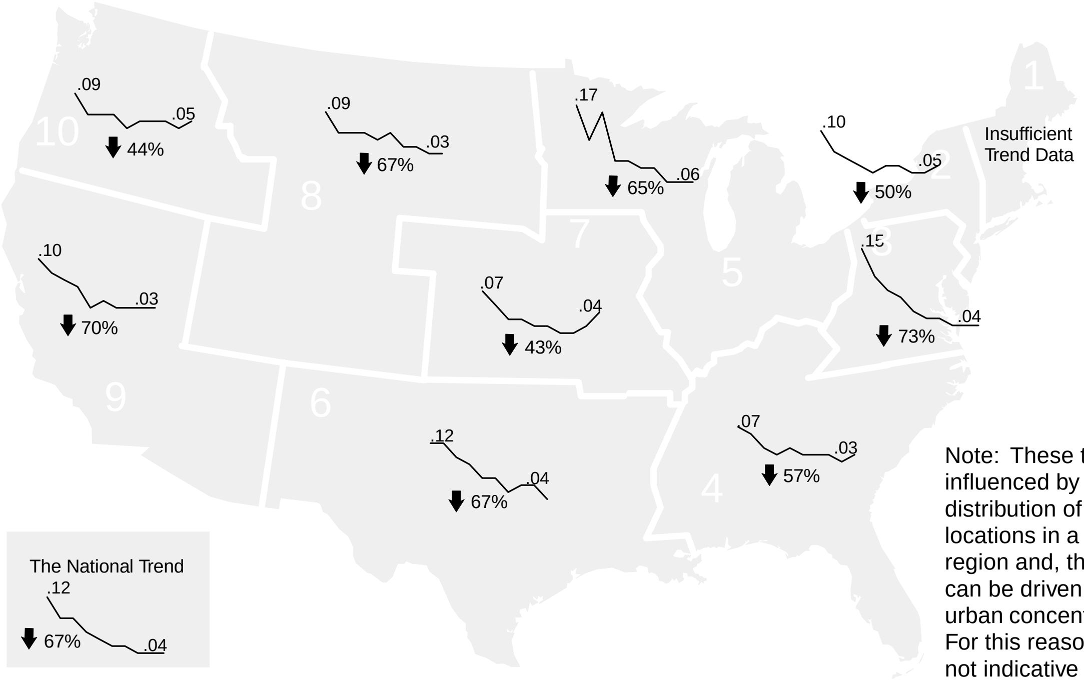


Figure 2-14. Trend in Pb maximum quarterly mean concentrations by EPA Region, 1988-1997.



Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ug/m3.

Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

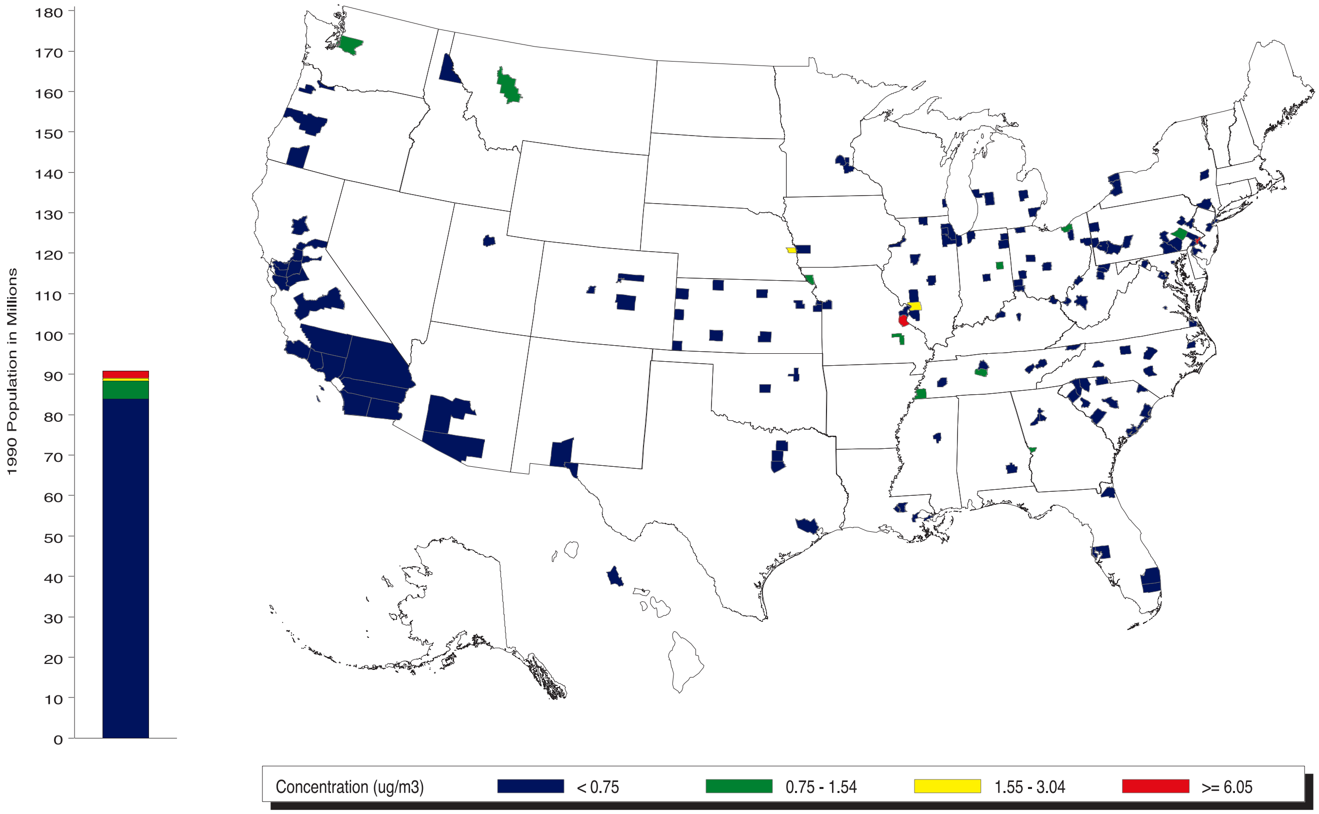
Figure 2-15. Pb maximum quarterly concentration in the vicinity of Pb point sources, 1997.

Rank	ST	Emission Source	Max Qtr Avg µg/m3
1	MO	Doe Run (Herculeneum)	8.53
2	PA	Franklin Smelter	6.98
3	IL	Chemetco	2.11
4	NE	ASARCO (Omaha)	1.95

● Exceeds the NAAQS
• Meets the NAAQS

Note: Site markers may overlap.

Figure 2-16. Highest Pb maximum quarterly mean by county, 1997.



NITROGEN DIOXIDE

- **Air Quality Concentrations**

1988–97	14% decrease
1996–97	no change

- **Emissions**

1988–97	1% decrease
1996–97	1% increase

Nature and Sources

Nitrogen dioxide (NO_2) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Nitrogen oxides (NO_x), the term used to describe the sum of NO, NO_2 and other oxides of nitrogen, play a major role in the formation of ozone in the atmosphere through a complex series of reactions with volatile organic compounds. A variety of NO_x compounds and their transformation products occur both naturally and as a result of human activities. Anthropogenic (i.e., man-made) emissions of NO_x account for a large majority of all nitrogen inputs to the environment. The major sources of anthropogenic NO_x emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. Most (about 95 percent) of NO_x from combustion sources is emitted as NO; the remainder is largely NO_2. Because NO is readily converted to NO_2 in the environment, the emissions estimates reported here assume nitrogen oxides are in the NO_2 form. Natural sources of NO_x are lightning, biological and abiological processes in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. Home heaters and gas stoves also produce substantial amounts of NO_2 in indoor settings.

Health and Environmental Effects

NO_2 is the only nitrogen oxide sufficiently widespread and commonly found in ambient air at high enough concentrations to be a matter of public health concern. The health effects of most concern associated with short-term exposures (e.g., less than 3 hours) to NO_2 at or near the ambient NO_2 concentrations seen in the United States include changes in airway responsiveness and pulmonary function in individuals with preexisting respiratory illnesses and increases in respiratory illnesses in children (5–12 years old).[7,8]

Evidence suggests that long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause alterations in the lung. Atmospheric transformation of NO_x can lead to the formation of ozone and nitrogen-bearing particles (e.g., nitrates and nitric acid). As discussed in the ozone and PM sections of this report, exposure to both PM and ozone is associated with adverse health effects.

Nitrogen oxides contribute to a wide range of effects on public welfare and the environment including potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, and visibility impairment. However, the role nitrogen deposition plays in the acidification of freshwater bodies and the eutrophication of estuarine and coastal waters (e.g., Chesapeake Bay) is the deposition-related issue of most concern in the United States. Adverse environmental effects include the loss or shift in number and type of species, and explosive algae growth leading to a depletion of oxygen in the water, and/or an increase in levels of toxins harmful to fish and other aquatic life. Nitrogen oxides are an important precursor both to ozone and to acidic deposition (see sections on ozone and sulfur dioxide trends.) NO_x emissions also can have a significant impact on particulate matter concentrations, most notably in some western urban areas.

Primary and Secondary Standards

The level for both the primary and secondary national ambient air quality standards (NAAQS) for NO_2 is 0.053 ppm annual arithmetic average, not to be exceeded.

National 10-Year Trends

The statistic used to track ambient NO_2 air quality trends is the annual mean NO_2 concentration. A total of 224 ambient NO_2 monitoring sites met the trends data completeness criteria. The national trend in annual mean NO_2 concentrations is shown graphically in Figure 2-17 for the 10-year period, 1988–1997. Based on measurements at 224 monitoring sites located in cities throughout the country, the 1997 national composite mean NO_2 concentration is 14 percent lower than the composite mean recorded in 1988, and is unchanged from the 1996 level. Figure 2-17 shows that sites recording the highest annual mean NO_2 concentrations (the 90th percentile) have recorded the largest reductions. Except for 1994, annual mean NO_2 concentrations have decreased yearly since 1989. Figure 2-18 shows how the trends in annual mean NO_2 concentrations vary among urban, suburban and rural monitoring locations. As Figure 2-18 illustrates, the highest annual mean NO_2 concentrations are typically found in urban areas, with significantly lower annual mean concentrations recorded at rural sites. Trends in annual mean NO_2 concentrations are similar at both urban and suburban sites. The 1997 composite mean at 80 urban sites is 19 percent lower than the 1988 level, compared to 17 percent lower at 96 suburban sites. At 46 rural sites, the composite mean NO_2 concentration decreased in 1990 and remained constant for the next 4 years. The 1997 composite mean NO_2 concentration at these rural sites is 22 percent lower than the 1988 composite mean level. (See Figure B-3 in Appendix B for a map of the NO_2 monitoring site locations.)

Atmospheric concentrations of NO_2 are determined by indirect photomultiplier measurement of the luminescence produced by a critical reaction of NO with ozone. The measurement of NO_2 is based first on the conversion of NO_2 to NO and then subsequent detection of NO using this well characterized chemiluminescence technique. This conversion is not specific for NO_2, hence chemiluminescence analyzers are subject to interferences produced by response to other nitrogen containing compounds (e.g., peroxyacetyl nitrate) (PAN) which can be converted to NO. The chemiluminescence technique has been reported to overestimate NO_2 due to these interferences. This is not an issue for compliance, because there are no violations of the NO_2 NAAQS. In addition, the interferences are believed to be relatively small in urban areas.[9] The air quality trends depicted are in urban locations, and are expected to be reasonable representations of urban NO_2 trends. However, that is not the case in rural and remote areas where air mass aging could foster greater relative levels of PAN and nitric acid and

Figure 2-17. Trend in annual NO_2 mean concentrations, 1988-1997.

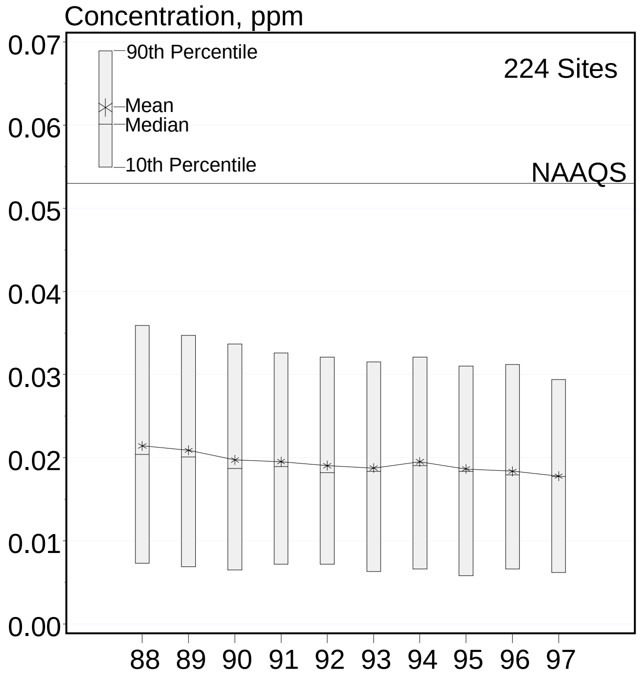


Figure 2-18. Trend in annual mean NO_2 concentrations by type of location, 1988-1997.

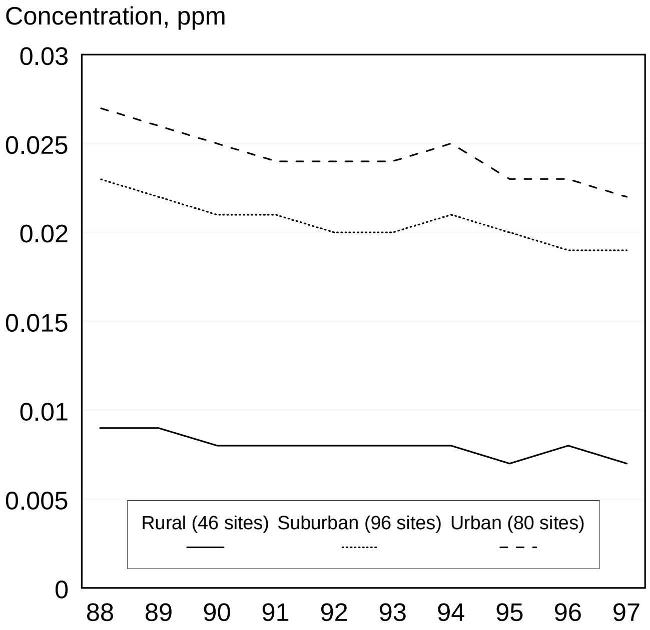


Figure 2-19. Trend in national total NO_x emissions, 1988-1997.

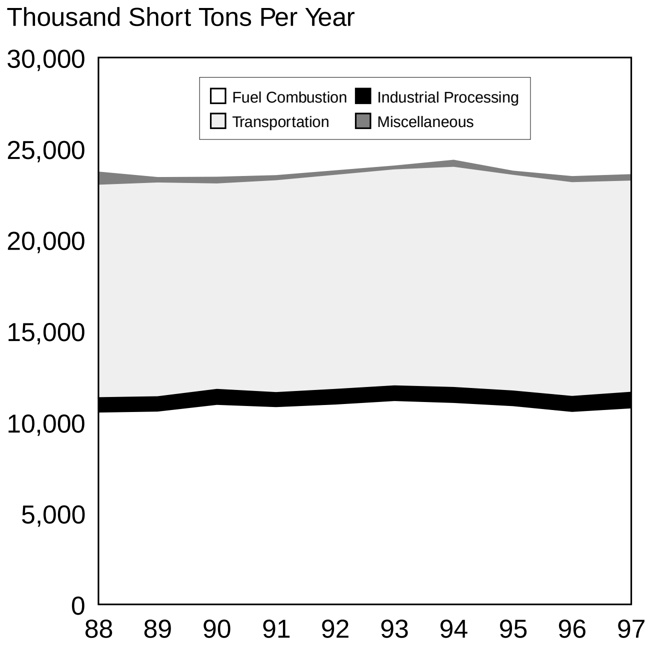
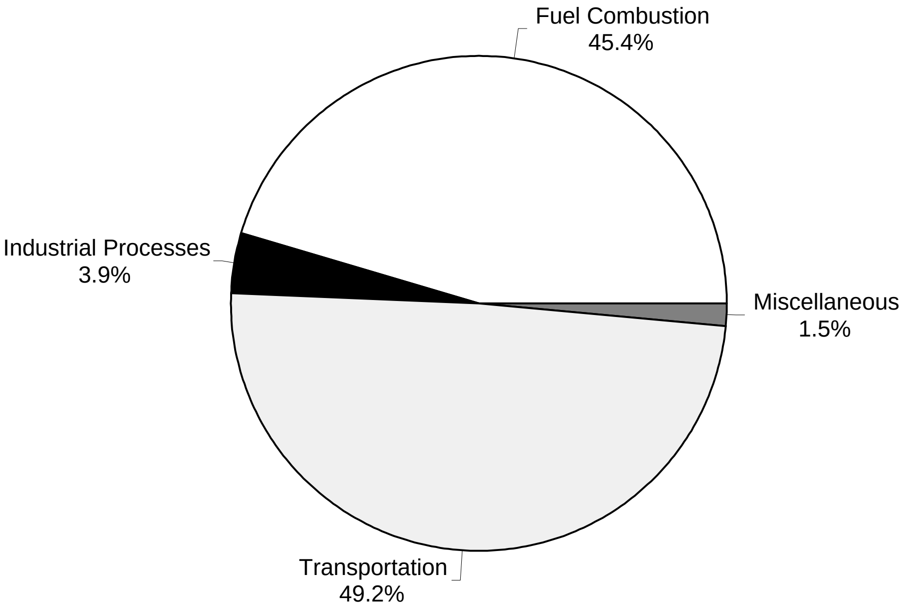


Figure 2-20. NO_x emissions by source category, 1997.



interfere significantly with the interpretation of NO_2 monitoring data.

Emissions Trends

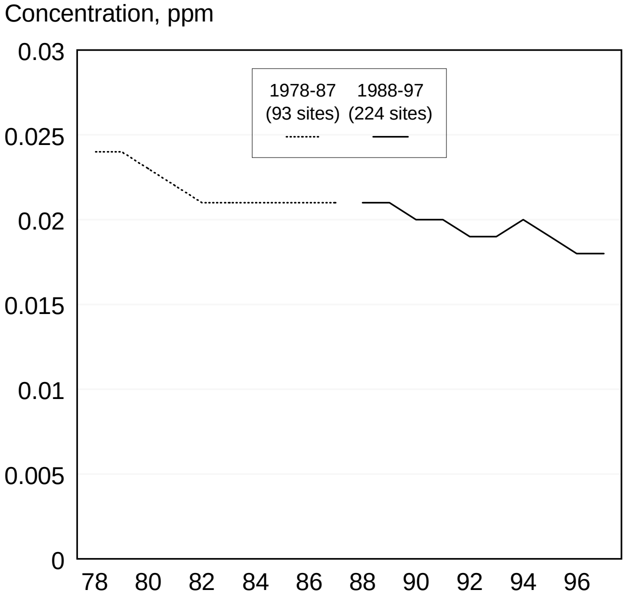
Figure 2-19 shows the 10-year trend in NO_x emissions. National total NO_x emissions in 1997 are 1 percent lower than the 1988 total, although changes in data availability and methodology between 1989 and 1990 (in the other combustion category) introduce some uncertainty in this comparison. Emissions from fuel combustion sources are 2 percent higher than the 1988 level, but 4 percent lower than the peak emissions of 1993. Figure 2-20 shows that the two primary sources of NO_x emissions are fuel combustion and transportation. Together these two sources comprise 95 percent of 1997 total NO_x emissions. Because most NO_2 monitors are located in urban, population-oriented areas, that are dominated by mobile sources, the reduction in ambient concentrations (a 14-percent decrease since 1988) more closely tracks the 8-percent decrease in NO_x emissions from highway vehicles. As noted previously in this report, VMT increased 25 percent nationally during the past 10 years. Emissions from coal-fired electric utilities account for roughly one quarter of all NO_x emissions and are not likely to impact most urban NO_2 monitoring sites. Between 1988 and 1997, emissions from these sources decreased 1 percent. Title IV (Acid Deposition Control) of the CAA provides a guideline for NOx reductions of approximately two million tons from 1980 emissions levels. In 1997, NO_x emissions were reduced 32 percent from 1990 levels at 263 coal-fired units under Phase I of the Acid Rain NO_x Control Program.[9] These units accounted for over three percent of total national NO_x emissions in 1997. Between 1996 and 1997, NO_x emissions from these sources increased 1 percent due to greater electrical production.[10] Table A-4 provides a listing of NO_x emissions by major source category.

The significance of the role of nitrogen oxides as a precursor to ozone formation was addressed in a final rule published by EPA in October 1998 (commonly known as the NO_x SIP Call). The rule calls for reductions in summertime NO_x emissions to reduce the regional transport of ozone [11] and set (1) a model cap-and-trade program, (2) revised statewide NO_x emission budgets, and (3) proposed revisions to the Acid Rain Program.[11] Although the rule does not mandate which sources must reduce emissions, EPA has estimated that reducing NO_x emissions from utilities and large non-utility point sources is one cost-effective strategy available to states. See the ozone section for more information concerning this rule.

National 20-Year Trends

As discussed previously, long-term national ambient air quality trends are difficult to assess because few monitoring sites have operated continuously in the same location for 20 years. Figure 2-21 presents 20-year trends in ambient NO_2 concentrations by combining two separate 10-year trends databases, 1978–1987 (93 sites) and 1988–1997 (224 sites). Nationally, annual mean NO_2 concentrations have decreased in urban areas by approximately 2 percent since 1978. As seen in Figure 2-21, annual mean NO_2 concentrations declined in the early 1980s, were relatively flat during the mid-to-late 1980s, and resumed their decline in the 1990s. The 1997 national composite mean NO_2 concentration is the lowest level reported during the past 20 years.

Figure 2-21. Long-term trend in annual mean NO_2 concentrations, 1978-1997.



Regional Trends

The map in Figure 2-22 shows the trends in NO_2 concentrations during the past 10 years, 1988–1997. The trends statistic is the regional composite mean of the NO_2 annual mean concentrations across all sites with at least 8 years of ambient measurements. Every EPA region (except Region 10 which does not have any NO_2 trend sites) recorded 10-year declines in composite annual mean NO_2 concentrations. Figure 2-22 shows that the largest reductions in composite annual mean NO_2 concentrations occurred in Region 9 (the South Coast of California), followed by Region 1 (the New England states), and the Region 2 states of New York and New Jersey.

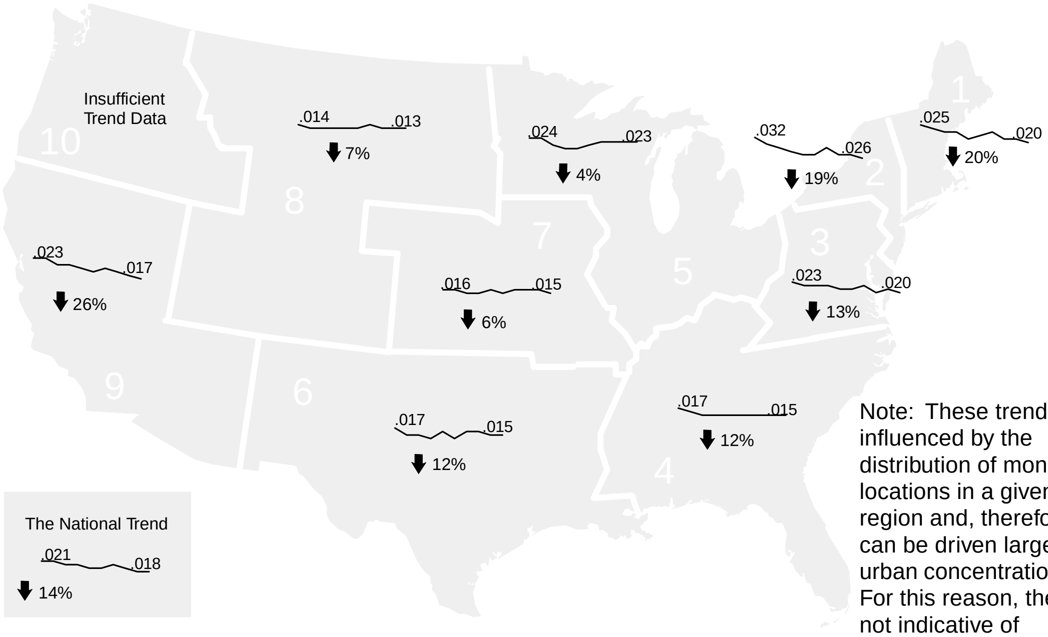
1997 Air Quality Status

All monitoring locations across the nation, including Los Angeles, met the NO_2 NAAQS in 1997. This is reflected on the map in Figure 2-23 that displays the highest annual mean NO_2 concentration measured in each county. In July 1998, EPA announced the redesignation of the South Coast Air Basin (the last remaining nonattainment area for NO_2) to attainment for the NO_2 NAAQS.[12]

Data Sources

The NO_2 ambient trends plotting points and emissions totals by source category are listed in Tables A-1 and A-4, respectively. The plotting points for the 20-year trend charts are listed in Table A-9. Table A-11 contains the highest annual mean NO_2 concentration by county in 1997.

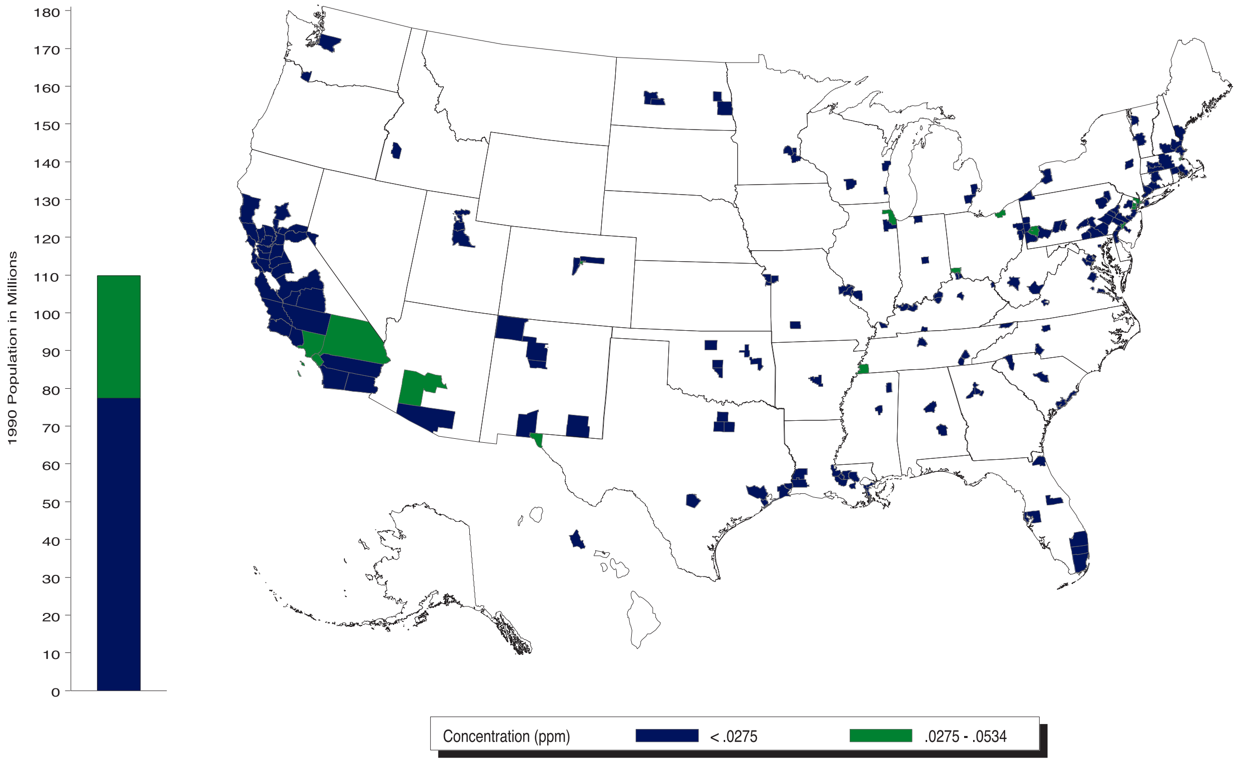
Figure 2-22. Trend in NO_2 maximum quarterly mean concentrations by EPA Region, 1988–1997.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

Figure 2-23. Highest NO_2 annual mean concentration by county, 1997.



Ozone

- **Air Quality Concentrations**

1988–97	19%	decrease (1-hr)
	16%	decrease (8-hr)
1996–97	no	change (1-hr)
	1%	decrease (8-hr)

- **Emissions**

1988–97	20%	decrease
1996–97	no	change

Nature and Sources

Ground level ozone has remained a pervasive pollution problem throughout the United States. Ozone is formed readily in the atmosphere by the reaction of VOCs and NO_x in the presence of heat and sunlight, which are most abundant in the summer. VOCs are emitted from a variety of sources including: motor vehicles, chemical plants, refineries, factories, consumer and commercial products, other industries, and natural (biogenic) sources. NO_x is emitted from motor vehicles, power plants, other sources of combustion and natural sources including lightning and biological processes in soil. Changing weather patterns contribute to yearly differences in ozone concentrations. Ozone and the precursor pollutants that cause ozone also can be transported into an area from pollution sources found hundreds of miles upwind.

Health and Environmental Effects

Ozone occurs naturally in the stratosphere and provides a protective layer high above the Earth. At ground-level however, it is the prime ingredient of smog. Short-term (1–3 hours) and prolonged (6–8 hours) exposures to ambient ozone concentrations have been linked to a number of health effects of concern. For example, increased hospital admissions and emergency room visits for respiratory causes have been associated with ambient ozone exposures.

Exposures to ozone can make people more susceptible to respiratory infection, result in lung inflammation, and aggravate pre-existing respiratory diseases such as asthma. Other health effects attributed to short-term and prolonged exposures to ozone, generally while individuals are engaged in moderate or heavy exertion, include significant decreases in lung function and increased respiratory symptoms such as chest pain and cough. Children active outdoors during the summer when ozone levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include adults who are active outdoors (e.g., outdoor workers) and individuals with pre-existing respiratory disease such as asthma and chronic obstructive lung disease; within each group there are individuals who are unusually responsive to ozone. In addition, long-term exposures to ozone present the possibility of irreversible changes in the lungs which could lead to premature aging of the lungs and/or chronic respiratory illnesses.

Ozone also affects vegetation and ecosystems, leading to reductions in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests, and other environmental stresses (e.g., harsh weather). In long-lived species, these effects may become evident only after several years or even decades, thus, having the potential for long-term effects on forest ecosystems and habitat quality for wildlife and endangered species. Further, ozone injury to the foliage of trees and other plants can decrease the aesthetic value of ornamental species as well as the natural beauty of our national parks and recreation areas.

Primary and Secondary 1-hour Ozone Standards

In 1979, EPA established 1-hour primary and secondary standards for ozone. The level of the 1-hour primary NAAQS is 0.12 ppm daily maximum 1-hour O_3 concentration that is not to be exceeded more than once per year on average. The secondary standard is identical to the primary standard. To encourage an orderly transition to the revised O_3 standards, the 1-hour standards will no longer apply to an area once EPA determines that the area has air quality data meeting the 1-hour standards. In 1998, EPA revoked the 1-hour O_3 NAAQS in 2918 counties in the United States leaving 225 counties where the 1-hour standard still applies.[13,14]

Primary and Secondary 8-hour Ozone Standards

On July 18, 1997, EPA established an 8-hour O_3 primary standard to protect against longer exposure periods that are of concern for both human health and welfare (vegetation).[15] The level of the national 8-hour primary and secondary ambient air quality standards for ozone is 0.08 ppm, daily maximum 8-hour average over 3 years. The standards are met when the 3-year average of the annual fourth-highest daily maximum 8-hour ozone concentration is less than or equal to 0.08 ppm.[15] EPA will designate ozone nonattainment areas for the 8-hour ozone NAAQS by July, 2000.[16]

National 10-Year Trends

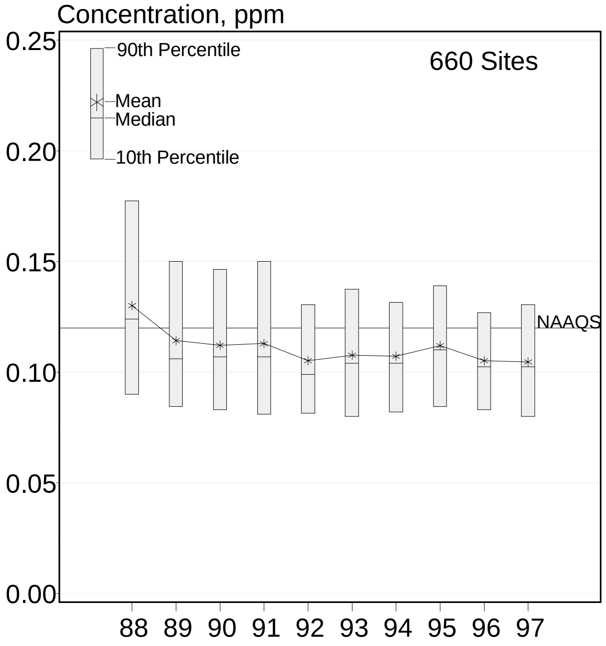
Because the 1-hour and 8-hour NAAQS have different averaging times and forms, two different statistics are used to track ambient O_3 air quality trends. For the 1-hour O_3 NAAQS, Figure 2-24 presents the national trend in the annual second-highest daily maximum 1-hour O_3 concentration at 660 monitoring sites. The inter-site variability for annual second highest daily maximum 1-hour O_3 concentrations is graphically shown by the 90th percentile, median, composite mean, and 10th percentile concentrations in Figure 2-24. This figure shows that during the past 10-years, higher concentrations have declined more rapidly (the 90th percentile concentration is down 28 percent), while the 1997 national composite average daily maximum 1-hour ozone concentration is 19 percent lower than the 1988 level. The composite mean concentration is unchanged between 1996 and 1997.

Although not shown, the composite average estimated exceedance rate (i.e., the average number of days when the daily maximum 1-hour average concentration exceeds the level of the 1-hour NAAQS) has declined 86 percent since 1988. As noted in previous reports, this statistic, which is simply a count of the number of times the level of the NAAQS has been exceeded, can vary significantly from year to year. Between 1996 and 1997, the national composite mean of the average number of exceedances of the ozone NAAQS declined 30 percent, primarily as a result of the 61 percent decrease in the exceedance rate at sites in California.

For the 8-hour ozone NAAQS, Figure 2-25 presents the trend in the annual fourth-highest 8-hour daily maximum O_3 concentration at the same 660 sites. The trend in the 8-hour O_3 statistic is similar to the 1-hour trend, although the concentration range is smaller. As measured by the composite mean concentration across all 660 sites, annual fourth-highest 8-hour average concentrations decreased 16 percent since the peak year of 1988. Although, the 8-hour national composite mean concentration decreased 1 percent between 1996 and 1997, the higher concentration sites, as shown by the 90th percentile concentrations, increased 2 percent since 1996.

Ambient O_3 trends are influenced by year-to-year changes in meteorological conditions, population growth, VOC to NO_x ratios, and changes in emissions from ongoing control measures. This 10-year trends period, with peak ozone years at both endpoints, demonstrates the importance of accounting for year to year variability in meteorological conditions when assessing ozone trends.[17,18] Previous *Trends Reports* have discussed an EPA statistical model, based on the Weibull probability distribution, that attempts to account for meteorological effects and helps to normalize the resulting trend estimates across years.[18] The model, applied on an individual metropolitan area basis, includes a trend component that adjusts the annual rate of change in ozone for concurrent impacts of meteorological conditions, including surface temperature and wind speed. Figure 2-26 displays the model results for both the 1-hour and 8-hour trends statistics averaged across 41 metropolitan areas. While the ambient monitoring data reflect the year-to-year variability in ozone conducive conditions, the meteorologically adjusted ozone trend provides a better indicator of the impact

Figure 2-24. Trend in annual second-highest daily maximum 1-hour O_3 concentrations, 1988-1997.



of emissions changes. For these 41 metropolitan areas, the adjusted trend for both averaging times shows continued improvement with an average decrease in O_3 concentrations of about 1 percent per year since 1986.

Figure 2-27 shows the 10-year change in ambient ozone concentrations among urban, suburban and rural monitoring sites. The highest ambient O_3 concentrations are typically found at suburban sites, consistent with the downwind transport of emissions from the urban center. During the past 10 years, the composite mean O_3 concentration decreased 23 percent at 117 urban sites and declined by 21 percent at 292 suburban sites. The 1997 composite mean concentration at 234 rural sites is 17 percent lower than the 1988 level.

EPA also announced that it intends to expand the rural ozone monitoring network and to explore opportunities to work with other federal agencies to develop a coordinated and long-term rural monitoring network.[15] One of the ways EPA is accomplishing this is the Clean Air Status and Trends Network (CASTNet) which was developed in response to the CAAA of 1990 requiring implementation of a national network to measure national status and trends. The CASTNet O_3 network, which consists of a total of 69 sites (50 CASTNet and 19 National Park Service (NPS) sites), was designed, in part, to provide information on the distribution of O_3 across rural areas of the United States.

CASTNet sites are considered regionally representative, and thus able to define geographic patterns of rural ozone across the United States. Meteorological variables also are recorded continuously and

Figure 2-25. Trend in annual fourth-highest daily maximum 8-hour O_3 concentrations, 1988-1997.

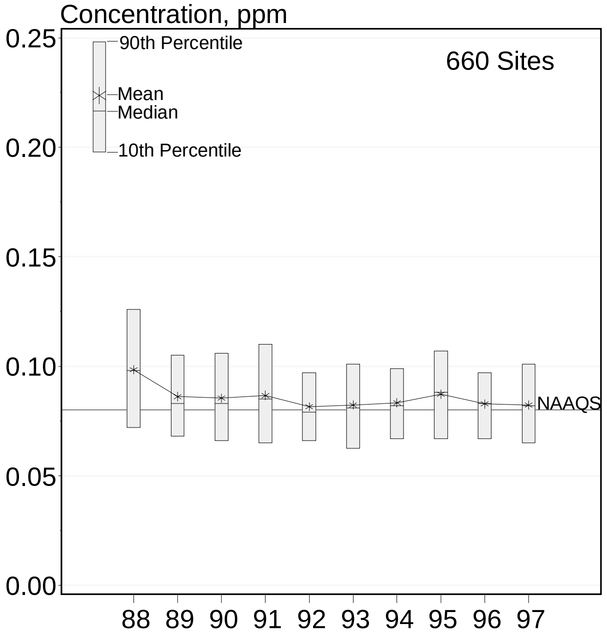


Figure 2-26. Comparison of actual and meteorologically adjusted trends in 1-hour and 8-hour 99th percentile O_3 concentrations, 1988-1997.

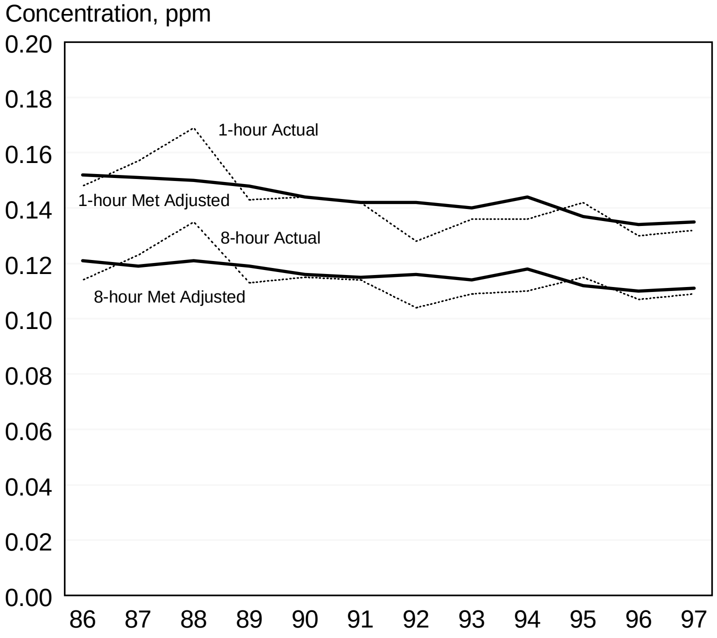


Figure 2-27. Trend in annual second-highest daily maximum 1-hour O_3 concentrations by location, 1988-1997.

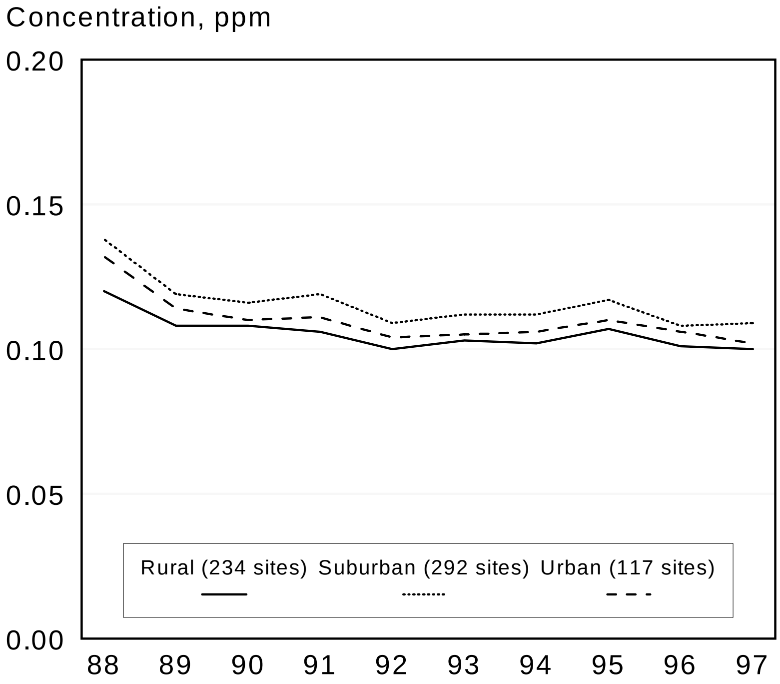
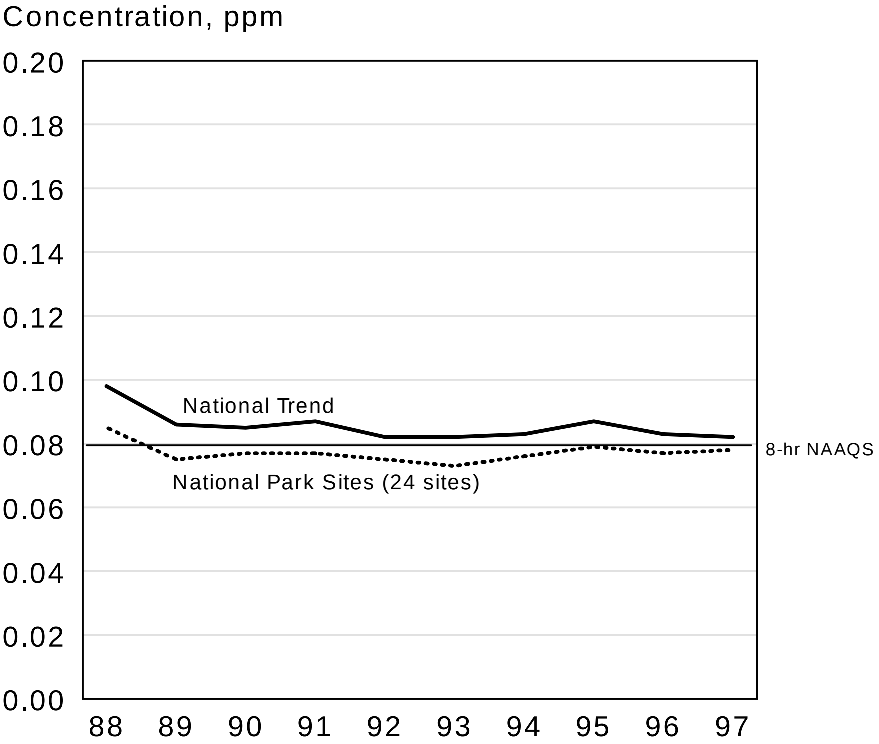


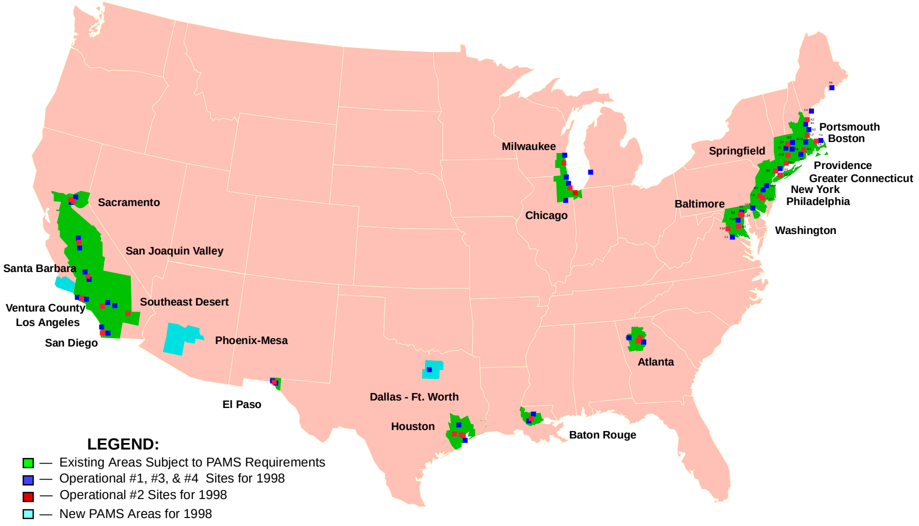
Figure 2-28. Trend in annual fourth-highest daily maximum 8-hour O_3 concentrations in National Parks, 1988-1997.



reported as hourly averages. See Chapter 7: Acid Deposition for more information concerning CASTNet.

Because several other federal agencies have a similar need to understand how ozone impacts the resources they manage, EPA is also working with these agencies to identify better ways to leverage existing monitoring and data collection and analysis efforts. For example, a special subset of rural environments, all national parks and wilderness areas exceeding 5,000 acres, were designated as Class I areas in the 1977 amendments to the CAA. These areas are accorded a higher degree of protection under the CAA provisions for the prevention of significant deterioration. The CAA further directs the federal land managers to protect air-quality related values (AQRVs). Sufficient monitoring data are available to assess 10-year trends in ambient O_3 concentrations at 24 NPS sites. Figure 2-28 compares the 10-year trend in the composite mean of the annual fourth highest 8-hour O_3 concentration at these 24 Class I sites with the national O_3 trend. Nonparametric regression was used to assess the statistical significance of the 10-year trend in 8-hour ozone concentrations for the composite mean across all 24 NPS sites, and at each of the NPS sites. Although the 1997 composite mean O_3 concentrations is 8 percent lower than the 1988 value, there is no statistically significant trend in the composite mean O_3 concentration at these NPS sites. On an individual site basis, only two sites, both in the Great Smoky Mountains National Park, had statistically significant upward trends. Although not statistically significant, of the remaining 22 sites, 11 sites had downward slopes, 8 upward and 3 sites showed no change. (See Chapter 3: Criteria Pollutants - Metropolitan Area Trends, for a description of the non-parametric regression procedure.)

Figure 2-29. Metropolitan areas subject to the PAMS program.



Enhanced Ozone Monitoring (PAMS)

Section 182(c)(1) of the CAA called for improved monitoring of ozone and its precursors, VOC and NO_x, to obtain more comprehensive and representative data on ozone air pollution. Responding to this requirement, EPA promulgated regulations in February 1993 to initiate the Photochemical Assessment Monitoring Stations (PAMS) program.[19] The PAMS program requires the establishment of an enhanced monitoring network in all ozone nonattainment areas classified as serious, severe, or extreme. Currently, 24 of the remaining 38 nonattainment areas for the 1-hour O_3 NAAQS are subject to PAMS; these areas are identified in Figure 2-29.

Each PAMS network consists of as many as five monitoring stations, depending on the area's population. These stations are carefully located according to meteorology, topography, and relative proximity to emissions sources of VOC and NO_x. Each PAMS network generally consists of four different types of monitoring sites (Types 1, 2, 3, and 4) designed to fulfill unique data collection objectives. Type 1 sites are located upwind of the metropolitan area to measure ozone and precursors being transported into the area. Type 2 sites, referred to as maximum precursor emissions impact sites, are designed to collect data on the type and magnitude of ozone precursor emissions emanating from the metropolitan area and are typically located immediately downwind of the central business district. Type 3 stations are intended to measure maximum ozone concentrations and are sited farther downwind of the urban area than the Type 2 sites. Type 4 PAMS sites are located downwind of the nonattainment area to assess ozone and precursor levels exiting the area and potentially contributing to the ozone problem in other areas. In addition to the surface monitoring sites, each PAMS area also is required to monitor upper air meteorology at one representative site.

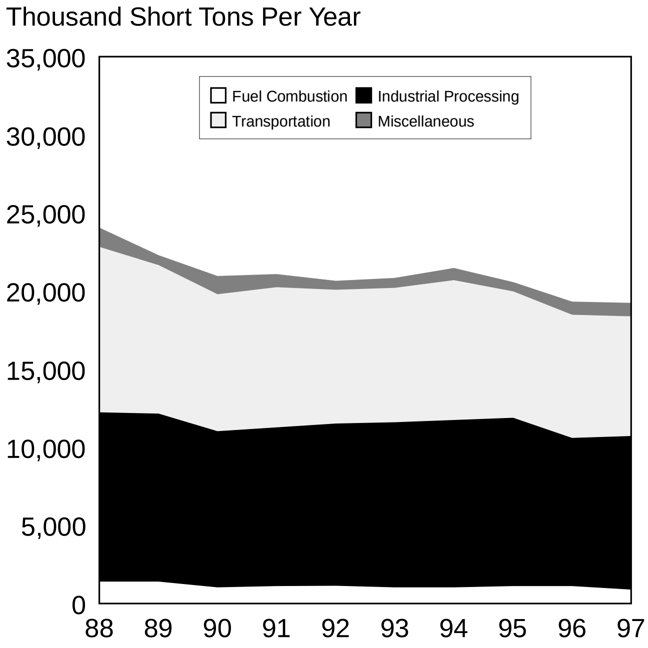
Regulations allow a 5-year transition or phase-in schedule for the program at a rate of at least one station per area per year. The first official year of implementation for PAMS was 1994. As of August 1998, there were 78 operating PAMS sites. The data collected at the PAMS sites include measurements of ozone, NO_x, total non-methane organic compounds (TNMOC), a target list of VOC species including several carbonyls, plus surface and upper air meteorology. Most PAMS sites measure 56 target hydrocarbons on an hourly or 3-hour basis during the PAMS monitoring season. Included in the monitored VOC species are 10 compounds classified as hazardous air pollutants (HAPs). The PAMS program is the only federally mandated initiative that requires routine monitoring of HAPs; for more information on HAPs see Chapter 5: Air Toxics. All PAMS stations measure ozone, NO_x, and surface meteorological parameters on an hourly basis. In general, the PAMS monitoring season spans the three summer months when weather conditions are most conducive for ozone formation. EPA allows states flexibility in network design and sampling plans in recognition of the fact that each PAMS area has its own unique characteristics and demands. For more information on the PAMS networks, data col-

Table 2-3. Summary of changes in O_3, NO_x and TNMOC at PAMS sites, 1996-1997.

Pollutant	Number of Sites			Median Percent Change
	Total	Up	Down	
O_3 2nd daily max 1-hr	69	-	-	1%
NO_x—Summer 6–9am mean	52	8	9	0%
TNMOC—Summer 6–9am mean	42	8	9	-2%

Note: The numbers shown in the “Up” and “Down” categories refer to the number of sites in which the change in summer 6–9am, mean concentrations between the years referenced is a statistically significant increase or decrease (as determined by a t-test with a significance level of .05). The total number of sites (“Total”) may not equal the sum of the corresponding “Up” and “Down” categories.

Figure 2-30. National total VOC emissions trend, 1988–1997.



lected, and analyses of the data, see the EPA PAMS web site at **http://www.epa.gov/oar/oaqps/pams**.

PAMS data provide the opportunity for state and local air pollution control agencies to effectively evaluate ozone nonattainment conditions, confirm attainment/nonattainment decisions, identify cost-effective control strategies, evaluate population risk exposure, and develop ozone and ozone precursor trends. The measurements have proven extremely valuable in verifying ozone precursor emissions inventories and in corroborating estimates of area-wide emissions reductions. The data can be used to evaluate, adjust, and provide input to the photochemical grid models used to develop ozone control strategies, as well as demonstrate their success.

Table 2-3 shows second daily maximum 1-hour O_3 concentrations and summer 6–9am mean NO_x and TNMOC concentrations for all reporting PAMS sites for the most recent 2-year period. Morning periods for NO_x and TNMOC are shown since those time frames are generally thought to be an appropriate indicator of anthropogenic emissions. In general, total VOC declined notably between 1994 and 1997, though most of the reductions occurred in the first 2 years, especially between 1994 and 1995. Previous editions of the *Trends Report* highlighted these reductions (as well as corresponding declines in selected VOC species) and attributed them, at least in part, to mobile source controls, specifically the implementation of reformulated gasoline (RFG). Between 1996 and 1997, total VOC only declined slightly (2 percent). NO_x concentrations at PAMS sites were even flatter. The median site concentration is unchanged between 1996 and 1997; only a third of the reporting sites had a significant change in either direction with a fairly even split between sites that showed increases and those that showed declines.

Emissions Trends

Figure 2-30 shows that national total VOC emissions (which contribute to ozone formation) from anthropogenic sources decreased 20 percent between 1988 and 1997. National total NO_x emissions (the other major precursor to ozone formation) increased 1 percent between 1988 and 1997. Recent control measures to reduce emissions include regulations to lower fuel volatility and to reduce NO_x and VOC emissions from tailpipes.[20] The effectiveness of these control measures is reflected in the 28 percent decrease in VOC emissions from transportation sources. VOC emissions from highway vehicles have declined 37 percent since 1988, while highway vehicle NO_x emissions have declined 8 percent since their peak level in 1994. Nationally, the two major sources of VOC emissions are industrial processes (51 percent) and transportation sources (40 percent) as shown in Figure 2-31. Solvent use comprises 66 percent of the industrial process emissions category and 34 percent of total VOC emissions. The emissions totals by source category and year can be found in Table A-5.

As required by the CAA, a cleaner burning fuel (RFG) has been sold since January 1, 1995 in those areas of the country with the worst ozone or smog problems. RFG is formulated to reduce automotive emissions of ozone-forming pollutants and toxic chemicals and is estimated to reduce both VOC and toxic emissions by more than 15 percent.[21] RFG sold during the summer ozone season has lower volatility than most conventional gasoline.[22] The RFG program is mandated year-round in 10 areas of the country (Los Angeles, San Diego, Hartford, New York, Philadelphia, Chicago, Baltimore, Houston, Milwaukee, and Sacramento). Besides these required areas, several other parts of the country exceeding the ozone standard have voluntarily entered the RFG program.[22]

Figure 2-31. VOC emissions by source category, 1997.

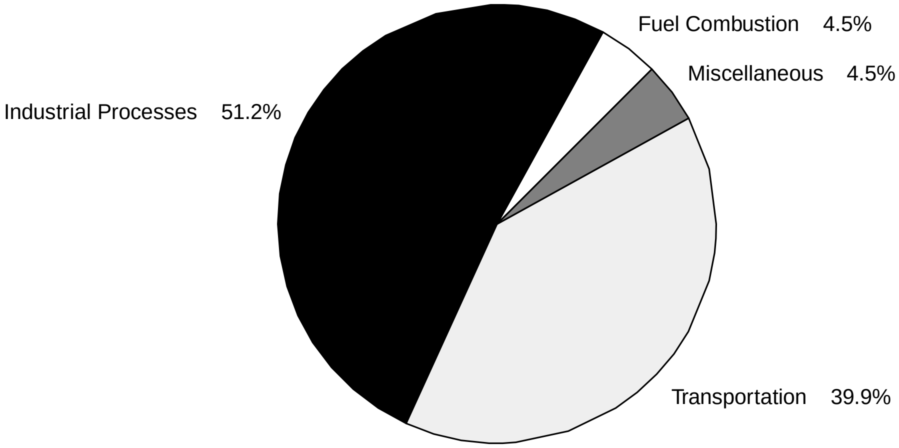


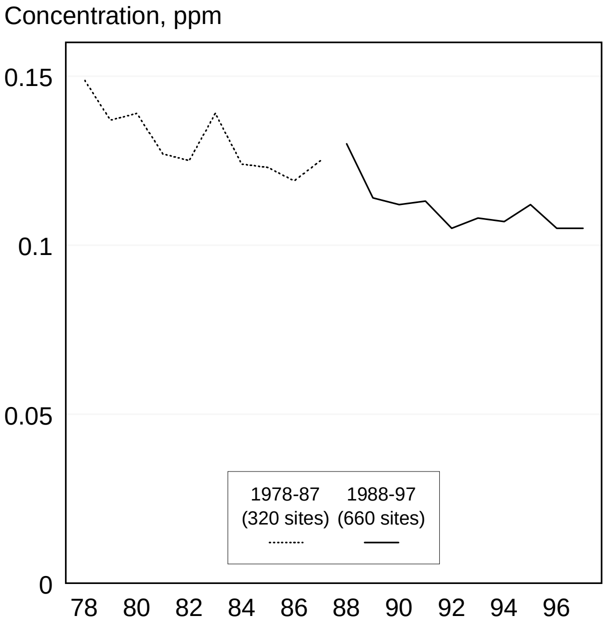
Table 2-4. Biogenic sources of VOC emissions by region.

Region	VOC	Source
Southwestern United States	Isoprene	Oak (mostly), citrus, eucalyptus
	Monoterpenes	Pine, citrus, eucalyptus
Northeastern United States	Isoprene	Oak (mostly), spruce
	Monoterpenes	Maple, hickory, pine, spruce, fir, cottonwood

In addition to anthropogenic sources of VOCs and NO_x, there are natural or biogenic sources of these compounds as well. Table 2-3 shows the different predominant plant species responsible for VOC emissions in different parts of the country for two major biogenic species of concern, isoprene and monoterpenes. Though we are not able to control the level of these natural emissions, when developing ozone control strategies, their presence is an important factor to consider. Biogenic NO_x emissions are associated with lightning and biological processes in soil.

On a regional basis, biogenic VOC emissions can be greater than anthropogenic VOC emissions. Biogenic NO_x emissions, on the other hand, are less than 10 percent of total NO_x emissions. EPA's estimates of total U.S. VOC emissions from biogenic sources are based on the Biogenic Emissions Inventory System—Version 2 (BEIS2).[23,24] A recent national estimate for annual total biogenic VOCs from vegetation

Figure 2-32. Trend in annual second-highest daily maximum 1-hour O_3 concentrations, 1978-1997.



is 29 million short tons, while biogenic nitric oxide emissions are estimated at 1.5 million short tons.[25] Biogenic emissions are influenced by fluctuations in temperature, with the highest emissions occurring in the summer when temperatures are highest. For example, an increase of 10 degrees Celsius (°C) can result in over a two-fold increase in both VOC and NO_x. Research in the area of biogenic emissions continues, and changes in emission estimates are to be expected and should be viewed with an uncertainty of at least a factor of two.

National 20-Year Trends

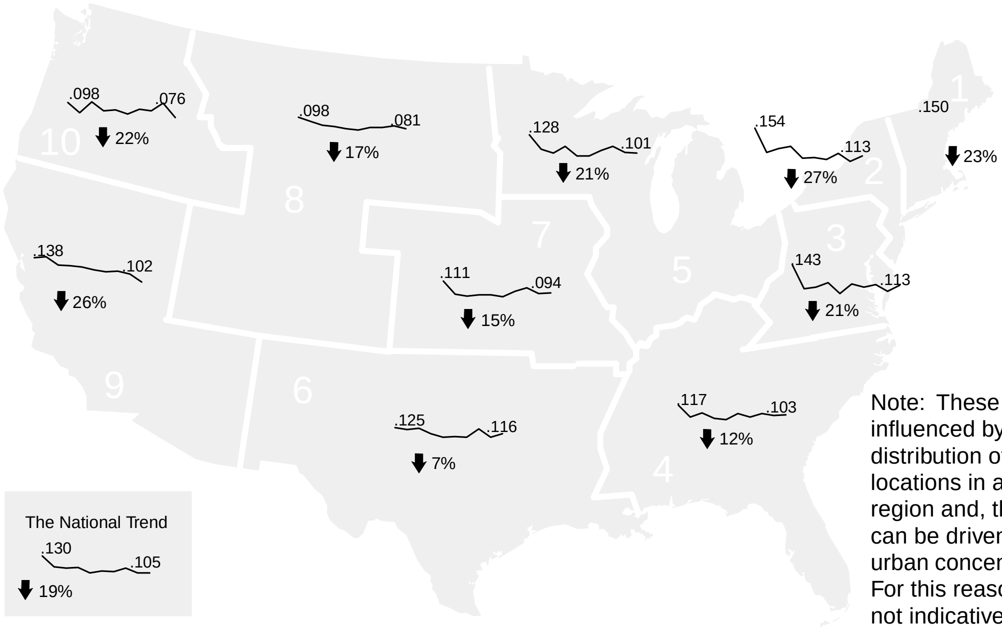
Long-term, quantitative ambient ozone trends are difficult to estimate due to changes in network design, siting criteria, spatial coverage and monitoring instrument calibration procedures during the past two decades. For example, in Figure 2-32 the first year of the early trends period, 1978, corresponds to the use of the old calibration procedure where concentration levels are less certain. Because only a few sites have monitored continuously for two decades, the 20-year trends line in Figure 2-32 is composed of two segments; 238 sites with complete data during the first 10 years, 1978–1987, and 660 sites meeting the data completeness criteria in the most recent 10 years, 1988–1997. Nationally, peak 1-hour O_3 concentrations, as measured by the composite mean of the annual second highest daily maximum 1-hour O_3 concentrations, declined 30 percent since 1978. Figure 2-32 clearly shows the peak ozone years of 1980, 1983, 1988 and 1995.

Regional Trends

The map in Figure 2-32 shows regional trends in 1-hour O_3 concentrations during the past 10 years, 1988–1997. The trends statistic is the composite mean of the annual second-highest daily maximum 1-hour O_3 concentration averaged across all sites in each EPA region with at least eight years of ambient O_3 measurements. Figure 2-34 shows the 10-year trends in the composite mean of the annual fourth-highest daily maximum 8-hour concentration. The trends for both the 1-hour and 8-hour trends statistics are similar, however, the magnitude of the reductions is larger for the annual second-highest 1-hour daily maximum O_3 concentrations as compared to the annual fourth-highest daily maximum 8-hour concentrations. Every EPA region recorded 10-year declines in composite mean 1-hour and 8-hour peak O_3 concentrations.

The greatest improvement in air quality occurred in Northeast, Mid-Atlantic, North Central and Pacific regions. The changes in O_3 concentrations since last year reflect the regional differences in meteorological conditions across the country. Summer 1997 statewide temperature and precipitation ranks are shown in Figure 2-35 based on preliminary meteorological data available from National Oceanic aand Atmospheric Administration (NOAA).[26] No state was within the top ten warm category and only eight states ranked within the warm third of the temperature distribution. Preliminary data indicate that Summer 1997 was the sixth coolest on record for Georgia and the ninth coolest since 1895 for both Mississippi and South Carolina. Nine states ranked within the top ten dry portion of the historical distribution for Summer 1997 including the fourth driest summer since 1895 for Virginia and Maryland and the fifth driest summer season for

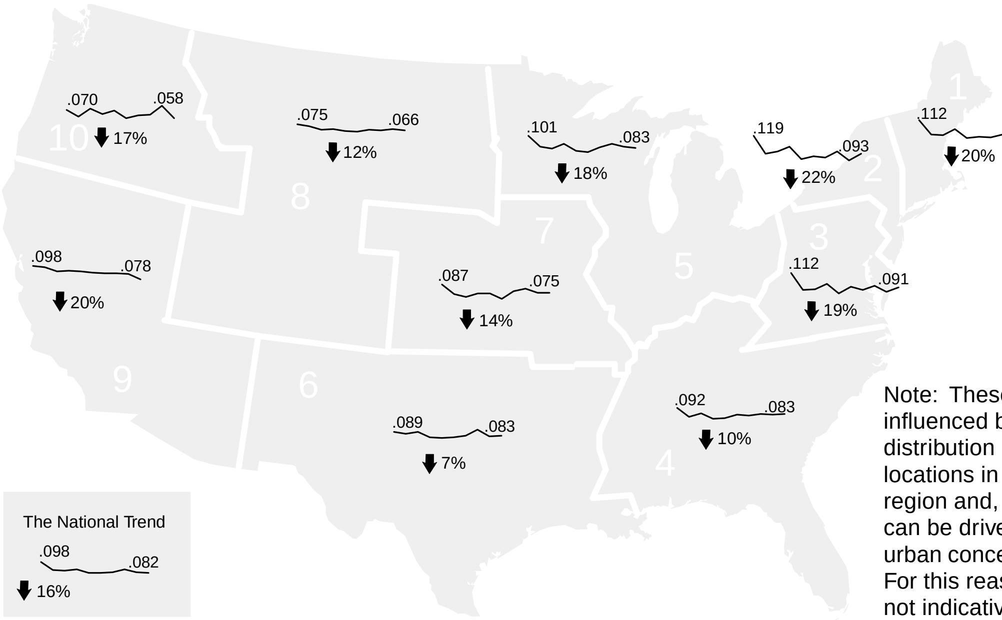
Figure 2-33. Trend in O_3 second maximum 1- hour concentrations by EPA Region, 1988-1997.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

Figure 2-34. Trend in O_3 fourth maximum 8-hour concentration by EPA Region, 1988-1997.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ppm.

New Jersey. Fifteen other states ranked within the dry-third of the distribution. It was the second wettest summer since records began for California and the ninth wettest summer on record for Montana.[26]

Addressing The Ozone Transport Issue

In recognition of long-standing regional ozone problems in the Northeastern United States, the 1990 CAAA established the Ozone Transport Commission (OTC) and the Northeast Ozone Transport Region which includes 12 states. Since that time, several other regional groups have formed to study various aspects of the problem and to try to identify acceptable solutions. EPA continues to be a contributor, partner, or interested party in each of these efforts. The most significant recent developments occurred as a result of a 2-year effort known as the Ozone Transport Assessment Group (OTAG), EPA worked in partnership with state and local government agencies in the 37 easternmost states, industry, and academia to address ozone transport. The extensive modeling analysis conducted by OTAG showed the significant contribution of transported precursor emissions to nonattainment of the ozone NAAQS. As a result of OTAG's findings on the role of nitrogen oxides as a precursor to ozone formation, EPA published a rule in October 1998 (commonly known as the NO_x SIP Call) that called for reductions in summertime NO_x emissions to reduce the regional transport of ozone.[10] The NO_x SIP Call sets (1) a model cap-and-trade program, (2) statewide NO_x emission budgets, and (3) proposed revisions to the acid rain program October 1998. More detailed information on the OTAG process and details on information generated by the OTAG workgroups are available on the OTAG web page at **http://www.epa.gov/ttn/otag**.

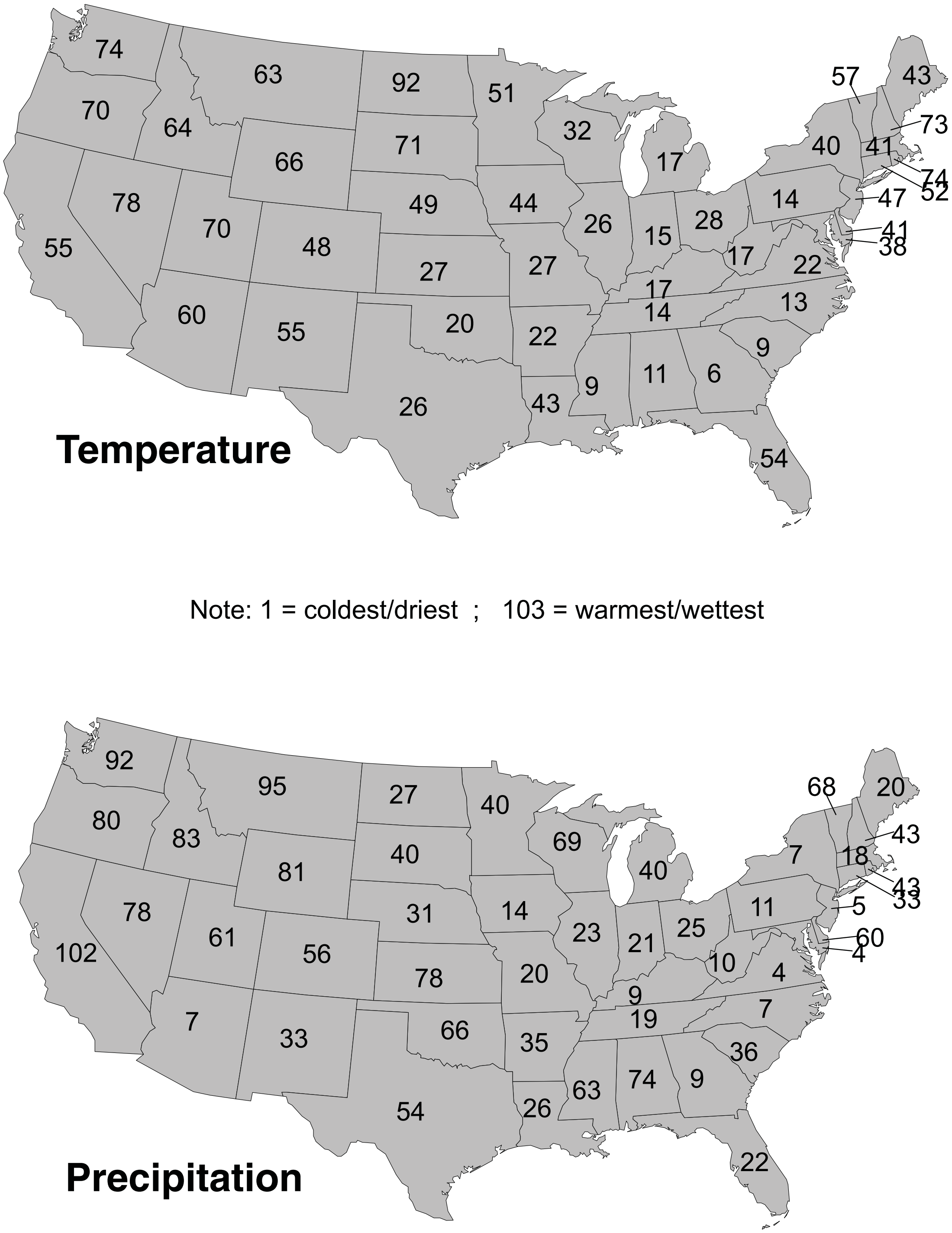
Other regional groups that have addressed regional ozone problems include the Lake Michigan Ozone Study (LMOS), the Southern Oxidant Study (SOS), the Southern Appalachian Mountain Initiative (SAMI), and the North American Research Strategy for Tropospheric Ozone (NARSTO). For more information on these groups, see **www.epa.govairprogm/oar/oaqps/airtrans/regional.html**.

1997 Air Quality Status

The map in Figure 2-36 presents the highest second daily maximum 1-hour concentration by county in 1997. The accompanying bar chart to the left of the map reveals that in 1997 approximately 48 million people lived in 77 counties where the annual second daily maximum 1-hour O_3 concentration was above the level of the 1-hour ozone NAAQS. These numbers represent an increase from the totals reported last year (39 million people living in 52 counties) with ozone concentrations above the level of the ozone NAAQS in 1996. As noted previously, meteorological conditions in some regions of the country were

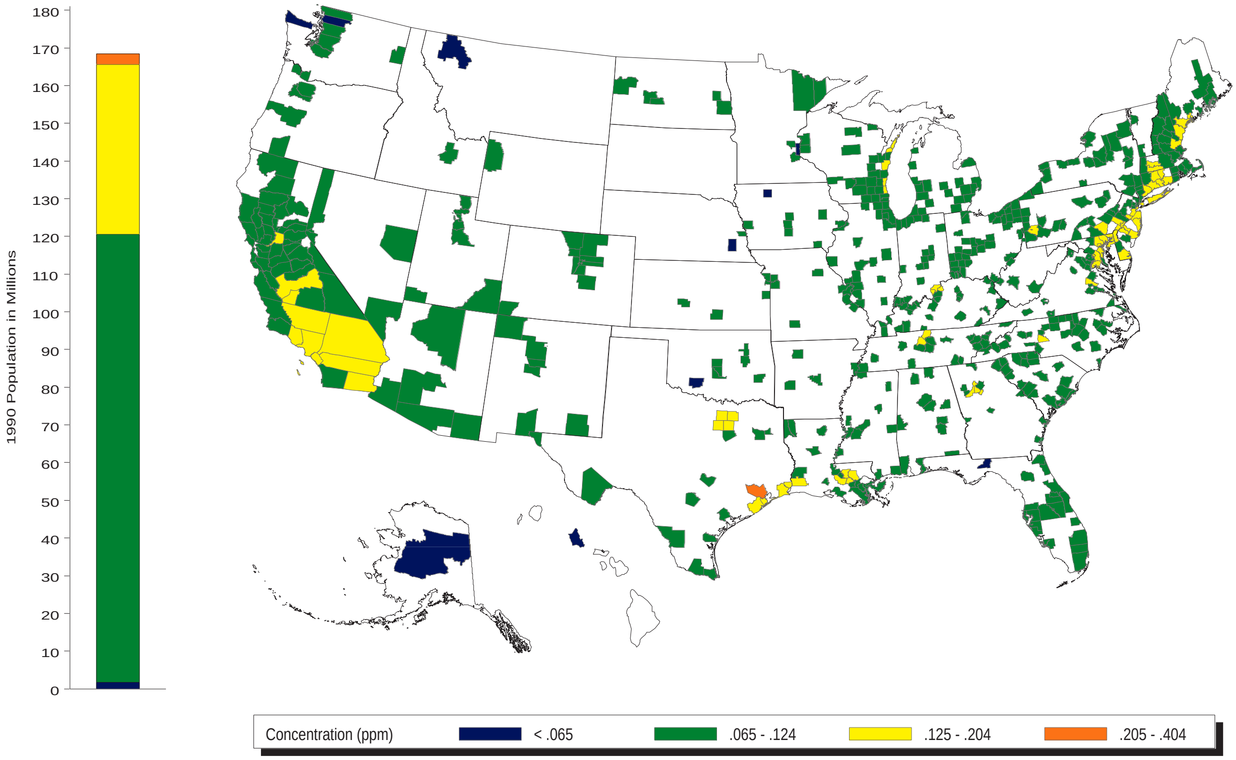
more conducive to peak O_3 formation in 1997, than in 1996. The map in Figure 2-36 shows large spatial differences, with higher O_3 concentrations typically found in Southern California, the Gulf Coast, and the Northeast and Northcentral states. Historically, the highest 1-hour concentrations are found in Los Angeles, however, 1997 is the first year that the highest 1-hour concentrations in Houston exceeded the levels recorded in Los Angeles.

Figure 2-35. Summer 1997 statewide temperature ranks (Source: NOAA, 1997).



Note: 1 = coldest/driest ; 103 = warmest/wettest

Figure 2-36. Highest second daily maximum 1-hour O_3 concentration by county, 1997.



PARTICULATE MATTER

- **Air Quality Concentrations**

1988–97	26%	decrease
1996–97	1%	decrease

- **Emissions**

1988–97	12%	decrease
1996–97	1%	decrease

Nature and Sources

PM is the general term used for a mixture of solid particles and liquid droplets found in the air. These particles, which come in a wide range of sizes, originate from many different stationary and mobile sources as well as from natural sources. They may be emitted directly by a source (direct emissions) or formed in the atmosphere by the transformation of gaseous precursor emissions such as SO_2 and NO_x (secondary particles). Their chemical and physical compositions vary depending on location, time of year, and meteorology.

Health and Environmental Effects

Scientific studies show a link between inhalable PM (alone, or combined with other pollutants in the air) and a series of significant health effects. Inhalable PM includes both fine and coarse particles. “Fine” particles are those that are less than 2.5 micrometers in diameter. Those between 2.5 and 10 micrometers are known as “coarse” particles. Both coarse and fine particles can accumulate in the respiratory system and are associated with numerous health effects. Exposure to coarse fraction particles is primarily associated with the aggravation of respiratory conditions such as asthma. Fine particles are most closely associated with such health effects as decreased lung function, increased hospital admissions and emergency room visits, increased respiratory symptoms and disease, and premature death. Sensitive groups that appear to be at greatest risk to such effects include the elderly, individuals with cardiopulmonary disease including asthma, and children.

In addition, PM causes adverse impacts to the environment. Fine PM is the major cause of reduced visibility in parts of the United States, including many of our National Parks. Other environmental impacts occur when particles deposit onto soils, plants, water, or materials. For example, particles containing nitrogen and sulfur that deposit onto land or water bodies may change the nutrient balance and acidity of those environments so that species composition and buffering capacity change. An ecosystem condition known as “nitrogen saturation,” where additions of nitrogen to soil over time exceed the capacity of the plants and microorganisms to utilize and retain the nitrogen, has already occurred in some areas of the United States.

Particles that are deposited directly onto the leaves of plants can, depending on their chemical composition, corrode leaf surfaces or interfere with plant metabolism. When deposited in sufficient quantities, such as near unpaved roads, tilled fields, or quarries, particles block sunlight from reaching the leaves, stressing or killing the plant. Finally, PM causes soiling and erosion damage to materials, including culturally important objects such as carved monuments and statues.

Primary and Secondary PM_{10} Standards

The PM trends reported here are based primarily on data collected when the previous NAAQS were in effect. These standards include both short- and long-term PM_{10} NAAQS. The long-term standard specifies an expected annual arithmetic mean not to exceed 50 $\mu g/m^3$ averaged over three years. The short-term (24-hour) standard of 150$\mu g/m^3$ is not to be exceeded more than once per year on average over 3 years. Together, these were the previous primary, or health-based, PM_{10} standards. The secondary, or welfare-based, standards for PM_{10} were identical to the primary standards.

The original standards for PM, established in 1971, were for total suspended particulate (TSP) matter. In 1987, EPA replaced the TSP standards with PM_{10} standards to focus on smaller particles of aerodynamic diameter less than or equal to 10 micrometers. These smaller particles caused the greatest health concern because of their ability to penetrate into sensitive regions of the respiratory tract. The most recent review of the PM standards concluded that still more protection from adverse health effects was needed. In July 1997, the primary (health-based) PM standards were revised to add two new $PM_{2.5}$ standards, set at 15$\mu g/m^3$ and 65 $\mu g/m^3$, respectively, for the annual and 24-hour standards, and to change the form of the 24-hour PM_{10} standard.[30] The secondary (welfare-based) standards were revised by making them identical to the primary standards.[30] The trends discussion of this section will focus on the PM_{10} standards that were in place when the majority of the 1988-1997 data presented in this report were collected.

National 10-Year Trends

The first complete year of PM_{10} trends data for most monitors is 1988, so this is the first time that the Trends Report has been able to present a full 10-year air quality trend for PM_{10}. Figure 2-37 shows a 26-percent decrease in the composite average of annual mean PM_{10} concentrations measured at 845 monitoring sites across the country between 1988 and 1997. The downward trend in PM_{10} annual means is apparent, with a leveling off of the trend occurring in the later years. Several factors have played a role in reducing PM_{10} concentrations since 1988. Where appropriate, states required emissions from industrial sources and construction activities to be reduced to meet the PM_{10} standards. Measures were also adopted to reduce street dust emissions, including the use of clean anti-skid materials like washed sand, better control of the amount of material used, and removal of the material from the street as soon as the ice and snow melt. Cleaner burning fuels like natural gas and fuel oil have replaced wood and coal as fuels for residential heating and industrial and electric utility furnaces. The final year change, between 1996 and 1997, shows a decrease of 1 percent. This same general trend can be seen if the sites are grouped as urban, suburban, and rural, as in Figure 2-38. The highest values are generally found at the urban sites, followed closely by the suburban sites. The PM_{10} composite annual mean is significantly lower at the rural sites, which are

Figure 2-37. Trend in annual mean PM_{10} concentrations, 1988-1997.

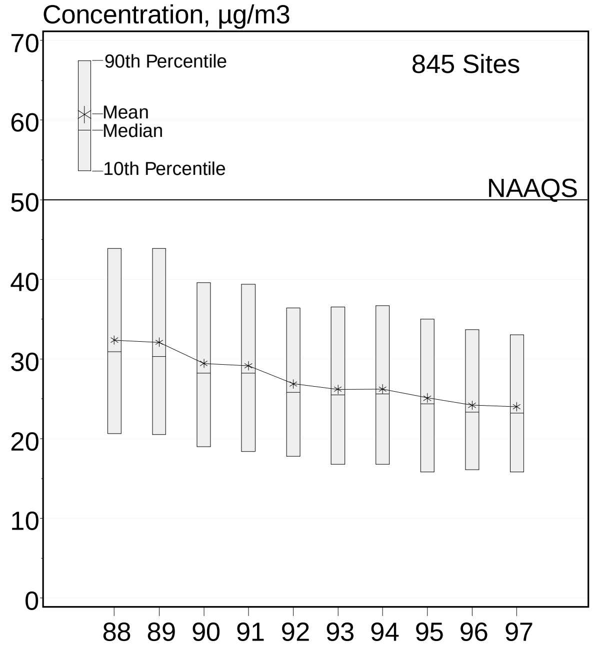
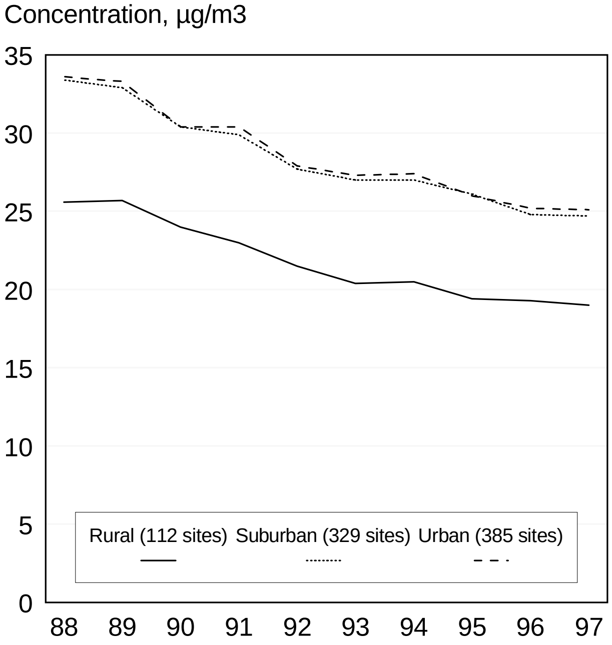


Figure 2-38. PM_{10} annual mean concentration trends by location, 1988-1997.



generally located away from local sources of PM_{10}.

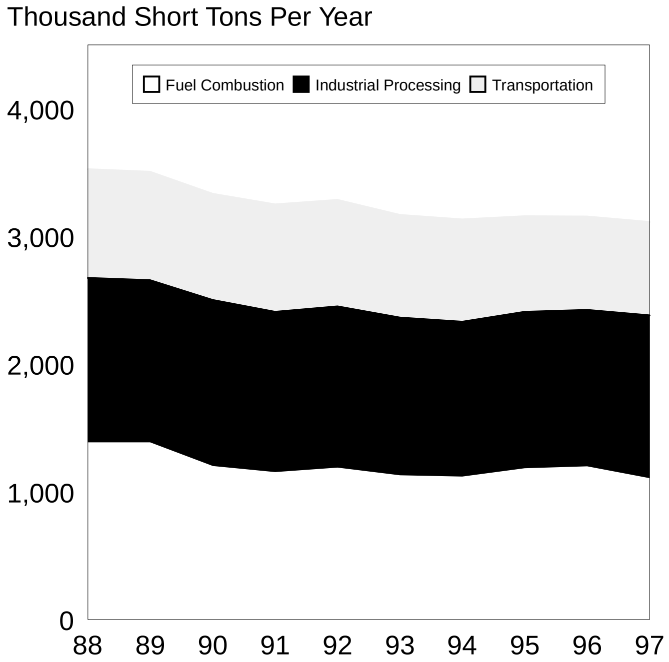
Emissions

Nationally, PM_{10} direct emissions decreased 12 percent between 1988 and 1997 (see Figure 2-39). Emissions of SO_2, a precursor of PM in the atmosphere, have also been reduced nationally, by 11 percent.

Direct PM_{10} emissions are generally examined in two separate groups. The first group, shown in Figures 2-39 and 2-40, is the more traditionally inventoried sources. These include fuel combustion, industrial processes, and transportation. Of these, the fuel combustion category saw the largest decrease over the 10-year period (-20 percent), with most of the decline attributable to a decrease in emissions from residential wood burning. Local control programs to curtail the use of residential wood heaters during times when the air was stagnant and to replace old woodstoves with new, cleaner-burning models are responsible for the decrease in residential wood burning, along with lower natural gas and fuel oil prices. Emissions from industrial processes changed very little over the 10-year period, while the transportation category decreased 14 percent. The second group of direct PM_{10} emissions is a combination of miscellaneous and natural sources including agriculture and forestry, wildfires and managed burning, fugitive dust from paved and unpaved roads, and wind erosion. As Figure 2-41 shows, these miscellaneous and natural sources actually account for about 90 percent of the total direct PM_{10} emissions nationwide, although they can be difficult to quantify compared to the traditionally inventoried sources. Because the emissions in the miscellaneous/natural group tend to fluctuate a great deal from year to year, the trend from one year to the next or over several years may not be particularly meaningful.

Table A-6 lists PM_{10} emissions estimates for the traditionally inventoried sources for 1988-1997. Miscellaneous and natural source PM_{10} emissions estimates are provided in Table A-7.

Figure 2-39. National PM_{10} emissions trend, 1988-1997 (traditionally inventoried primary PM sources only).



Regional Trends

Figure 2-42 is a map of regional trends for the PM_{10} annual mean from 1988 to 1997. All ten EPA regions show decreasing trends over the 10-year period, ranging from 19 to 33 percent. The largest decreases are generally seen in the western part of the United States, and the two westernmost regions, IX and X, started at the highest annual mean concentrations back in 1988. In the western states, programs such as those with residential wood heaters and agricultural practices have helped reduce emissions of PM_{10}. Soil moisture levels have also been higher (from more rainfall) in many western states in recent years. In the eastern United States, the Title IV Acid Rain Program has certainly contributed to the decrease in PM_{10} emissions. The program has reduced SO_2 and NO_x emissions, both precursors of particulate matter in the atmosphere (see the section on SO_2 in this chapter for more on the Acid Rain Program).

1997 Air Quality Status

The map in Figure 2-43 displays the highest second maximum 24-hour PM_{10} concentration by county in 1997. The highest second maximum was recorded in Howell County, Missouri at a monitor adjacent to a charcoal kiln facility. The bar chart which accompanies the national map shows the number of people living in counties within each concentration range. The colors on the map and bar chart correspond to the colors of the concentration ranges displayed in the map legend. In 1997, approximately 5 million people lived in 10 counties where the second highest maximum 24-hour PM_{10} concentration was above the level of the 24-hour PM_{10} NAAQS. When both the current annual and 24-hour standards are considered, there were 8 million people living in 13 counties with PM_{10} concentrations above the PM_{10} NAAQS in 1997.

The Revised Standards

The form of the 24-hour PM_{10} standard changed from the one-expected-exceedance form to a concentration-based 99th percentile form, averaged over 3 years. EPA changed the form of the 24-hour PM_{10} standard from an expected-exceedance form to a concentration-based form because the new form relates more directly to PM concentrations associated with health effects. The concentration-based form also avoids exceedances, regardless of size, from being counted equally in attainment tests. The method for computing the 99th percentile for comparison to the 24-hour standard is found in the

Figure 2-40. PM_{10} emissions from traditionally inventoried source category, 1997.

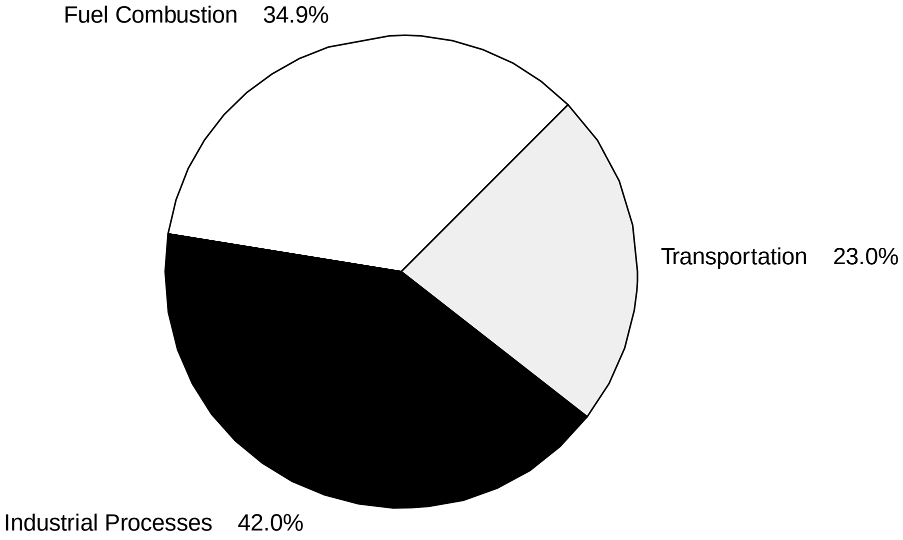


Figure 2-41. Total PM_{10} emissions by source category, 1997.

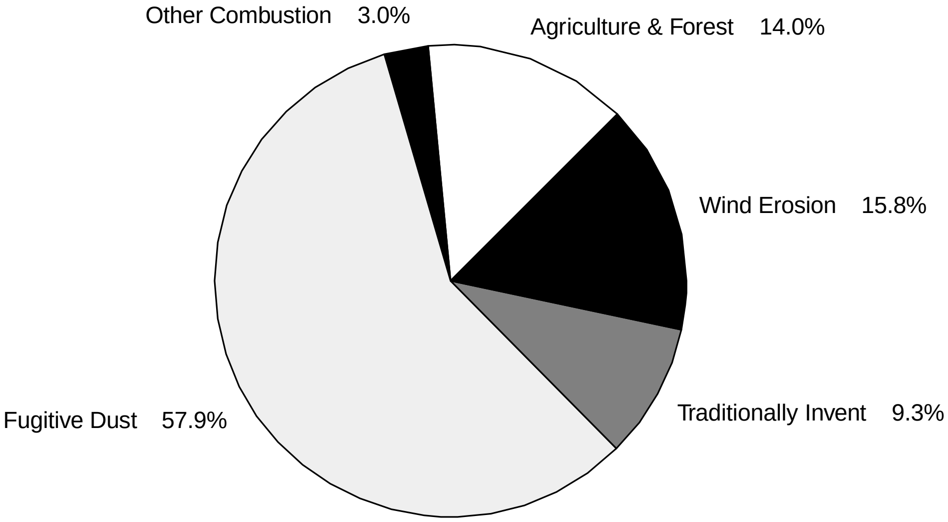
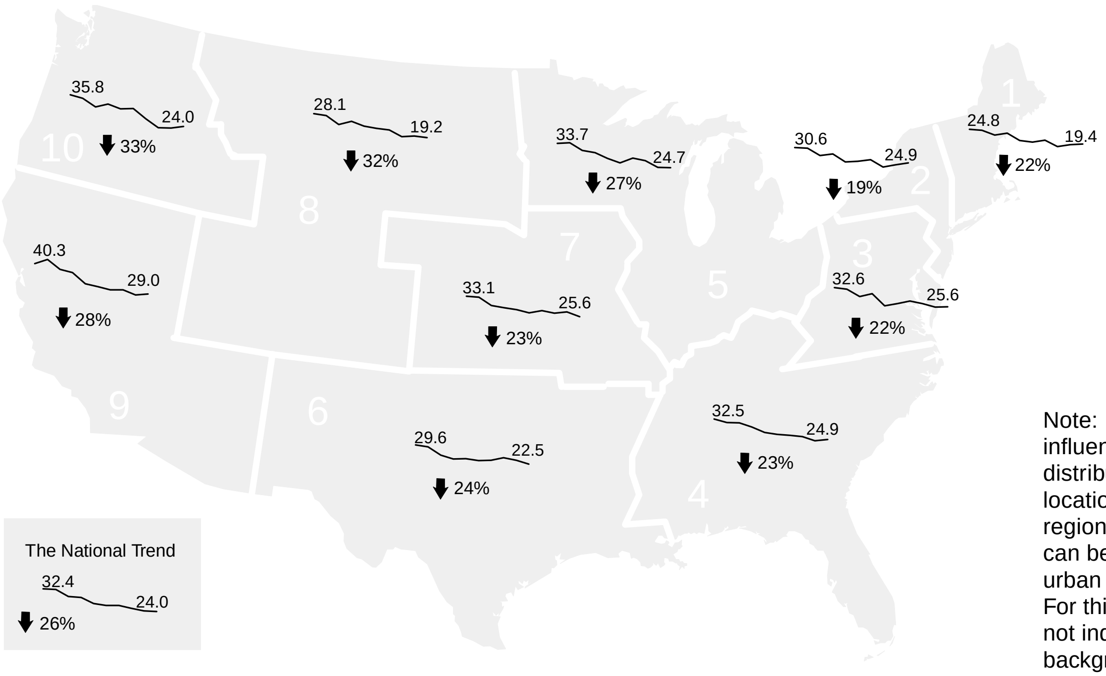


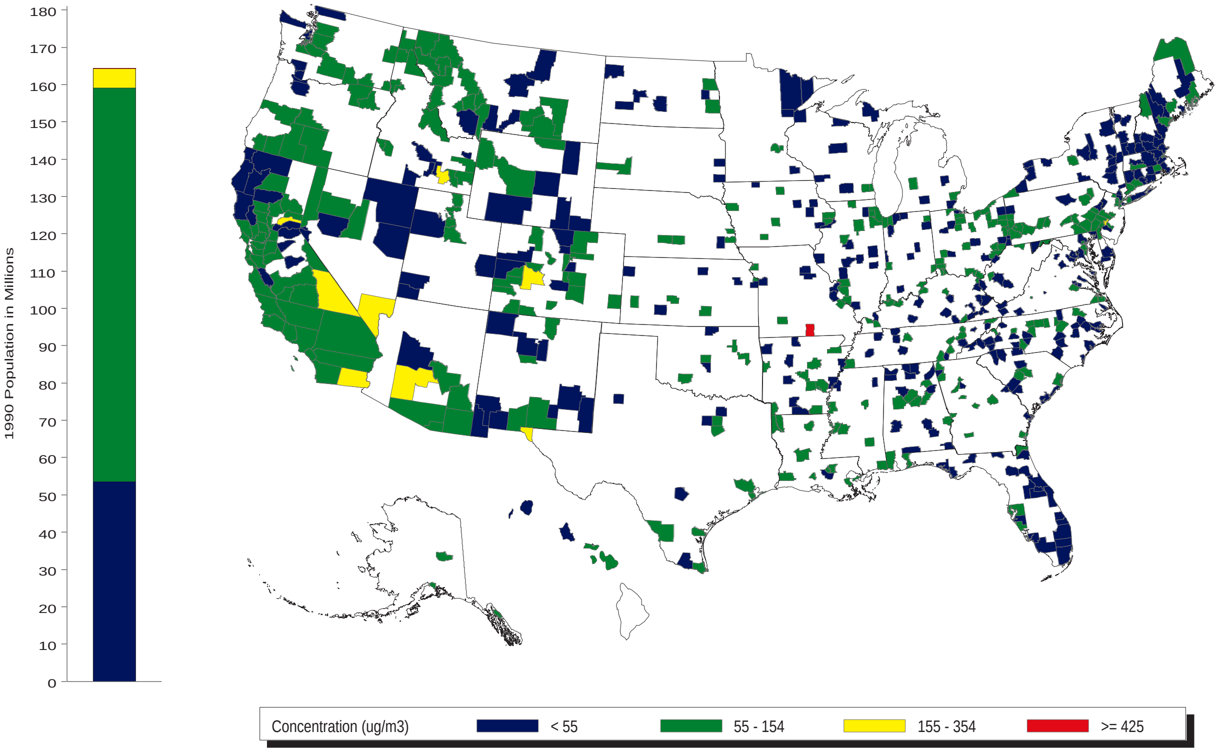
Figure 2-42. Trend in PM_{10} annual mean concentration by EPA Region, 1988-1997.



Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2. Concentrations are ug/m3.

Figure 2-43. Highest second maximum 24-hour PM_{10} concentration by county, 1997.



Code of Federal Regulations (40 CFR Part 50, Appendix N).

The form of the 24-hour $PM_{2.5}$ standard is also a percentile form, although it is a 98th percentile. Like PM_{10}, it is averaged over 3 years. The form of the annual standard for $PM_{2.5}$ is a 3-year average of the annual arithmetic mean, just as for the PM_{10} standard. However, unlike PM_{10}, compliance with the $PM_{2.5}$ annual standard may be judged from single or multiple community-oriented monitors reflective of a community-based spatial average. A spatial average can be more representative of community-wide ambient PM exposures.

Beginning in 1998, the revised PM standards require that measurements be reported at conditions of local temperature and pressure (LTP). This is a change from the way PM_{10} data are reported under the pre-existing standards, which specify standard temperature and pressure (STP) for measurement reporting. High altitude or cold regions will see the biggest changes in their concentration levels using LTP, but all monitoring locations will probably see some difference.

Sampling frequencies will change at some locations due to the revised PM standards. New minimum sampling frequency requirements are specified. The number of samples collected in a year has an effect on which concentration value will correspond to the 98th or 99th percentile (i.e. the maximum concentration value collected, the second maximum, and so on). More frequent sampling is desirable because it can force the 98th or 99th percentile to be a value less than the max, making the statistic more stable.

Characterizing PM_{10} Trends Under the Revised Standards

Figure 2-44 shows a 10-year trend of the average 99th percentile for 845 sites across the country. The 99th percentile shown in the trend is computed by the Aerometric Information Retrieval System (AIRS). The current AIRS uses a slightly different algorithm to compute a 99th percentile than the Code of Federal Regulations (CFR) specifies. The next version of AIRS will correct this inconsistency. Meanwhile, the resulting difference between the two algorithms is insignificant when computing a trend of 845 sites such as Figure 2-43. Any comparisons to the standards for compliance purposes would of course need to use the algorithm specified in the CFR. The trend data show a 25-percent decrease in average 99th percentile concentration between 1988 and 1997.

Characterizing $PM_{2.5}$ Trends Under the Revised Standards

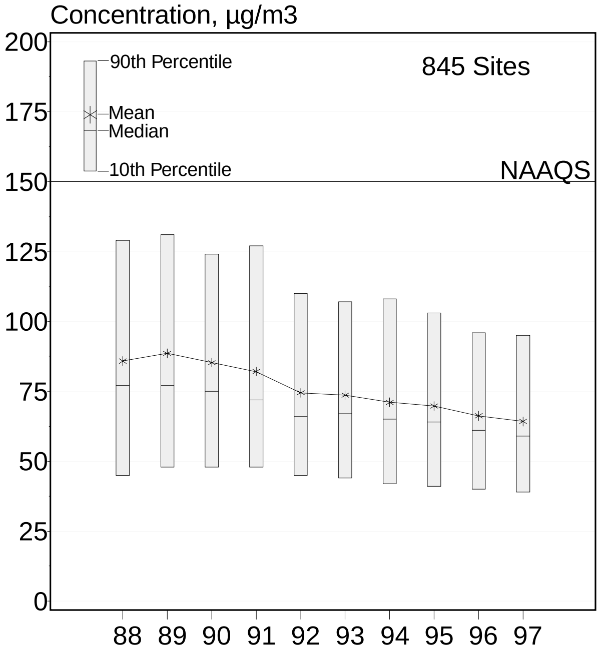
A trend of $PM_{2.5}$ ambient concentration data is not presented here because there are not enough monitors in place at this time to portray an accurate national trend of urban air quality. The network of monitors required for the new $PM_{2.5}$ standard will be phased in over the next few years. For a look at spatial patterns and trends in fine particle concentrations, the reader is directed to the chapter on visibility which documents data derived from the IMPROVE aerosol network. These data are derived from a sampler which is not a Federal Reference Method (FRM) sampler for $PM_{2.5}$. The data provide a good estimate of urban and nonurban concentrations; however, these data cannot be used for compliance determinations and should be used for preliminary assessments only.

In order to get some idea of the nature of fine PM, some emissions information coupled with ambient data measurements can be examined. EPA is working to improve its $PM_{2.5}$ emission inventory. In the meantime, a general assessment of the emission sources contributing to $PM_{2.5}$ can be obtained by evaluating $PM_{2.5}$ monitoring data. The paragraphs below provide a broad overview of the nationwide concentrations, composition, and sources of $PM_{2.5}$ based on actual $PM_{2.5}$ measurements and the emission inventory of sources contributing within each composition category.

$PM_{2.5}$ is composed of a mixture of particles directly emitted into the air and particles formed in the air from the chemical transformation of gaseous pollutants. The principal types of secondary particles are ammonium sulfate and ammonium nitrate formed in the air from gaseous emissions of SO_2 and NO_x, reacting with NH_3. The main source of SO_2 is combustion of fossil fuels in boilers (including electric utilities), and the main sources of NO_x are combustion of fossil fuel in boilers and mobile sources. Some secondary particles are also formed from volatile organic compounds which are emitted from a wide range of combustion and other sources.

The principal types of directly emitted particles are those that predominantly consist of crustal materials and those consisting of elemental and organic carbonaceous materials resulting from the incom-

Figure 2-44. PM_{10} trend in the average 99th percentile concentration, 1988-1997.



plete combustion of fossil fuels and biomass materials. The main sources of crustal particles are roads, construction and agriculture. The main sources of combustion-related particles are mobile sources such as diesels, managed burning, open burning, residential wood combustion, and utility, commercial, and industrial boilers.

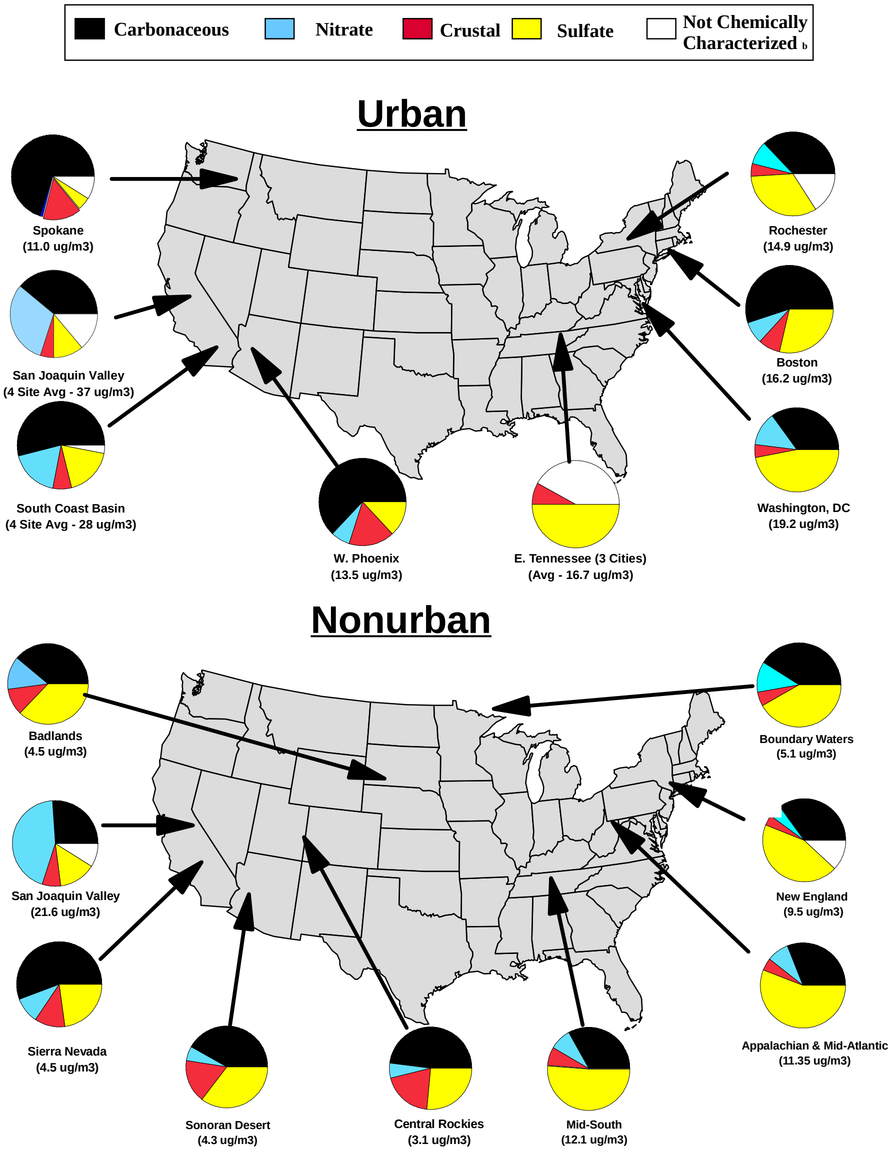
Figure 2-45 summarizes information from actual measurements of ambient $PM_{2.5}$. It shows how $PM_{2.5}$ composition varies in both the eastern and western United States. The ambient samples were chemically analyzed to determine the amount of ammonium sulfate and nitrate, crustal material and carbonaceous material. The concentration and composition data are based on at least one year of data from each monitoring location. The data were collected using a variety of non-federal reference methods and cannot be used to determine compliance with the $PM_{2.5}$ NAAQS.

The figure shows the composition of $PM_{2.5}$ in both urban and nonurban areas of the United States. The composition information represents a range of urban and nonurban locations. The published composition data for the East are somewhat limited, but preliminary information from several recently completed urban studies is included. It shows relatively consistent composition of $PM_{2.5}$ across much of the East. The available information consistently shows that $PM_{2.5}$ in the East is dominated by ammonium sulfate on a regional scale and also by carbonaceous particles emitted directly by combustion processes. Regional concentrations of $PM_{2.5}$ are generally higher throughout much of the East, due to the regional influence of ammonium sulfate caused by higher SO_2 emissions throughout much of the East and the ubiquitous nature of combustion processes. (See Chapter 7: Acid Deposition for a description of spatial patterns and trends in sulfate air quality.) The regional concentrations of $PM_{2.5}$ are lower in the western United States than in the East and the composition is more variable. The West differs from the East in two important ways. First, nonurban $PM_{2.5}$ concentrations are much lower in the West than in the East. This is because the East is blanketed regionally by relatively higher concentrations of ammonium sulfate, whereas regional sulfate concentrations in the West are much lower. Second, several western areas, notably the San Joaquin Valley and the Rubidoux area of the South Coast basin have higher ammonium nitrate concentrations. Nitrate concentrations are also higher in nonurban areas of Southern California inland from the South Coast basin. Such pockets of high nitrate concentrations have not been reported in the East. Crustal material is a relatively small constituent of $PM_{2.5}$ in both the West and East, even in arid and agricultural areas such as Phoenix (Arizona) and the San Joaquin Valley of California.

Figure 2-46 depicts the link between sources and the composition components of $PM_{2.5}$. The EPA has developed a National Emissions Trends (NET) inventory for use in analyzing trends in emissions over time, conducting various in house analyses for PM, and for use in regional scale modeling.[31] The NET covers all 50 states and includes point, area, on-road mobile, non-road mobile sources and biogenic/geogenic emissions. Point sources are located individually while county tallies are used for area and mobile source category groups. The inventory includes emissions of SO_2, NO_x, VOC, CO, PM_{10}, elemental carbon and organic carbon. Of these pollutants, only CO is not a contributor to the ambient fine particulate burden. The 1996 NET has been completed for these pollutants and also, a preliminary 1996 NET inventory of $PM_{2.5}$ and NH_3 emissions has been compiled for review by the states. The figure is based in part on information in this preliminary $PM_{2.5}$ inventory and the inventory will be incorporated into the 1996 NET following State review and refinements.

Figure 2-46 provides a link between the sources in the NET inventory and the composition information shown in Figure 2-46. The stacked bar graphs show the relative magnitude of emissions SO_2, NO_x, carbonaceous and crustal-related particles. SO_2 is emitted mostly from the combustion of fossil fuels in boilers operated by electric utilities and industry. Less than 20 percent of SO_2 emissions nationwide are from industrial processes and mobile sources. NO_x emissions are more evenly divided between stationary source and mobile source fuel combustion and biogenic sources are also about 10 percent of NO_X emissions. SO_2 and NO_X also form ammonium sulfate and nitrate in the presence of ammonia under certain atmospheric conditions. Animal husbandry, mobile sources,

Figure 2-45. Summary of information from actual measurements of ambient $PM_{2.5}$.

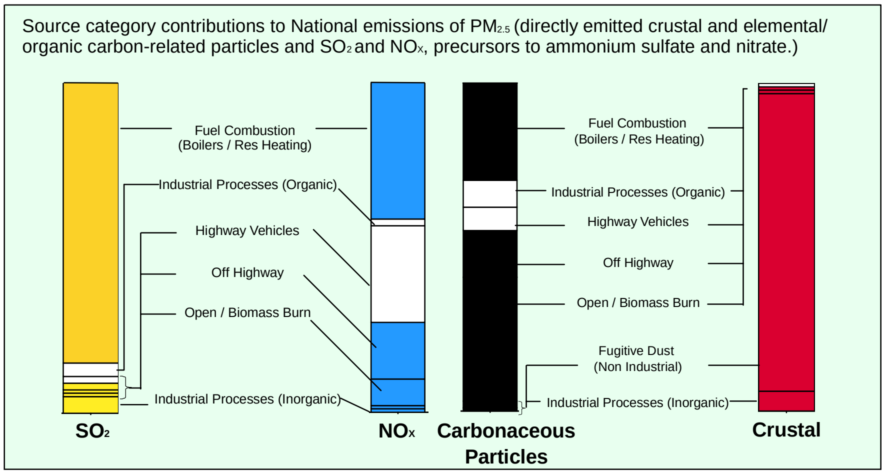


a. $PM_{2.5}$ mass concentrations are based on at least one year of monitoring at each location using a variety of non-federal reference methods. They should not be used to determine compliance with the $PM_{2.5}$ NAAQS. Urban pies are based on one site per city or area unless otherwise noted. With exception of the Sierra Nevada and Badlands, nonurban pies represent an average of two or more sites located in the same region.

b. A white segment in a pie indicates that the sum of the constituents (as determined by separate analyses) was less than the gravimetrically determined mass concentration. This could be because study objectives did not require analysis of certain constituents (e.g., no carbon or nitrate analyses for the Tennessee sites) or a variety of technical reasons.

Figure 2-46. $PM_{2.5}$ emission sources.

Sulfur Dioxide	Ammonium sulfate particles are formed from emissions of gaseous SO_2 (and also SO_3 and sulfuric acid aerosols) emitted mostly from utility and industrial boilers and to a lesser degree from certain industrial processes and mobile sources.
Nitrogen Oxides	Ammonium nitrate particles are formed from emissions of gaseous NO_x emitted mostly from utility and industrial boilers but also from highway and off highway mobile sources and to a lesser degree, biogenic and miscellaneous combustion sources and certain industrial processes.
Ammonia	Ammonium sulfate and nitrate particles are formed from emissions of SO_2 and NO_x reacting with gaseous ammonia. Emission sources are animal husbandry, fertilizer manufacturing and application and to a lesser degree from mobile sources, and other combustion and industrial processes.
Carbonaceous Particles	Carbonaceous particles are emitted directly and as condensed liquid droplets from fuel combustion, burning of forests, rangelands and fields; off highway and highway mobile sources (gas and diesel); and certain industrial processes.
Crustal	Particles emitted directly from non industrial surface (e.g., paved and unpaved road traffic, construction, agricultural operations, high wind events) and some industrial processes.



Source category contributions to National emissions of $PM_{2.5}$ (directly emitted crustal and elemental/ organic carbon-related particles and SO_2 and NO_x, precursors to ammonium sulfate and nitrate.)

Note: Composition and source contributions vary among urban areas. Also, some carbonaceous material is formed from organic gases reacting in the atmosphere. The magnitude of these secondary organics is believed small, but more research is needed.

industrial processes and fertilizer application are sources of ammonia. The main sources of carbonaceous (combustion-related) particles are about equally divided among fuel combustion in boilers, biomass combustion and mobile sources. Key biomass sources are wildfires, managed burning and residential wood burning. Principal mobile sources include both on and off road diesels, gasoline engines and aircraft, railroads and ships. Industrial process emissions will likely be important in some areas as will miscellaneous combustion sources. The main sources of crustal particles are roads, construction, agriculture and high wind events. Crustal materials are the predominant component of PM_{10}, but Figure 2-46 shows that $PM_{2.5}$ is predominantly comprised of secondary particles and directly emitted carbonaceous particles. The composition (and thus the sources) of $PM_{2.5}$ and PM_{10} are markedly different because most of the crustal material particles are larger than 2.5 micrometers while almost all of the secondary particles and directly emitted carbonaceous particles are smaller than 2.5 micrometers.

Used together, the figures can give a qualitative feel for the combined influence of specific source types on ambient $PM_{2.5}$ overall (e.g., fuel combustion in boilers, organic and inorganic industrial processes, highway and off highway mobile sources, open burning of waste/biomass and fugitive dust). For example, Figure 2-46 shows that fuel combustion in boilers contributes significantly to both sulfate and carbonaceous mass. Figure 2-45 shows that both sulfate and carbonaceous particles are found in abundance in $PM_{2.5}$ in the East and that carbonaceous particles are also abundant in the West. Thus, preliminary conclusions are (1) that fuel combustion in boilers is a significant contributor to $PM_{2.5}$ in the ambient air and (2) that fugitive dust sources do not appear to play a particularly important role in ambient air samples of $PM_{2.5}$.

Notes on Data Sources for $PM_{2.5}$

Composition and concentration data for all non-urban locations were obtained from the Interagency Monitoring of Protected Visual Environments (IMPROVE) except for the New England location which is based on combined non-urban data from IMPROVE and the Northeast States for Coordinated Air Use Management (NESCAUM). Washington, D.C. data also were obtained from IMPROVE and the Boston and Rochester data are based on NESCAUM.[References: a) IMPROVE, Co-operative Center for Research in the Atmosphere, Colorado State University, Ft. Collins, CO, July 1996. b) Salmon, Lynn, and Glen R. Cass, October, 1997, Progress Report to NESCAUM: Determination of Fine Particle Contraction and Chemical Composition in the Northeastern United States, 1995, California Institute of Technology, Pasadena, CA 91125. Draft.] Note that the NESCAUM data is still subject to minor revision. The South Coast information is adapted from Christoforou. [Reference: Christoforou, C.S., Lynn G. Salmon, Michael P. Hannigan, Paul A. Soloman and Glen R. Cass, Trends in Fine Particle Concentration and Chemical Composition. Accepted for publication in Journal of Air and Waste Management Association, Pittsburgh, PA.] Phoenix data is from the EPA's Particulate Matter (PM) Research Monitoring Network [Reference: The National Environmental Research Laboratory/ Research Triangle Park PM Research Monitoring Network, U.S. EPA, Research Triangle Park, NC 27711, 1997.] with the exception of the nitrate estimates which were adapted from Desert Research Institute (DRI). [References: (a) PM_{10} and $PM_{2.5}$ Variations in Time and Space, Desert Research Institute, Reno, NV, October 1995. (b) Watson, John G. and Tom Moore, personal communications with T.G. Pace, December 1997.] The San Joaquin data are from DRI. [Reference: PM_{10} and $PM_{2.5}$ Variations in Time and Space, Desert Research Institute, Reno, NV, October 1995.] Spokane's composition and concentration data was obtained from Norris. [Reference: 7. Norris, Gary and Jane Koenig, Preliminary Analysis of PM and Daily Emergency Room Visits for Asthma in Spokane, Washington, USA, Presented at International Symposium on Health Effects of PM, Prague, Czech Republic, April 1997.] Eastern Tennessee data was obtained from studies conducted in Knoxville and Chattanooga by the Tennessee Valley Authority and in Nashville by the Harvard School of Public Health.89 [References: (a) Tanner, R. (Tennessee Valley Authority) Personal Communication with T.G. Pace, January, 1998. (b) Bahadori, Tina and Helen Suh (Harvard School of Public Health) Personal Communication with T.G. Pace, January, 1998]

Non-urban data are based on averages of several monitoring locations in the region. Urban data are based on only one location in each area and may not represent the entire urban area. The exceptions to this are the South Coast and San Joaquin Valley areas of California where multiple locations are averaged together. In the South Coast basin, Rubidoux recorded the highest average $PM_{2.5}$ and nitrate concentrations. Additional information on the composition of $PM_{2.5}$ within these areas of California is discussed further in Christoforou and DRI. [References: a) Christoforou, C. S., Lynn G. Salmon, Michael P. Hannigan, Paul A. Soloman and Glen R. Cass, Trends in Fine Particle Concentration and Chemical Composition. Accepted for publication in Journal of Air and Waste Management Association, Pittsburgh, PA. and b) PM_{10} and $PM_{2.5}$ Variations in Time and Space, Desert Research Institute, Reno, NV, October 1995.]

SULFUR DIOXIDE

- **Air Quality Concentrations**

1988–97	39%	decrease
1996–97	4%	decrease

- **Emissions**

1988–97	12%	decrease
1996–97	3%	increase

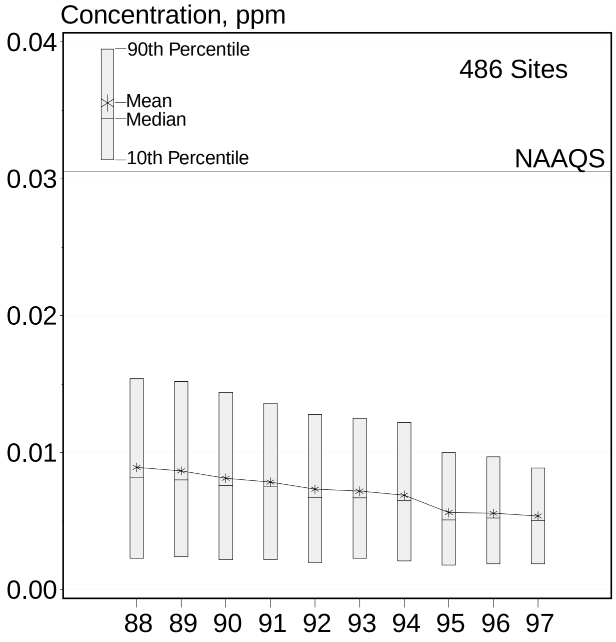
Nature and Sources

SO_2 belongs to the family of SO_x gases. These gases are formed when fuel containing sulfur (mainly coal and oil) is burned, and during metal smelting and other industrial processes. The highest monitored concentrations of SO_2 are recorded in the vicinity of large industrial facilities.

Health and Environmental Effects

High concentrations of SO_2 can result in temporary breathing impairment for asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels while at moderate exertion may result in reduced lung function that may be accompanied by symptoms such as wheezing, chest tightness, or shortness of breath. Other effects that have been associated with longer-term exposures to high concentrations of SO_2, in conjunction with high levels of PM, include respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease. The subgroups of the population that may be affected under these conditions include individuals with cardiovascular disease or chronic lung disease, as well as children and the elderly. Additionally, there are a variety of environmental concerns associated with high concentrations of SO_2. Because SO_2, along with NO_x, is a major precursor to acidic deposition (acid rain), it contributes to the acidification of soils, lakes and streams and the associated adverse impacts on ecosystems. (See Chapter 7: Acid Deposition). SO_2 exposure to vegetation can increase foliar injury, decrease plant growth and yield, and decrease the number and variety of plant species in a given community. SO_2 also is a major precursor to $PM_{2.5}$, which is of significant concern to human health (as discussed in the particulate matter section of this chapter), as well as a main pollutant that impairs visibility. (See Chapter 6: Visibility Trends). Finally, SO_2 can accelerate the corrosion of natural and man-made materials (e.g., concrete and limestone) which are used in buildings and monuments, as well as paper, leather, iron-containing metals and zinc and other protective coatings.

Figure 2-47. Trend in annual mean SO_2 concentrations, 1988-1997.



Primary and Secondary Standards

There are both short- and long-term primary NAAQS for SO_2. The short-term (24-hour) standard of 0.14 ppm (365 µg/m^3) is not to be exceeded more than once per year. The long-term standard specifies an annual arithmetic mean not to exceed 0.030 ppm (80 µg/m^3). The secondary NAAQS (3-hour) of 0.50 ppm (1,300 µg/m^3) is not to be exceeded more than once per year.

National 10-Year Trends

The national composite average of SO_2 annual mean concentrations decreased 39 percent between 1988 and 1997 as shown in Figure 2-47, with the largest single-year reduction (19 percent) occurring between 1994 and 1995.[32] The trend has since leveled off, declining only 4 percent from 1996–1997. This same general trend is seen in Figure 2-48 which plots the ambient concentrations grouped by urban, suburban, and rural sites. It shows that the mean concentrations at the urban and suburban sites are consistently higher than those at the rural sites. However, the 1994–1995 reduction in the concentrations at non-rural sites does narrow the gap between the trends. The greater reduction seen in the non-rural sites reflects the fact that the proportion of non-rural sites is greater in the eastern United States, which is where most of the 1994–1995 emissions reductions at electric utilities occurred.[33]

Emissions Trends

National SO_2 emissions decreased 12 percent between 1988 and 1997, with a sharp decline between 1994 and 1995, similar to the decline in the ambient concentrations. Unlike the air quality trend, the emissions trend begins to climb again from 1995–1997, as shown in Figure 2-49. This dramatic reduction and subsequent increase is driven by the yearly changes in emissions from the electric utility industry. Much of the increase was caused by units not yet affected by the acid rain program. These units will be in the program, and subject to a national emissions cap, beginning in 2000. The electric utility industry accounts for most of the fuel combustion category in Figure 2-50. In particular, the coal-burning power plants have consistently been the largest contributor to SO_2 emissions as documented in Table A-8 in Appendix A.

Figure 2-48. Annual mean SO_2 concentration by trend location, 1988-1997.

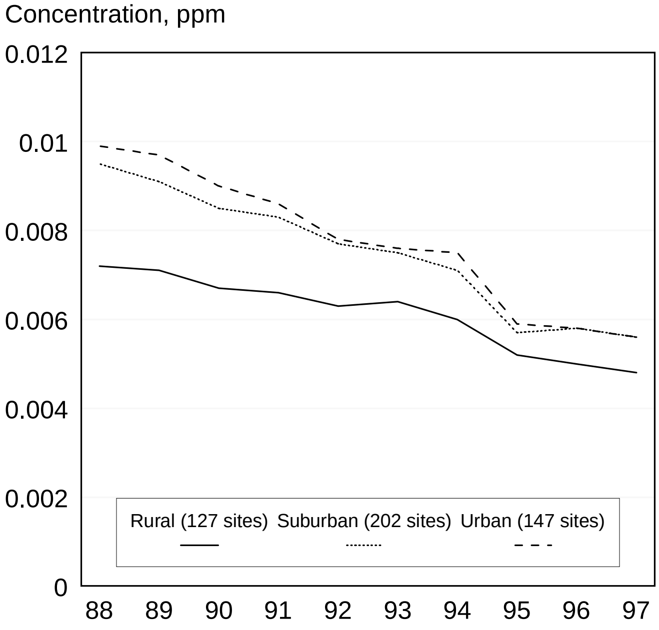


Figure 2-49. National total SO_2 emissions trend, 1988-1997.

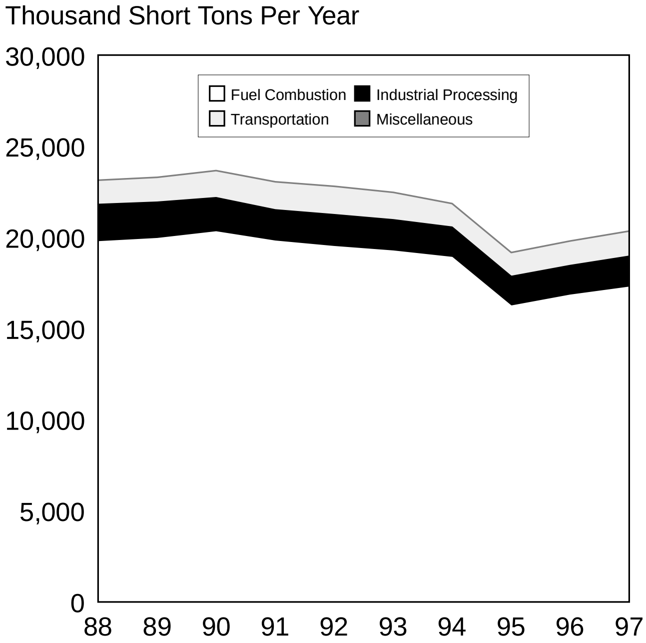


Table 2-5. Total SO_2 Emissions from Phase I units and Non-Phase I units, 1994-97 (thousand short tons).

	1994	1995	1996	1997	1994-95	1995-97
Phase I units	6,915	4,938	5,259	5,304	-1,977	+366
Non-Phase I units and Other Units	7,974	7,142	7,373	7,778	-832	+636
All Electric Utility units	14,889	12,080	12,632	13,082	-2,809	+1,002

Figure 2-50. SO_2 emissions by source category, 1997.

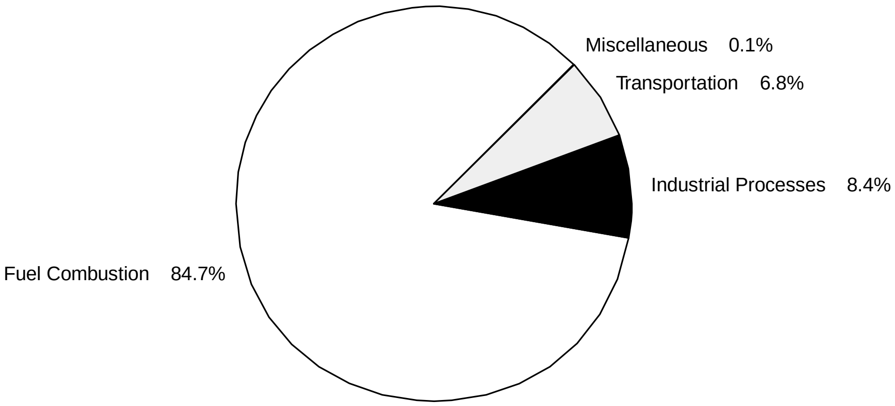
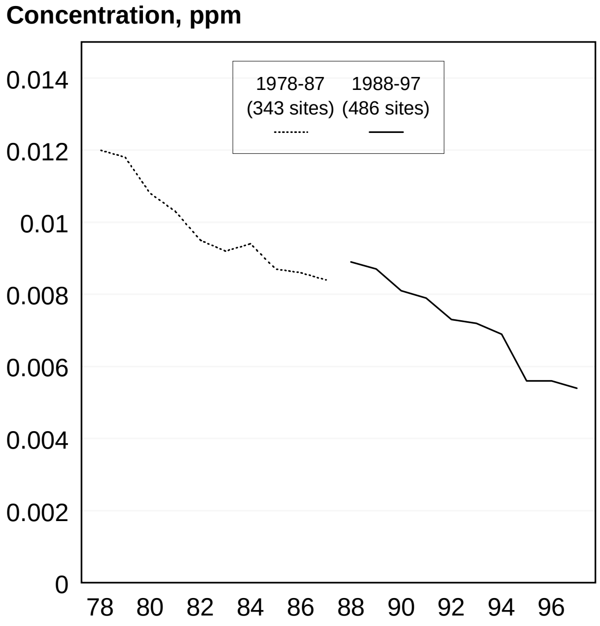


Figure 2-51. Long-term ambient SO_2 trend, 1978-1997.

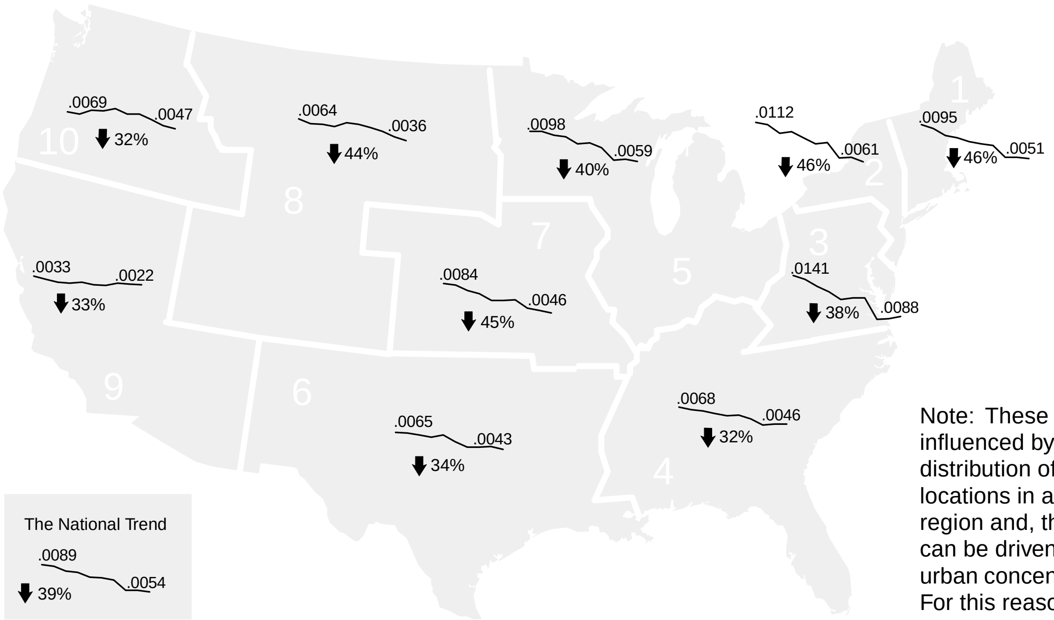


The Acid Rain Program

The national reductions from 1994–1995 in emissions and ambient concentrations of SO_2 are due mainly to Phase I implementation of the Acid Rain Program. Established by EPA under Title IV of the CAA, the Acid Rain Program's principal goal is to achieve significant reductions in SO_2 and NO_x emissions. Phase I compliance for SO_2 began in 1995 and significantly reduced emissions from the participating utilities.[33] Table 2-5 shows this reduction in terms of Phase I and other units and Non-Phase I and other units.[34] The 1994–1995 decrease in total SO_2 emissions from electric utilities is due largely to the Phase I emissions reduction which accounted for 70 percent (1,977 thousand short tons) of the total reduction (2,809 thousand short tons) from electric utilites.

Since 1995, however, total SO_2 emissions from electric utilities have increased. Again, Table 2-4 explains this increase in terms of Phase I units and Non-Phase I units. Most Phase I plants overcomplied in 1995 and were able to use their banked emission allowances in 1996 and 1997. As a result, SO_2 emissions have increased slightly at some Phase I sources since the initial reduction in 1995. However, Phase I units account for only 37 percent of the total 1995 to 1997 increase. The majority of the increase is attributed to those units not yet participating in the acid rain program. Most of these units will be included in Phase II of the Program, which begins in 2000. When fully implemented, total SO_2 emissions from electric utilities are capped at 8.9 million tons per year.

Figure 2-52. Trend in SO_2 annual arithmetic mean concentration by EPA Region, 1988-1997.



Alaska is in EPA Region 10; Hawaii, EPA Region 9; and Puerto Rico, EPA Region 2.
Concentrations are ppm.

Note: These trends are influenced by the distribution of monitoring locations in a given region and, therefore, can be driven largely by urban concentrations. For this reason, they are not indicative of background regional concentrations.

For more information on the acid rain program, visit **http://www.epa.gov/acidrain**.

National 20-Year Trends

The progress in reducing ambient SO_2 concentrations during the past 20 years is shown in Figure 2-51. While there is a slight disconnect in the trend line between 1987 and 1988 due to the mix of trend sites in each 10-year period, an overall downward trend is evident. In addition to the previously mentioned effects of the Acid Rain Program, these steady reductions over time were accomplished by installing flue-gas control equipment at coal-fired generating plants, reducing emissions from industrial processing facilities such as smelters and sulfuric acid manufacturing plants, reducing the average sulfur content of fuels burned, and using cleaner fuels in residential and commercial burners.

Regional Trends

The map of regional trends in Figure 2-52 shows that ambient SO_2 concentrations are generally higher in the northeastern United States. The effects of Phase I of the Acid Rain Program are seen most vividly in the northeast. In particular, concentrations fell 21–25 percent between 1994 and 1995 in EPA Regions 1, 2, 3, and 5. These broad regional trends are not surprising since most of the units affected by Phase I of the Acid Rain Program also are located in the northeast as shown in Figure 2-53. This figure also shows that ambient concentrations have increased slightly between 1995 and 1997 in Regions III and IV where many of the electric utility units not yet affected by the Acid Rain Program are located.

1997 Air Quality Status

The most recent year of ambient data shows that only one area, Buchanan County, Missouri, did not meet the primary SO_2 short-term standard, according to Figure 2-54. The high ambient concentration levels were due to emissions from the local power plant, St. Joe Power and Light Company.

Figure 2-53. Plants affected by Phase I of the Acid Rain Program.

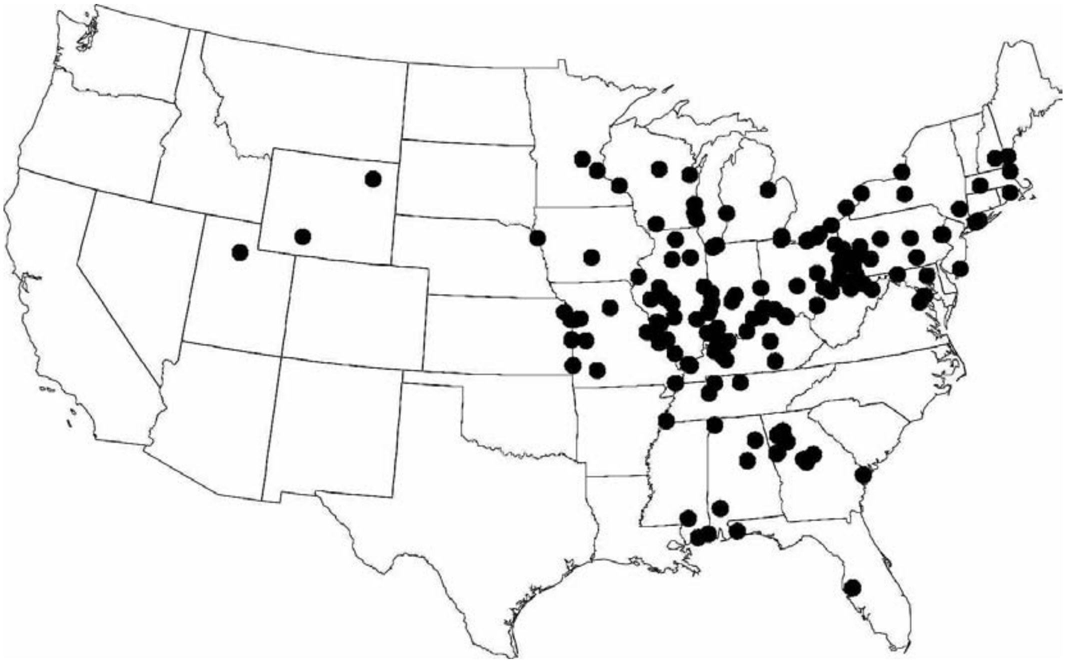
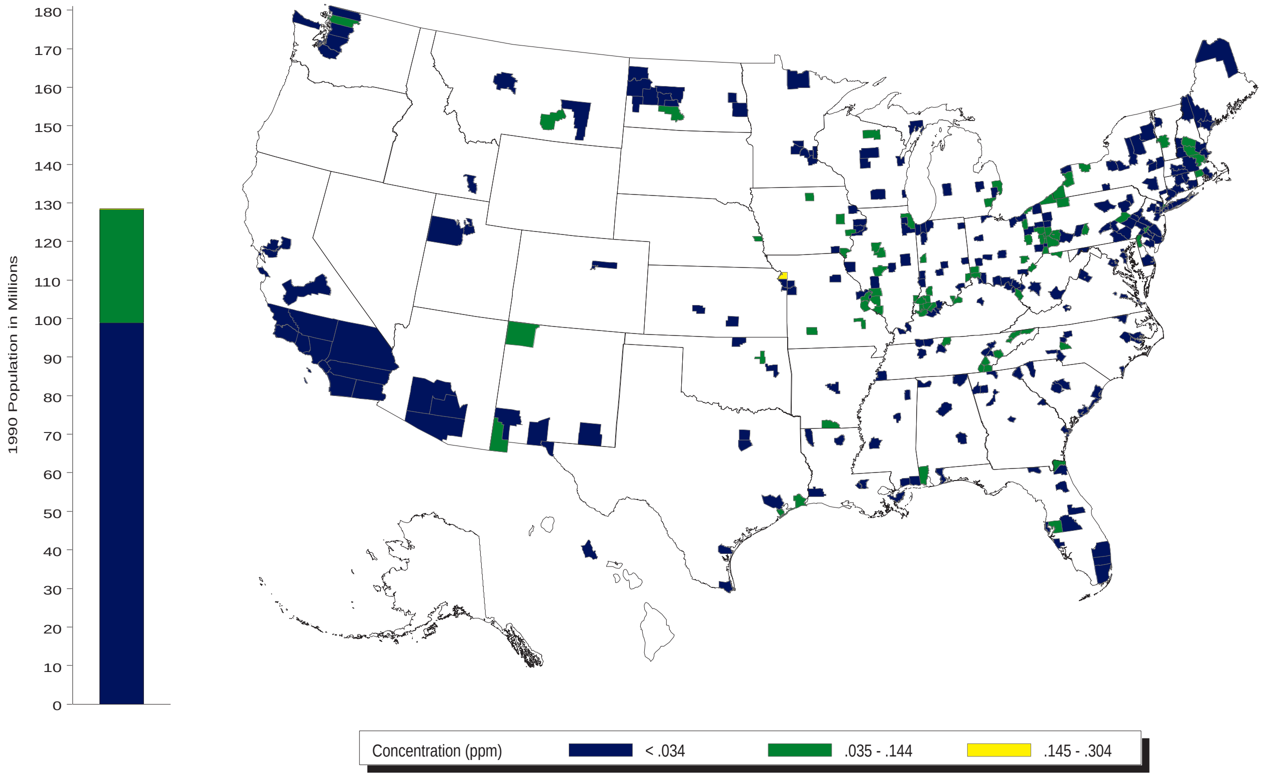


Figure 2-54. Highest second maximum 24-hour SO_2 concentration by county, 1997.



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The emission reduction analyses associated with NO_x compliance results in this report focus on 263 of the 265 Phase I NO_x units (representing 170 Table I units and 95 substitution units whose owners chose to participate in Phase I as part of an SO_2 compliance strategy). EPA had determined, as of July 1998, that these units had met the required emission limitation; the two other Phase I units were pending a decision on their alternative emission limitation petitions and determined to be conditionally in compliance.

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14. "Identification of Additional Ozone Areas Attaining the 1-Hour Standard and to Which the 1-Hour Standard is No Longer Applicable; Final Rule," *Federal Register*, 63 FR 39431, Washington, D.C., July 22, 1998.

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27. "Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; Proposed Rule," *Federal Register*, 62 FR 60317, Washington, D.C., November 7, 1997.

28. "Supplemental Notice for the Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; Proposed Rule," *Federal Register*, 63 FR 25902, Washington, D.C., May 11, 1998.

29. "Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone; Final Rule," *Federal Register*, 63 FR 57355, Washington, D.C., October 27, 1998.

30. *National Ambient Air Quality Standards for Particulate Matter: Final Rule*, July 18, 1997. (62 FR 38652), **http://www.epa.gov/ttn/oarpg/rules.html**.

31. *National Air Pollutant Emissions Trends Report,* EPA-454/R-97-011, US EPA, Research Triangle Park, NC 27711, December 1997.

32. The annual mean is used to show trends in national SO_2 air quality because it is a more stable statistic than the 24-hour statistic.

33. *1997 Compliance Report*: *Acid Rain Program*, EPA-430-R-98-012, U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C., August 1998.

34. The 1995, 1996, and 1997 data for electric utility units in the acid rain program were measured by continuous emissions monitors or equivalent continuous monitoring methods and reported to EPA's Acid Rain Division. The 1994 data are based on fuel use reported to DOE/Energy Information Administration and AP-42 emissions factors. "Phase I units" consist of the 400 units that were subject to Phase I compliance during the first three years (1995-1997) of the acid rain program. These data were obtained from U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Atmospheric Programs, Acid Rain Division, (Mail code: 6204J), Washington, D.C.

CHAPTER 3

Criteria Pollutants - Metropolitan Area Trends

http://www.epa.gov/oar/aqtrnd97/chapter3.pdf

This chapter presents status and trends in criteria pollutants for Metropolitan Statistical Areas (MSAs) in the United States. The MSA trends and status give a local picture of air pollution and can reveal regional patterns of trends. Such information can allow one to gauge the air pollution situation where they live although not all areas in the country are in MSAs and not all MSAs are included here. A complete list of MSAs and their boundaries can be found in the Statistical Abstract of the United States.[1] The status and trends of metropolitan areas are based on four tables found in Appendix A (A-13 through A-16). Table A-13 gives the 1997 peak statistics for all MSAs, providing the status of the most recent year. Ten-year trends are shown for the 251 MSAs having data that meet the trends criteria explained in Appendix B. Table A-14 lists these MSAs and reports criteria pollutant trends as "upward" or "downward," or "not significant." These categories are based on a statistical test, known as the Theil test, which is described later in this chapter. The results of these tests are displayed in Figures 3-1 through 3-9 as maps showing upward, downward or non-significant trends. Another way to assess trends in MSAs is to examine Pollutant Standards Index (PSI) values.[2,3] The PSI is used to combine daily information on one or more criteria pollutants into an easily understood format, which can then be presented to the public in a timely manner. Tables A-15 and A-16 list the number of days with PSI values greater than 100 (unhealthy for sensitive groups) for the nation's 94 largest metropolitan areas (population greater than 500,000). Table A-15 lists PSI values based on all pollutants, while Table A-16 lists PSI values based on ozone alone. For the 10-year period, the PSI calculated for ozone is based on the revised standard discussed in Chapter 2. The tables listing PSI data from previous reports may not agree with the tables in this report because of the new way to calculate the PSI for ozone.

Not every MSA appears in these tables because of the availability of data or the size of the MSA. There are MSAs with no ongoing monitoring because they are not believed to have pollution problems. The same is true for certain combinations of MSAs and pollutants. There are also MSAs with so little information that the criteria for trends analysis are not met (see Appendix B). Finally, there are MSAs that do not meet the population criteria for tables A-15 and A-16 and, therefore, are not included.

STATUS: 1997

The air quality status for MSAs can be found in Table A-13 (for related information, see Table A-12, peak concentrations for all counties with monitors that reported to the Aerometric Information Retrival System (AIRS) database). Table A-13 lists peak statistics for all criteria pollutants measured in an MSA. Since certain areas are not considered to have a problem with all criteria pollutants, all criteria pollutants are not measured in all MSAs and, therefore, are designated as "ND" (no data) for those pollutants. Examining Table A-13 shows that 129 areas had peak concentrations from at least one criteria pollutant exceeding standard levels. The number of areas is dramatically increased over the count from 1996 data (45 areas). The increase can be attributed to the change from the pre-existing ozone and particulate matter (PM) National Ambient Air Quality Standards (NAAQS) to the revised ozone and PM NAAQS and levels of the revised ozone and PM standards discussed in Chapter 2, rather than changes in ambient concentrations. These 129 areas represent 53 percent of the U.S. population. Similarly, there were 6 areas representing 8 percent of the population that had peak statistics that exceeded two or more standards. Only two areas, (Philadelphia, PA and St. Louis, MO) representing 3 percent of the U.S. population, had peak statistics from three pollutants that exceeded the respective standards. High values for two pollutants, PM_{10} and lead, are due to localized industrial sources in both of these MSAs. There were no areas, however, that violated four or more standards. In fact, 1997 was the sixth year in a row that there were no violations of the nitrogen dioxide (NO_2) standards in the United States.

TRENDS ANALYSIS

Table A-14 displays air quality trends for MSAs.[4] The data in this table are average statistics of pollutant concentrations from the subset of ambient monitoring sites that meet the trends criteria explained in Appendix B. A total of 251 MSAs have at least one monitoring site that meet these criteria. As stated previously, not all pollutants are measured in every MSA.

From 1988 to 1997, statistics based on the NAAQS were calculated for each site and pollutant with available data. Spatial averages were obtained for each of the 251 MSAs by averaging these statistics across all sites in an MSA. This process resulted in one value per MSA per year for each pollutant. Although there are seasonal aspects of certain pollutants and, therefore, seasonality in monitoring intensity for different MSAs, the averages for every MSA and year provide a consistent value with which to assess trends.

Since air pollution levels are affected by variations in meteorology, emissions, and day-to-day activities of populations in MSAs, trends in air pollution levels are not always well defined. To assess upward or downward trends, a linear regression was applied to these data. An advantage of using the regression analysis is the ability to test whether or not the upward or downward trend is real (significant) or just a chance product of year-to-year variation (not significant). Since the underlying pollutant distributions do not meet the usual assumptions required for common least squares regression, the regression analysis was based upon a nonparametric method commonly referred to as the Theil test.[5,6,7] Because linear regression estimates the trend from changes during the entire 10-year period, it is possible to detect an upward or downward trend even when the concentration level of the first year equals the concentration level of the last year. Also, this method uses a median estimator which is not influenced by single extreme values.

Table 3-1 summarizes the trend analysis performed on the 251 MSAs. It shows that there were no upward trends in carbon monoxide (CO) and PM_{10} (annual mean) at any of the MSAs over the past decade. Of the 251 MSAs, 221 had downward trends in at least one of the criteria pollutants, and only 15 had upward trends. A closer look at these 15 MSAs reveals that most are well below the NAAQS for the respective pollutant, meaning that their upward trends are not immediately in danger of violating the NAAQS. The areas that were near or exceeding a NAAQS all involved 8-hour ozone with a significant upward trend. These results demonstrate significant improvements in urban air quality over the past decade.

Table 3-1. Summary of MSA 10-Year Trend Analyses, by Pollutant

		Total # MSAs	# MSAs Up	# MSAs Down	# MSAs with No Significant Change
CO	Second Max, 8-hour	142	0	102	40
Lead	Max Quarterly Mean	93	1	73	19
NO_2	Arithmetic Mean	92	4	51	37
Ozone	Second Daily Max, 1-hour	193	1	46	146
Ozone	Fourth Daily Max, 8-hour	193	4	32	157
PM_{10}	99th Percentile, 24-hour	207	0	159	48
PM_{10}	Weighted Annual Mean	207	4	78	125
SO_2	Arithmetic Mean	146	2	102	42
SO_2	Second Max, 24-hour	146	3	93	50

Figure 3-1. CO Trends in Metropolitan Statistical Areas, 1988–1997.

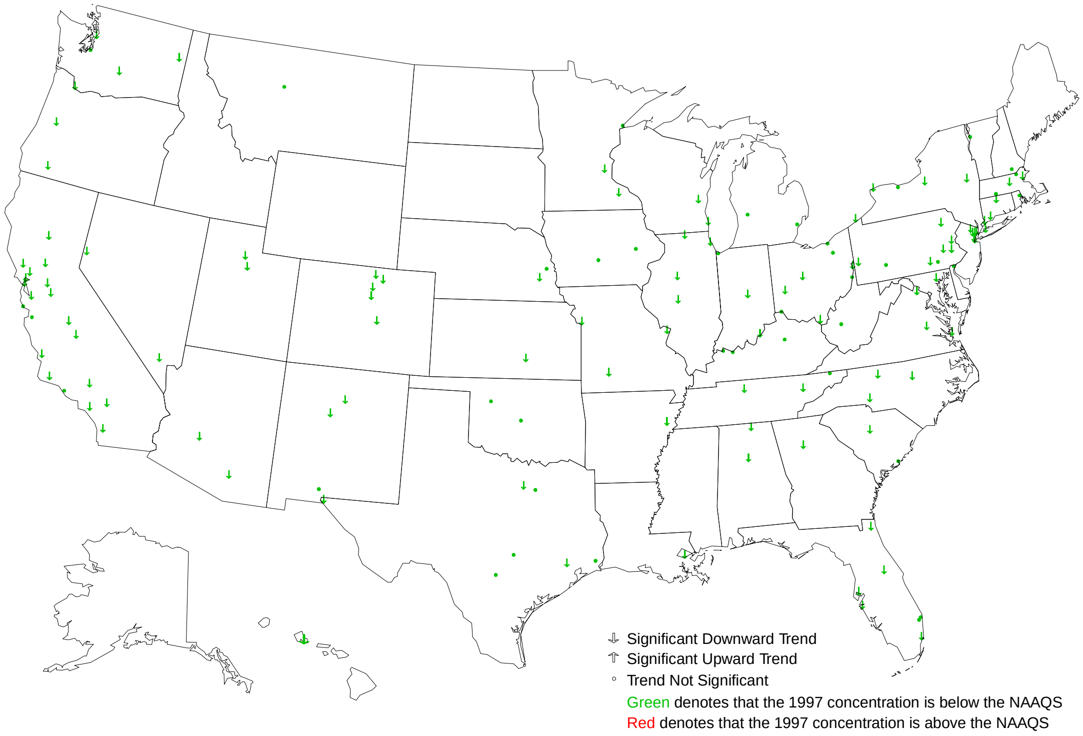


Figure 3-2. Pb Trends in Metropolitan Statistical Areas, 1988–1997.

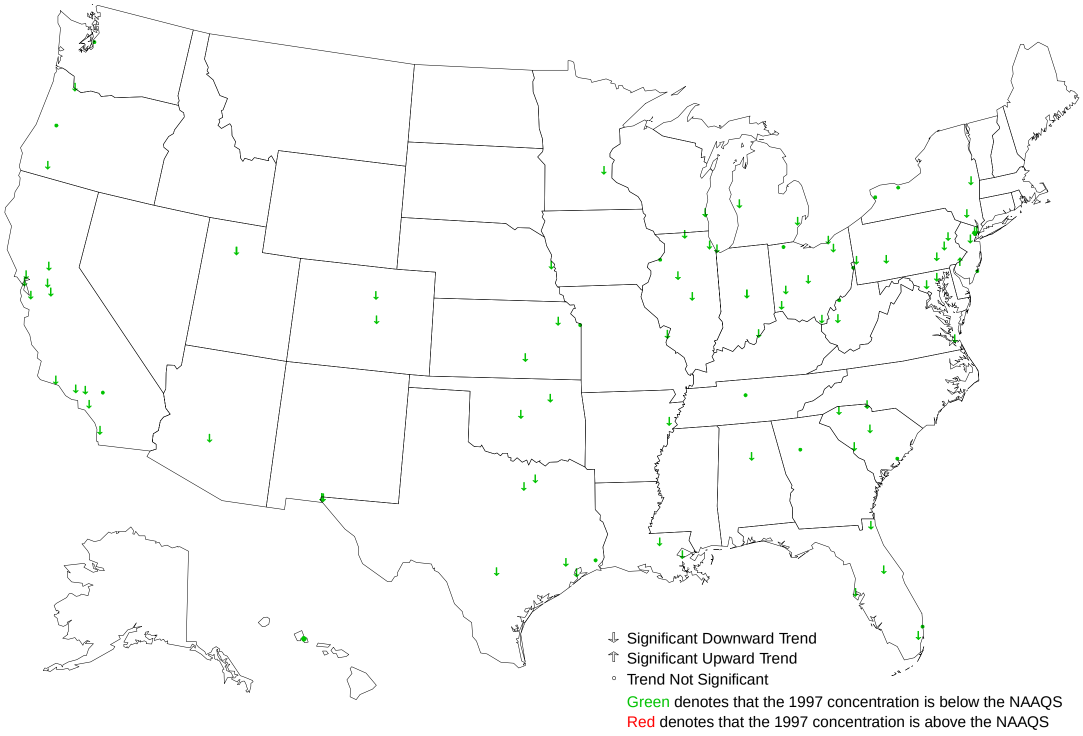


Figure 3-3. NO_2 Trends in Metropolitan Statistical Areas, 1988–1997.

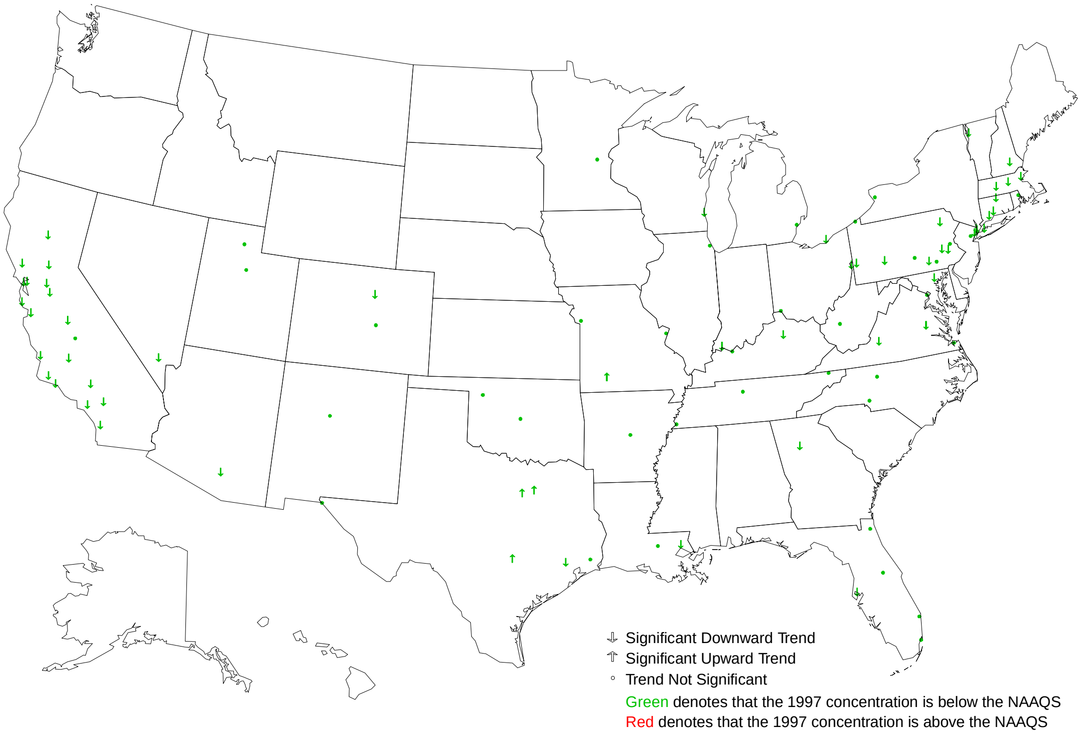


Figure 3-4. Ozone Trends in Metropolitan Statistical Areas (Fourth Max 8-hour), 1988–1997.

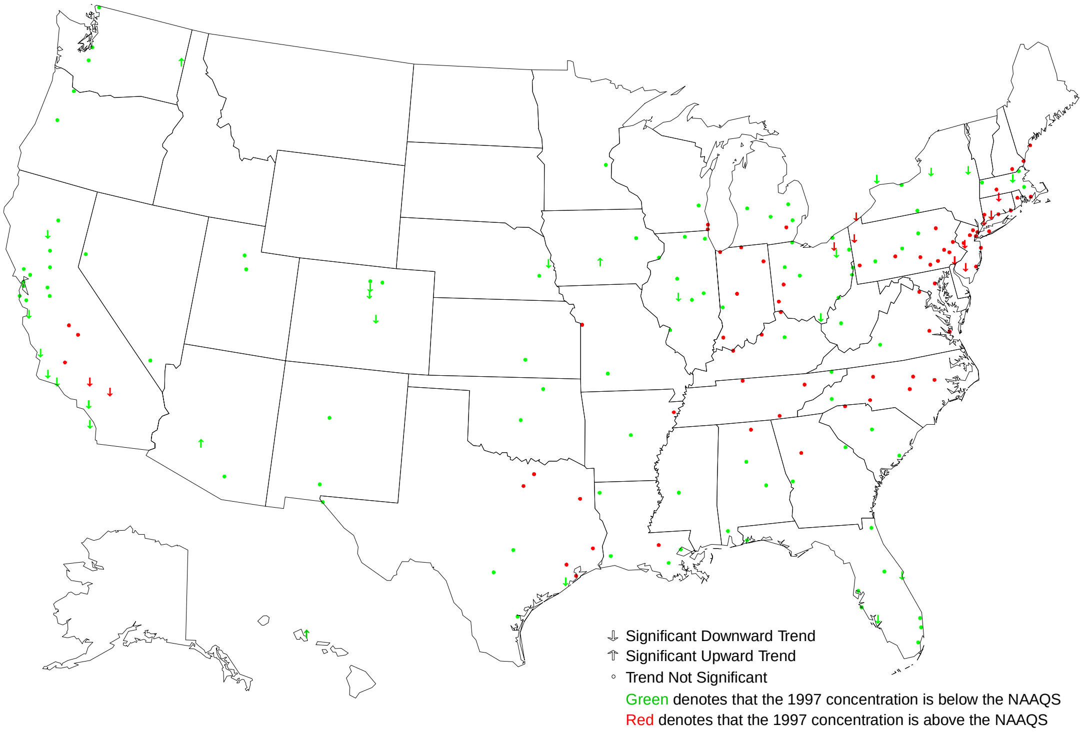


Figure 3-5. Ozone Trends in Metropolitan Statistical Areas (Second Daily Max 1-hour), 1988–1997.

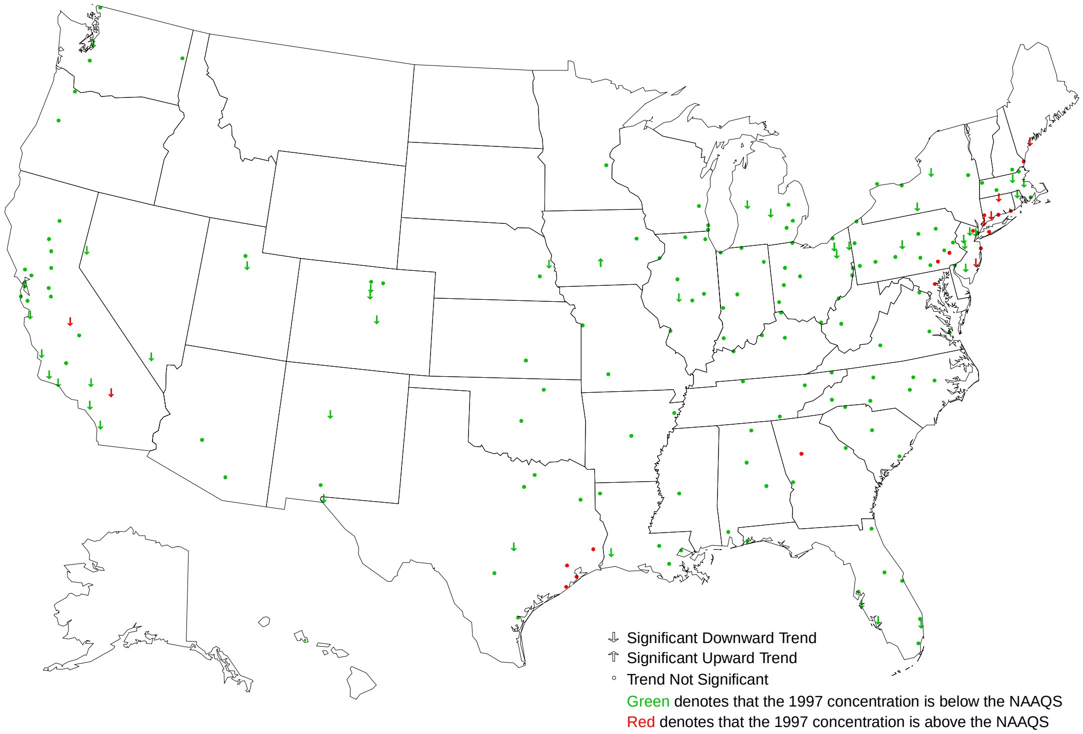
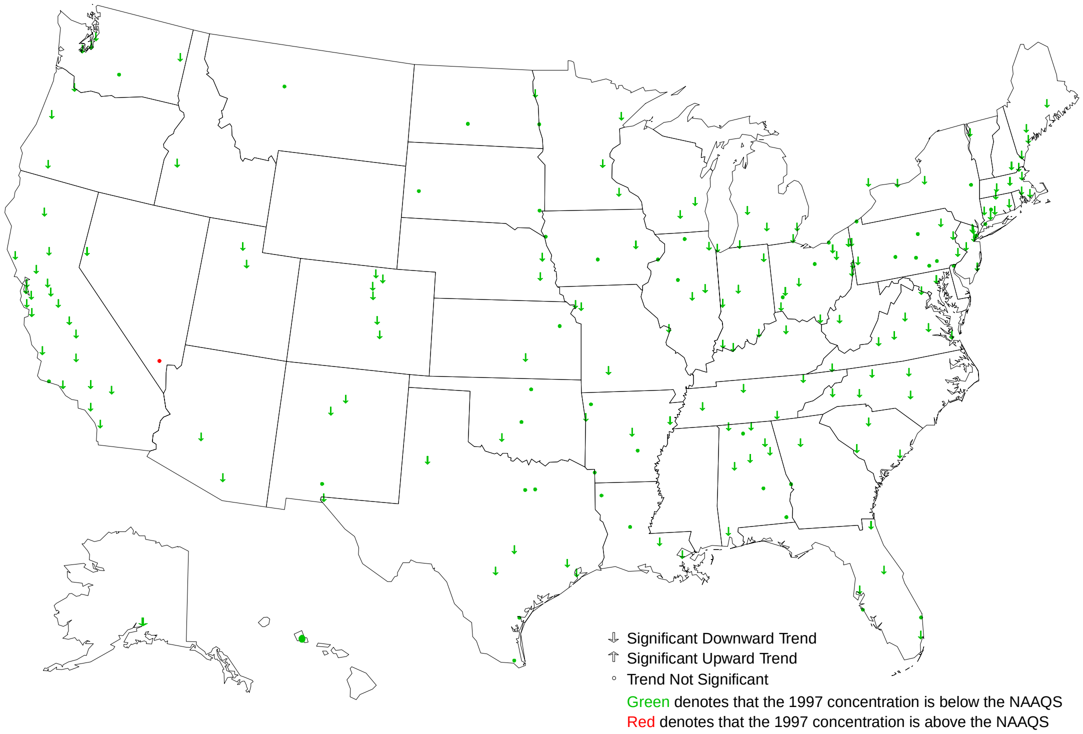


Figure 3-6. PM_{10} Trends in Metropolitan Statistical Areas (Weighted Annual Mean), 1988–1997.



Figures 3-1 through 3-9 summarize the results of the trends analysis geographically. This gives another general indicator of how air quality varies from one region to another. Figure 3-1 shows the geographic distribution of trends for CO. The figure shows that while most of the nation is experiencing a downward trend, there are small pockets where the trend is non-significant (Southern Pennsylvania to Kentucky and parts of Texas, Oklahoma, and New Mexico). Figure 3-2 shows that trends for lead (Pb) are down for almost all of the country. Figure 3-3 shows that trends for NO_2 are either down or non-significant with a small pocket of upward trends in Texas. Figures 3-4 and 3-5 show the ozone situation for MSAs throughout the country. Most MSAs have a non-significant trend with downward trends showing up in Southern California and some of the Northeast corridor. Figure 3-5, based on the 8-hour ozone standard, shows more areas with 1997 data above the level of the revised standard. Figures 3-6 and 3-7 show trends for the annual and the revised daily form of the PM_{10} standards. Figure 3-6 shows the PM_{10} weighted annual mean has mostly downward trends with the exception of areas in Pennsylvania and the northern plains states and a few other isolated MSAs. The daily form of the standard (Figure 3-7) shows non-significant trends from Pennsylvania in all directions except southwest, and from the northern plains south to all the plains states and into Arkansas and Louisiana. Figures 3-8 and 3-9 give a picture of the annual and daily SO_2 forms of the standard. A busy area from Illinois through New Jersey show downward trends, while many of these MSAs have non-significant trends for the daily form of the SO_2 standard.

THE POLLUTANT STANDARDS INDEX

PSI values are derived from pollutant concentrations. They are reported daily in all urban areas of the United States with populations exceeding 200,000. The PSI is reported as a value between zero and 500 or a descriptive word (e.g., "unhealthy") and is featured on local television or radio news programs and in newspapers.

Figure 3-7. PM_{10} Trends in Metropolitan Statistical Areas (99th Percentile), 1988–1997.

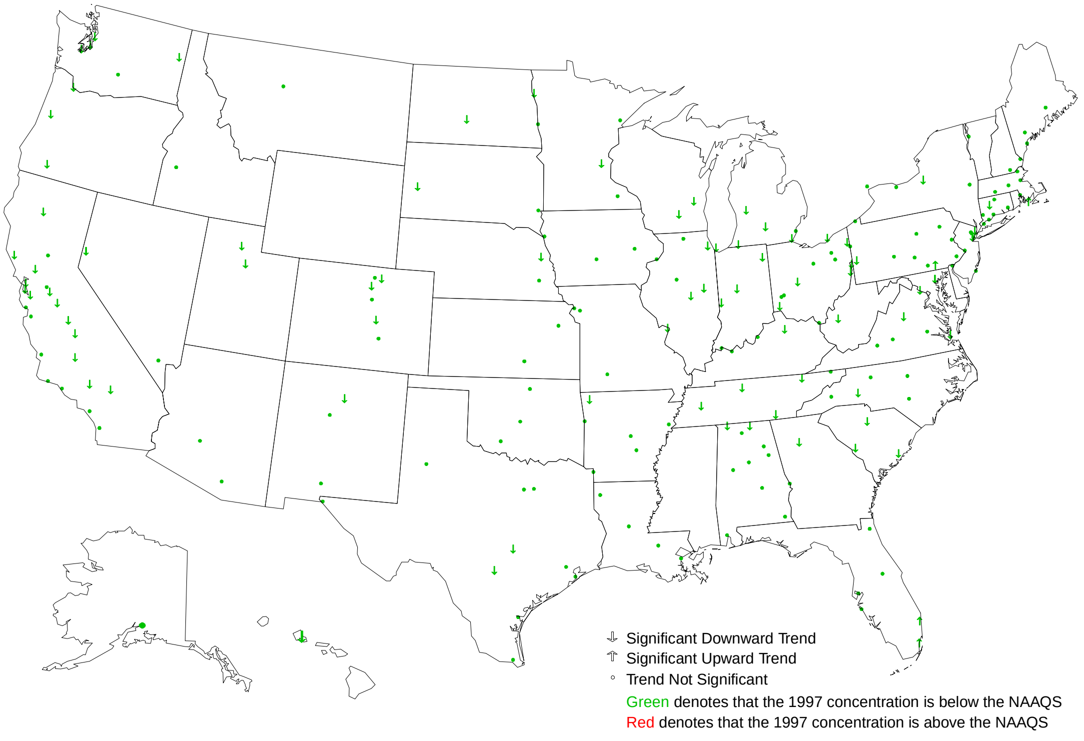


Figure 3-8. SO_2 Trends in Metropolitan Statistical Areas (Arithmetic Mean), 1988–1997.

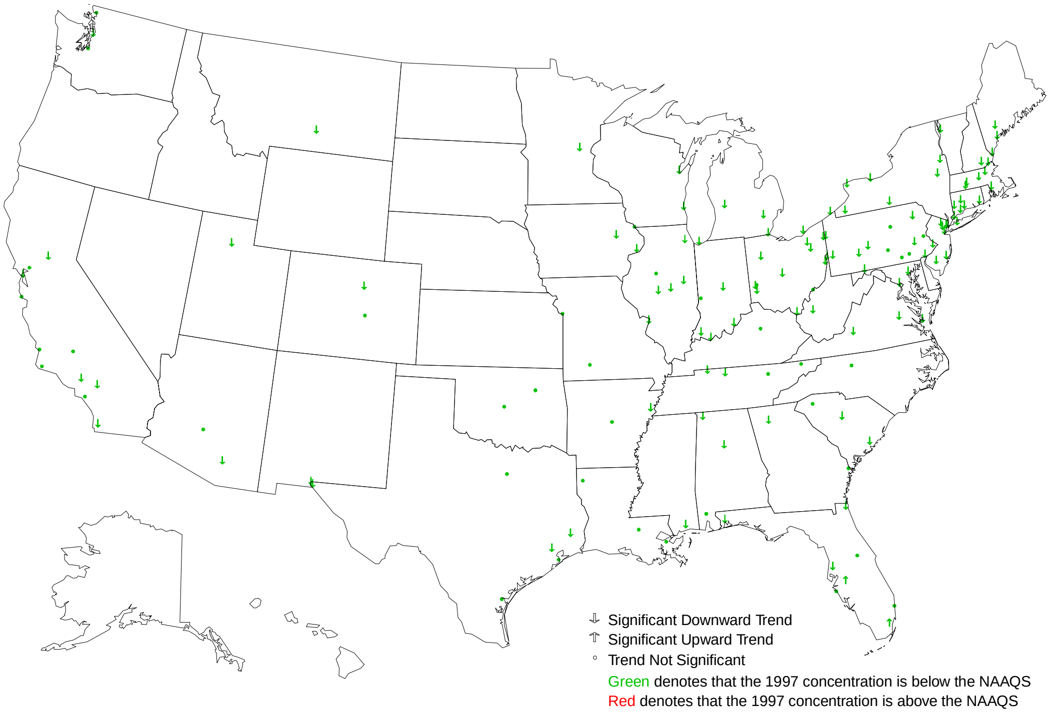
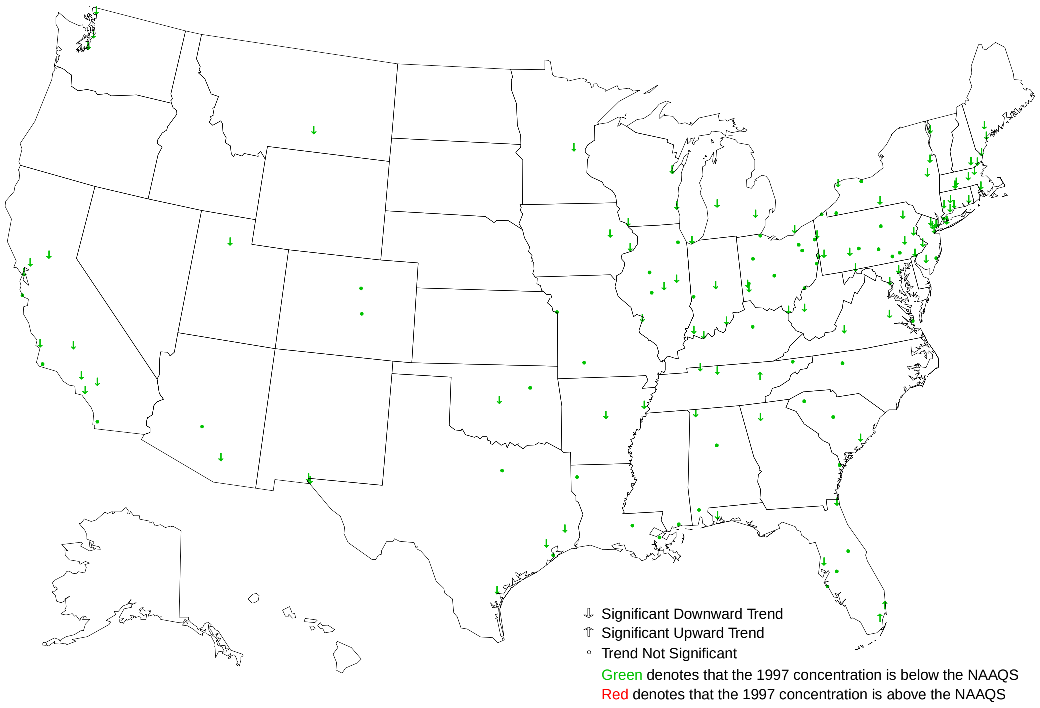


Figure 3-9. SO_2 Trends in Metropolitan Statistical Areas (Second Max 24-Hour), 1988–1997.



Based on their short-term NAAQS, Federal Episode Criteria,[8] and Significant Harm Levels,[9] the PSI is computed for PM_{10}, SO_2, CO, O_3, and NO_2. Lead is the only criteria pollutant not included in the index because it does not have a short-term NAAQS, a Federal Episode Criteria, or a Significant Harm Level. Since the PSI is a tool used to communicate pollution concerns to a wide audience, there are also colors linked to the general descriptors of air quality. The five PSI color categories and their respective health effects descriptors are listed in Table 3-2.

The PSI integrates information on criteria pollutant concentrations across an entire monitoring network into a single number that represents the worst daily air quality experienced in an urban area. For each of the criteria pollutants, concentrations are converted into an index value between zero and 500. The pollutant with the highest index value is reported as the PSI for that day. Therefore, the PSI does not take into account the possible adverse effects associated with combinations of pollutants (i.e., synergism).[2,3]

A PSI value of 100 corresponds to the standard established under the Clean Air Act (CAA). A PSI value greater than 100 indicates that at least one criteria pollutant (with the exception of NO_2) exceeded the level of the NAAQS, therefore designating air quality to be in the unhealthful range on that day. Relatively high PSI values activate public health warnings. For example, a PSI of 200 initiates a First Stage Alert at which time sensitive populations (e.g., the elderly and persons with respiratory illnesses) are advised to remain indoors and reduce physical activity. A PSI of 300 initiates a Second Stage Alert at which time the general public is advised to avoid outdoor activity.

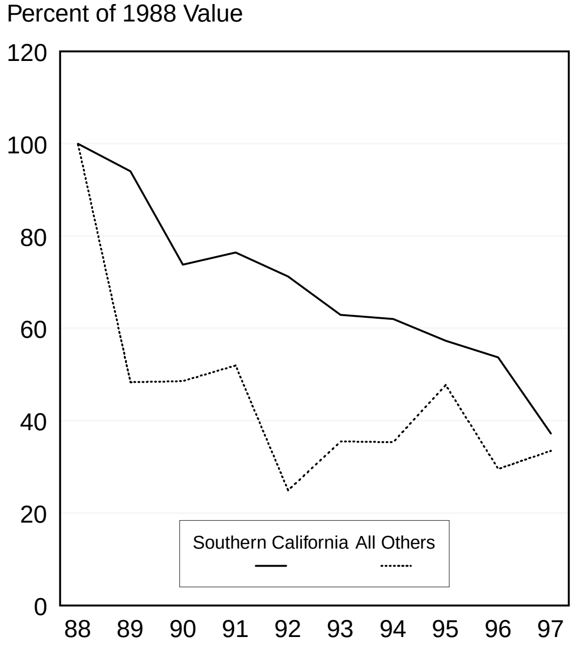
EPA is revising the PSI to reflect the revised ozone and PM NAAQS, which will incorporate the latest health effects information used to revise the standards. The analysis presented here uses a suggested revision for ozone that states were encouraged to use during the Summer of 1998. The PSI used for this analysis

Table 3-2. Pollutant Standards Index Values with Pollutant Concentration, Health Descriptors, and PSI Colors.

INDEX VALUE	AIR QUALITY LEVEL	POLLUTANT LEVELS					HEALTH EFFECT DESCRIPTOR	PSI COLORS
		PM-10 (24-hour) ug/m^3	SO_2 (24-hour) ug/m^3	CO (8-hour) ppm	O_3 (1-hour) ppm	NO_2 (1-hour) ppm		
500	SIGNIFICANT HARM	600	2,620	50	0.6	2.0		
400	EMERGENCY	500	2,100	40	0.5	1.6	HAZARDOUS	RED
300	WARNING	420	1,600	30	0.4	1.2		
							VERY UNHEALTHFUL	ORANGE
200	ALERT	350	800	15	0.2	0.6		
							UNHEALTHFUL	YELLOW
100	NAAQS	150	365	9	0.12	a		
							MODERATE	GREEN
50	50% OF NAAQS	50	80[b]	4.5	0.06	a		
							GOOD	BLUE
0		0	0	0	0	a		

[a] No index values reported at concentration levels below those specified by "Alert Level" criteria.
[b] Annual primary NAAQS.

Figure 3-10. Number of days with PSI values > 100, as a percentage of 1988 value.



incorporates the level (0.08 ppm) and form (max 8-hour average) of the revised ozone standard for all 10 years. For this reason, Tables A-15 and A-16 may not agree with PSI tables in earlier reports for the same year.

SUMMARY OF PSI ANALYSES

Of the five criteria pollutants used to calculate the PSI, CO, O_3, PM_{10}, and SO_2 generally contribute to the PSI value. Nitrogen dioxide is rarely the highest pollutant measured because it does not have a short-term NAAQS and can only be included when concentrations exceed one of the Federal Episode Criteria or Significant Harm Levels. Ten-year PSI trends are based on daily maximum pollutant concentrations from the subset of ambient monitoring sites that meet the trends criteria in Appendix B.

Since a PSI value greater than 100 indicates that the level of the NAAQS for at least one criteria pollutant has been exceeded on a given day, the number of days with PSI values greater than 100 provides an indicator of air quality in urban areas. Figure 3-10 shows the trend in the number of days with PSI values greater than 100 summed across the nation's 94 largest metropolitan areas as a percentage of the 1988 value. Because of their magnitude, PSI totals for Los Angeles, CA, Riverside, CA, Bakersfield, CA, and San Diego, CA are shown separately as Southern California. Plotting these values as a percentage of 1988 values allows two trends of different magnitudes to be compared on the same graph. The long-term air quality improvement in urban areas is evident in this figure. Between 1988 and 1997, the total number of days with PSI values greater than 100 decreased 56 percent in Southern California and 66 percent in the remaining major cities across the United States. While five criteria pollutants can contribute to the PSI, the index is driven mostly by ozone. The unusual ozone year, 1988, can be seen in this figure by the large decrease between 1988 and 1989 for all the areas but Southern California. Southern California was less affected by the unusual meteorology experienced that year in most of the nation (see Chapter 2). In fact, Figure 3-10 shows how much year-to-year meteorology affects air pollution levels, since Southern California has less year-to-year variability in meteorology and a smoother trend.

PSI estimates depend on the number of pollutants monitored as well as the number of monitoring sites where data are collected. The more pollutants measured and sites that are available in an area, the better the estimate of the PSI for a given day. Ozone accounts for the majority of days with PSI values above 100, but is collected at only a small number of sites in each area. Table A-16 shows the number of days with PSI values greater than 100 that are attributed to ozone alone. Comparing Table A-15 and A-16, the number of days with a PSI above 100 are increasingly due to ozone. In fact, the percentage of days with a PSI above 100 due to ozone have increased from 92 percent in 1988, to 97 percent in 1997. The increase is even more dramatic when the unusual meteorology experienced in 1988 is recognized (the 1989 percentage was much lower, 82 percent). This increase reveals that ozone increasingly accounts for those days above the 100 level and reflects the success in achieving lower CO and PM_{10} concentrations. However, the typical one-in-six day sampling schedule for most PM_{10} sites limits the number of days that PM_{10} can factor into the PSI determination.

The PSI currently is undergoing revision to reflect the changes in the ozone and PM NAAQS. These revisions will be proposed in the Spring of 1998 and should be finalized by the end of 1998. Concurrently, the Federal Episode Criteria and Significant Harm Levels for ozone and PM are being revised to reflect the health effects data that motivated the revisions to the ozone and PM NAAQS.

REFERENCES AND NOTES

1. *Statistical Abstracts of the United States, 1997*, U.S. Department of Commerce, U.S. Bureau of the Census.

2. *Measuring Air Quality, The Pollutant Standards Index*, EPA-451/K-94-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, February 1994.

3. *Code of Federal Regulations,* 40 CFR Part 58, Appendix G.

4. Note: Although the results are summarized in the report for comparison purposes, the intent of publishing Tables A-14 through A-16 is to present information on a localized basis, to be used on a localized basis (i.e., one MSA at a time). Therefore, no attempt was made to adjust the Type I error to a table-wide basis. All the tests for trends were conducted at the 5-percent significance level. No inference has been made from the tables as a whole.

5. T. Fitz-Simons and D. Mintz, "Assessing Environmental Trends with Nonparametric Regression in the SAS Data Step," American Statistical Association 1995 Winter Conference, Raleigh, NC, January, 1995.

6. Freas, W.P. and E.A. Sieurin, "A Nonparametric Calibration Procedure for Multi-Source Urban Air Pollution Dispersion Models," presented at the Fifth Conference on Probability and Statistics in Atmospheric Sciences, American Meteorological Society, Las Vegas, NV, November 1977.

7. M. Hollander and D.A. Wolfe, *Nonparametric Statistical Methods*, John Wiley and Sons, Inc., New York, NY, 1973.

8. *Code of Federal Regulations,* 40 CFR Part 51, Appendix L.

9. *Code of Federal Regulations,* 40 CFR Part 51, section 51.151.

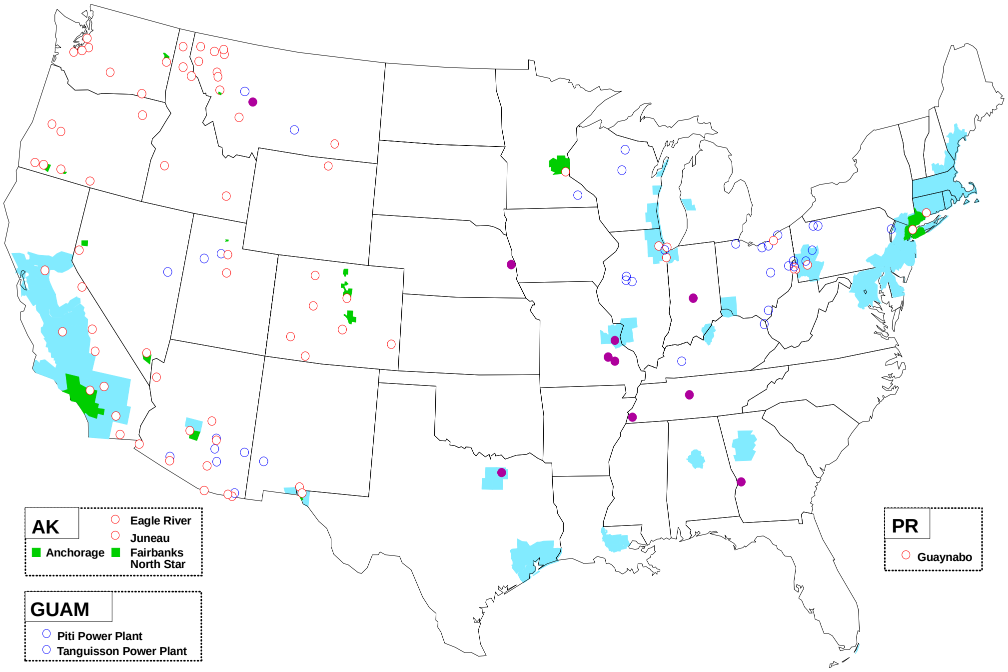
CHAPTER 4

Criteria Pollutants - Nonattainment Areas

http://www.epa.gov/oar/aqtrnd97/chapter4.pdf

This chapter provides general information on geographical regions known as nonattainment areas. When an area does not meet the air quality standard for one of the criteria pollutants it may be subject to the formal rule-making process which designates it as nonattainment. The Clean Air Act Amendments (CAAA) further classify ozone, carbon monoxide, and some particulate matter nonattainment areas based on the magnitude of an area's problem. Nonattainment classifications may be used to specify what air pollution reduction measures an area must adopt and when the area must reach attainment. The technical details underlying these classifications are discussed in the Code of Federal Regulations, Part 81 (40 CFR 81), see **http://www.epa.gov/epacfr40**.

Figure 4-1. Location of nonattainment areas for criteria pollutants, September 1998.



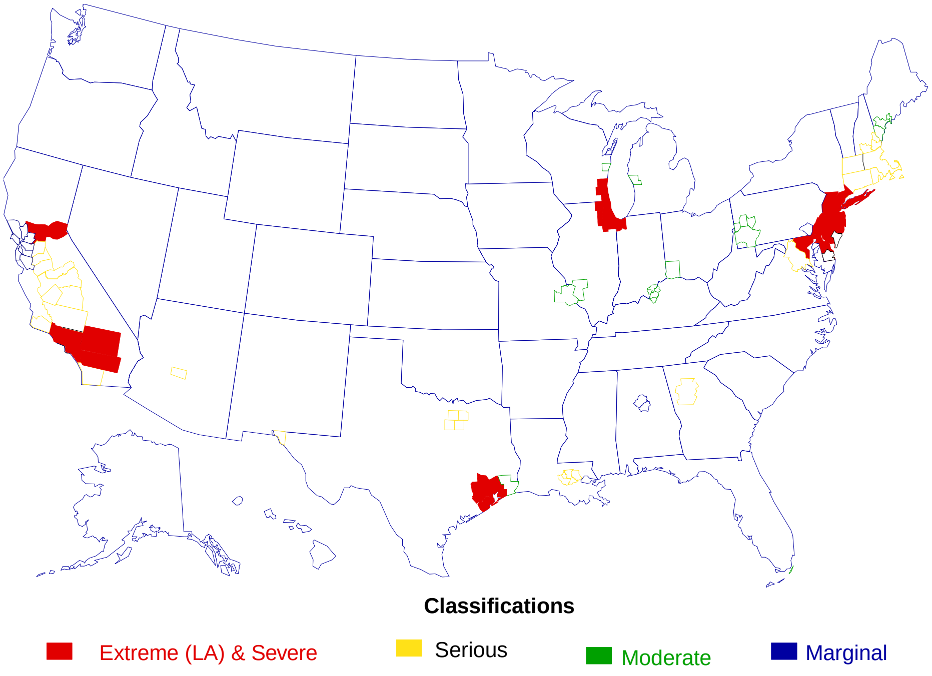
Note: Incomplete data, not classified, and Section 185(a) areas are not shown.

*Ozone nonattainment areas on map are based on the pre-existing ozone standard. Nonattainment designations based on the revised 8-hour ozone standard will not be designated until 2000.

**PM_{10} nonattainment areas on map are based on the pre-existing PM_{10} standards. Nonattainment designations based on the revised PM_{10} standards have not yet been made.

🟩 CO
● Lead
▭ Ozone*
○ PM_{10}**
○ SO_2

Figure 4-2. Classified ozone nonattainment areas where 1-hour standard still applies, September 1998.



Note: San Francisco is Classified Other / Sec 185A & Incomplete Data Areas Not Included

Figure 4-1 shows the location of the nonattainment areas for each criteria pollutant as of September 1998. Figure 4-2 identifies the ozone nonattainment areas by degree of severity. A summary of nonattainment areas can be found in Table A-17 in Appendix A. This condensed list also is located on the Internet at **http://www.epa.gov/airs/nonattn.html** and is updated as areas are redesignated. Note that Section 185a areas (formerly known as "transitional areas") and incomplete areas are excluded from the counts in Table A-17. For information on these areas including Section 185a and incomplete areas see the EPA Green Book site located at **http://www.epa.gov/oar/oaqps/greenbk**.

As of September 1998, there were a total of 130 nonattainment areas on the condensed nonattainment list. The areas on the condensed list are displayed alphabetically by state.

Table 4-1. Areas Redesignated Between September 1997 and September 1998.

CO
- Chico, CA
- Fresno, CA
- Lake Tahoe South Shore, CA
- Modesto, CA
- Portland, OR
- Stockton, CA
- Sacramento, CA
- San Francisco-Oakland–San Jose, CA
- San Diego, CA

Pb
- The number of lead nonattainment areas remained the same since September 1997.

NO$_2$
- Los Angeles–South Coast Air Basin, CA

Ozone
- Evansville, IN
- Richmond, VA
- San Francisco Bay Area, CA (redesignated to nonattainment)

PM$_{10}$
- Granite City, IL
- Vermillion, IN

SO$_2$
- Benton Co., TN
- Humphreys Co., TN
- Polk Co., TN
- Muscatine Co., IA

Table 4-2. Ozone Revocations of Nonattainment Areas Only

- Albany-Schenectady-Troy, NY
- Allentown-Bethlehem-Easton, PA-NJ
- Altoona, PA
- Atlantic City, NJ
- Buffalo-Niagra Falls, NY
- Erie, PA
- Essex Co., (Whiteface Mtn.), NY
- Harrisburg-Lebanon-Carlisle, PA
- Jefferson Co., NY
- Johnstown, PA
- Knox Co. and Lincoln Co., ME
- Lewiston-Auburn, ME
- Manchester, NH
- Poughkeepsie, NY
- Reno, NV
- Scranton–Wilkes-Barre, PA
- Smyth Co. (White Top Mtn.), VA
- Sussex Co., DE
- York, PA
- Youngstown-Warren-Sharon, OH-PA*

* Youngstown was redesignated April 4, 1996.

Table 4-3. Nonattainment Status

Pollutant	1991 # areas	1998 # areas	1998 Population (in 1,000s)
CO	42	20	34,047
Pb	12	10	1,375
NO_2	1	0	0
O_3	100	38	99,824
PM_{10}	70	77	29,890
SO_2	51	34	4,695

There are approximately 113 million people living in areas currently designated as nonattainment.

Areas redesignated between September 1997 and September 1998 are listed in Table 4-1, by pollutant. All redesignations were to attainment except for the San Francisco Bay Area which was redesignated to nonattainment for ozone. Subsequent to the 1997 O_3 National Ambient Air Quality Standards (NAAQS) revision, EPA revoked the 1-hour O_3 NAAQS in most U.S. counties.[1,2] Nonattainment areas that had the 1-hour ozone standard revoked are listed in Table 4-2. The present status of nonattainment areas compared to the status after nonattainment designations resulting from the CAAA is shown in Table 4-3. Ozone nonattainment areas for the new 8-hour standard will not be designated until the year 2000.[3]

REFERENCES

1. "Identification of Ozone Areas Attaining the 1-Hour Standard and to Which the 1-Hour Standard Is No Longer Applicable; Final Rule," *Federal Register*, 63 FR 2804, Washington, D.C., June 5, 1998.

2. "Identification of Additional Ozone Areas Attaining the 1-Hour Standard and to Which the 1-Hour Standard Is No Longer Applicable; Final Rule," *Federal Register*, 63 FR 39431, Washington, D.C., July 22, 1998.

3. "Re-Issue of Early Planning Guidance for the Revised Ozone and Particulate Matter (PM) National Ambient Air Quality Standards (NAAQS)," memorandum from S. Shaver, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 17, 1998.

CHAPTER 5

Air Toxics

http://www.epa.gov/oar/aqtrnd97/chapter5.pdf

BACKGROUND

Hazardous air pollutants (HAPs), commonly referred to as air toxics or toxic air pollutants, are pollutants known to cause or suspected of causing cancer or other serious human health effects or ecosystem damage. Section 112 of the CAA now lists 188 pollutants or chemical groups as hazardous air pollutants and targets sources emitting them for regulation.[1] Examples of air toxics include heavy metals like mercury and chromium; organic chemicals like benzene, 1,3-butadiene, perchloroethylene (PERC), dioxins, and polycyclic organic matter (POM).

HAPs are emitted from literally thousands of sources including: large stationary industrial facilities or major point sources (such as electric power plants or utilities), smaller area sources (such as neighborhood dry cleaners), and mobile sources (such as automobiles). Adverse effects to human health and the environment due to HAPs can result from exposure to air toxics from individual facilities, exposure to mixtures of pollutants found in urban settings, or exposure to pollutants emitted from distant sources that are transported through the atmosphere over regional, national or even global airsheds. Exposures of concern to HAPs can be either short-term or long-term in nature. In addition to breathing air contaminated with air toxics, people can also be exposed to some HAPs through other pathways such as through the ingestion of contaminated food from waters polluted from the deposition of HAPs. Some HAPs can bioaccumulate in body tissues. When a predator feeds on contaminated prey, concentrations of these bioaccumulative HAPs can build up in the predator's tissues, magnifying the toxic burden. Presently, over 2,299 U.S. water bodies are under fish consumption advisories (for particular species of fish), representing approximately 16.5 percent of the nation's total lake acreage, and 8.2 percent of the nation's river miles.[2]

Health and Environmental Effects

Compared to information for the criteria pollutants described in previous chapters, less information is available concerning potential health and environmental effects of the HAPs. Most of the information on potential health effects of these pollutants is derived from experimental animal data. The different health effects which may be caused by HAPs include cancer, neurological, cardiovascular, and respiratory effects, effects on the liver, kidney, immune system and reproductive system and effects on fetal and child development. The timing of effect and the severity (e.g. minor or reversible vs serious, irreversible, and life-threatening) may vary among HAPs and with the exposure circumstances. In some rare cases, effects can be seen immediately. Rare cases involve the catastrophic release of lethal pollutants, such as the 1984 incident in Bhopal, India where more than 2,000 people were killed from the release of methyl isocyanate into the atmosphere. In other cases, the resulting effects (e.g. liver damage or cancer) are associated with long-term exposures and may not appear until years after exposure. About half of the HAPs have been classified by EPA as "known", "probable" or "possible" human carcinogens. Known human carcinogens have been demonstrated to cause cancer in humans. Examples of these include benzene, which has been shown to cause leukemia in workers exposed over several years to certain amounts in their workplace air, and arsenic, which has been associated with lung cancer in workers at metal smelters. Probable and possible human carcinogens include chemicals that we are less certain cause cancer in people, yet for which laboratory animal testing indicates carcinogenic effects.

Some HAPs pose particular hazards to people of a certain age or stage in life (e.g. as a young child, adolescent, adult, or elderly person). Available data indicate that about a third of HAPs are developmental or reproductive toxicants (e.g. mercury). This means that exposure during the development of a fetus or young child may prevent normal development into a healthy adult. Other such critical exposures may affect the ability to conceive or give birth to a healthy child. Ethylene oxide, for example, has been associated with increased miscarriages in exposed workers, and has affected reproductive ability in both male and female laboratory animals.

Toxic air pollutants can have a variety of environmental impacts in addition to the threats they pose to human health. Animals, like humans, may experience health problems if they breathe sufficient concentrations of HAPs over time, or ingest HAPs through contaminated food (e.g. fish). Apart from the laboratory testing results on animal species that make up a large portion of the human health effects database, and aquatic toxicity criteria for some HAPs, little quantitative information currently exists to describe the nature and scope of the effects of air toxics on non-human species.

One of the more documented ecological concerns associated with toxic air pollutants is the potential for some HAPs to damage aquatic ecosystems. For example, a number of studies suggest that deposited air toxics contribute to deleterious effects such as reproductive failures, developmental disorders, disease, and premature death in fish and wildlife species native to the Great Lakes.Deposited air pollutants can be significant contributors to overall pollutant loadings entering water bodies (especially for persistent chemicals which continue to move among air, water, and sediments). For the Great Lakes, international programs have examined the importance of deposition of air toxics, relative to other loadings such as direct discharge. While data are presently insufficient for many quantitative estimates comparing air deposition and other loading pathways, deposition of air toxics to the Great Lakes is considered significant and continues to be investigated with a binational monitoring network, the Integrated Atmospheric Deposition Network (IADN).[3]

Persistent air toxics are of particular concern in aquatic ecosystems, as toxics levels can magnify up the food chain resulting in exposures greater than those expected based solely on the levels in water or air. For example, the Florida panther, an endangered species which inhabits the Everglades, has experienced adverse effects because of the high levels of mercury that have accumulated in the panther’s tissues from eating fish contaminated with mercury. Such “bioaccumulation” and “biomagnification” (where the levels of a toxic substance increase as you go higher in the food chain) are also seen in breeding loons in New England, a bird which feeds on fish in waters contaminated by airborne mercury. Studies are showing that an estimated 30 per cent of the breeding loons have mercury levels that put them at risk of behavioral, reproductive and other effects.

AIR TOXICS CONTROL PROGRAM

The Regulatory Response

In 1990, Congress amended Section 112 of the CAA by adding a new approach to the regulation of HAPs. This new approach is divided into two phases. The first requires the development of technology-based emissions standards for sources of the 188 HAPs. The second phase is to evaluate remaining problems or risks, and develop additional regulations to address sources of those problems, as needed.

The first phase is comprised of the technology-based standards, known as MACT (Maximum Achievable Control Technology) and GACT (Generally Achievable Control Technology) regulations, under Sections 112(d). All large, or major, sources of the 188 HAPs must be addressed by such regulations, as well as the smaller, area, sources found to carry significant risk or identified as important under the Specific Pollutants Strategy [Section 112(c)(6)] or the urban program [Sections 112(c)(3) and 112(k)]. Some combustion sources, such as municipal waste combustors, are regulated under equivalent requirements in Section 129. The purpose of this technology-based approach is to use

Figure 5-1. National total HAP emissions by source type, based on 1993 NTI.

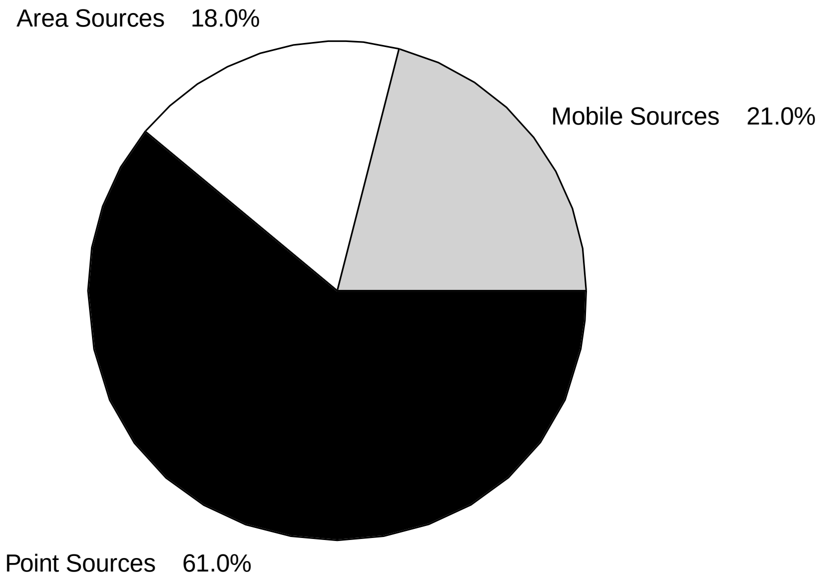
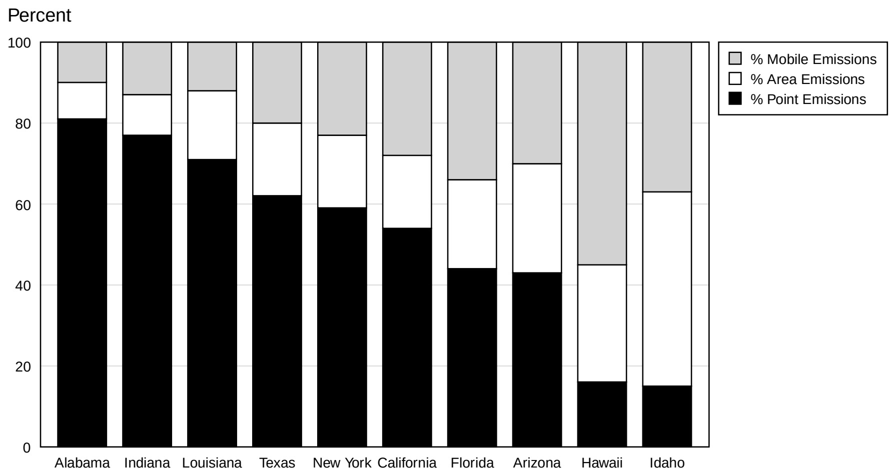


Figure 5-2. Source category contributions for selected states, based on 1993 NTI.



available control technologies or changes in work practices to get emission reductions for as many of the listed HAPs as possible. Although there is no health test in this phase, it is intended that effective MACT standards will reduce a majority of the HAP emissions and, with it, potential risks from regulated sources.

After application of the technology-based standards comes Phase Two, which consists of strategies and programs for evaluating remaining risks and ensuring that the overall program has achieved a sufficient reduction in risks to public health and the environment. This phase will be implemented primarily through the integrated urban air toxics strategy, which will evaluate risks in urban areas from the mix of source types present, and the residual risk program for MACT-controlled sources (Section 112(f)). The integrated urban strategy will identify at least 30 HAPs which have the greatest health risk in urban areas, and assure that area sources accounting for 90% of the total emissions of those urban HAPs are subject to MACT or GACT regulations. In addition, the strategy will target long-term actions to substantially reduce risks from urban air toxics from all sources, to include a 75 percent reduction in cancer risk from major and area sources.

The second phase will also use information generated through the special studies required in the Clean Air Act --the Great Waters program [Section 112(m)], and the Mercury and Utility Studies [Section 112(n)]. The Great Waters program contains an ongoing examination of atmospheric deposition of air toxics to aquatic ecosystems, and the effects of those toxics when concentrated through the food web. The Mercury Study examined the adverse effects of, and possible controls for, mercury from all sources. The Utility Study examined health hazards of, and possible controls for, the numerous toxics from electric utilities.

The components of this two phase approach are described in more detail later in this chapter.

The CAA recognizes that not all problems are national problems or have a single solution. Authority for national emission standards are complemented by authorities to examine problems on other scales in order to address specific concerns. The Act also provides mechanisms for increasing partnerships among EPA, States and local programs in order to address problems specific to these regional and local environments. As we move toward the 21st century, EPA's air toxics program is beginning to progress from the more technologically-based approach for regulating toxics to the more risk-based approach. This shift will require more and better information about all emission sources of HAPs, ambient levels of HAPs and human and ecosystem exposure to HAPs. The development of an "information infrastructure" to inform the risk-based decisions has been a priority for the EPA over the last few years. The next part of this chapter summarizes the resulting activities and data from major

Figure 5-3. HAP Emissions by state, based on 1993 NTI.

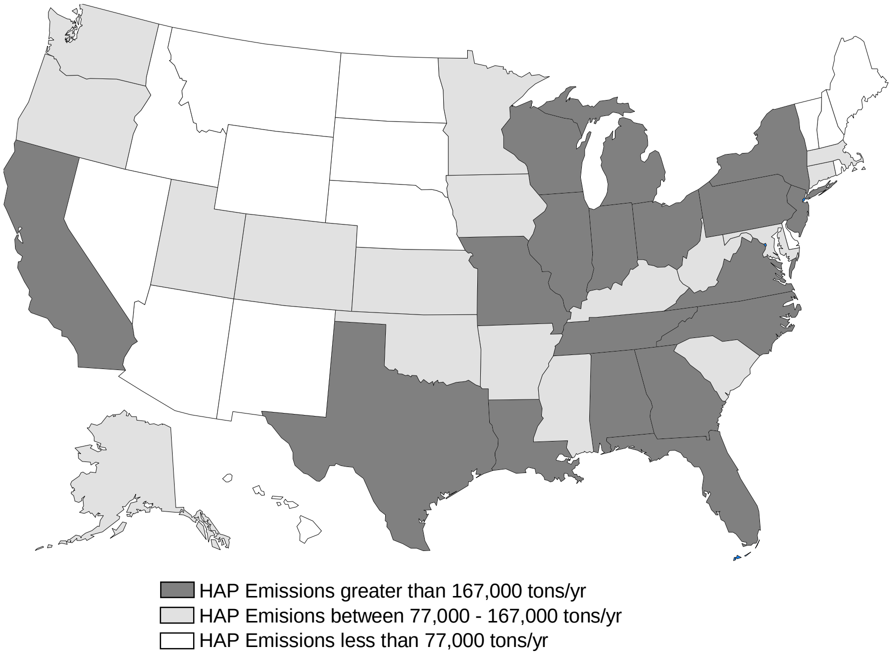


Figure 5-4. State Data Summary for 1996 NTI.

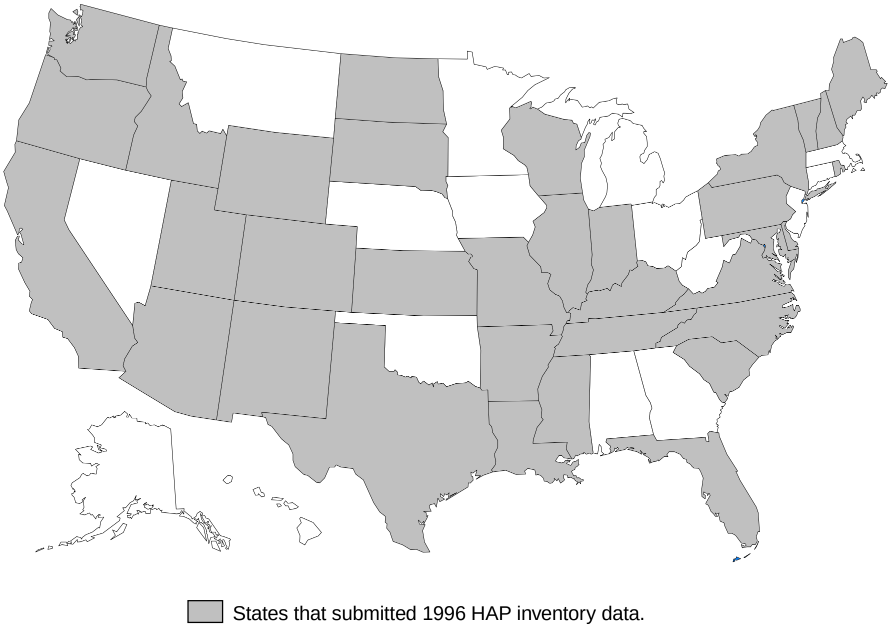


Table 5-1. Emission Reductions from Full Implementation of MACT Standards

Compliance Date	MACT Source Category	HAPs Emitted	Total Baseline Pre-MACT Emissions[b]	Emissions Reduction[b]	Total Post-MACT Emissions[b]
11/15/93	Coke Ovens: Charging, Top side, and Door leaks[a]	Benzene Coke oven gases Polycyclic Organic Matter	1,760 tpy	80% = 1,408 tpy	352 tpy
9/23/96	Perchloroethylene Dry Cleaning Facilities	Perchloroethylene	95,700 tpy	56% = 53,592 tpy	42,108 tpy
3/8/96	Industrial Process Cooling Towers	Chromium & compounds	25 tpy	>99%	0
12/15/96 (w/o new control device), **12/15/97** (w/ new control device)	Magnetic Tape Manufacturing	Methyl ethyl ketone Methyl isobutyl ketone Toluene	4,470 tpy	51% = 2,300 tpy	2,170 tpy
1/25/96 (decorative) **1/25/97** (hard & anodizing)	Chrome Electroplating: – Decorative – Hard – Anodizing	Chromium & compounds	11.5 160 3.9 = 175.4 tpy	99% = 173 tpy	2 tpy
4/22/97	Hazardous Organic NESHAP (HON)	Total unspeciated HAPs	573,000 tpy	90%= 515,700 tpy	57,300 tpy
112/2/97	Halogenated Solvent Cleaning	Methyl chloroform Methylene chloride Tetrachloroethylene Trichloroethylene	142,000 tpy	60% = 85,200 tpy	56,800 tpy
12/15/97	Gasoline Distribution	Benzene Cumene Ethyl benzene Ethylene dichloride Hexane Lead & compounds Methyl tert-butyl ether Polycyclic Organic Matter Toluene 2,2,4-Trimethylpentane Xylenes (o,m,p)	44,200 tpy	5% = 2,210 tpy	41,990 tpy
12/16/97	Shipbuilding and Ship Repair Facilities	Acrylonitrile Chlorine Chromium & compounds Diethanolamine Ethylbenzene Ethylene dichloride Ethylene glycol Glycol ethers Lead & compounds Manganese & compounds Methyl chloroform Methyl ethyl ketone Methyl isobutyl ketone Methylene chloride Nickel & compounds Polycyclic Organic Matter Toluene Trichloroethylene Xylenes (o,m,p)	7,890 tpy	24% = 1,894 tpy	5,996 tpy
12/23/97	Secondary Lead Smelting	Acetaldehyde Acetophenone Acrolein Acrylonitrile Antimony & compounds Arsenic & compounds Benzene Biphenyl Bis (2-ethylhexyl)phthalate 1,3-Butadiene Cadmium & compounds Carbon disulfide Chlorobenzene Chloroform Chromium & compounds Cumene Dibutyl phthalate 1,3-Dichloropropene Dioxins/Furans Ethyl carbamate Ethylbenzene Formaldehyde Hexane Lead & compounds Manganese & compounds Mercury & compounds Methyl bromide Methyl chloride Methyl ethyl ketone Methyl iodide Methylene chloride Nickel & compounds Phenol Polycyclic Organic Matter Propionaldehyde Styrene 1,1,2,2-Tetrachloroethane Toluene Trichloroethylene Xylenes(o,m,p)	2,030 tpy	72% = 1,421 tpy	609 tpy

[a] Due to the various criteria for implementation dates for coke ovens, the date shown here is the Effective Date.
[b] tons per year is abbreviated as tpy.

sectors of that infrastructure -- emissions inventories, ambient monitoring, and modeling. Data from these three areas are already assisting the EPA in more quantitatively characterizing the air toxics problems. As the information continues to improve, it will provide the base for air toxics decisions in the future.

Table 5-2. Comparison of 1993 to 1996 Emission Reductions for Mobile On-Road Gasoline Vehicles

1993 Total HAP Emissions (tons per year)	1996 Total HAP Emissions (tons per year)	Emissions Reduction (tons per year)
1,571,000	1,313,000	258,000 = 16%

Table 5-3. HAPs Emitted From On-Road Gasoline Vehicles

- Acetaldehyde
- Acrolein
- Arsenic and compounds
- Benzene
- 1,3-Butadiene
- Chromium and compounds
- Dioxins/Furans (defined as TEQ)
- Ethylbenzene
- Formaldehyde
- n-Hexane
- Lead and compounds
- Manganese and compounds
- Mercury and compounds
- Methyl tert-butyl ether[a]
- Nickel and compounds
- Polycyclic Organic Matter (defined as 16-PAH)
- Propionaldehyde
- Styrene
- Toluene
- Xylenes (ortho-,meta-,para-)

[a] not available for the 1993 inventory year

AIR TOXICS CHARACTERIZATION

Emissions Data - National Toxics Inventory

In 1993, there were approximately 8.1 million tons of air toxics released to the air according to EPA's National Toxics Inventory (NTI). These emissions came from all types of manmade sources, including large industrial sources, small stationary sources, and mobile sources. As shown in Figure 5-1, 1993 NTI estimates reveal that point, or major, sources (sources of hazardous air pollutants (HAPs) emitting more than 10 tons per year of an individual HAP or 25 tons per year of aggregate emissions of HAPs) account for approximately 61 percent of the total HAP emissions, nationally, while area sources (smaller stationary sources) contribute approximately 18 percent, and mobile sources contribute 21 percent. Since these estimates vary from State to State, Figure 5-2 illustrates the range in percent contributions of point, area, and mobile source emissions for selected states. Figure 5-2 shows that point source contributions ranged from 81 percent (Alabama) to 16 percent (Hawaii), area source contributions ranged from 48 percent (Idaho) to 9 percent (Alabama), and mobile source contributions ranged from 55 percent (Hawaii) to 10 percent (Alabama). Figure 5-3 presents the geographic distribution of 1993 emissions of HAPs by mass at the State level. While this figure shows total emissions of HAPs for each State, it does not imply relative health risk from exposure to HAPs. The categorization of pollutant emissions as high, medium, and low only provides a rough sense of the geographic distribution of emissions. In viewing these figures it is important to note that some states may show relatively high emissions totals as a result of very large emissions from a few facilities. Likewise, relatively large emissions totals may also result from numerous small point sources.

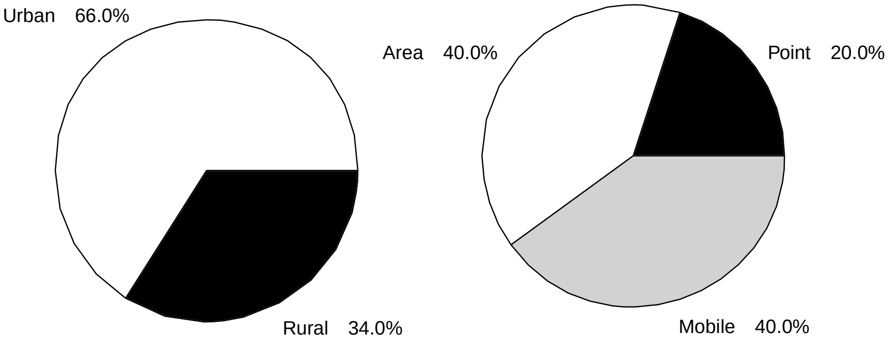
The EPA periodically updates the NTI and is currently compiling the 1996 NTI. The 1993 NTI includes emissions information for 166 of the 188 HAPs from 958 point-, area-, and mobile-source categories. Emissions data from the Toxic Release Inventory (TRI) were used as the foundation of the 1993 NTI. However, the TRI's lack of emission estimates from mobile and area sources severely limit its utility as a comprehensive air toxics emissions database.[4] Analysis of the 1993 NTI suggests that the TRI data alone represent less than 10 percent (760,000 tons / year) of the total NTI emissions. The NTI, therefore,

Table 5-4. 33 Draft Urban HAPs[a]

HAP Name	CAS Number
Acetaldehyde	75070
Acrolein	107028
Acrylonitrile	107131
Arsenic and compounds	
Benzene	71432
Bis(2-ethylhexyl)phthalate	117817
1,3-Butadiene	106990
Cadmium and compounds	
Carbon tetrachloride	56235
Chloroform	67663
Chromium and compounds	
1,4-Dichlorobenzene	106467
1,3-Dichloropropene	542756
Dioxins/Furans (defined as TEQ)	
Ethylene dibromide (dibromoethane)	106934
Ethylene dichloride (1,2-dichloroethane)	107062
Ethylene oxide	75218
Formaldehyde	50000
Hydrazine	302012
Lead and compounds	
Manganese and compounds	
Mercury and compounds	
Methylene chloride (dichloromethane)	75092
Methylene diphenyl diisocyanate (MDI)	101688
Nickel and compounds	
Polycyclic organic matter (defined as 16-PAH)	
Propylene dichloride (1,2-dichloropropane)	78875
Tetrachloroethylene (perchloroethylene)	127184
Trichloroethylene	79016
Vinyl chloride	75014
Coke oven emissions	
Methyl chloride	
Quinoline	

[a] The first 30 HAPs in this list have significant contributions from area source categories, and thus, required listing under sections 112(c)(3) and 112(k). The last 3 HAPs, coke oven emissions, methyl chloride, and quinoline are predominantly emitted by major sources.

Figure 5-5. National emissions of 30 draft urban area source HAPs, 1990.



sought other sources to fill in the gaps. Data from EPA studies, such as the Mercury Study,[5] inventories for Clean Air Act sections 112c(6) and 112(k), and data collected during development of Maximum Achievable Control Technology (MACT) Standards under section 112(d), supplement the TRI data in the NTI.

The 1993 and 1996 NTIs also incorporate data from State and local HAP inventories. The 1996 NTI currently includes 38 HAP inventory data from State and local agencies (representing 34 States). Figure 5-4 shows the States that have submitted 1996 HAP inventory to EPA. Thus, the State and local HAP inventories will form the new foundation of the 1996 NTI. One other important distinction between the 1993 and 1996 NTI is that 1993 data are allocated at the county level, whereas, the 1996 NTI data will be allocated at the facility level for point (major) sources. This allows for greater spatial detail in the 1996 NTI. The complete 1996 NTI is targetted for completion in the Fall of 1999.

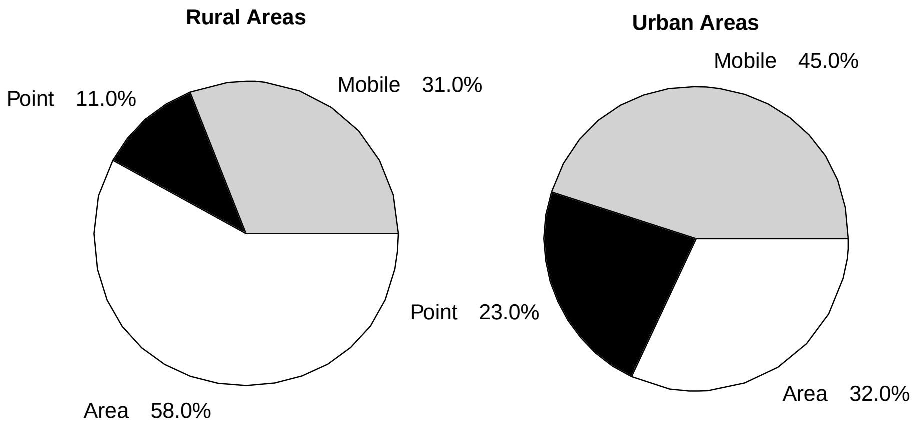
As a result of the implementation of MACT standards, point source emissions are estimated to have decreased by over 660,000 tons from 1993 through 1997. Table 5-1 presents a summary of estimated emission reductions from the full implementation of MACT standards with compliance dates through 1997.

Table 5-2 compares 1993 and 1996 mobile on-road source emissions. Mobile on-road emissions decreased by 258,000 tons over this time period, primarily as a result of regulations requiring the use of reformulated fuels. (See the Ozone section in Chapter 2: National Trends for Criteria Pollutants.) Table 5-3 lists HAPs emitted from on-road gasoline vehicles that have emission estimates in the 1993 and 1996 NTIs. Although the EPA addresses stationary and mobile sources under separate regulatory authorities and through separate offices, these emissions are being evaluated together in EPA's air toxics strategies. Section 202(l) requires EPA to regulate the emissions of HAPs from motor vehicles. EPA's reformulated gasoline program requires a 15 percent year-round reduction in the total mass of toxic emissions. EPA's Office of Mobile Sources has provided estimation methodologies for the mobile source-emitted HAPs included in the NTI.

The EPA is compiling the NTI every three years (1993, 1996, 1999, etc.) The emissions estimates in the NTI, regardless of base year, have several limitations. The NTI is a repository of HAP emissions data from various sources, and it varies in quality and completeness among source categories, geographic location, and estimation methods. As the process of compiling these data is evolving, estimates will likely improve. However, as new base year inventories are compiled and source category and emissions calculation methods change, emissions estimates are likely to change over time because of these factors as well as because of actual changes in emissions.

EMISSIONS DATA

Figure 5-6. National urban and rural emissions of 30 draft urban area source HAPS, 1990.



Section 112(k) Interim Inventory for Urban HAPs

To support the regulation of area sources in urban areas under CAA Section 112(k), which requires selecting at least 30 HAPs that pose the greatest threat to public health in the largest number of urban areas, EPA compiled an interim 1990 emissions inventory for proposed urban HAPs. The EPA conducted an analysis to comprehensively identify the pollutants that pose the largest public health threat in urban areas. The result was a draft list of 33 urban HAPs. Of these, 3 are emitted predominantly from major sources and 30 have emissions from multiple source types, but with significant contributions from area sources. Table 5-4 lists the 33 draft urban area source HAPs. Figures 5-5 and 5-6 present summary data from the interim urban area emissions inventory for the 30 HAPs significantly associated with area sources. Figure 5-5 indicates that area sources account for 40 percent of emissions of these 30 HAPs, mobile sources account for 40 percent, and point (major) sources account for 20 percent. Further, Figure 5-5 also shows that urban emissions of these 30 HAPs account for 66 percent of total emissions while rural emissions account for 34 percent. Figure 5-6 summarizes source type contributions of emissions of these 30 HAPs by rural and urban geographic areas. Urban geographic areas have higher proportions of mobile and point sources than rural areas. The 1990 interim urban emission inventory has undergone extensive external and internal review and has subsequently been incorporated into the 1993 NTI. The urban inventory is available at the following website. **www.epa.gov/ttn/uatw/112k/riurban.html.**

It should be noted that the percentage contributions (mobile, point, area) shown in Figure 5-5 for the interim urban inventory differ significantly from those shown in Figure 5-1 for the 1993 NTI. The primary reason for this difference is that the interim urban inventory includes data for only the 30 urban HAPs while the 1993 NTI incorpo-

Table 5-5. Summary of Changes in Mean Concentration for HAPs Measured as a Part of the PAMS Program (24-hour measurements), 1995-1997*

HAP	1995 to 1996 # Sites	 # Up	 # Down	1996 to 1997 # Sites	 # Up	 # Down
Acetaldehyde	2	0	0	4	1	1
Benzene	5	1	2	12	0	4
Ethylbenzene	5	0	2	12	0	2
Formaldehyde	2	0	0	4	1	1
Hexane	4	0	0	10	0	2
Toluene	5	0	1	12	0	1
Styrene	5	1	2	11	1	5
m/p-Xylene	5	0	0	10	0	3
o-Xylene	5	0	1	12	1	3
2,2,4-Trimethylpentane	5	0	3	11	0	4

* Note that the terms #Up and #Down refer to the number of sites in which the change in annual mean concentration between 1995 and 1996, or 1996 and 1997, is a statistically significant increase or decrease. The total number of sites (# sites) may not necessarily equal the sum of the corresponding #Up and #Down categories.

Table 5-6. Comparison of Loading Estimates for the Great Lakes

Chemical	Year	Superior (kg/yr)	Michigan (kg/yr)	Huron (kg/yr)	Erie (kg/yr)	Ontario (kg/yr)
PCBs (wet+dry)	1988	550	400	400	180	140
	1992	160	110	110	53	42
	1994	85	69	180	37	64
	1996	50	42	na	34	na
DDT (wet+dry)	1988	90	64	65	33	26
	1992	34	25	25	12	10
	1994	17	32	37	46	16
	1996	4	12	na	2	na
B(a)P (wet+dry)	1988	69	180	180	81	62
	1992	120	84	84	39	31
	1994	200	250	na	240	120
	1996	77	117	na	160	na
Pb (wet+dry)	1988	230,000	540,000	400,000	230,000	220,000
	1992	67,000	26,000	10,000	97,000	48,000
	1994	51,000	72,000	100,000	65,000	45,000
	1996	na	na	na	na	na

rates data for 166 HAPs. Further, the subset of 30 pollutants included in the interim urban inventory are those with significant contributions from area sources, as indicated above. An analysis of the 1993 NTI inventory for the subset of 30 urban HAPs indicates similar percentage contributions to those shown in Figure 5-5.

Ambient Air Quality Data

Presently, there is no national ambient air quality monitoring network designed to perform routine measurements of air toxics levels. Therefore, ambient data for individual air toxic pollutants is limited (both spatially and temporally) in comparison to the data available from the long-term, nationwide monitoring for the six criteria pollutants. EPA has several efforts underway which, although less effective than a comprehensive and routine HAPs network, will provide some information useful to assessing the toxics issue.

The Agency's Photochemical Assessment Monitoring Stations (PAMS) collect data on concentrations of ozone and its precursors (VOCs and NO_x) in 21 areas across the nation classified as serious, severe or extreme nonattainment areas for ozone. Because a number of ozone precursors are also air toxics, ambient data collected from PAMS sites can be used for limited evaluations of toxics problems in selected urban areas as well as assessment of the tropospheric ozone formation. Despite some limitations, the PAMS sites will provide consistent, long-term measurements of selected toxics in major metropolitan areas. The

PAMS program requires routine measurement of 10 HAPs: acetaldehyde, benzene, ethyl benzene, formaldehyde, hexane, styrene, toluene, m / p-xylene, o-xylene and 2,2,4-trimethlypentane.

Preliminary analysis of measurements of selected HAPs in PAMS areas indicate that concentrations of certain toxic VOCs in those areas appear to be declining. Table 5-5 shows 2-year comparisons for 24-hour measurements for the ten parameters measured at PAMS sites for the periods 1995-1996 and 1996-1997.[6] For a more detailed discussion of the PAMS program, see the Ozone section in Chapter 2: National Trends of Criteria Pollutants.

In addition to the PAMS program, EPA continues to administer and support voluntary programs through which states may collect ambient air quality measurements for suites of toxics. These programs include the Urban Air Toxics Monitoring Program (UATMP), as well as the Non-Methane Organic Compound (NMOC) and Speciated Non-Methane Organic Compound (SNMOC) monitoring programs. The UATMP is the program dedicated to toxics monitoring which involves measurements of 37 VOCs and 13 carbonyl compounds.[7] In the current programs, five states are participating and operating 15 ambient measurement sites for toxics.[8] The EPA is currently working to incorporate data from these measurement programs into national and local air toxics assessments. Results from these analyses will be discussed in future editions of this report.

In addition to ambient concentration monitoring, EPA also participates in efforts to measure the atmospheric deposition of toxic pollution. In 1990 the U.S. and Canada initiated a joint measurement program, the Integrated Atmospheric Deposition Network (IADN), to assess the relative importance of atmospheric deposition to the Great Lakes, and to provide information about sources of these pollutants.[9] The network consists of master (research-grade) stations on each lake, with additional satellite stations. Two master stations in Canada and three in the United States were chosen to be representative of regional deposition patterns. In addition to collecting data on precipitation rates, temperature, relative humidity, wind speed and direction, and solar radiation collected at each site, IADN measures concentrations of target chemicals in rain and snow (wet deposition), airborne particles (dry deposition), and airborne organic vapors.[10]

Table 5-6 presents the results of a comparison of deposition estimates from IADN studies performed between 1988 and 1996 (1996 loadings estimates for Lake Huron and Lake Ontario are not yet available). These estimates reveal a significantly large decline in loadings from the atmosphere of PCBs and DDT, which would be expected considering that use of DDT has been restricted since 1972 and banned since 1988, and PCBs are no longer manufactured and are being phased out of use. The vast majority of the PCBs and DDT being recorded by the monitoring network results from emissions (via chemical volatility) from soil and water contaminated with these chemicals and transport to the lakes. On the other hand, benzo(a)pyrene (B(a)P), a by-product of combustion processes and one of the most toxic polycyclic aromatic hydrocarbons yet characterized, is being emitted by a number of current sources around the Great Lakes.

Loadings to the lakes show some variability at each site from year to year, probably due in part to the range of error inherent in the B(a)P loadings calculations and to fluctuations in ambient concentrations.[11]

Mercury's adverse effects on ecological and public health have raised the level of awareness regarding its persistence in the environment. As a result, there has been a concerted effort by local, State, and national environmental agencies to accurately measure the annual progress of regulations and technologies aimed at reducing mercury. The Mercury Deposition Network (MDN) is a key element of these efforts. A subsidiary of the National Atmospheric Deposition Program (NADP), the MDN currently consists of nearly 40 sites located in 16 States and two Canadian provinces. The MDN monitors the presence of mercury and methyl mercury in precipitation and has enabled scientists to compile a national database of weekly precipitation concentrations. As a result, State and federal air regulators can monitor progress in reducing mercury and amend policy decisions accordingly. There are plans to expand the network in the near future, pending availability of new funds. Additional information about the network is available on the Internet at **http://nadp.sws.uiuc.edu/mdn/**.

Concurrent with the monitoring efforts discussed in this section, EPA has recently initiated a program to identify, compile and catalogue all previously collected monitoring data for air toxics which is not now centrally archived. This effort is focusing presently on the compilation of measurements previously made by state and local agencies. These data will contribute to the development of an expanded and enhanced information infrastructure for air toxics.[12] All data completed as a result of this effort will be made universally accessible to all interested programs and analysts.

In addition, the Agency is also sponsoring a related project to develop environmental indicators based on air quality monitoring data, emissions data, modeling data, and administrative/programmatic data that can effectively demonstrate the extent and severity of the air toxics problem, and any progress made toward solving it in future years through regulatory or voluntary programs. Indicators will be included that consider population exposure and health risk, as well as ambient concentrations and emissions. Such indicators will be used to make geographic comparisons and assess temporal trends in subsequent trends reports.[13]

Modeled Air Quality Levels

The EPA has recently developed and demonstrated a national air toxics modeling system, as part of its Cumulative Exposure Project (CEP), which has been designed to provide a broad screening-level quantitative perspective on outdoor air toxics concentrations. The CEP utilized an atmospheric dispersion model, called ASPEN (the Assessment System for Population Exposure Nationwide), in conjunction with a preliminary national emissions inventory, including both human-made and natural sources of emissions, to estimate the ambient air toxics concentrations for the year 1990. The outputs generated by the model were annual average outdoor concentrations for 148 air toxics, estimated at each census tract in the continental U.S. (There are 60,803 census tracts in the continental U.S. which vary in physical size but generally have about 4,000 residents each.) Given the inherent uncertainties involved in computer modeling and emission inventories, the CEP results are most reliable when analyzed on a national or State scale, but less so at the county and census tract levels.

The results of this preliminary application of the model for 1990, although considered to include uncertainties, indicate that outdoor HAP concentrations may be significantly elevated in many urban areas when compared to rural areas, and that many predicted levels are relatively high, suggesting potential public health concerns. The results thus lend support to the decision of Congress in 1990 to strengthen the air toxics provisions of the Clean Air Act. It is important to note, however, that these preliminary CEP estimates for 1990 do not reflect the reality that, since that time, the EPA and State and local governments have issued regulations that have reduced and will continue to significantly reduce air toxic emissions from major industries, such as chemical plants and oil refineries, as well as from motor vehicles. Specific results from the 1990 run of the model can be reviewed on the Internet at **http://www.epa.gov/CumulativeExposure**.

Further development and demonstration of the CEP modeling approach, now referred to as CEP-II, will represent a significant evolution in the ability of the EPA to assess the nature and magnitude of the air toxics problem on a national scale. In its CEP-II efforts, the EPA is currently using model performance evaluations and improved emissions information from State and local agencies to update and refine the methods employed in the original CEP analysis. Later this year, the EPA plans to use the CEP-II model based on the improved 1996 NTI emissions inventory. In future years, EPA plans to continue to refine the modeling approach and utilize results from these model simulations to help track air toxics problems and the success of efforts to address them. Results from these simulations will be included in future Trends Reports to provide a national perspective on air toxics trends.

AIR TOXICS REGULATION AND IMPLEMENTATION STATUS

The CAA greatly expanded the number of industries affected by national air toxics emissions controls. Large industrial complexes (major sources) such as chemical plants, oil refineries, marine tank vessel loading, aerospace manufacturers, steel mills, and a number of surface coating operations are some of the industries being controlled for toxic air pollution. Where warranted, smaller sources (area sources) of toxic air pollution such as dry cleaning operations, solvent cleaning, commercial sterilizers, secondary lead smelters, and a chrome plating are have also been regulated. EPA estimates that over the next 10 years the technology-based phase of the air toxics program will reduce emissions by 1.5 million tons per year.[14]

The MACT Program

The technology-based regulation of air toxics emissions is already beginning to achieve significant emissions reductions of HAPs. As of September 1997, Maximum Achievable Control Technology (MACT) standards have been promulgated for 52 source categories. Sixteen major- and eight area-source categories have begun to take action toward complying with the standards required by the 2- and 4-year MACT regulations. Sources are required to comply with these standards within three years of the effective date of the regulation, with some exceptions. In October 1997, to comply with Section 112(s), EPA released a report to Congress describing the status of the HAP program under the CAA. EPA estimates that the 2- and 4-year standards will reduce HAP emissions by approximately 980,000 tons / year when fully implemented.[14] In addition, EPA has promulgated regulations on municipal waste combustors and hospital / medical / infectious waste incinerators under Section 129 of the CAA. These regulations will significantly reduce emissions of the listed Section 129 pollutants, including particulate matter, sulfur dioxide, hydrogen chloride, oxides of nitrogen, carbon monoxide, lead, mercury, dioxins and dibenzofurans. For example, mercury emissions from municipal waste combustors are estimated to be reduced in the year 2000 by about 98 percent from 1990 levels. When the regulations become fully effective, mercury emissions from hospital / medical / infectious waste incinerators are estimated to be reduced by 93-95 percent from 1995 levels.

The air toxics program and other air pollution programs, such as the NAAQS program, complement each other. Many air toxics are also particulate matter (PM) or VOCs which can be ozone precursors. As such, many control efforts to meet the NAAQS for ozone and PM10 also reduce air toxic emissions. Furthermore, as air pollution control strategies for automobiles become more stringent, air toxic emissions from vehicles also are reduced. Requirements under the air toxics program can also significantly reduce emissions of some of the six NAAQS pollutants. For example, MACT standards are predicted to reduce approximately 1.8 million tons per year in combined emissions of particulate matter and VOC as ozone precursors. EPA's final air toxics rule for organic chemical manufacturing alone is expected to reduce VOC emissions by nearly 1 million tons annually.

The Specific Pollutants Strategy

Section 112(c)(6) of the CAA requires EPA to identify sources of seven specific compounds (alkylated lead compounds, POM, mercury, hexachlorobenzene, PCBs, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and 2,3,7,8-tetrachlorodibenzofuran), and to regulate sources accounting for at least 90 percent of the emissions of each pollutant.20 MACT standards must be developed by EPA for sources of these HAPs that are not subject to current MACT standards. In order to meet the requirements of Section 112(c)(6), EPA compiled national inventories of sources and emissions of each of the seven HAPs, and identified source categories for regulation.[15]

The Integrated Urban Air Toxics Strategy

To address the problem of exposure to air toxics in urban areas, EPA is developing an integrated urban air toxics strategy that addresses the urban air toxics risks from both stationary and mobile sources. This strategy is expected to produce a set of actions that will be more responsive to the cumulative risks presented by multiple sources of toxics and combined exposures to multiple toxics. By considering urban air toxics emissions from all sources, EPA will better respond to the relative risks posed by any one pollutant and / or source category. Thus, integration of the activities under both the air toxics and mobile source sections of the Act will more realistically address the total exposure and will better allow us and the States to develop activities to address risks posed by toxic pollutants where the emissions and risks are most significant and controls are most cost effective.

Under the urban program, EPA's first phase regulatory task is to identify at least 30 HAPs that are of particular concern when emitted in urban areas, especially from area sources. Then, EPA is to reduce risks from these pollutants, first by regulating sources that account for 90 percent of the emissions of the HAPs of concern. Regulations of area sources under this program can be with MACT or GACT regulations. In September of 1998, EPA released a draft of the Integrated Urban Air Toxics Strategy to the public for comment. In the draft strategy, EPA provided, a draft list of 33 HAPs that are of particular concern when emitted in urban areas, including a subset of 30 particularly relevant to area sources. EPA also provided a draft list of area source categories that may require regulation in the future to meet the "90% requirement". This list may change before it is published as final.

After identifying the HAPs and their sources, EPA will examine the MACT, vehicle fuels and emissions program, and other air toxics-related programs, including State and local programs, to assess the risk reduction that can be reasonably expected once these other programs have been fully implemented. Then EPA will identify what additional controls may be needed. Since point, area, and mobile sources in urban areas emit many of the same pollutants EPA believes this integrated approach is the most efficient and cost-effective way to address the health risks attributable to exposure to air toxics in urban areas. In the draft strategy published in September of 1998, EPA included schedules for potential actions to address HAP emissions from mobile sources and stationary sources (including consideration of the requirements to reduce cancer risk from these sources by at least 75 percent and to substantially reduce other risks). Schedules for developing tools and databases to better understand cumulative exposures to HAPs were also included in the draft strategy.[16]

Residual Risk

To determine whether risks are acceptable after the application of MACT standards, Congress added, in Section 112(f), a human health risk and adverse environmental effects criteria to the second regulatory phase. In this phase, referred to as "residual risk" standard setting, EPA is required to promulgate additional standards for those source categories that are emitting HAPs at levels that present an unacceptable risk to the public or the environment. Congress directed that residual risk standards should "provide an ample margin of safety to protect public health." Risks of cancer and other health effects, as well as the potential for adverse environmental effects will be considered in setting residual risk standards. Using a risk management framework, EPA is currently conducting residual risk assessments to determine whether technology-based emission standards are sufficient to protect human health. The first rules, if necessary, are due in 2002.

EPA is also required by Section 112(f)(1)of the Act to provide a report to Congress describing the methodology of approaches assessing these residual risks, the public health significance of any remaining risks, and technical and economic issues associated with controlling the risks. The report is currently scheduled for publication in early 1999.

SPECIAL STUDIES/PROGRAMS

The Great Waters Program

Section 112(m) of the CAA requires the Agency to study and report to Congress every two years on the extent of atmospheric deposition of HAPs and other pollutants to the Great Lakes, Chesapeake Bay, Lake Champlain, and coastal waters, and the need for new regulations to protect these water bodies. The pollutants of concern to this effort include mercury, chlorinated organics and other persistent, bioaccumulating HAPs, as well as nitrogen compounds. This program coordinates with extensive research programs to provide new understanding of the complicated issue of atmospheric deposition of air pollution to water bodies. New scientific findings are incorporated into each required biennial report to Congress and appropriate regulatory recommendations are made as warranted by those findings. This statute provides the authority to introduce new regulations or influence those under development in order to prevent adverse effects from these pollutants to human health and the environment.

The Mercury Study

The Mercury Study is a comprehensive study of mercury emissions from anthropogenic sources in the United States, an assessment of the public health and ecological effects of such emissions, and an analysis of technologies to control mercury emissions, and the costs of such control. The study is mandated by Section 112(n)(1)(B) of the CAA because mercury is, as an element, eternally persistent, as well as bioaccumulative and the cause of fish consumption advisories in more than 39 States. A number of observations can be made regarding trends in mercury use and emissions. The overall use of mercury by industrial and manufacturing source categories has significantly declined. Industrial use of mercury declined by nearly 75 percent between 1988 and 1995. Much of this decline can be attributed to the elimination of mercury as a paint additive and the phase-out of mercury in household batteries. Reducing mercury in manufactured products is important because emissions of mercury are most likely to occur when these products are broken or discarded. Based on trends in mercury use, EPA predicts that manufacturing use of mercury will continue to decline. Chlorine production from mercury cell chlor-alkali plants will continue to account for most of the use in, and emissions from, the manufacturing sector. This industry has indicated it will voluntarily reduce mercury use by 50 percent by 2006. Secondary production of mercury may increase as more recycling facilities begin operations to recover mercury from discarded products and wastes. A significant decrease will occur in mercury emissions from municipal waste combustors and medical waste incinerators when the final regulations promulgated by EPA for these source categories are fully implemented. Emissions from both categories will decline by at least 90 percent from 1995 levels; to roughly 6 tons per year from municipal waste combustors and 1 ton per year from medical waste incinerators. In addition, EPA has proposed mercury emission limits for hazardous waste combustors. Based on 1995 estimates, coal-fired utility boilers are the largest source category at 52 tons per year. Future mercury emissions from utility boilers depend on a number of factors including the nation's energy needs, fuel choices, industry restructuring and other requirements under the CAA (e.g., the acid rain program). A recent EPA analysis also predicted mercury emissions will decline at least 11 tons per year as a result of implementation of the ambient standards for fine particulate matter. International efforts to reduce greenhouse gases will also reduce mercury emissions. The Mercury Study Report to Congress was completed in December 1997.[5]

The Utility Air Toxics Study

As mandated by Section 112(n)(1)(A) of the CAA, the Agency has completed a study of HAP emissions from fossil fuel-fired (coal, oil, and gas) electric utilities, the associated hazards to public health, as well as an assessment of alternative emissions control strategies. EPA released a final report from this study in February, 1998.[17] The report identifies 67 HAPs emitted from electric utilities, and predicts that by the year 2010 a 30 percent increase in HAP emissions from coal-fired utilities while emissions from oil-fired utilities are estimated to decline by 50 percent. Though substantial uncertainties exist in these future emission estimates, they are based on projected energy demands, changes in fuel mix at utilities, and expected emission reductions from the Acid Rain Program. While significant uncertainty exists regarding the risks posed from HAP emissions, the main pollutants of concern from electric utilities include: mercury, arsenic, nickel, and dioxin. Due to the uncertainties mentioned, the Agency has deferred a final decision on the need for additional control of HAP emissions from electric utilities until more information on this industry is available.

REFERENCES

1. This list originally included 189 chemicals. The CAA allows EPA to modify this list if new scientific information becomes available that indicates a change should be made. Using this authority, the Agency modified the list to remove caprolactam in 1996, reducing the list to 188 pollutants (Hazardous Air Pollutant List; Modification, 61 FR 30816, June 18, 1996).

2. "Update: Listing of Fish and Wildlife Advisories," announcing the availability of the 1996 update for the database: Listing of Fish and

Wildlife Advisories (LFWA); U.S. EPA Fact Sheet, EPA-823-97-007, June 1997.

3. Hillery, B.R., Hoff, R.M., and Hites, R.A. 1997. "Atmospheric contaminant deposition to the Great Lakes determined from the Integrated Atmospheric Deposition Network." Chapter 15 in Atmospheric Deposition of Contaminants to the Great Lakes and Coastal Waters. 1997, Joel E. Baker, Editor. SETAC Press. (Society of Environmental Toxicology and Chemistry.)

4. In addition to the absence of emissions estimates for area and mobile source categories, there are other significant limitations in the TRI's portrayal of overall HAP emissions. First, facilities with Standard Industrial Classification (SIC) codes outside the range of 20 to 39 (the manufacturing SICs) are not required to report. Therefore, HAP emissions from facilities such as mining operations, electric utilities, and oil and gas production operations are not represented in the TRI. Further, TRI data are self-reported by the emitting facilities, and TRI does not require facilities to perform any actual monitoring or testing to develop their reported estimates. Consequently, the accuracy of the reported data may vary from facility to facility and from year to year. Finally, the original TRI list only required reporting for 173 of the 188 HAPs identified in the CAA.

5. Mercury Study Report to Congress. Volume II. An Inventory of Anthropogenic Mercury Emissions in the United States. EPA-452/R-97-004b. The report can also be access via the internet at: **http://www.epa.gov/ttnuatw1/112nmerc/mercury.html**

6. Summaries of the health effects associated with the compounds included in this analysis are provided below:

Acetaldehyde: The primary effects on humans, reported from short-term exposure to low to moderate levels of acetaldehyde, are irritation of eyes, skin, and respiratory tract. Short-term exposure effects on animals also include slowed respiration and elevated blood pressure. Effects on humans from long-term acetaldehyde exposure resemble those of alcoholism. Long-term exposures of animals have resulted in changes in respiratory tract tissues, as well as growth retardation, anemia, and kidney effects. While no information is available on acetaldehyde effects on human reproduction or development, both such effects have been observed in animal tests. Based on evidence of tumors in animals, EPA has classified acetaldehyde as a probable human carcinogen.

Benzene: Reported effects on humans, from short-term exposure to low to moderate benzene levels, include drowsiness, dizziness, headache, and unconsciousness as well as eye, skin and respiratory tract irritation. Effects on both humans and animals from long-term benzene exposure include blood and immune system disorders. Reproductive effects have been reported for women exposed to high benzene levels and adverse effects on the developing fetus have been observed in animal tests. Changes in human chromosome number and structure have been reported under certain exposures. EPA has classified benzene as a known human carcinogen.

Formaldehyde: Reported effects on humans, from short-term and long-term exposure to formaldehyde, are mainly irritation of eyes, nose, throat, and, at higher levels, the respiratory tract. Long-term exposures of animals have also resulted in damage to respiratory tract tissues. Although little information is available on developmental effects to humans, animal tests do not indicate effects on fetal development. EPA has classified formaldehyde as a probable human carcinogen.

Toluene: Effects on the CNS of humans and animals have been reported, from short-term exposure to low to moderate levels of toluene, and include dysfunction, fatigue, sleepiness, headaches, and nausea. Short-term exposure effects also include cardiovascular symptoms in humans and depression of the immune system in animals. CNS effects are also observed in long-term exposures of humans and animals. Additional long-term exposure effects include irritation of eyes, throat and respiratory tract in humans and changes in respiratory tract tissue of animals. Repeated toluene exposure has been observed to adversely affect the developing fetus in humans and animals. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider toluene classifiable as to human carcinogenicity.

Xylenes: Reported effects on humans, from short-term exposure to high levels of xylenes, include irritation of eyes, nose, and throat, difficulty breathing, impairment of the CNS and gastrointestinal effects. Similar effects have been reported in animals in addition to effects on the kidney. Human effects from long-term exposure to xylenes are to the CNS, respiratory and cardiovascular systems, blood, and kidney. Long-term animal exposures to high levels of xylenes have shown effects on the liver. Effects on the developing fetus have been observed in animal studies. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider xylenes classifiable as to human carcinogenicity.

Ethylbenzene: Effects reported, from short-term exposures of humans to high levels of ethyl benzene, include dizziness, depression of the CNS, eye, mucous membrane, nose and respiratory tract irritation, and difficulty breathing. In short-term exposures of laboratory animals, additional effects on the liver, kidney and pulmonary system have also been reported. Long-term exposures of animals have demonstrated effects on blood cells, the liver and kidneys. Effects on fetal development have also been observed in animal exposures. Due to a lack of information for humans and inadequate animal evidence, EPA does not consider ethyl benzene classifiable as to human carcinogenicity.

Styrene: Exposure to styrene vapors can cause irritation of eyes, nose, throat and respiratory tract in humans. Effects on the CNS of humans including dizziness, fatigue, sleepiness, headaches, nausea, and effects on intellectual function and memory have also been reported from long-term exposure to styrene. Long-term exposures of animals have demonstrated effects on the CNS, liver and kidney as well as eye and nasal irritation. Although the available information for humans is inconclusive, animal tests do not indicate effects on reproduction or fetal development. When styrene is absorbed into the human body, some of it is metabolized into styrene oxide, a direct acting mutagen that causes tumor developmen in test animals. The carcinogenicity of styrene is currently under review by EPA.

Hexane: Reported effects on humans, from short-term exposure to high levels of hexane, include irritation of eyes, mucous membranes, throat and skin, as well as impairment of the CNS including dizziness, giddiness, headaches, and slight nausea. Long-term human exposure from inhalation is associated with a slowing of peripheral nerve signal conduction which causes numbness in the extremities and muscular weakness, as well as changes to the retina which causes blurred vision. Animal exposures to hexane have resulted in damage to nasal, respiratory tract, lung and peripheral nerve tissues, as well as effects on the CNS. No information is available on hexane effects on human reproduction or development. Limited laboratory animal data indicate a potential for testicular damage in adults, while several animal studies show no effect on fetal development. EPA has not classified hexane as to human carcinogenicity.

2,2,4-Trimethylpentane: Little information is available on the effects of 2,2,4-trimethylpentane overexposure in humans. Laboratory animals exposed to high levels for short periods have developed irritation, fluid build-up and bleeding in the lungs, as well as depression of CNS function. Kidney and liver effects have been reported from long-term animal exposures. No information is available on the potential for reproductive or developmental effects or on the carcinogenic potential of 2,2,4-trimethylpentane.

7. Twenty-eight of the 37 VOCs, and four of the 13 carbonyls measured as a part of the UATMP are defined as HAPs in section 112(b)(1) of the CAA.

8. The following states are presently participating in the UATMP: Arkansas, Louisiana, New Jersey, Texas, and Vermont.

9. The IADN fulfills legislative mandates in Canada and the United States that address the monitoring of air toxics. An international Great Lakes deposition network is mandated by Annex 15 of the Great Lakes Water Quality Agreement between the United States and Canada. In the United States, the CAA requires a Great Lakes deposition network.

10. The target chemicals include PCBs, pesticides, PAHs and metals. The compounds included as “target chemicals” were selected based on the following criteria: presence on List 1 of Annex 1 of the Great Lakes Water Quality Agreement (substances believed to be toxic and

present in the Great Lakes); established or perceived water quality problem; presence on the International Joint Commission's Water Quality Board's list of criteria

pollutants; evidence of presence in the atmosphere and an important deposition pathway; and feasibility of measurement in a routine monitoring network.

11. Hoff, R.M., Strachan, W.M.J., Sweet, C.W., D.F. Gatz, Harlin, K., Shackleton, M., Cussion, S., Chan, C.H., Brice, K.A., Shroeder, W.H., Bidleman, T.F., Atmospheric Deposition of Toxic Chemicals to the Great Lakes: A Review of Data Through 1994, Atmos. Environ., 1996, 30, 3505-3527. For additional references see A, B, C listed below.

A. Hornbuckle, K.C., Jeremaison, J.D., Sweet, C.W., Eisenreich, S., "Seasonal Variations in Air-Water Exchange of Polychlorinated Biphenyls in Lake Superior", J. Environ. Sci. Technol. 1994, 28, 1491-1501.

B. Hillery, B.R., Basu I., Sweet, C.W., Hites, R.A., Temporal and Spatial Trends in a Long-Term Study of Gas-Phase PCB Concentrations near the Great Lakes, Environ. Sci. Technol. 1997, 31, 1811-1816.

C. Hillery, B.R., Hoff, R.M., Hites, R. Atmospheric Contaminant Deposition to the Great Lakes Determined from the International Atmospheric Deposition Network, In Atmospheric Deposition of Contaminants to the Great Lakes and Coastal Water, Baker, J.E., ed., Society for Environmental Toxicology and Chemistry, 1997.

12. Interest in participation in this voluntary effort and/or requests for further information about this data cataloguing effort should be directed to Rhonda Thompson, Office of Air Quality Planning and Standards, Mail Drop 14, Research Triangle Park, North Carolina 27711; 919-541-5538; and thompson.rhonda@epa.gov.

13. The scheduled completion date for this project is April 1999; however, interim products will be released as completed. Additional information on this project is available through Vasu Kilaru, Office of Air Quality Planning and Standards, Mail Drop 14, Research Triangle Park, North Carolina 27711: 919-541-5332; and kilaru.vasu@epa.gov.

14. Second Report to Congress on the Status of the Hazardous Air Pollutant Program Under the CAA, Draft. EPA-453/R-96-015. October 1997.

15. The final inventory report is available at the following Internet address: www.epa.gov/ttn/uatw/112cfac.html.

16. The draft inventory report is available at the following Internet address: **www.epa.gov/ttn/uatw/112kfac.html**

17. *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress: Volume 1*, U.S. EPA 1998. EPA 453/R-98-004a.

CHAPTER 6

Visibility Trends

http://www.epa.gov/oar/aqtrnd97/chapter6.pdf

INTRODUCTION

The Clean Air Act (CAA) authorizes the United States Environmental Protection Agency (EPA) to protect visibility, or visual air quality, through a number of programs. These programs include the national visibility program under sections 169A and 169B of the Act, the prevention of significant deterioration program for the review of potential impacts from new and modified sources, the secondary National Ambient Air Quality Standards (NAAQS) for PM_{10} and $PM_{2.5}$ and section 401 under the provisions for acid deposition control. The national visibility program established in 1980 requires the protection of visibility in 156 mandatory federal Class I areas across the country (primarily national parks and wilderness areas). The CAA established as a national visibility goal, "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory federal Class I areas in which impairment results from manmade air pollution." The Act also calls for state programs to make "reasonable progress" toward the national goal.

In 1987, the Interagency Monitoring of Protected Visual Environments (IMPROVE) visibility network was established as a cooperative effort between EPA, the National Oceanic and Atmospheric Administration, the National Park Service, the U.S. Forest Service, the Bureau of Land Management, the U.S. Fish & Wildlife Service, and State governments. The objectives of the network are to establish current conditions, to track progress toward the national visibility goal by documenting long-term trends, and to provide information for determining the types of pollutants and sources primarily responsible for visibility impairment. Chemical analysis of aerosol measurements provides ambient concentrations and associated light extinction for PM_{10}, $PM_{2.5}$, sulfates, nitrates, organic and elemental carbon, crustal material, and a number of other elements. The IMPROVE program has established protocols for aerosol, optical, and photographic monitoring methods, and these methods are employed at more than 70 sites, most of which are Class 1 areas. Over the next few years, an additional 78 monitoring sites using the IMPROVE protocol will be established. The analyses presented in this chapter are based on data from the IMPROVE network, which can be found on the Internet at: **ftp://alta_vista.cira.colostate.edu/DATA/IMPROVE**.[1]

This chapter presents aerosol and light extinction data collected between 1988 and 1997 at 37 Class I areas in the IMPROVE network. Because the CAA calls for the tracking of "reasonable progress" in preventing future impairment and remedying existing impairment, this analysis looks at trends in visibility impairment across the entire range of the visual air quality distribution. To facilitate this approach, visibility data have been sorted into quintiles, or 20 percent segments of the overall distribution, and average values have been calculated for each quintile. Trends are often presented in terms of the haziest ("worst") 20 percent, middle 20 percent, and clearest ("best") 20 percent of the annual distribution of data. Figure 6-1 provides a photographic illustration of very clear and very hazy conditions at Glacier National Park in Montana, and Dolly Sods Wilderness Area in West Virginia.[2] Figure 6-3 is a map of the 37 Class I areas with 6 or more years of IMPROVE monitoring data included in this analysis.

NATURE AND SOURCES OF THE PROBLEM

Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases

Figure 6-1. Images of Glacier National Park and Dolly Sods WA.

in the atmosphere. It is most simply described as the haze that obscures the clarity, color, texture, and form of what we see. The same particles linked to serious health and environmental effects (sulfates, nitrates, organic carbon, elemental carbon [commonly called soot], and crustal material) can also significantly affect our ability to see.

Both primary emissions and secondary formation of particles contribute to visibility impairment. Primary particles, such as elemental carbon from diesel and wood combustion or dust from certain industrial activities or natural sources, are emitted directly into the atmosphere. Secondary particles that are formed in the atmosphere from primary gaseous emissions include sulfate from sulfur dioxide (SO_2) emissions, nitrates from nitrogen oxide (NO_x) emissions, and organic carbon particles formed from condensed hydrocarbon emissions. In the eastern United States, reduced visibility is mainly attributable to secondarily formed particles, particularly those less than a few micrometers in diameter. While secondarily formed particles still account for a significant amount in the West, primary emissions from sources such as woodsmoke generally contribute a larger percentage of the total particulate load than in the East. The only primary gaseous pollutant that directly reduces visibility is nitrogen dioxide (NO_2), which can sometimes be seen in a visible plume from an industrial facility, or in some urban areas with high levels of motor vehicle emissions.

Visibility conditions in rural Class I areas vary regionally across the United States. Rural areas in the East generally have higher levels of impairment than most remote sites in the West. Higher eastern levels are generally due to higher regional concentrations of sulfur dioxide and other anthropogenic emissions, higher estimated regional background levels of fine particles, and higher average relative humidity levels. Humidity can significantly increase the effect of pollution on visibility. Some particles, such as sulfates, accumulate water and grow in size, becoming more efficient at scattering light. Annual average relative humidity levels are 70-80 percent in the East as compared to 50-60 percent in the West. Poor summer visibility in the eastern United States is primarily the result of high sulfate particle concentrations combined with high humidity levels.

Visibility conditions are commonly expressed in terms of three mathematically related metrics: visual range, light extinction, and deciviews. Visual range is the metric best known by the general public. It is the maximum distance at which one can identify a black object against the horizon, and is typically described in miles or kilometers. Light extinction, inversely related to visual range, is the sum of light scattering and light absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm^{-1}), with larger values representing poorer visibility. Unlike visual range, the light extinction coefficient allows one to express the relative contribution of one particulate matter (PM) constituent versus another to overall visibility impairment. Using speciated mass measurements collected from the IMPROVE samplers "reconstructed light extinction" can be calculated by multiplying the aerosol mass for each constituent by its appropriate "dry extinction coefficient," and then summing these values for each constituent. Because sulfates and nitrates become more efficient at scattering light with increasing humidity, these values are also multiplied by a relative humidity adjustment factor.[3] Annual and seasonal light extinction values developed by this approach correlate well with optical measurements of light extinction (by transmissometer) and light scattering (by nephelometer).

The deciview metric was developed because changes in visual range and light extinction are not proportional to human perception. For example, a 5-mile change in visual range can be either very apparent or not perceptible, depending on the base line level of ambient pollution. The deciview metric provides a linear scale for perceived visual changes over the entire range of conditions, from clear to hazy, analogous to the decibel scale for sound. Under many scenic conditions, a change of one deciview is considered to be perceptible by the average person. A deciview of zero represents pristine conditions.

It is important to understand that the same amount of pollution can have dramatically different effects on visibility depending on existing conditions. Most importantly, visibility in cleaner environments is more sensitive to increases in $PM_{2.5}$ particle concentrations than visibility in more polluted areas. This principle is illustrated in Figure 6-2, which characterizes visibility at Shenandoah National Park under a range of conditions.[5] A clear day at Shenandoah can be represented by a visual range of 80 miles, with conditions approximating naturally-occurring visibility (i.e., without pollution created by human activities). An average day at Shenandoah is represented by a visual range of 18 miles, and is the result of an additional 10 g/m^3 of fine particles in the atmosphere. The two bottom scenes, with visual ranges of eight and six miles respec-

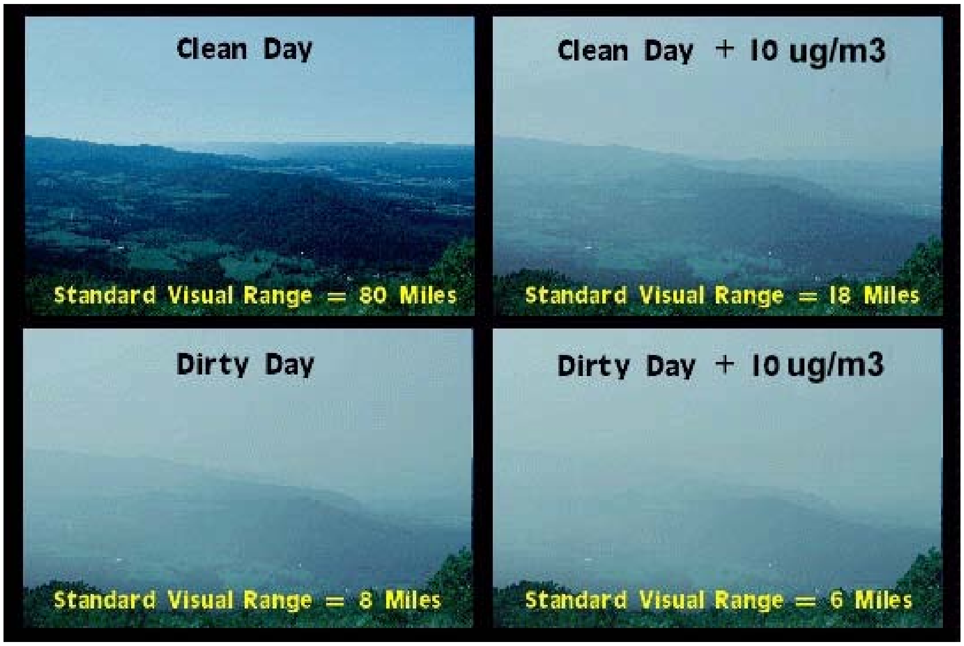
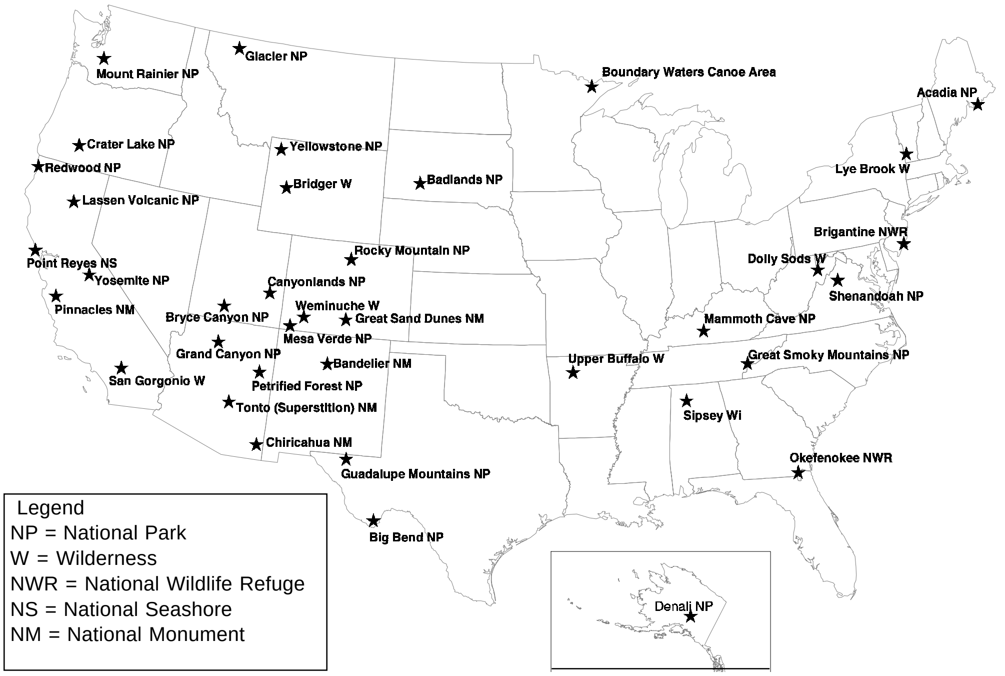


Figure 6-2. Shenandoah National Park on clear and hazy days and the effect of adding 10ug/m^3 of fine particles to each.

Figure 6-3. 37 Class I Areas in the IMPROVE Network with at least 6 years of data.



tively, illustrate that the perceived change in visibility due to an additional 10 g/m^3 of fine particles to an already degraded atmosphere is much less perceptible than adding this amount to a clean atmosphere. Thus, to achieve a given level of perceived visibility improvement, a larger reduction in fine particle concentrations is needed in more polluted areas. Conversely, a small amount of pollution in a clean area can dramatically decrease visibility.

LONG-TERM TRENDS

Visibility impairment is presented here using visual range data collected since 1960 at 280 monitoring stations located at airports across the country. Trends in visibility impairment can be inferred from these long-term records of visual range. Figure 6-4 describes long-term U.S. visibility impairment trends derived from such data.[4] The maps show the amount of haze during the summer months of 1970, 1980, and 1990. The dark blue color represents the best visibility, and red represents the worst visibility. Overall, these maps show that summer visibility in the eastern United States declined between 1970 and 1980, and improved slightly between 1980 and 1990. These trends follow overall trends in emissions of sulfur oxides during these periods.

RECENT TRENDS IN RURAL AREAS: 1988-1997

Aerosol and light extinction data have been collected for 10 consecutive years (1988-1997) at 30 sites in the IMPROVE network, and for 6 consecutive years (1992-1997) at 11 sites in the network. Of these 41 sites, 4 sites (Washington, D.C.; Bliss State Park, CA; Great Basin NP, NV; and Sequoia NP, CA) were omitted from the analyses in this chapter for reasons of missing data or location in an urban area. Washington, DC is the only urban location. The remaining 37 represent rural Class I areas: eleven are located in the East, and 26 are located in the West, as shown in Figure 6-3. Because of the significant regional variations in visibility conditions, this chapter does not present aggregate national trends, but instead groups the data into eastern and western regions. As noted earlier, trends in this chapter are frequently presented in terms of the annual average values for the clearest ("best") 20 percent, middle 20 percent , and haziest ("worst") 20 percent of the days monitored each year. To date, two 24-hour aerosol samples have been taken each week from IMPROVE sites, resulting in a potential for 104 sampling days per year. Beginning in 1999, aerosol samples will be taken every 3 days, consistent with the approach used for new $PM_{2.5}$ aerosol monitoring.

REGIONAL VISIBILITY TRENDS FOR THE EASTERN AND WESTERN UNITED STATES

Figures 6-5a and 6-5b illustrate eastern and western trends for total light extinction. These figures, presented with equivalent scales, demonstrate the regional difference in overall levels of visibility impairment. One can see that the worst visibility days in the west are only slightly more impaired than the best days in the East. It should also be noted that eight additional eastern sites are reflected in Figure 6-5a beginning in 1992, bringing to eleven the total number of eastern sites reflected in the values plotted in Figure 6-5a for 1992-97. By adding the 8 eastern sites to the dataset, the magnitude of average impairment levels has increased, although the general slope of the trends for clearest, middle, and haziest days appear similar to the trends based on three sites. Figure 6-5a shows that in the East, the haziest visibility days do not appear to be getting any better. Eastern impairment on the haziest days reached a low point in 1993, but both the 3- and 11- site trends have increased by about 4% by 1997. The best visibility days appear to be relatively flat or improving slightly. The middle 20 percent of the distribution appears to have a downward trend exceeding 10 percent for both the 3-sites and 11-site lines.

In the West, there appears to be steady visibility improvement in each of the 3 quintiles presented in Figure 6-5b for the period 1988-1997. Total light extinction for the aggregation of 26 western sites declined by 11-14 percent for each of the 3 categories. In the East, the average deciview value for the worst visibility days increased by about 0.5, while in the West, the average value decreased by 1.5 deciviews.

The area plots in Figures 6-6a through 6-6f show the relative contribution to aerosol light extinction

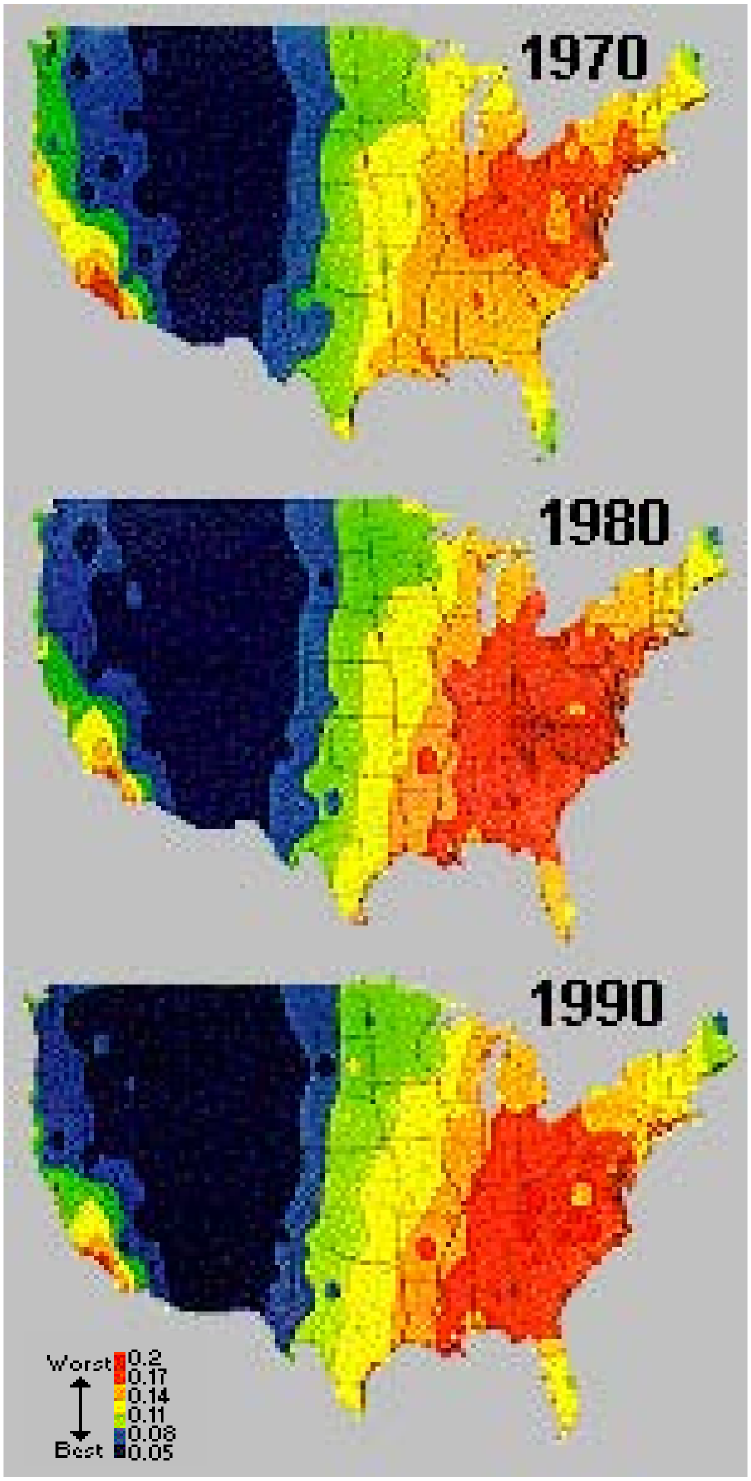


Figure 6-4. Long-term trend for 75th percentile light coefficient from airport visual data (July-September).

by the five principal particulate matter constituents measured by IMPROVE at eastern and western sites for the best, middle, and worst 20 percent days. Note that the scale differs for the eastern and western figures in order to more clearly present the relative contribution of the five components. By understanding the total magnitude of each $PM_{2.5}$ component, the change in aerosol composition over time, and the effect of these components on changing visibility, policymakers can design strategies to address health and environmental concerns.

In the East, (Figures 6-6a, b, and c), sulfate is clearly the largest contributor to visibility impairment, ranging from 64 percent of aerosol extinction during the best days to 80% on the worst days. Since reaching a low point in 1993, light extinction due to sulfate has increased slightly about 7 percent by 1997. Organic carbon is the next largest contributor to visibility impairment in the East, accounting for 12 percent of aerosol extinction on the best days and averaging 9 percent on the most impaired days. Over the period 1992-1997, the contribution of organic carbon to aerosol light extinction appears to be declining for the clearest, middle, and haziest days. The third largest contributor in the East is nitrate, which also accounts for about 12 percent of aerosol light extinction on the best days and about 5 percent on the haziest days.

In the West, sulfate is also the most significant single contributor to aerosol light extinction on the best, middle, and worst 20 percent days of the distribution. Sulfate typically accounts for 35-45 percent of aerosol light extinction. However, organic carbon (19-22 percent), crustal material (16-20 percent), and nitrates (12-15 percent) play a more significant role (as a percentage of aerosol extinction) in western sites than eastern ones. Based on this aggregation of 26 sites, it appears that organic carbon and elemental carbon are showing downward trends in western Class I areas.

Trends in Specific Class I Areas

IMPROVE data from 37 Class I area monitoring sites (29 with data for 1988-1997, 8 with data for 1992-1997) were analyzed for upward or

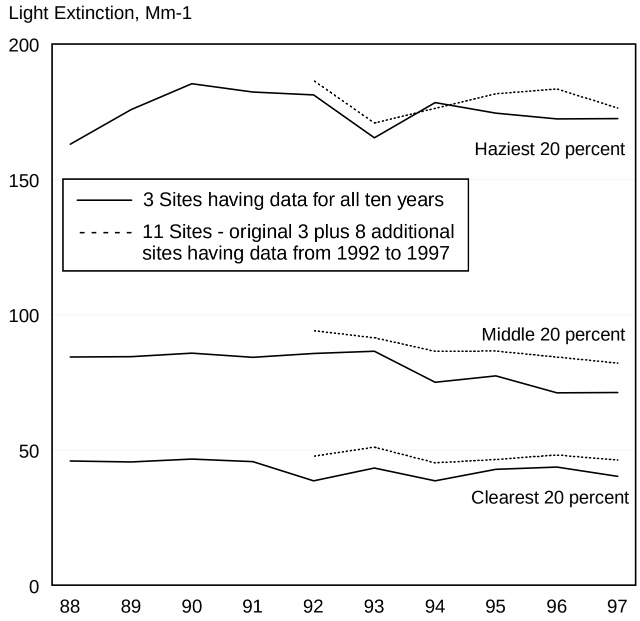


Figure 6-5a. Total light extinction trends for eastern Class I areas for haziest, middle, and clearest 20 percent of the distribution, 1988-1997.

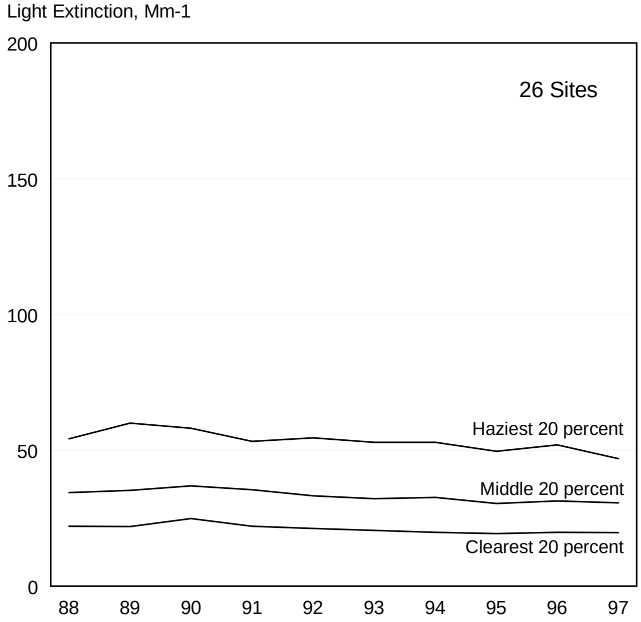


Figure 6-5b. Total light extinction trends for western Class I areas for haziest, middle, and clearest 20 percent of the distribution, 1988-1997.

downward trends using a nonparametric regression methodology described in Chapter 3: Criteria Pollutants - Metropolitan Area Trends.

Table 6-1 summarizes the trends analysis performed on these 37 sites for total light extinction (expressed in deciviews), light extinction due to sulfate, and light extinction due to organic carbon.

Overall, about one-fourth of the sites showed a significant downward trend in deciviews on the worst days, and more than one-third of the sites exhibited a significant improvement in visibility on the best days. Only a few sites showed a significant downward trend for light extinction due to sulfate, whereas one-half to three-fourths of the sites demonstrated significant improvements in light extinction due to organic carbon. Two sites were found to have statistically significant upward trends for the 9 parameters presented: Badlands National Park (SD) showed a significant upward trend in deciviews for the worst days, and San Gorgonio Wilderness (CA) showed a significant positive trend for light extinction due to sulfate. Several other sites also had positive slopes for various parameters, indicating some degree of an upward trend. A review of the annual data plotted

Figure 6-6a. Aerosol light extinction in eastern Class I areas for the clearest 20 percent of the distribution, 1988-1997.

- ☐ Sulfate
- ▨ Elemental Carbon
- ☐ Organic Carbon
- ■ Nitrate
- ▨ Crustal Material

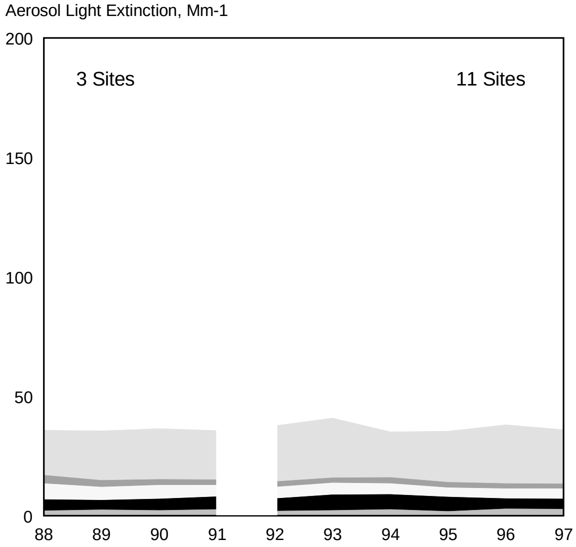


Figure 6-6b. Aerosol light extinction in eastern Class I areas for the middle 20 percent of the distribution, 1988-1997.

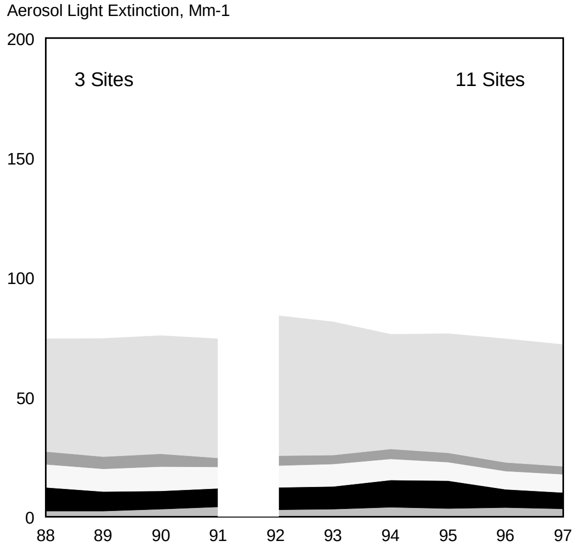
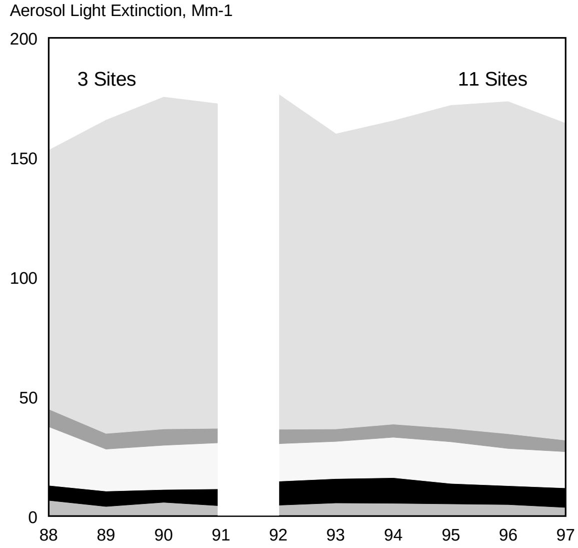


Figure 6-6c. Aerosol light extinction in eastern Class I areas for the haziest 20 percent of the distribution, 1988-1997.



Notes:

1) To better discern the trend in each component, the vertical scales for the plots of the Western Class I areas are smaller than those for the plots of the Eastern Class I areas.

2) In the Eastern Class I area plots, the 1988-1991 trend is based on the 3 sites with available data. Beginning in 1992 and going through 1997, there are 8 additional sites with trend data.

for each site as well as the results from the nonparametric regression method described in Chapter 3 shows that several sites have positive slopes and should be monitored closely for potential upward trends for either the best, middle, or worst 20 percent of the days in the distribution. Table 6-2 lists those sites which may be of potential concern.

CURRENT CONDITIONS

Current annual average conditions range from about 18-40 miles in the rural East and about 35-90 miles in the rural West. On an annual average basis, natural visibility conditions have been estimated at approximately 80-90 miles in the East and up to 140 miles in the West.[5] Natural visibility varies by region primarily because of slightly higher estimated background levels of $PM_{2.5}$ particles in the East, and the more significant effect of relative humidity on particle concentrations in the East than in the West.

Figures 6-7a, 6-7b, and 6-7c illustrate regional visibility impairment in terms of reconstructed aerosol light extinction based on measurements at IMPROVE sites between 1995 and 1997. Maps are presented for the clearest, middle and haziest 20 percent of the distribution. The pie charts show the relative contribution of different particle constituents to visibility impairment. Annual average aerosol light extinction due to these particles is indicated by the value next to each pie and by the size of each pie.[6] Figure 6-7 also shows that visibility impairment is generally greater in the rural East compared to most of the West. As not-

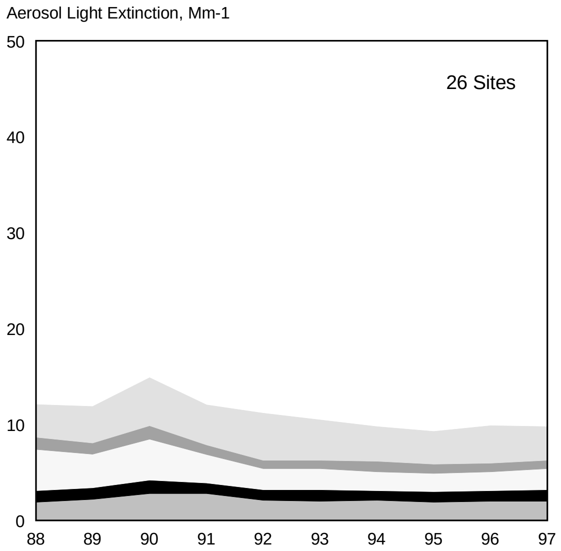


Figure 6-6d. Aerosol light extinction in western Class I areas for the clearest 20 percent of the distribution, 1988-1997.

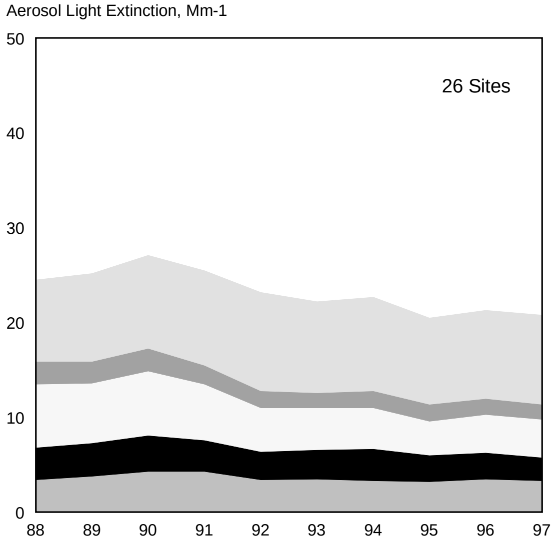


Figure 6-6e. Aerosol light extinction in western Class I areas for the middle 20 percent of the distribution, 1988-1997.

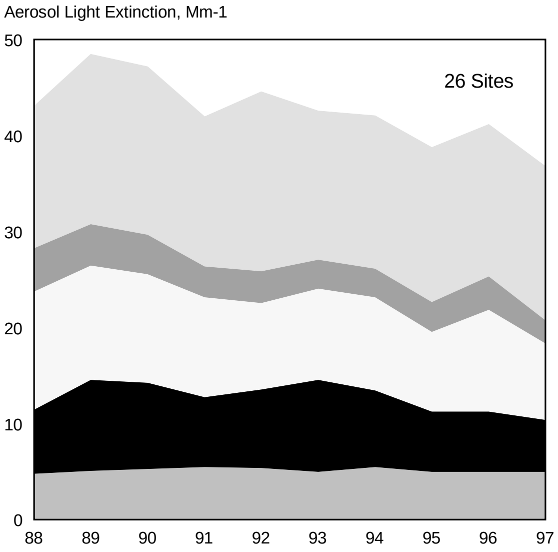


Figure 6-6f. Aerosol light extinction in western Class I areas for the haziest 20 percent of the distribution, 1988-1997.

Table 6-1. Summary of Class I Area trend* analysis.

Parameter	Number of Sites With Significant Upward (**Deteriorating**) Trends		Number of Sites With Significant Downward (**Improving**) Trends	
	West	**East**	**West**	**East**
Deciviews, worst 20%	1	0	9	0
Deciviews, middle 20%	0	0	15	3
Deciviews, best 20%	0	0	11	2
Light extinction due to sulfate, worst 20%	0	0	0	0
Light extinction due to sulfate, middle 20%	0	0	0	3
Light extinction due to sulfate, best 20%	1	0	2	0
Light extinction due to organic carbon, worst 20%	0	0	15	1
Light extinction due to organic carbon, middle 20%	0	0	24	5
Light extinction due to organic carbon, best 20%	0	0	22	5

* Based on a total of 37 monitored sites with at least 6 years of data: 26 in the West, 11 in the East.

ed earlier, sulfates account for more than 60 percent of annual average light extinction at most rural eastern sites. Sulfate plays a particularly significant role in the humid summer months due to its nature to attract and dissolve in atmospheric water vapor, most notably in the Appalachian, northeast, and mid-south regions. Nitrates, organic carbon, and elemental carbon all account for between 10-15 percent of total light extinction in most Eastern locations.

In the rural West, sulfates also play a significant role, typically accounting for about 25-40 percent of total light extinction in most regions. In several areas of the West, however, Sulfates account for over 50 percent of annual average light extinction, including Mt Rainier, WA, Point Reyes, CA, Redwood NP, CA, and the Cascades of Oregon. Organic carbon typically makes up 15-35 percent of total light extinction in the rural West, elemental carbon (absorption) accounts for about 15-25 percent, and soil dust (coarse PM) accounts for about 10-20 percent. Nitrates typically account for less than 10 percent of total light extinction in western locations, except in the southern California region, where it accounts for almost 40 percent.

Figures 6-8a, 6-8b, and 6-8c illustrate current levels of visibility impairment, in terms of deciviews, for the clearest, middle, and haziest 20 percent days based on IMPROVE data from 1995-1997.[7] Note that the deciview scale is more compressed than the scale for visual range or light extinction, with larger values representing greater visibility degradation. Most of the sites in the intermountain West and Colorado Plateau have annual average impairment of 12 deciviews or less, with the worst days ranging up to 16 deciviews. Several other western sites in the northwest and California experience levels on the order of 15-25 deciviews on the haziest 20 percent of days. Many rural locations in the East have annual aver-

Table 6-2. Class I areas with potentially deteriorating visibility (based on trend in deciviews).

Clearest 20% Days	Middle 20% Days	Haziest 20% Days
Brigatine Wilderness (NJ) Dolly Sods wilderness (WV) Lye Brook Wilderness (VT) Okefenokee Wilderness (FL) San Gorgonio Wilderness (CA)	Lye Brook Wilderness (VT) Upper Buffalo Wilderness (AR)	Badlands NP (SD) Bandelier National Monument (NM) Big Bend NP (TX) Bryce Canyon NP (UT) Great Smokies NP (TN) Mammoth Cave NP (KY) Shenandoah NP (VA) Sipsey Wilderness (AL)

Figure 6-7a. Aerosol light extinction (in Mm-1) for the clearest 20% days and contribution by individual particulate matter constituents, based on 1995-1997 IMPROVE data.

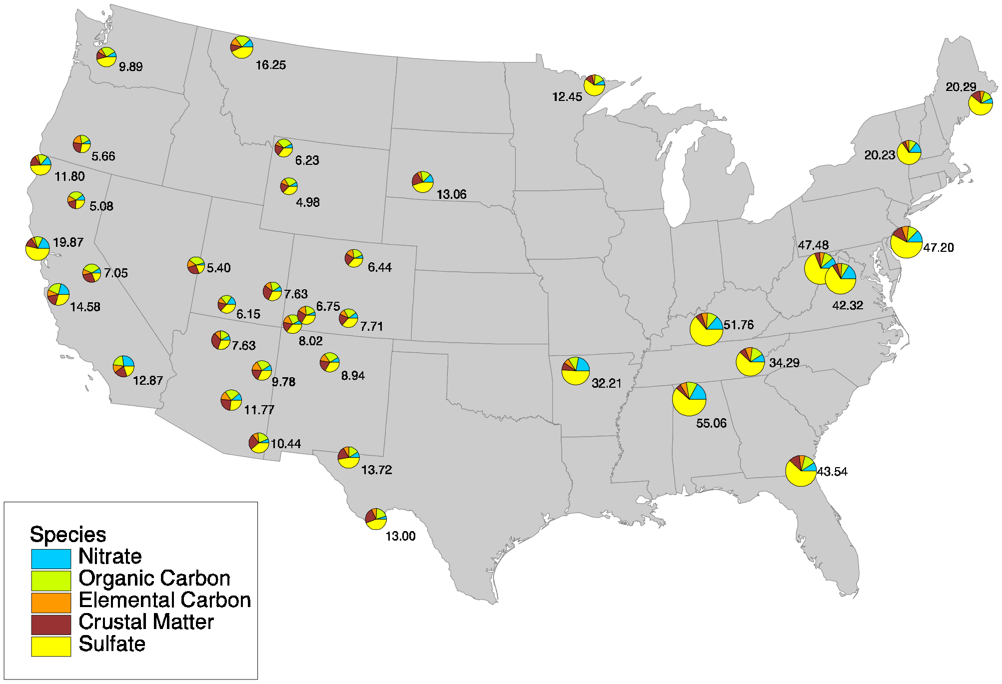


Figure 6-7b. Aerosol light extinction (in Mm-1) for the middle 20% days and contribution by individual particulate matter constituents, based on 1995-1997 IMPROVE data.

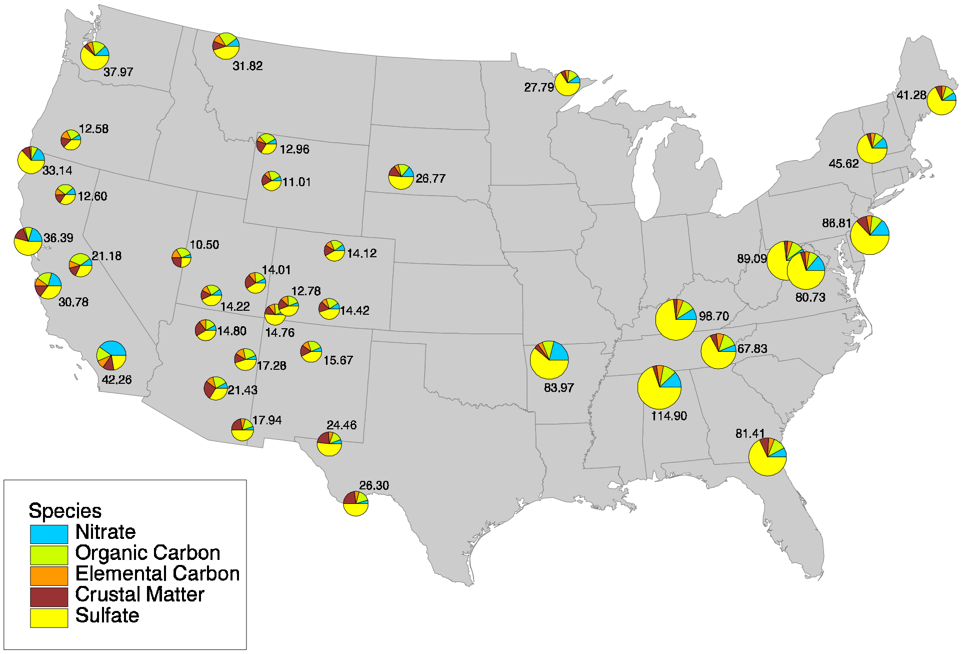


Figure 6-7c. Aerosol light extinction (in Mm-1) for the haziest 20% days and contribution by individual particulate matter constituents, based on 1995-1997 IMPROVE data.

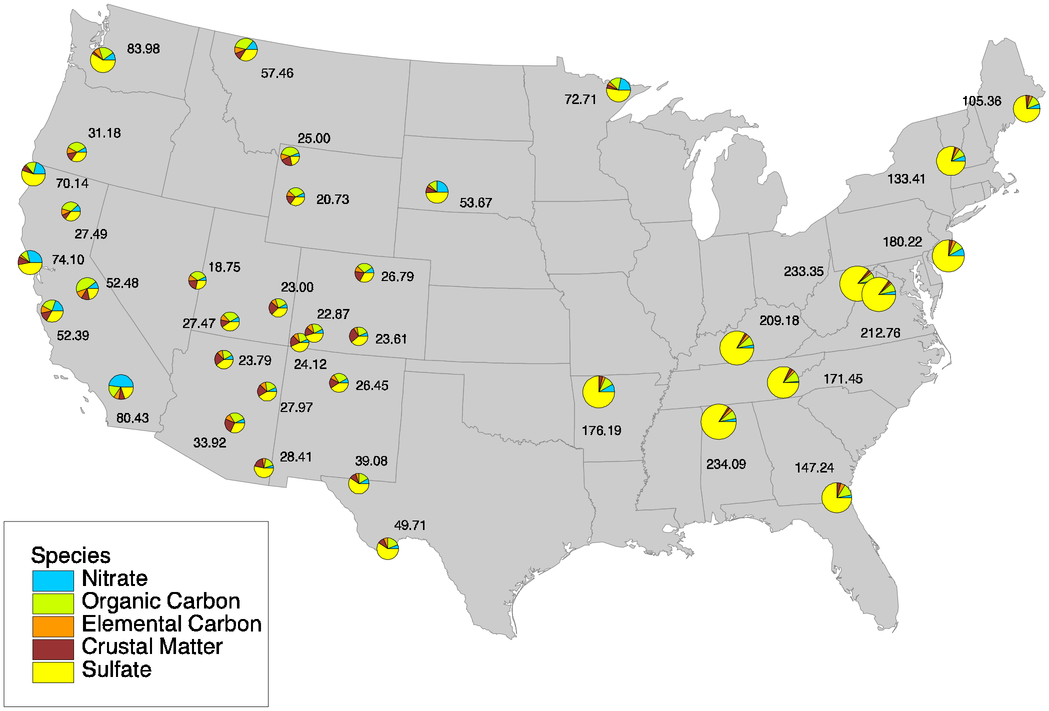


Figure 6-8a. Current visibility impairment expressed in deciviews for the clearest 20% days based on 1995-1997 IMPROVE data.

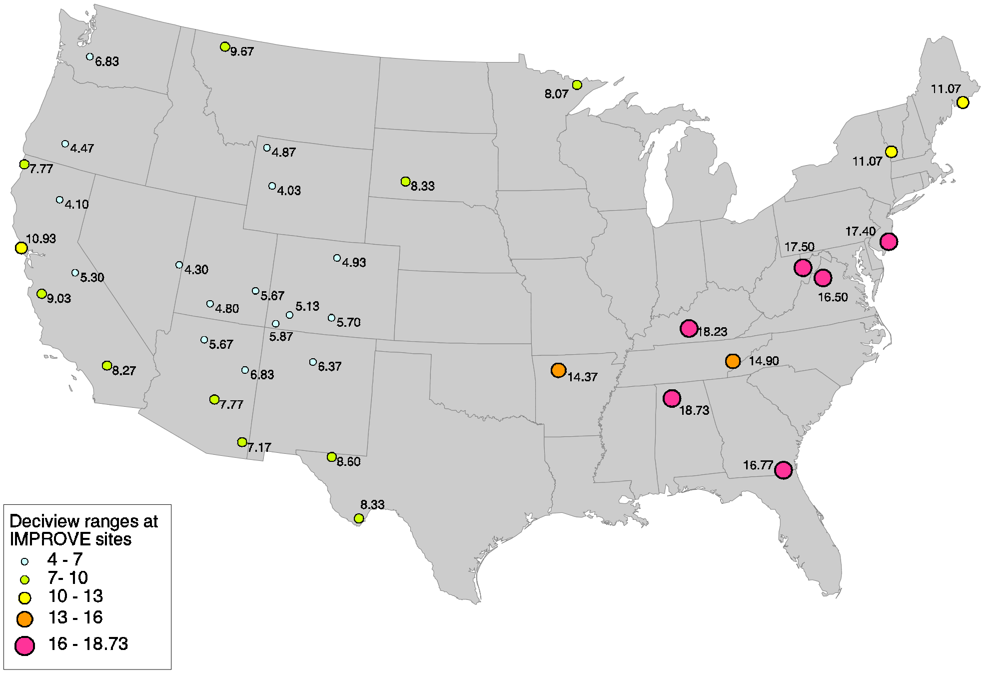


Figure 6-8b. Current visibility impairment expressed in deciviews for the middle 20% days based on 1995-1997 IMPROVE data.

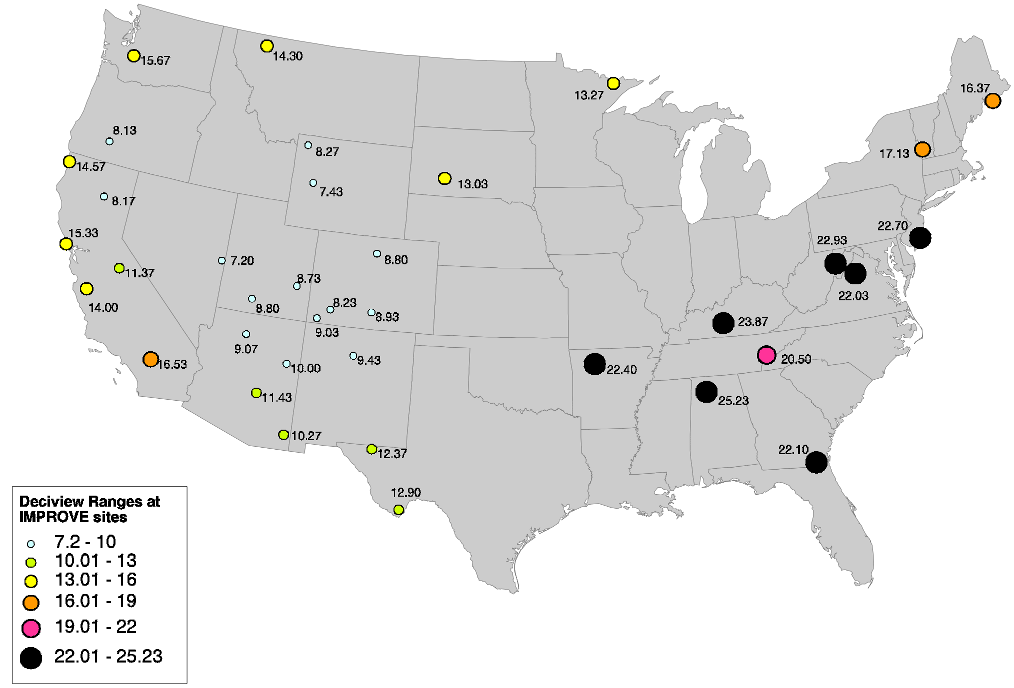
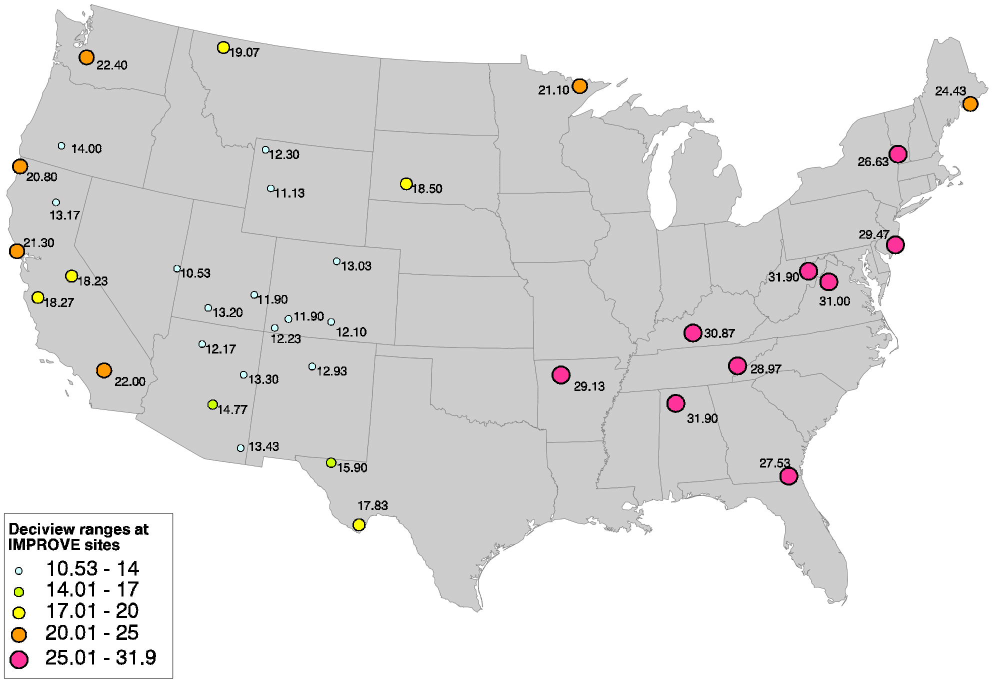


Figure 6-8c. Current visibility impairment expressed in deciviews for the haziest 20% days based on 1995-1997 IMPROVE data.



age values exceeding 23 deciviews, with average visibility levels on the haziest days up to 33 deciviews.

PROGRAMS TO IMPROVE VISIBILITY

In July 1997, EPA proposed a new regional haze program to address visibility impairment in national parks and wilderness areas caused by numerous sources located over broad regions. The proposed program takes into consideration scientific findings and policy recommendations from a number of sources, including the National Academy of Sciences, the Grand Canyon Visibility Transport Commission, and a Federal Advisory Committee on Ozone, Particulate Matter, and Regional Haze Implementation Programs. The proposal lays out a framework within which states can conduct regional planning and develop implementation plans which are to achieve "reasonable progress" toward the national visibility goal of no human-caused impairment in the 156 mandatory Class I federal areas across the country. Because of the common precursors and the regional nature of the ozone, PM, and regional haze problems, EPA is developing these implementation programs together to integrate future planning and control strategy efforts to the greatest extent possible. Implementation of the PM and Ozone NAAQS in conjunction with a future regional haze program is expected to improve visibility in urban as well as rural areas across the country. Other air quality programs are expected to lead to emissions reductions that will improve visibility in certain regions of the country. The acid rain program will achieve significant regional reductions in the emissions of SO_2, which is expected to reduce sulfate haze particularly in the eastern United States. The recent NO_x State Implementation Plan (SIP) call to reduce emissions from sources of NO_x to reduce formation of ozone should also improve regional visibility conditions to some degree. In addition, the NAAQS, mobile source, and woodstove programs to reduce fuel combustion and soot emissions can benefit areas adversely impacted by visibility impairment due to sources of organic and elemental carbon.

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2. PhotoCD images provided by Kristi Savig and John Molenar, Air Resource Specialists, Inc., Fort Collins, Colorado 80525.

3. Sisler, J. *Spatial and Seasonal Patterns and Long-Term Variability of the Composition of the Haze in the United States: An Analysis of Data from the IMPROVE Network*. Colorado State University, Cooperative Institute for Research in the Atmosphere. Fort Collins, CO., 1996.

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4. R.B. Husar, J.B. Elkins, W.E. Wilson, "U.S. Visibility Trends, 1906-1992," Air and Waste Management Association 87th Annual Meeting and Exhibition, Cincinnati, OH, 1994.

5. Irving, Patricia M., ed., *Acid Deposition: State of Science and Technology*, Volume III, Terrestrial, Materials, Health, and Visibility Effects, The U.S. National Acid Precipitation Assessment Program, Chapter 24, page 24-76.

6. See reference 1.

7. See reference 1.

CHAPTER 7

Acid Deposition

http://www.epa.gov/oar/aqtrnd97/chapter7.pdf

Sulfur and nitrogen oxides are emitted into the atmosphere primarily from the burning of fossil fuels. These emissions react in the atmosphere to form compounds that are transported long distances and are subsequently deposited in the form of pollutants such as particulate matter (sulfates and nitrates), SO_2, NO_2, nitric acid and when reacted with volatile organic compounds (VOCs) form ozone. The effects of atmospheric deposition include acidification of lakes and streams, nutrient enrichment of coastal waters and large river basins, soil nutrient depletion and decline of sensitive forests, agricultural crop damage, and impacts on ecosystem biodiversity. Toxic pollutants and metals also can be transported and deposited through atmospheric processes. (See Chapter 5: Air Toxics.)

Both local and long-range emission sources contribute to atmospheric deposition. Total atmospheric deposition is determined using both wet and dry deposition measurements. Wet deposition is the portion dissolved in cloud droplets and is deposited during rain or other forms of precipitation. Dry deposition is the portion deposited on dry surfaces during periods of no precipitation as particles or in a gaseous form. Although the term "acid rain" is widely recognized, the dry deposition portion ranges from 20 to 60 percent of total deposition.

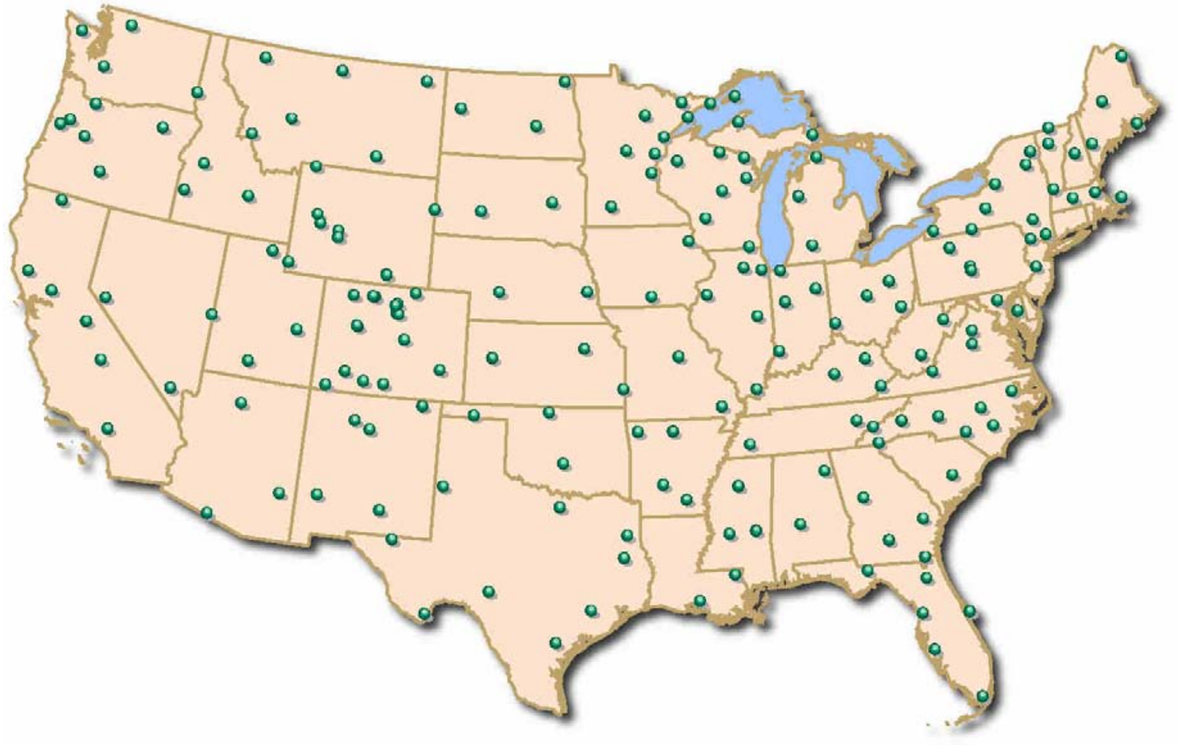
The United States Environmental Protection agency (EPA) is required by several Congressional and other mandates to assess the effectiveness of air pollution control efforts. These mandates include Title IX of the Clean Air Act Amendments (CAAA), the National Acid Precipitation Assessment Program (NAPAP), the Government Performance and Results Act, and the U.S. Canada Air Quality Agreement. One measure of effectiveness of these efforts is whether sustained reductions in the amount of atmospheric deposition over broad geographic regions are occurring. However, changes in the atmosphere happen very slowly and trends are often obscured by the wide variability of measurements and climate. Numerous years of continuous and consistent data are required to overcome this variability, making long-term monitoring networks especially critical for characterizing deposition levels and identifying relationships among emissions, atmospheric loadings, and effects on human health and the environment.

For wet and dry deposition, these studies typically include measurement of concentration levels of key chemical components as well as precipitation amounts. For dry deposition, analyses also must include meteorological measurements that are used to estimate rate of the actual deposition, or "flux." Data representing total deposition loadings (e.g., total sulfate or nitrate) are what many environmental scientists use for integrated ecological assessments.

PRIMARY ATMOSPHERIC DEPOSITION MONITORING NETWORKS

The National Atmospheric Deposition Program (NADP) and the Clean Air Status and Trends Network (CASTNet), described in detail below, were developed to monitor wet and dry acid deposition, respectively. Monitoring site locations are predominantly rural by design to assess the relationship between regional pollution and changes in regional patterns in deposition. CASTNet also includes measurements of rural ozone and the chemical constituents of $PM_{2.5}$. Rural monitoring sites of NADP and CASTNet provide data where sensitive ecosystems are located and provide insight into natural background levels of pollutants where urban influences are minimal. These data provide needed information to scientists and policy analysts to study and evaluate numerous environmental effects, particularly those caused by regional sources of emissions for which long range trans-

Figure 7-1. The NADP/NTN Network.



port plays an important role. Measurements from these networks are also important for understanding non-ecological impacts of air pollution such as visibility impairment and damage to materials, particularly those of cultural and historical importance.

National Atmospheric Deposition Network

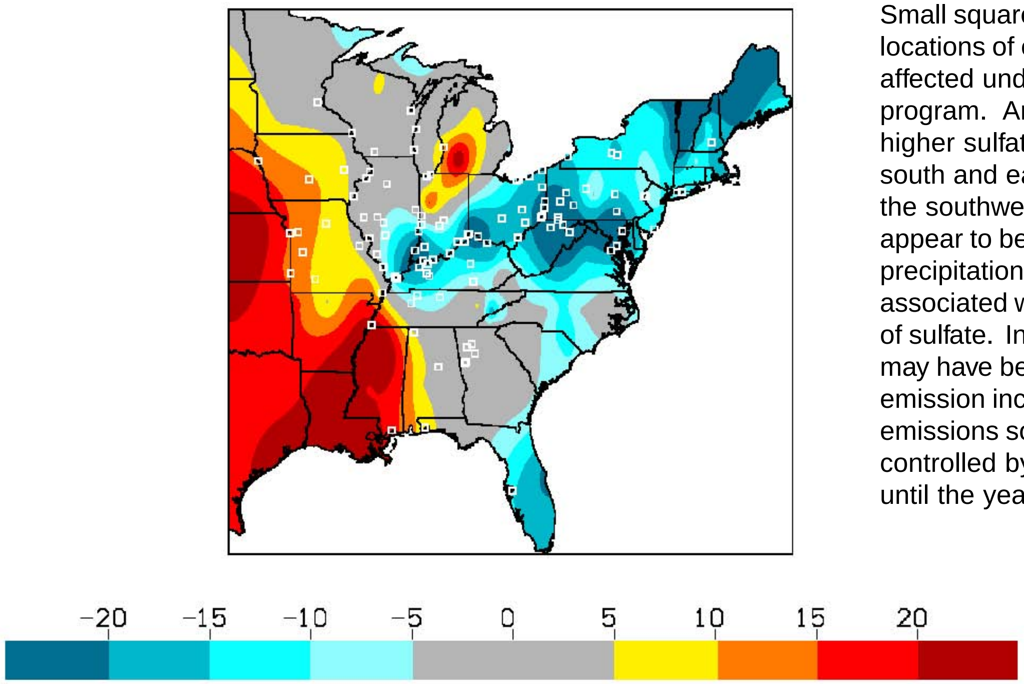
The NADP was initiated in the late 1970s as a cooperative program between federal and state agencies, universities, electric utilities, and other industries to determine geographical patterns and trends in precipitation chemistry in the United States. Collection of weekly wet deposition samples began in 1978. The size of the NADP Network grew rapidly in the early 1980s when the major research effort by the NAPAP called for characterization of acid deposition levels. At that time, the network became known as the NADP/NTN (National Trends Network). By the mid-1980s, the NADP had grown to nearly 200 sites where it stands today as the longest running national deposition monitoring network (see Figure 7-1).

The NADP analyzes the constituents important in precipitation chemistry, including those affecting rainfall acidity and those that may have ecological effects. The Network measures sulfate, nitrate, hydrogen ion (measure of acidity), ammonia, chloride, and base cations (calcium, magnesium, potassium). To ensure comparability of results, laboratory analyses for all samples are conducted by the NADP's Central Analytical Lab at the Illinois State Water Survey. A new subnetwork of the NADP, the Mercury Deposition Network (MDN) measures mercury in precipitation. The MDN is discussed in Chapter 5 of this report.

TRENDS ANALYSES FOR SULFATE AND NITRATE CONCENTRATIONS IN WET DEPOSITION

Sulfate concentrations in precipitation have decreased over the past two decades.[1] The reductions were relatively large in the early 1980s followed by more moderate declines until 1995. These reductions in sulfates are similar to changes in SO_2 emissions. In 1995, however, concentrations of sulfates in precipitation over a large area of the Eastern United States exhibited a dramatic and unprecedented reduction.[2] In 1995 and continued in 1996, sulfates have been estimated to be 10–25 percent lower than levels expected with a continuation of 1983–1994 trends (see Figure 7-2). This important reduction in acid precipitation is directly related to the large regional decreases in SO_2 emis-

Figure 7-2. Percent differences in mean annual measured sulfate concentrations as compared to projected concentrations for 1995–1996 for the Eastern United States (from NADP/NTN).



Small squares on the map show locations of electric utility plants affected under Phase I of the acid rain program. Areas on the map depicting higher sulfate concentrations (e.g., south and east of Lake Michigan and the southwestern portion of map) appear to be due to below average precipitation volumes, which are associated with higher concentrations of sulfate. In addition, these results may have been affected by SO_2 emission increases at some Phase II emissions sources that will not be controlled by the acid rain program until the year 2000.

sions resulting from Phase I of the acid rain program (see the SO_2 section in Chapter 2). The largest reductions in sulfate concentrations occurred along the Ohio River Valley and in states immediately downwind of this region. For example, the average reduction in sulfate concentrations in Ohio was approximately 21 percent, in Maryland, 27 percent, and in Pennsylvania, 15 percent. The largest decrease (32 percent) occurred in the northern portion of West Virginia. Reductions in hydrogen ion concentrations (H^+) in the East, the primary indicator of precipitation acidity, were very similar to those of sulfate concentrations, both in magnitude and location. Nitrate concentrations at NADP/NTN sites were not appreciably different in 1995–1996 from historical levels.[3] Analyses based on the 1997 data are not yet available.

The dense network of NADP/NTN sites facilitate the development of concentration and wet deposition maps to describe the trends and spatial patterns in the constituents of acid precipitation. Figures 7-3 and 7-4 show sulfate and nitrate concentrations in precipitation levels for 1997. Sulfate concentrations in precipitation are highest in the Great Lake States and areas extending eastward. Nitrates in precipitation are more regionally uniform. The highest nitrate levels in precipitation are in the vicinity of the Great Lakes, with relatively high concentrations extending from the Plains States to the Northeast.

Reported concentrations and total wet deposition are both dependent on the amount of precipitation in a particular year. While larger amounts of precipitation can dilute the measured pollutant concentration, it also can contribute to higher levels of wet deposition. Figures 7-5 and 7-6 present estimates for total wet deposition of sulfates and nitrates respectively, by multiplying concentration by the total amount of precipitation. During 1997, the highest sulfate wet deposition occurred in western New York State extending southward through the Ohio Valley and along the Appalachian ridge. Nitrate deposition shows a similar pattern.

Clean Air Status and Trends Network

The CASTNet provides atmospheric data on the dry deposition component of total acid deposition, ground-level ozone and other forms of atmospheric pollution. CASTNet is considered the nation's primary source for atmospheric data to estimate dry acidic deposition and to

Figure 7-3. Sulfate concentration in precipitation, 1997.

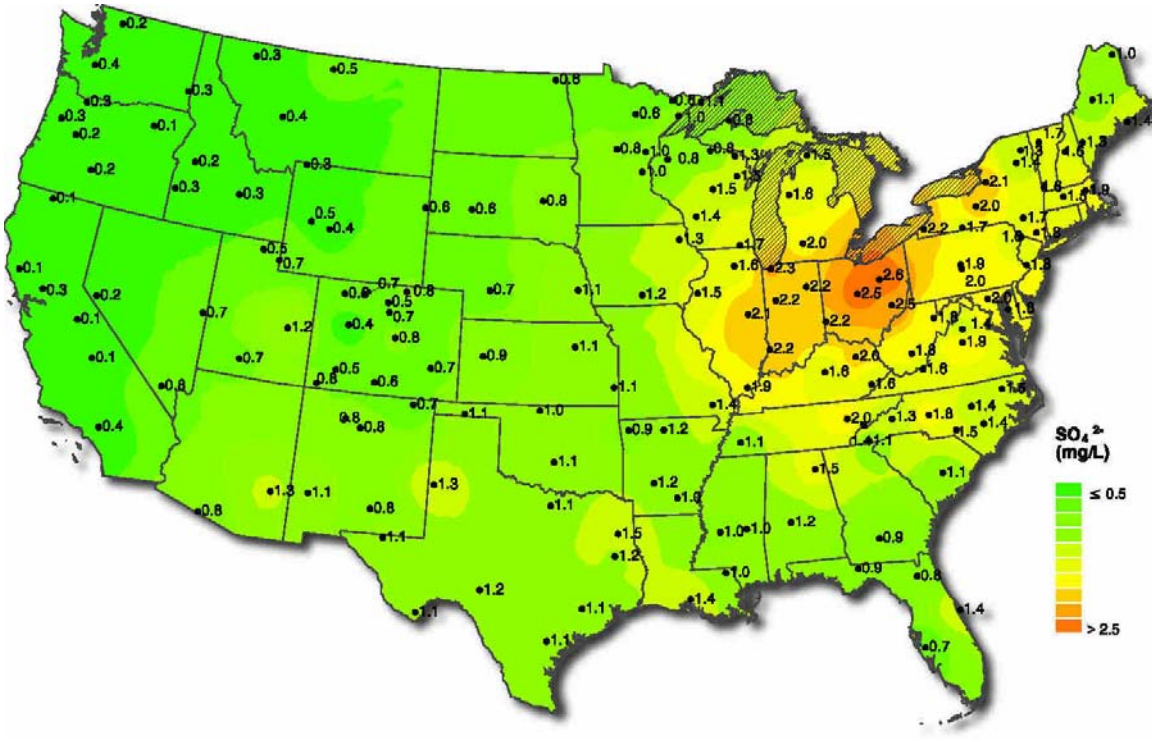


Figure 7-4. Nitrate concentration in precipitation, 1997.

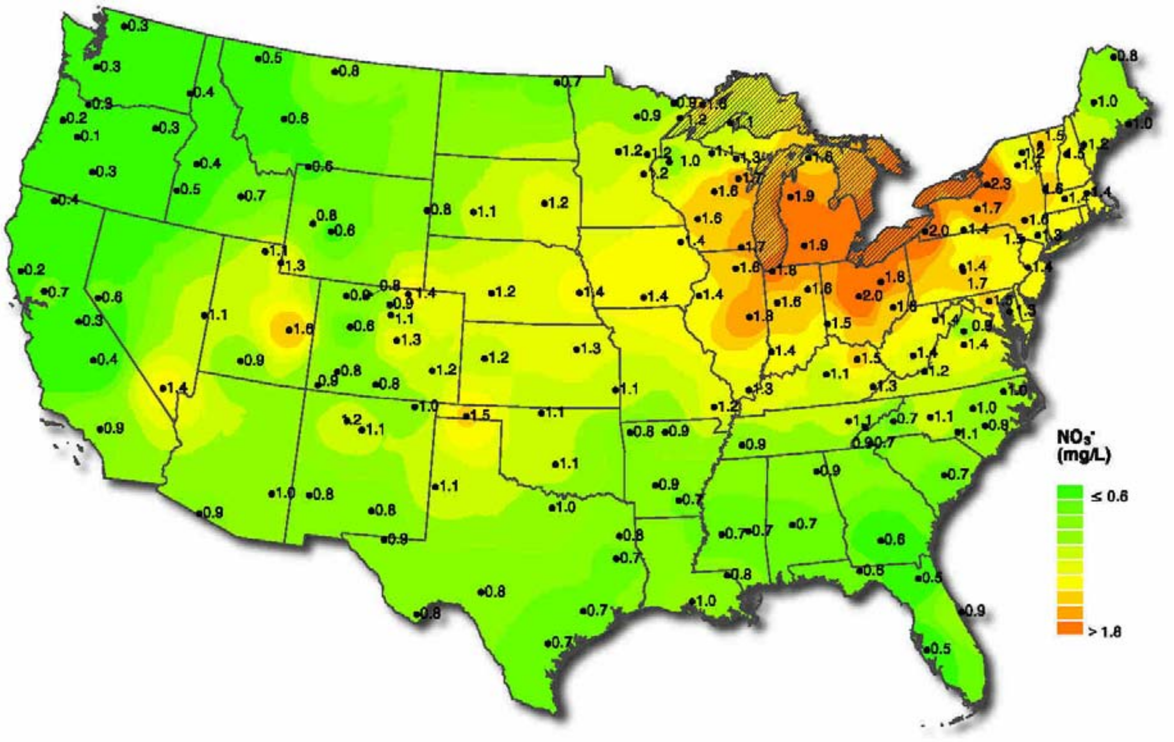


Figure 7-5. Wet deposition of sulfate, 1997.

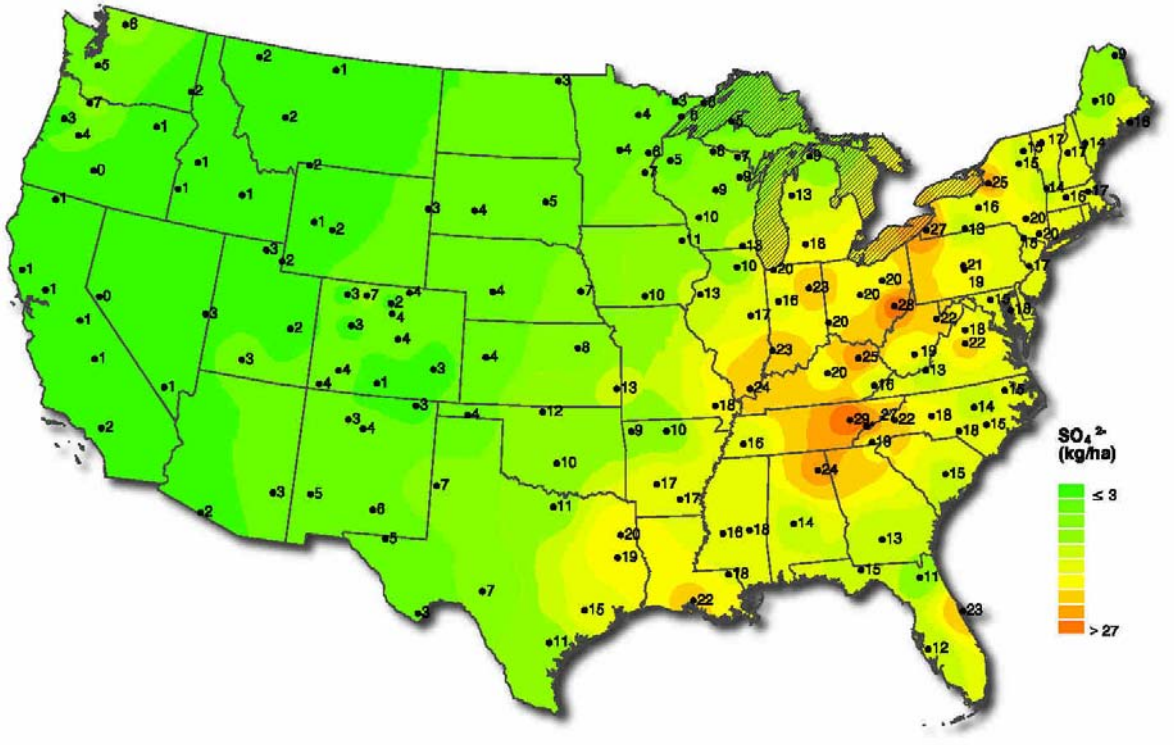


Figure 7-6. Wet deposition of nitrate, 1997.

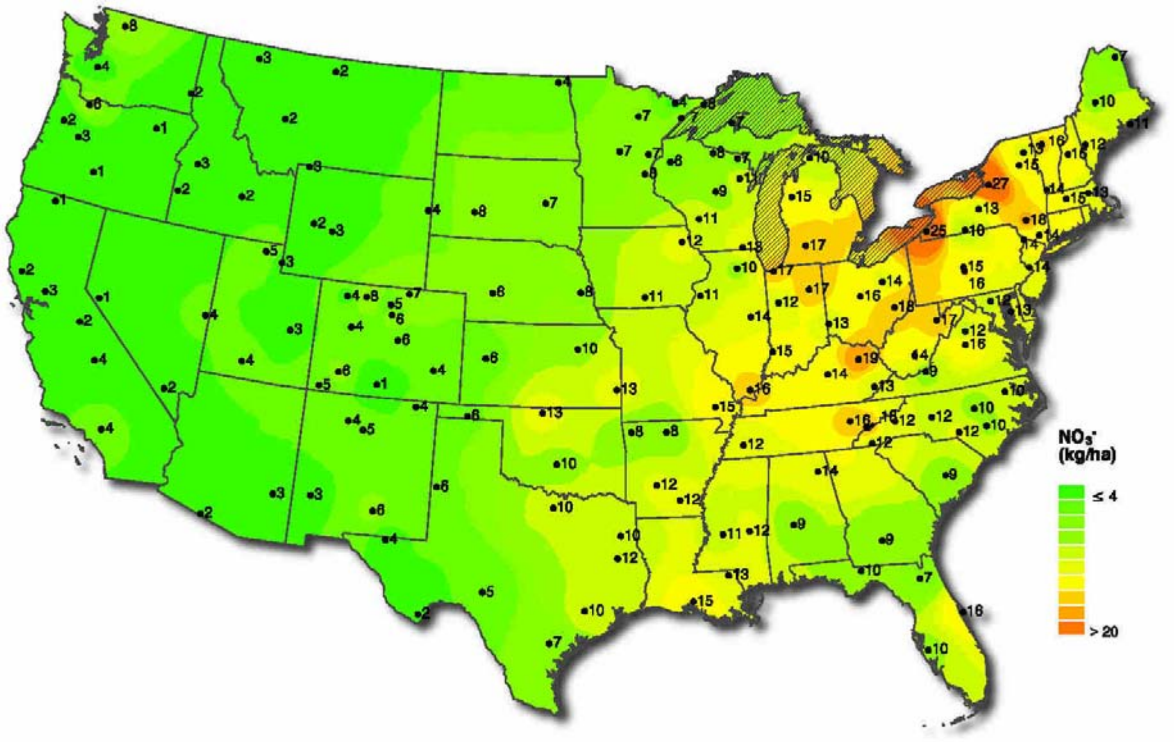


Figure 7-7. The CASTNet Network.

provide data on rural ozone levels. Used in conjunction with other national monitoring networks, CASTNet is used to determine the effectiveness of national emission control programs. Established in 1987, CASTNet now comprises 72 monitoring stations across the United States, as shown in Figure 7-7. The longest data records are primarily at eastern sites. The majority of the monitoring stations are operated by EPA's Office of Air and Radiation; however, 19 stations are operated by the National Park Service in cooperation with EPA. Of the total number of sites, 67 measure dry-deposition; 18 measure wet-deposition; 68 measure ozone; and 8 measure aerosols for visibility assessment.

Each CASTNet dry deposition station measures:

- weekly average atmospheric concentrations of sulfate, nitrate, ammonium, sulfur dioxide, and nitric acid.
- hourly concentrations of ambient ozone levels.
- meteorological conditions required for calculating dry deposition rates.

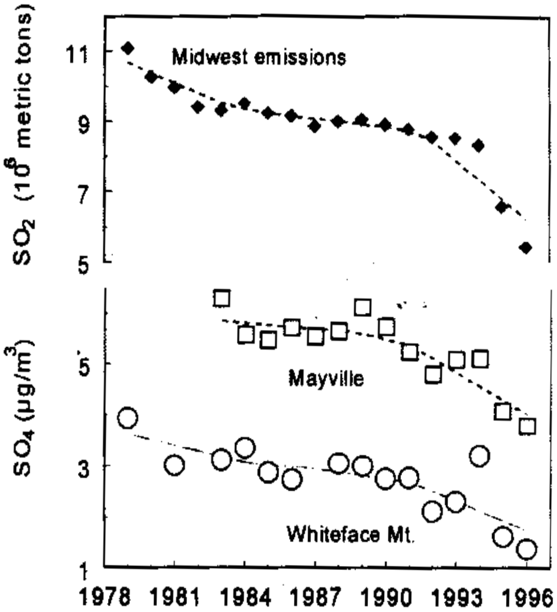
Dry Deposition

Dry deposition rates are calculated using atmospheric concentrations, meteorological data, and information on land use, vegetation, and surface conditions. CASTNet complements the database compiled by NADP. Because of the interdependence of wet and dry deposition, CASTNet also collects wet deposition data at the 18 sites where there are no NADP/NTN stations within a 50 km radius. Together, these two long-term databases provide the necessary data to estimate trends and spatial patterns in total atmospheric deposition. National Oceanic and Atmospheric Administration (NOAA) also operates a smaller dry deposition network called Atmospheric Integrated Assessment Monitoring Network (AIRMoN) focused on addressing research issues specifically related to dry deposition measurement.

Concentration Trends Analysis at CASTNet Sites

CASTNet data were analyzed for the period 1989–1995. During this 7-year period, atmospheric concentrations of sulfur dioxide and sulfate at 34 eastern CASTNet sites showed statistically-significant declining trends. The average reduction in sulfur dioxide concentrations for all sites was 35

Figure 7-8. Trends in annual mean aerosol sulfate concentrations at Whiteface Mountain and Mayville, 1978–1996.



Also shown are annual SO_2 emissions for the Midwest as explained in the text. Lines through the points are the result of multiple regression and smoothing and are only added to aid the eye.

percent and in sulfate concentrations was 26 percent. Trends in total nitrate concentrations (nitrates plus nitric acid) were not as pronounced, with an average reduction of 8 percent. A regional estimate for a cluster of sites in the Ohio River Valley showed a close correspondence between declining sulfur dioxide concentration (35 percent) and declining sulfur dioxide emissions (32 percent) in this region.[4]

The relationship between regional SO_2 emissions and sulfate air quality is graphically illustrated in Figure 7-8. This recently published graph compares long-term trends (1978–1996) in annual mean aerosol sulfate concentrations at two rural locations in New York State with upwind SO_2 emissions for the Midwest region (MN, WI, IL, MI, IN, OH, WV, KY and Western PA). Although average air quality fluctuates from year to year, the underlying trend in annual sulfate concentrations tracks emissions with both trends exhibiting a small decrease. Then, sulfates declined sharply in 1995, corresponding to a 36 percent reduction in regional emissions. During 1995, emissions from this region accounted for 38 percent of the national emission inventory. The air quality improvement (~1 µg/m^3) was approximately 30 percent for Mayville and an impressive 47 percent for the more distant Whiteface Mountain location.[4]

Rural Ozone

Ozone data collected by CASTNet are complementary to the larger ozone data sets gathered by the State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS) networks. Most air quality samples at SLAMS/NAMS sites are located in urban areas, while CASTNet sites are in rural locations. Hourly ozone measurements are taken at each of the 50 sites operated by EPA. Data from these sites provide information to help characterize ozone transport issues and ozone exposure levels. Future trend reports will present information on rural O_3 concentrations measured at CASTNet sites.

References

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APPENDIX A

Data Tables

http://www.epa.gov/oar/aqtrnd97/appenda.pdf

Table A-1. National Air Quality Trends Statistics for Criteria Pollutants, 1988–1997

Statistic	# of Sites	Units	Percentile	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Carbon Monoxide													
2nd Max. 8 hr.	368	ppm	95th	11.1	11.1	10.6	9.9	8.5	8.0	8.1	7.6	7.4	6.8
2nd Max. 8 hr.	368	ppm	90th	10.2	9.8	8.8	8.8	7.8	7.2	7.6	6.7	6.5	6.0
2nd Max. 8 hr.	368	ppm	75th	7.7	7.8	7.1	7.0	6.4	5.9	6.2	5.5	5.1	4.9
2nd Max. 8 hr.	368	ppm	50th	6.0	5.9	5.4	5.2	4.8	4.7	4.9	4.2	3.9	3.8
2nd Max. 8 hr.	368	ppm	25th	4.3	4.4	4.2	3.9	3.7	3.6	3.8	3.2	3.0	2.8
2nd Max. 8 hr.	368	ppm	10th	3.4	3.4	3.1	3.0	2.8	2.9	2.8	2.5	2.3	2.1
2nd Max. 8 hr.	368	ppm	5th	2.8	2.8	2.5	2.3	2.3	2.2	2.2	2.3	2.0	1.8
2nd Max. 8 hr.	368	ppm	Arith. Mean	6.3	6.3	5.8	5.6	5.1	4.9	5.0	4.5	4.2	3.9
Lead													
Max. Qtr. AM	195	ppm	95th	0.37	0.27	0.29	0.20	0.18	0.17	0.14	0.12	0.12	0.12
Max. Qtr. AM	195	ppm	90th	0.22	0.16	0.16	0.15	0.13	0.10	0.09	0.08	0.08	0.08
Max. Qtr. AM	195	ppm	75th	0.13	0.11	0.09	0.07	0.06	0.06	0.05	0.05	0.04	0.04
Max. Qtr. AM	195	ppm	50th	0.08	0.06	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.02
Max. Qtr. AM	195	ppm	25th	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01
Max. Qtr. AM	195	ppm	10th	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Max. Qtr. AM	195	ppm	5th	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Max. Qtr. AM	195	ppm	Arith. Mean	0.12	0.09	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.04
Nitrogen Dioxide													
Arith. Mean	224	ppm	95th	0.044	0.043	0.040	0.043	0.038	0.036	0.040	0.039	0.037	0.034
Arith. Mean	224	ppm	90th	0.036	0.035	0.034	0.033	0.032	0.032	0.032	0.031	0.031	0.029
Arith. Mean	224	ppm	75th	0.027	0.027	0.025	0.025	0.024	0.024	0.025	0.023	0.024	0.023
Arith. Mean	224	ppm	50th	0.020	0.020	0.019	0.019	0.018	0.018	0.019	0.018	0.018	0.018
Arith. Mean	224	ppm	25th	0.014	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.011
Arith. Mean	224	ppm	10th	0.007	0.007	0.007	0.007	0.007	0.006	0.007	0.006	0.007	0.006
Arith. Mean	224	ppm	5th	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Arith. Mean	224	ppm	Arith. Mean	0.021	0.021	0.020	0.020	0.019	0.019	0.020	0.019	0.018	0.018
Ozone													
2nd Max. 1-hr	660	ppm	95th	0.200	0.177	0.170	0.170	0.160	0.156	0.151	0.152	0.144	0.144
2nd Max. 1-hr	660	ppm	90th	0.178	0.150	0.147	0.150	0.131	0.138	0.132	0.139	0.127	0.131
2nd Max. 1-hr	660	ppm	75th	0.147	0.124	0.120	0.123	0.112	0.120	0.117	0.123	0.115	0.116
2nd Max. 1-hr	660	ppm	50th	0.124	0.106	0.107	0.107	0.099	0.104	0.104	0.110	0.103	0.103
2nd Max. 1-hr	660	ppm	25th	0.105	0.095	0.095	0.095	0.090	0.091	0.092	0.098	0.092	0.090
2nd Max. 1-hr	660	ppm	10th	0.090	0.085	0.083	0.081	0.082	0.080	0.082	0.085	0.083	0.080
2nd Max. 1-hr	660	ppm	5th	0.082	0.080	0.074	0.075	0.075	0.074	0.076	0.077	0.077	0.075
2nd Max. 1-hr	660	ppm	Arith. Mean	0.130	0.114	0.112	0.113	0.105	0.108	0.107	0.112	0.105	0.105
4th Max. 8-hr	660	ppm	95th	0.136	0.119	0.117	0.116	0.107	0.110	0.107	0.113	0.103	0.105
4th Max. 8-hr	660	ppm	90th	0.126	0.105	0.106	0.110	0.097	0.101	0.099	0.107	0.097	0.101
4th Max. 8-hr	660	ppm	75th	0.112	0.093	0.094	0.097	0.087	0.091	0.091	0.096	0.090	0.091
4th Max. 8-hr	660	ppm	50th	0.098	0.083	0.083	0.085	0.079	0.081	0.082	0.088	0.083	0.082
4th Max. 8-hr	660	ppm	25th	0.082	0.075	0.075	0.073	0.073	0.073	0.074	0.077	0.075	0.073
4th Max. 8-hr	660	ppm	10th	0.072	0.068	0.066	0.065	0.066	0.063	0.067	0.067	0.067	0.065
4th Max. 8-hr	660	ppm	5th	0.065	0.061	0.060	0.059	0.061	0.058	0.060	0.060	0.062	0.059
4th Max. 8-hr	660	ppm	Arith. Mean	0.098	0.086	0.085	0.087	0.082	0.082	0.083	0.087	0.083	0.082

Table A-1. National Air Quality Trends Statistics for Criteria Pollutants, 1988–1997 (continued)

Statistic	# of Sites	Units	Percentile	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
PM_{10}													
Annual Avg.	845	µg/m^3	95th	52.2	52.3	46.0	45.9	42.0	41.5	39.5	39.3	38.2	37.8
Annual Avg.	845	µg/m^3	90th	43.9	43.9	39.6	39.4	36.4	36.5	36.7	35.0	33.7	33.0
Annual Avg.	845	µg/m^3	75th	37.6	36.8	34.4	33.5	31.3	30.3	30.7	29.3	27.9	27.6
Annual Avg.	845	µg/m^3	50th	30.9	30.3	28.2	28.2	25.8	25.5	25.6	24.4	23.3	23.2
Annual Avg.	845	µg/m^3	25th	25.9	25.5	23.4	23.6	22.0	21.0	21.1	20.0	19.4	19.5
Annual Avg.	845	µg/m^3	10th	20.6	20.5	19.0	18.4	17.8	16.8	16.8	15.8	16.1	15.8
Annual Avg.	845	µg/m^3	5th	17.5	17.5	16.2	15.1	14.2	13.5	13.2	12.7	13.2	12.6
Annual Avg.	845	µg/m^3	Arith. Mean	32.4	32.1	29.5	29.2	26.9	26.2	26.2	25.1	24.2	24.0
99th Pctile	845	µg/m^3	95th	165.0	167.0	154.0	154.0	136.0	126.0	123	124.0	115.0	111.0
99th Pctile	845	µg/m^3	90th	129.0	131.0	124.0	127.0	110.0	107.0	108	103.0	96.0	95.0
99th Pctile	845	µg/m^3	75th	98.0	96.0	95.0	91.0	84.0	83.0	86	77.0	77.0	76.0
99th Pctile	845	µg/m^3	50th	77.0	77.0	75.0	72.0	66.0	67.0	65	64.0	61.0	59.0
99th Pctile	845	µg/m^3	25th	59.0	60.0	59.0	58.0	55.0	56.0	52	52.0	50.0	48.0
99th Pctile	845	µg/m^3	10th	45.0	48.0	48.0	48.0	45.0	44.0	42	41.0	40.0	39.0
99th Pctile	845	µg/m^3	5th	36.0	41.0	43.0	43.0	38.0	37.0	37	36.0	35.0	33.0
99th Pctile	845	µg/m^3	Arith. Mean	85.8	88.6	85.3	82.1	74.5	73.6	71	69.8	66.2	64.2
Sulfur Dioxide													
Arith. Mean	486	ppm	95th	0.0195	0.0182	0.0165	0.0161	0.0154	0.0153	0.0138	0.0115	0.0113	0.0106
Arith. Mean	486	ppm	90th	0.0154	0.0152	0.0144	0.0136	0.0128	0.0125	0.0122	0.0100	0.0097	0.0089
Arith. Mean	486	ppm	75th	0.0118	0.0115	0.0107	0.0099	0.0095	0.0093	0.0090	0.0074	0.0073	0.0070
Arith. Mean	486	ppm	50th	0.0082	0.0080	0.0076	0.0076	0.0068	0.0067	0.0065	0.0051	0.0053	0.0051
Arith. Mean	486	ppm	25th	0.0051	0.0049	0.0044	0.0046	0.0042	0.0039	0.0037	0.0033	0.0033	0.0031
Arith. Mean	486	ppm	10th	0.0023	0.0024	0.0022	0.0022	0.0020	0.0023	0.0021	0.0018	0.0019	0.0019
Arith. Mean	486	ppm	5th	0.0017	0.0016	0.0015	0.0015	0.0014	0.0015	0.0015	0.0014	0.0014	0.0014
Arith. Mean	486	ppm	Arith. Mean	0.0089	0.0087	0.0081	0.0079	0.0073	0.0072	0.0069	0.0056	0.0056	0.0054
2nd Max. 24-hr	487	ppm	95th	0.0960	0.0960	0.0850	0.0720	0.074	0.0720	0.0720	0.0570	0.0600	0.0520
2nd Max. 24-hr	487	ppm	90th	0.0740	0.0760	0.0660	0.0610	0.061	0.0580	0.0620	0.0480	0.0470	0.0440
2nd Max. 24-hr	487	ppm	75th	0.0560	0.0530	0.0500	0.0450	0.044	0.0420	0.0450	0.0330	0.0330	0.0330
2nd Max. 24-hr	487	ppm	50th	0.0390	0.0390	0.0340	0.0320	0.031	0.0280	0.0330	0.0220	0.0230	0.0230
2nd Max. 24-hr	487	ppm	25th	0.0250	0.0240	0.0210	0.0210	0.019	0.0190	0.0190	0.0160	0.0150	0.0140
2nd Max. 24-hr	487	ppm	10th	0.0120	0.0120	0.0100	0.0100	0.010	0.0100	0.0090	0.0080	0.0090	0.0080
2nd Max. 24-hr	487	ppm	5th	0.0070	0.0070	0.0060	0.0070	0.006	0.0055	0.0050	0.0050	0.0050	0.0050
2nd Max. 24-hr	487	ppm	Arith. Mean	0.0437	0.0419	0.0382	0.0352	0.034	0.0329	0.0343	0.0261	0.0266	0.0253

Table A-2. National Carbon Monoxide Emissions Estimates, 1988–1997 (thousand short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMBUSTION	**7,373**	**7,443**	**5,510**	**5,856**	**6,154**	**5,585**	**5,519**	**5,934**	**5,980**	**4,817**
Electric Utilities	314	321	363	349	350	362	370	372	394	406
Coal	*230*	*233*	*234*	*234*	*236*	*246*	*247*	*250*	*248*	*254*
Oil	*25*	*26*	*20*	*19*	*15*	*16*	*15*	*10*	*11*	*12*
Gas	*48*	*51*	*51*	*51*	*51*	*49*	*53*	*55*	*76*	*79*
Internal Combustion	*11*	*11*	*57*	*45*	*47*	*51*	*55*	*58*	*59*	*62*
Industrial	669	672	879	920	955	1,043	1,041	1,056	1,072	1,110
Coal	*87*	*87*	*105*	*101*	*102*	*101*	*100*	*98*	*99*	*100*
Oil	*46*	*46*	*74*	*60*	*64*	*66*	*66*	*71*	*72*	*73*
Gas	*265*	*271*	*226*	*284*	*300*	*322*	*337*	*345*	*348*	*362*
Other	*173*	*173*	*279*	*267*	*264*	*286*	*287*	*297*	*306*	*318*
Internal Combustion	*98*	*96*	*195*	*208*	*227*	*268*	*251*	*245*	*247*	*257*
Other	6,390	6,450	4,268	4,587	4,849	4,180	4,108	4,506	4,513	3,301
Residential Wood	*6,086*	*6,161*	*3,781*	*4,090*	*4,332*	*3,679*	*3,607*	*3,999*	*3,993*	*2,778*
Other	*303*	*288*	*488*	*497*	*517*	*502*	*502*	*506*	*520*	*522*
INDUSTRIAL PROCESSES	**7,034**	**7,013**	**5,852**	**5,740**	**5,683**	**5,898**	**5,839**	**5,791**	**5,816**	**6,052**
Chemical & Allied Processing	1,917	1,925	1,183	1,127	1,112	1,093	1,171	1,223	1,222	1,287
Metals Processing	2,101	2,132	2,640	2,571	2,496	2,536	2,475	2,380	2,378	2,465
Petroleum & Related Industries	441	436	332	345	371	371	338	348	348	364
Other Industrial Processes	711	716	537	548	544	594	600	624	635	663
Solvent Utilization	2	2	5	5	5	5	5	6	5	6
Storage & Transport	56	55	76	28	17	51	24	25	25	26
Waste Disposal & Recycling	1,806	1,747	1,079	1,116	1,138	1,248	1,225	1,185	1,203	1,242
TRANSPORTATION	**85,779**	**80,870**	**73,224**	**77,443**	**75,511**	**76,030**	**77,883**	**70,377**	**69,353**	**67,014**
On-Road Vehicles	71,081	66,050	57,848	62,074	59,859	60,202	61,833	54,106	52,944	50,257
Non-Road Sources	14,698	14,820	15,376	15,368	15,652	15,828	16,050	16,271	16,409	16,755
MISCELLANEOUS	**15,895**	**8,154**	**11,208**	**8,751**	**7,052**	**7,013**	**9,613**	**7,049**	**9,462**	**9,568**
Fires	15,895	8,154	11,176	8,724	7,022	6,979	9,585	7,021	9,435	9,540
Other	NA	NA	32	28	30	34	28	28	27	28
TOTAL ALL SOURCES	**116,081**	**103,480**	**95,794**	**97,790**	**94,400**	**94,526**	**98,854**	**89,151**	**90,611**	**87,451**

Note: Some columns may not sum to totals due to rounding.

Table A-3. National Lead Emissions Estimates, 1988–1997 (short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMBUSTION	**511**	**505**	**500**	**495**	**490**	**495**	**494**	**488**	**493**	**496**
Electric Utilities	66	67	64	61	59	61	61	57	61	64
Coal	*46*	*46*	*46*	*46*	*47*	*49*	*49*	*50*	*52*	*53*
Oil	*20*	*21*	*18*	*15*	*12*	*12*	*12*	*7*	*8*	*11*
Industrial	19	18	18	18	17	19	18	17	16	17
Coal	*14*	*14*	*14*	*15*	*14*	*14*	*14*	*14*	*13*	*13*
Oil	*5*	*4*	*4*	*3*	*3*	*5*	*4*	*3*	*3*	*4*
Other	426	420	418	416	414	415	415	414	416	415
Commercial/Institutional Coal	*5*	*4*	*4*	*3*	*3*	*4*	*3*	*4*	*5*	*5*
Commercial/Institutional Oil	*5*	*4*	*4*	*4*	*4*	*3*	*3*	*3*	*3*	*4*
Misc. Fuel Comb. (except residential)	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*	*400*
Residential Other	*16*	*12*	*10*	*9*	*7*	*8*	*8*	*8*	*7*	*7*
INDUSTRIAL PROCESSES	**3,090**	**3,161**	**3,278**	**3,081**	**2,734**	**2,869**	**3,005**	**2,873**	**2,892**	**2,897**
Chemical & Allied Processing	136	135	136	132	93	92	96	163	167	159
Metals Processing	1,965	2,088	2,169	1,975	1,773	1,899	2,027	2,048	2,052	2,038
Other Industrial Processes	172	173	169	167	56	54	53	58	51	54
Waste Disposal & Recycling	817	765	804	807	812	824	829	604	622	646
TRANSPORTATION	**3,452**	**1,802**	**1,197**	**592**	**584**	**547**	**544**	**563**	**525**	**522**
On-Road Vehicles	2,566	982	421	18	19	19	19	19	20	19
Non-Road Sources	886	820	776	574	565	528	525	544	505	503
TOTAL ALL SOURCES	**7,053**	**5,468**	**4,975**	**4,168**	**3,808**	**3,911**	**4,043**	**3,924**	**3,910**	**3,915**

Note: Some columns may not sum to totals due to rounding.

Table A-4. National Nitrogen Oxides Emissions Estimates, 1988–1997 (thousand short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMBUSTION	**10,472**	**10,538**	**10,895**	**10,779**	**10,928**	**11,111**	**11,015**	**10,828**	**10,519**	**10,724**
Electric Utilities	6,544	6,593	6,663	6,519	6,504	6,651	6,565	6,385	6,060	6,178
Coal	*5,666*	*5,676*	*5,642*	*5,559*	*5,579*	*5,744*	*5,636*	*5,579*	*5,542*	*5,588*
Oil	*272*	*285*	*221*	*212*	*170*	*180*	*163*	*96*	*103*	*131*
Gas	*556*	*582*	*565*	*580*	*579*	*551*	*591*	*562*	*264*	*286*
Internal Combustion	*50*	*49*	*235*	*168*	*175*	*176*	*175*	*148*	*151*	*159*
Industrial	3,188	3,209	3,035	2,979	3,071	3,151	3,147	3,145	3,170	3,270
Coal	*617*	*615*	*585*	*570*	*574*	*589*	*602*	*597*	*599*	*614*
Oil	*296*	*294*	*265*	*237*	*244*	*245*	*241*	*247*	*246*	*240*
Gas	*1,584*	*1,625*	*1,182*	*1,250*	*1,301*	*1,330*	*1,333*	*1,324*	*1,336*	*1,385*
Other	*121*	*120*	*131*	*129*	*126*	*124*	*124*	*123*	*125*	*130*
Internal Combustion	*569*	*556*	*874*	*793*	*825*	*863*	*846*	*854*	*864*	*902*
Other	740	736	1,196	1,281	1,353	1,309	1,303	1,298	1,289	1,276
Commercial/Institutional Coal	*38*	*38*	*40*	*36*	*38*	*40*	*40*	*38*	*38*	*40*
Commercial/Institutional Oil	*117*	*106*	*97*	*88*	*93*	*93*	*95*	*103*	*102*	*107*
Commercial/Institutional Gas	*157*	*159*	*200*	*210*	*225*	*232*	*237*	*231*	*234*	*241*
Misc. Fuel Comb. (Except Residential)	*11*	*11*	*34*	*32*	*28*	*31*	*31*	*30*	*29*	*30*
Residential Wood	*74*	*75*	*46*	*50*	*53*	*45*	*44*	*49*	*48*	*34*
Residential Other	*343*	*347*	*780*	*865*	*916*	*867*	*857*	*847*	*838*	*825*
INDUSTRIAL PROCESSES	**860**	**852**	**892**	**816**	**857**	**861**	**878**	**873**	**879**	**917**
Chemical & Allied Processing	273	273	168	165	163	155	160	158	159	167
Metals Processing	82	83	97	76	81	83	91	98	98	102
Petroleum & Related Industries	100	97	153	121	148	123	117	110	110	115
Other Industrial Processes	315	311	378	352	361	370	389	399	403	421
Solvent Utilization	3	3	1	2	3	3	3	3	3	3
Storage & Transport	2	2	3	6	5	5	5	6	6	6
Waste Disposal & Recycling	85	84	91	95	96	123	114	99	100	103
TRANSPORTATION	**11,659**	**11,731**	**11,278**	**11,639**	**11,750**	**11,849**	**12,069**	**11,830**	**11,650**	**11,595**
On-Road Vehicles	7,661	7,682	7,041	7,374	7,440	7,510	7,672	7,323	7,171	7,035
Non-Road Sources	3,998	4,049	4,237	4,265	4,310	4,339	4,397	4,507	4,479	4,560
MISCELLANEOUS	**727**	**293**	**371**	**286**	**254**	**225**	**383**	**237**	**343**	**346**
TOTAL ALL SOURCES	**23,718**	**23,414**	**23,436**	**23,520**	**23,789**	**24,046**	**24,345**	**23,768**	**23,391**	**23,582**

Note: Some columns may not sum to totals due to rounding.

Table A-5. National Volatile Organic Compounds Emissions Estimates, 1988–1997 (thousand short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMBUSTION	**1,360**	**1,372**	**1,005**	**1,075**	**1,114**	**993**	**989**	**1,073**	**1,079**	**861**
Electric Utilities	37	37	47	44	44	45	45	44	49	51
Coal	*27*	*27*	*27*	*27*	*27*	*29*	*29*	*29*	*28*	*29*
Oil	*7*	*7*	*6*	*5*	*4*	*4*	*4*	*3*	*3*	*3*
Gas	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*8*	*8*
Internal Combustion	*1*	*1*	*12*	*10*	*10*	*10*	*10*	*10*	*10*	*10*
Industrial	136	134	182	196	187	186	196	206	208	217
Coal	*7*	*7*	*7*	*6*	*7*	*6*	*8*	*6*	*6*	*6*
Oil	*16*	*16*	*12*	*11*	*12*	*12*	*12*	*12*	*12*	*12*
Gas	*61*	*61*	*58*	*60*	*52*	*51*	*63*	*73*	*73*	*77*
Other	*36*	*36*	*51*	*51*	*49*	*51*	*50*	*50*	*51*	*53*
Internal Combustion	*15*	*15*	*54*	*68*	*66*	*66*	*64*	*65*	*66*	*69*
Other	1,188	1,200	776	835	884	762	748	823	822	593
Residential Wood	*1,155*	*1,169*	*718*	*776*	*822*	*698*	*684*	*759*	*758*	*527*
Other	*33*	*31*	*58*	*59*	*62*	*64*	*63*	*64*	*64*	*9*
INDUSTRIAL PROCESSES	**10,853**	**10,755**	**10,000**	**10,178**	**10,380**	**10,578**	**10,738**	**10,780**	**9,482**	**9,836**
Chemical & Allied Processing	982	980	634	710	715	701	691	660	436	458
Metals Processing	74	74	122	123	124	124	126	125	70	73
Petroleum & Related Industries	645	639	612	640	632	649	647	642	517	538
Other Industrial Processes	408	403	401	391	414	442	438	450	439	458
Solvent Utilization	5,945	5,964	5,750	5,782	5,901	6,016	6,162	6,183	6,273	6,483
Storage & Transport	1,842	1,753	1,495	1,532	1,583	1,600	1,629	1,652	1,312	1,377
Waste Disposal & Recycling	959	941	986	999	1,010	1,046	1,046	1,067	433	449
TRANSPORTATION	**10,583**	**9,506**	**8,765**	**8,965**	**8,569**	**8,619**	**8,940**	**8,106**	**7,899**	**7,660**
On-Road Vehicles	8,290	7,192	6,313	6,499	6,072	6,103	6,401	5,701	5,502	5,230
Non-Road Sources	2,293	2,314	2,452	2,466	2,498	2,516	2,538	2,405	2,397	2,430
MISCELLANEOUS	**1,231**	**642**	**1,164**	**845**	**579**	**641**	**798**	**599**	**846**	**858**
Other Combustion	1,230	641	1,064	756	485	535	710	511	761	770
Fires	*1,230*	*641*	*1,061*	*753*	*482*	*532*	*707*	*508*	*758*	*767*
Other	*NA*	*NA*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Other	1	1	100	89	94	105	88	88	85	87
TOTAL ALL SOURCES	**24,027**	**22,274**	**20,935**	**21,063**	**20,642**	**20,830**	**21,465**	**20,558**	**19,306**	**19,214**

Note: Some columns may not sum to totals due to rounding.

Table A-6. National PM_{10} Emissions Estimates, 1988–1997 (thousand short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMBUSTION	**1,381**	**1,382**	**1,196**	**1,147**	**1,184**	**1,124**	**1,113**	**1,179**	**1,192**	**1,101**
Electric Utilities	276	271	295	257	257	279	273	268	288	290
Coal	*261*	*255*	*265*	*232*	*234*	*253*	*246*	*244*	*264*	*265*
Oil	*11*	*12*	*9*	*10*	*7*	*9*	*8*	*5*	*5*	*6*
Gas	*1*	*1*	*1*	*1*	*0*	*1*	*1*	*1*	*0*	*0*
Internal Combustion	*3*	*3*	*20*	*15*	*16*	*17*	*17*	*18*	*18*	*19*
Industrial	243	243	270	233	244	257	270	302	306	314
Coal	*70*	*70*	*84*	*72*	*74*	*71*	*70*	*70*	*71*	*72*
Oil	*48*	*48*	*52*	*44*	*45*	*45*	*44*	*49*	*50*	*48*
Gas	*45*	*44*	*41*	*34*	*40*	*43*	*43*	*45*	*45*	*47*
Other	*79*	*78*	*87*	*72*	*74*	*86*	*74*	*73*	*75*	*78*
Internal Combustion	*3*	*3*	*6*	*10*	*11*	*12*	*38*	*64*	*65*	*68*
Other	862	869	631	657	683	588	570	610	598	497
Residential Wood	*807*	*817*	*501*	*535*	*558*	*464*	*446*	*484*	*472*	*368*
Other	*55*	*52*	*130*	*122*	*124*	*124*	*125*	*126*	*126*	*129*
INDUSTRIAL PROCESSES	**1,294**	**1,276**	**1,306**	**1,264**	**1,269**	**1,240**	**1,219**	**1,231**	**1,232**	**1,277**
Chemical & Allied Processing	62	63	77	68	71	66	76	67	67	70
Metals Processing	208	211	214	251	250	181	184	212	211	220
Petroleum & Related Industries	60	58	55	43	43	38	38	40	40	41
Other Industrial Processes	601	591	583	520	506	501	495	511	510	530
Solvent Utilization	2	2	4	5	5	6	6	6	6	6
Storage & Transport	101	101	102	101	117	114	106	109	109	114
Waste Disposal & Recycling	259	251	271	276	278	334	313	287	290	296
TRANSPORTATION	**852**	**849**	**831**	**841**	**835**	**806**	**802**	**751**	**733**	**734**
On-Road Vehicles	369	367	336	349	343	321	320	293	274	268
Non-Road Sources	483	482	495	491	492	485	481	457	459	466
TOTAL ALL SOURCES	**3,527**	**3,507**	**3,333**	**3,252**	**3,288**	**3,170**	**3,134**	**3,161**	**3,157**	**3,112**

Table A-7. Miscellaneous and Natural Particulate Matter Emissions Estimates, 1988–1997 (thousand short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
MISCELLANEOUS	**39,445**	**37,461**	**24,420**	**24,122**	**23,866**	**24,197**	**25,462**	**22,453**	**24,715**	**25,152**
Agriculture & Forestry	7,453	7,320	5,146	5,106	4,909	4,475	4,690	4,661	4,708	4,707
Other Combustion	1,704	912	1,203	941	785	768	1,048	778	1,004	1,015
Fires	1,645	853	1,158	896	739	722	1,002	732	978	989
Other	*59*	*59*	*45*	*45*	*46*	*46*	*46*	*46*	*26*	*26*
Cooling Towers	NA	NA	0	0	0	0	0	1	1	1
Fugitive Dust	30,287	29,229	18,069	18,076	18,171	18,954	19,722	17,013	19,002	19,430
Wind Erosion	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Unpaved Roads	*12,379*	*11,798*	*11,234*	*11,206*	*10,918*	*11,430*	*11,370*	*10,362*	*12,060*	*12,305*
Paved Roads	*5,900*	*5,769*	*2,248*	*2,399*	*2,423*	*2,462*	*2,538*	*2,409*	*2,390*	*2,515*
Construction	*11,662*	*11,269*	*4,249*	*4,092*	*4,460*	*4,651*	*5,245*	*3,654*	*3,950*	*4,022*
Other	*346*	*392*	*336*	*377*	*369*	*409*	*569*	*586*	*602*	*587*
NAT. SOURCES (wind erosion)	**18,110**	**12,101**	**2,092**	**2,077**	**2,227**	**509**	**2,160**	**1,146**	**5,316**	**5,316**
TOTAL ALL SOURCES	**57,555**	**49,562**	**26,512**	**26,199**	**26,093**	**24,706**	**27,622**	**23,599**	**30,031**	**30,468**

Note: Some columns may not sum to totals due to rounding.

Table A-8. National Sulfur Dioxide Emissions Estimates, 1988–1997 (thousand short tons)

Source Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FUEL COMBUSTION	**19,758**	**19,923**	**20,290**	**19,795**	**19,492**	**19,244**	**18,886**	**16,229**	**16,814**	**17,260**
Electric Utilities	15,987	16,215	15,909	15,784	15,416	15,189	14,889	12,080	12,632	13,082
Coal	*15,221*	*15,404*	*15,220*	*15,087*	*14,824*	*14,527*	*14,313*	*11,603*	*12,137*	*12,529*
Oil	*734*	*779*	*639*	*652*	*546*	*612*	*522*	*413*	*436*	*486*
Gas	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*9*	*2*	*4*
Internal Combustion	*31*	*30*	*49*	*45*	*46*	*49*	*53*	*55*	*57*	*61*
Industrial	3,111	3,086	3,550	3,256	3,292	3,284	3,218	3,357	3,399	3,365
Coal	*1,856*	*1,840*	*1,914*	*1,805*	*1,783*	*1,763*	*1,740*	*1,728*	*1,762*	*1,769*
Oil	*806*	*812*	*927*	*779*	*801*	*809*	*777*	*912*	*918*	*847*
Gas	*360*	*346*	*543*	*516*	*552*	*555*	*542*	*548*	*548*	*572*
Other	*83*	*82*	*158*	*142*	*140*	*140*	*141*	*147*	*147*	*153*
Internal Combustion	*6*	*6*	*9*	*14*	*16*	*17*	*19*	*23*	*23*	*24*
Other	660	624	831	755	784	772	780	793	782	813
Commercial/Institutional Coal	*172*	*169*	*212*	*184*	*190*	*193*	*192*	*200*	*200*	*206*
Commercial/Institutional Oil	*295*	*274*	*425*	*376*	*396*	*381*	*391*	*397*	*389*	*414*
Commercial/Institutional Gas	*2*	*2*	*7*	*7*	*7*	*8*	*8*	*8*	*8*	*8*
Misc. Fuel Comb. (Except Residential)	*1*	*1*	*6*	*6*	*6*	*6*	*6*	*5*	*5*	*6*
Residential Wood	*11*	*11*	*7*	*7*	*8*	*6*	*6*	*7*	*7*	*5*
Residential Other	*180*	*167*	*175*	*176*	*177*	*178*	*177*	*176*	*173*	*171*
INDUSTRIAL PROCESSES	**2,052**	**2,010**	**1,900**	**1,721**	**1,758**	**1,723**	**1,676**	**1,637**	**1,644**	**1,718**
Chemical & Allied Processing	449	440	297	280	278	269	275	286	287	301
Metals Processing	707	695	726	612	615	603	562	530	530	552
Petroleum & Related Industries	443	429	430	378	416	383	379	369	368	385
Other Industrial Processes	411	405	399	396	396	392	398	403	409	427
Solvent Utilization	1	1	0	0	1	1	1	1	1	1
Storage & Transport	5	5	7	10	9	5	2	2	2	2
Waste Disposal & Recycling	36	36	42	44	44	71	60	47	48	50
TRANSPORTATION	**1,317**	**1,364**	**1,476**	**1,528**	**1,558**	**1,499**	**1,301**	**1,313**	**1,366**	**1,380**
On-Road Vehicles	553	570	542	570	578	517	301	304	340	320
Non-Road Sources	764	794	934	958	980	982	1,000	1,008	1,026	1,061
MISCELLANEOUS	**27**	**11**	**12**	**11**	**10**	**9**	**15**	**9**	**13**	**13**
TOTAL ALL SOURCES	**23,154**	**23,308**	**23,678**	**23,057**	**22,819**	**22,478**	**21,880**	**19,189**	**19,836**	**20,371**

Note: Some columns may not sum to totals due to rounding.

Table A-9. National Long-Term Air Quality Trends, 1978–1997

Year	CO 2nd Max. 8-hr ppm	Pb Max. Qtr. µg/m³	NO_2 Arith. Mean ppm	Ozone 2nd Max. 1-hr ppm	PM_{10} Wtd. Arith. Mean µg/m³	SO_2 Arith. Mean ppm
1978–87	***(208 sites)***	***(160 sites)***	***(93 sites)***	***(320 sites)***	**—**	***(343 sites)***
1978	9.7	1.16	0.024	0.149	—	0.0120
1979	9.5	1.01	0.024	0.137	—	0.0118
1980	8.8	0.76	0.023	0.139	—	0.0108
1981	8.5	0.60	0.022	0.127	—	0.0103
1982	7.9	0.53	0.021	0.125	—	0.0095
1983	7.8	0.39	0.021	0.139	—	0.0092
1984	7.8	0.35	0.021	0.124	—	0.0094
1985	7.0	0.24	0.021	0.123	—	0.0087
1986	7.0	0.15	0.021	0.119	—	0.0086
1987	6.7	0.12	0.021	0.125	—	0.0084
1988–97	***(368 sites)***	***(195 sites)***	***(224 sites)***	***(660 sites)***	***(845 sites)***	***(486 sites)***
1988	6.3	0.12	0.021	0.130	32.4	0.0089
1989	6.3	0.09	0.021	0.114	32.1	0.0087
1990	5.8	0.09	0.020	0.112	29.5	0.0081
1991	5.6	0.07	0.020	0.113	29.2	0.0079
1992	5.1	0.06	0.019	0.105	26.9	0.0073
1993	4.9	0.05	0.019	0.108	26.2	0.0072
1994	5.0	0.05	0.020	0.107	26.2	0.0069
1995	4.5	0.04	0.019	0.112	25.1	0.0056
1996	4.2	0.04	0.018	0.105	24.2	0.0056
1997	3.9	0.04	0.018	0.105	24.0	0.0054

Table A-10. National Air Quality Trends by Monitoring Location, 1988–1997

Statistic	# of Sites	Units	Location	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Carbon Monoxide													
2nd Max. 8 hr.	12	ppm	Rural	3.0	2.7	2.6	2.6	2.2	1.8	2.1	2.1	1.7	1.6
2nd Max. 8 hr.	145	ppm	Suburban	6.0	6.1	5.6	5.3	5.0	4.8	5.0	4.3	4.0	3.9
2nd Max. 8 hr.	208	ppm	Urban	6.8	6.7	6.2	6.0	5.4	5.1	5.3	4.7	4.5	4.1
Lead													
Max. Qtr.	4	µg/m^3	Rural	0.08	0.06	0.07	0.06	0.05	0.05	0.03	0.03	0.02	0.03
Max. Qtr.	99	µg/m^3	Suburban	0.09	0.08	0.07	0.06	0.05	0.04	0.04	0.04	0.03	0.03
Max. Qtr.	90	µg/m^3	Urban	0.14	0.09	0.10	0.07	0.06	0.06	0.05	0.05	0.05	0.05
Nitrogen Dioxide													
Arith. Mean	46	ppm	Rural	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.007	0.008	0.007
Arith. Mean	96	ppm	Suburban	0.023	0.022	0.021	0.021	0.020	0.020	0.021	0.020	0.019	0.019
Arith. Mean	80	ppm	Urban	0.027	0.026	0.025	0.024	0.024	0.024	0.025	0.023	0.023	0.023
Ozone													
2nd Max. 1-hr	234	ppm	Rural	0.120	0.108	0.108	0.106	0.100	0.103	0.102	0.107	0.101	0.100
2nd Max. 1-hr	292	ppm	Suburban	0.138	0.119	0.116	0.119	0.109	0.112	0.112	0.117	0.108	0.109
2nd Max. 1-hr	117	ppm	Urban	0.132	0.114	0.110	0.111	0.104	0.105	0.106	0.110	0.106	0.102
PM$_{10}$													
Wtd. Arith. Mean	112	µg/m^3	Rural	25.6	25.7	24.0	23.0	21.5	20.4	20.5	19.4	19.3	19.0
Wtd. Arith. Mean	329	µg/m^3	Suburban	33.4	32.9	30.4	29.9	27.7	27.0	27.0	26.1	24.8	24.7
Wtd. Arith. Mean	385	µg/m^3	Urban	33.6	33.3	30.4	30.4	27.9	27.3	27.4	26.0	25.2	25.1
Sulfur Dioxide													
Arith. Mean	127	ppm	Rural	0.0072	0.0071	0.0067	0.0066	0.0063	0.0064	0.0060	0.0052	0.0050	0.0048
Arith. Mean	202	ppm	Suburban	0.0095	0.0091	0.0085	0.0083	0.0077	0.0075	0.0071	0.0057	0.0058	0.0056
Arith. Mean	147	ppm	Urban	0.0099	0.0097	0.0090	0.0086	0.0078	0.0076	0.0075	0.0059	0.0058	0.0056

Table A-11. National Air Quality Trends Statistics by EPA Region, 1988–1997

	Statistic	# of Sites	Units	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Region 1													
CO	2nd Max. 8-hr	16	ppm	6.2	5.9	6.2	5.7	5.8	4.9	6.1	5.4	4.9	4.2
Pb	Max. Qtr.	—	µg/m^3	—	—	—	—	—	—	—	—	—	—
NO_2	Arith. Mean	16	ppm	0.025	0.024	0.023	0.023	0.021	0.022	0.023	0.021	0.021	0.020
O_3	2nd Max. 1-hr	37	ppm	0.150	0.121	0.119	0.130	0.110	0.118	0.115	0.117	0.102	0.1116
O_3	4th Max. 8-hr	37	ppm	0.112	0.091	0.090	0.099	0.086	0.088	0.087	0.091	0.080	0.090
PM_{10}	Wtd. Arith. Mean	71	µg/m^3	24.8	24.4	22.7	23.4	20.6	20.1	20.7	18.4	19.1	19.4
SO_2	Arith. Mean	50	ppm	0.0095	0.0090	0.0081	0.0079	0.0073	0.0070	0.0068	0.0053	0.0053	0.0051
Region 2													
CO	2nd Max. 8-hr	26	ppm	6.3	6.3	5.6	5.6	5.0	4.6	5.3	4.6	4.0	3.6
Pb	Max. Qtr.	12	µg/m^3	0.10	0.07	0.06	0.05	0.04	0.05	0.05	0.04	0.04	0.05
NO_2	Arith. Mean	11	ppm	0.032	0.030	0.029	0.028	0.027	0.027	0.029	0.027	0.027	0.026
O_3	2nd Max. 1-hr	31	ppm	0.154	0.118	0.124	0.127	0.110	0.111	0.108	0.117	0.105	0.113
O_3	4th Max. 8-hr	31	ppm	0.119	0.093	0.096	0.103	0.085	0.089	0.087	0.096	0.083	0.093
PM_{10}	Wtd. Arith. Mean	58	µg/m^3	30.6	30.4	27.7	28.2	25.3	25.5	26.1	23.4	24.3	24.9
SO_2	Arith. Mean	38	ppm	0.0112	0.0109	0.0098	0.0100	0.0092	0.0084	0.0086	0.0066	0.0067	0.0061
Region 3													
CO	2nd Max. 8-hr	41	ppm	5.6	5.6	5.2	4.7	4.4	4.3	4.7	4.0	3.7	3.4
Pb	Max. Qtr.	24	µg/m^3	0.15	0.11	0.09	0.08	0.06	0.05	0.05	0.04	0.04	0.04
NO_2	Arith. Mean	33	ppm	0.023	0.022	0.022	0.022	0.021	0.021	0.022	0.020	0.021	0.020
O_3	2nd Max. 1-hr	78	ppm	0.143	0.108	0.110	0.117	0.101	0.115	0.110	0.114	0.104	0.113
O_3	4th Max. 8-hr	78	ppm	0.112	0.087	0.088	0.096	0.082	0.092	0.087	0.093	0.084	0.091
PM_{10}	Wtd. Arith. Mean	64	µg/m^3	32.6	32.0	29.3	30.4	26.0	26.7	27.7	26.7	25.5	25.6
SO_2	Arith. Mean	64	ppm	0.0141	0.0136	0.0127	0.0120	0.0110	0.0112	0.0112	0.0084	0.0085	0.0088
Region 4													
CO	2nd Max. 8-hr	55	ppm	5.6	6.0	5.3	4.9	4.9	5.0	4.6	4.3	3.8	4.0
Pb	Max. Qtr.	27	µg/m^3	0.07	0.06	0.04	0.03	0.04	0.03	0.03	0.03	0.02	0.03
NO_2	Arith. Mean	21	ppm	0.017	0.016	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
O_3	2nd Max. 1-hr	111	ppm	0.116	0.100	0.106	0.098	0.096	0.105	0.100	0.105	0.102	0.103
O_3	4th Max. 8-hr	110	ppm	0.092	0.079	0.084	0.076	0.077	0.082	0.081	0.083	0.082	0.083
PM_{10}	Wtd. Arith. Mean	100	µg/m^3	32.5	31.1	31.0	29.5	27.5	26.8	26.4	26.0	24.5	24.9
SO_2	Arith. Mean	66	ppm	0.0068	0.0065	0.0063	0.0060	0.0057	0.0058	0.0053	0.0045	0.0046	0.0046
Region 5													
CO	2nd Max. 8-hr	44	ppm	5.6	5.7	5.1	4.9	4.5	4.4	5.2	4.1	3.3	3.1
Pb	Max. Qtr.	45	µg/m^3	0.17	0.12	0.16	0.09	0.09	0.08	0.08	0.06	0.06	0.06
NO_2	Arith. Mean	13	ppm	0.024	0.024	0.022	0.021	0.021	0.022	0.023	0.023	0.023	0.023
O_3	2nd Max. 1-hr	126	ppm	0.128	0.107	0.101	0.111	0.097	0.097	0.105	0.111	0.102	0.101
O_3	4th Max. 8-hr	126	ppm	0.101	0.085	0.082	0.089	0.079	0.077	0.084	0.089	0.085	0.083
PM_{10}	Wtd. Arith. Mean	145	µg/m^3	33.7	33.9	31.4	30.3	28.1	26.5	28.3	27.4	24.8	24.7
SO_2	Arith. Mean	124	ppm	0.0098	0.0098	0.0093	0.0091	0.0082	0.0083	0.0077	0.0061	0.0062	0.0059

Table A-11. National Air Quality Trends Statistics by EPA Region, 1988–1997 (continued)

	Statistic	# of Sites	Units	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Region 6													
CO	2nd Max. 8-hr	33	ppm	6.1	6.1	6.1	5.4	5.4	5.3	4.7	4.4	4.9	4.4
Pb	Max. Qtr.	25	µg/m^3	0.12	0.12	0.10	0.09	0.07	0.07	0.05	0.06	0.06	0.04
NO_2	Arith. Mean	21	ppm	0.017	0.015	0.015	0.014	0.016	0.014	0.016	0.016	0.015	0.015
O_3	2nd Max. 1-hr	64	ppm	0.125	0.122	0.124	0.116	0.111	0.112	0.111	0.123	0.111	0.116
O_3	4th Max. 8-hr	64	ppm	0.089	0.086	0.089	0.081	0.080	0.081	0.083	0.092	0.082	0.083
PM_{10}	Wtd. Arith. Mean	92	µg/m^3	29.6	28.9	25.8	24.4	24.5	23.8	24.0	24.9	23.9	22.5
SO_2	Arith. Mean	34	ppm	0.0065	0.0064	0.0062	0.0059	0.0062	0.0053	0.0046	0.0046	0.0047	0.0043
Region 7													
CO	2nd Max. 8-hr	23	ppm	5.1	5.2	4.9	5.0	4.3	4.2	4.1	3.9	4.0	3.7
Pb	Max. Qtr.	19	µg/m^3	0.07	0.05	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.04
NO_2	Arith. Mean	11	ppm	0.016	0.016	0.015	0.015	0.016	0.015	0.016	0.016	0.016	0.015
O_3	2nd Max. 1-hr	30	ppm	0.111	0.092	0.089	0.091	0.091	0.088	0.096	0.101	0.093	0.094
O_3	4th Max. 8-hr	30	ppm	0.087	0.073	0.069	0.074	0.074	0.066	0.077	0.081	0.075	0.075
PM_{10}	Wtd. Arith. Mean	48	µg/m^3	33.1	32.8	29.7	28.9	28.2	27.0	27.8	26.9	27.4	25.6
SO_2	Arith. Mean	31	ppm	0.0084	0.0082	0.0075	0.0071	0.0062	0.0062	0.0063	0.0052	0.0049	0.0046
Region 8													
CO	2nd Max. 8-hr	22	ppm	8.0	7.0	6.3	6.4	6.1	5.4	5.0	4.7	4.5	4.3
Pb	Max. Qtr.	7	µg/m^3	0.09	0.06	0.06	0.06	0.05	0.06	0.04	0.04	0.03	0.03
NO_2	Arith. Mean	17	ppm	0.014	0.013	0.013	0.013	0.013	0.013	0.014	0.013	0.013	0.013
O_3	2nd Max. 1-hr	20	ppm	0.098	0.092	0.086	0.084	0.081	0.079	0.083	0.083	0.085	0.081
O_3	4th Max. 8-hr	20	ppm	0.075	0.072	0.067	0.068	0.065	0.064	0.067	0.066	0.068	0.066
PM_{10}	Wtd. Arith. Mean	101	µg/m^3	28.1	27.4	24.1	25.3	23.5	22.7	22.1	19.6	19.9	19.2
SO_2	Arith. Mean	33	ppm	0.0064	0.0058	0.0057	0.0054	0.0059	0.0057	0.0053	0.0048	0.0041	0.0036
Region 9													
CO	2nd Max. 8-hr	93	ppm	7.0	6.9	6.4	6.3	5.4	4.9	5.3	4.7	4.5	4.2
Pb	Max. Qtr.	31	µg/m^3	0.10	0.08	0.07	0.06	0.03	0.04	0.03	0.03	0.03	0.03
NO_2	Arith. Mean	81	ppm	0.023	0.023	0.021	0.021	0.020	0.019	0.020	0.019	0.018	0.017
O_3	2nd Max. 1-hr	150	ppm	0.138	0.139	0.127	0.126	0.124	0.120	0.117	0.118	0.114	0.102
O_3	4th Max. 8-hr	150	ppm	0.098	0.096	0.090	0.091	0.090	0.088	0.087	0.087	0.086	0.078
PM_{10}	Wtd. Arith. Mean	111	µg/m^3	40.3	41.8	38.1	36.9	32.8	31.8	30.6	30.6	28.7	29.0
SO_2	Arith. Mean	37	ppm	0.0033	0.0029	0.0025	0.0024	0.0025	0.0022	0.0021	0.0024	0.0023	0.0022
Region 10													
CO	2nd Max. 8-hr	15	ppm	9.5	8.8	7.8	8.2	7.6	6.5	6.1	5.9	5.9	5.5
Pb	Max. Qtr.	5	µg/m^3	0.09	0.06	0.06	0.06	0.04	0.05	0.05	0.05	0.04	0.05
NO_2	Arith. Mean	—	ppm	—	—	—	—	—	—	—	—	—	—
O_3	2nd Max. 1-hr	13	ppm	0.098	0.083	0.099	0.086	0.087	0.081	0.088	0.086	0.097	0.076
O_3	4th Max. 8-hr	13	ppm	0.070	0.060	0.072	0.064	0.069	0.058	0.062	0.063	0.076	0.058
PM_{10}	Wtd. Arith. Mean	55	µg/m^3	35.8	34.4	31.2	32.3	30.5	30.6	26.9	23.6	23.5	24.0
SO_2	Arith. Mean	9	ppm	0.0069	0.0066	0.0071	0.0070	0.0073	0.0066	0.0066	0.0059	0.0051	0.0047

Table A-12. Maximum Air Quality Concentrations by County, 1997

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m^3)	PM_{10} 99 Pctile (µg/m^3)	SO_2 24-hr (ppm)
AL	CALHOUN CO	116,034	.	.	.	.	.	49	51	.
AL	CLAY CO	13,252	.	.	.	0.092	0.079	.	.	.
AL	COLBERT CO	51,666	.	.	.	.	.	41	44	0.020
AL	DE KALB CO	54,651	.	.	.	.	.	49	51	.
AL	ELMORE CO	49,210	.	.	.	0.087	0.070	.	.	.
AL	ESCAMBIA CO	35,518	.	.	.	.	.	51	55	.
AL	ETOWAH CO	99,840	.	.	.	.	.	58	63	.
AL	FRANKLIN CO	27,814	.	.	.	.	.	43	49	.
AL	GENEVA CO	23,647	.	.	.	0.084	0.073	.	.	.
AL	HOUSTON CO	81,331	.	.	.	.	.	50	58	.
AL	JACKSON CO	47,796	.	.	.	.	.	.	.	0.023
AL	JEFFERSON CO	651,525	6.1	.	.	0.122	0.088	111	111	0.018
AL	LAWRENCE CO	31,513	.	.	.	0.090	0.076	.	.	.
AL	LIMESTONE CO	54,135	.	.	.	.	.	35	40	.
AL	MADISON CO	238,912	3.1	.	.	0.096	0.086	48	50	.
AL	MARENGO CO	23,084	.	.	.	.	.	52	57	.
AL	MOBILE CO	378,643	.	.	.	0.117	0.081	142	166	0.049
AL	MONTGOMERY CO	209,085	1.2	.	0.0080	0.083	0.068	53	57	0.005
AL	MORGAN CO	100,043	.	.	.	.	.	48	55	.
AL	PIKE CO	27,595	.	0.62	.	.	.	48	51	.
AL	RUSSELL CO	46,860	.	.	.	.	.	55	68	.
AL	SHELBY CO	99,358	.	.	0.0100	0.115	0.084	67	71	.
AL	SUMTER CO	16,174	.	.	.	0.070	0.062	.	.	.
AL	TALLADEGA CO	74,107	.	.	.	.	.	67	70	.
AL	TUSCALOOSA CO	150,522	.	.	.	.	.	55	70	.
AL	WALKER CO	67,670	.	.	.	.	.	43	46	.
AK	ANCHORAGE BOROUGH	226,338	7.1	.	.	.	.	127	113	.
AK	FAIRBANKS N. STAR BOR.	77,720	12.1	.	.	.	.	59	59	.
AK	JUNEAU BOROUGH	26,751	.	.	.	.	.	90	90	.
AK	YUKON-KOYUKUK CA	8,478	.	.	.	0.057	0.051	.	.	.
AZ	COCHISE CO	97,624	.	.	.	0.070	0.065	74	77	.
AZ	COCONINO CO	96,591	.	.	.	0.076	0.072	.	.	.
AZ	GILA CO	40,216	.	.	.	.	.	68	158	.
AZ	GRAHAM CO	26,554	.	.	.	.	.	62	95	.
AZ	MARICOPA CO	2,122,101	7.8	0.03	0.0319	0.113	0.091	308	301	0.010
AZ	PIMA CO	666,880	4.4	0.01	0.0178	0.097	0.079	129	134	0.004
AZ	PINAL CO	116,379	.	.	.	.	.	.	.	0.024
AZ	SANTA CRUZ CO	29,676	.	.	.	.	.	93	126	.
AZ	YAVAPAI CO	107,714	.	.	.	.	.	27	33	.
AZ	YUMA CO	106,895	.	.	.	0.072	0.063	.	.	.
AR	ARKANSAS CO	21,653	.	.	.	.	.	67	81	.
AR	ASHLEY CO	24,319	.	.	.	.	.	63	93	.
AR	CRAIGHEAD CO	68,956	.	.	.	.	.	60	75	.
AR	CRITTENDEN CO	49,939	.	.	.	0.122	0.091	44	45	.
AR	GARLAND CO	73,397	.	.	.	.	.	44	80	.
AR	JEFFERSON CO	85,487	.	.	.	.	.	61	78	.
AR	MARION CO	12,001	.	.	.	.	.	31	60	.
AR	MILLER CO	38,467	.	.	.	.	.	64	78	.
AR	MONTGOMERY CO	7,841	.	.	.	0.077	0.068	.	.	.
AR	NEWTON CO	7,666	.	.	.	0.088	0.073	.	.	.
AR	OUACHITA CO	30,574	.	.	.	.	.	52	61	.
AR	PHILLIPS CO	28,838	.	.	.	.	.	47	59	.
AR	POPE CO	45,883	.	.	.	.	.	46	52	.
AR	PULASKI CO	349,660	4.7	.	0.0103	0.100	0.078	61	86	0.006

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (μg/m³)	NO$_2$ AM (ppm)	O$_3$ 2nd Max (ppm)	O$_3$ 4th Max (ppm)	PM$_{10}$ 2nd Max (μg/m³)	PM$_{10}$ 99 Pctile (μg/m³)	SO$_2$ 24-hr (ppm)
AR	SEBASTIAN CO	99,590	.	.	.	.	.	59	68	.
AR	UNION CO	46,719	.	.	.	.	.	38	56	0.049
AR	WASHINGTON CO	113,409	.	.	.	.	.	36	54	.
AR	WHITE CO	54,676	.	.	.	.	.	55	77	.
CA	ALAMEDA CO	1,279,182	3.6	0.00	0.0198	0.111	0.072	55	65	.
CA	AMADOR CO	30,039	1.4	0.00	.	0.117	0.084	.	.	.
CA	BUTTE CO	182,120	4.5	0.00	0.0132	0.074	0.066	84	108	.
CA	CALAVERAS CO	31,998	1.0	.	.	0.118	0.085	34	112	.
CA	COLUSA CO	16,275	.	.	.	0.090	0.073	63	60	.
CA	CONTRA COSTA CO	803,732	3.1	0.01	0.0160	0.095	0.072	71	77	0.012
CA	DEL NORTE CO	23,460	.	.	.	.	.	46	58	.
CA	EL DORADO CO	125,995	3.6	.	0.0111	0.120	0.092	52	62	.
CA	FRESNO CO	667,490	7.1	0.00	0.0208	0.140	0.115	111	125	0.002
CA	GLENN CO	24,798	.	.	.	0.085	0.076	59	72	.
CA	HUMBOLDT CO	119,118	.	.	.	.	.	41	56	.
CA	IMPERIAL CO	109,303	16.7	0.03	0.0152	0.150	0.105	192	199	0.011
CA	INYO CO	18,281	.	.	.	0.084	0.077	256	402	.
CA	KERN CO	543,477	3.2	0.00	0.0244	0.141	0.105	96	137	0.005
CA	KINGS CO	101,469	.	.	0.0138	0.125	0.097	126	199	.
CA	LAKE CO	50,631	.	.	.	0.080	0.058	17	18	.
CA	LOS ANGELES CO	8,863,164	15.0	0.07	0.0432	0.168	0.120	93	116	0.010
CA	MADERA CO	88,090	.	.	.	0.085	.	.	.	.
CA	MARIN CO	230,096	2.6	.	0.0163	0.077	0.048	60	72	.
CA	MARIPOSA CO	14,302	.	.	.	0.111	0.093	39	62	.
CA	MENDOCINO CO	80,345	2.8	.	0.0101	0.067	0.054	50	66	.
CA	MERCED CO	178,403	.	.	0.0132	0.090	0.074	.	.	.
CA	MONO CO	9,956	3.3	.	.	0.083	0.077	99	112	.
CA	MONTEREY CO	355,660	1.7	.	0.0098	0.082	0.061	70	91	.
CA	NAPA CO	110,765	3.9	.	0.0121	0.075	0.055	71	78	.
CA	NEVADA CO	78,510	.	.	.	0.108	0.096	158	136	.
CA	ORANGE CO	2,410,556	5.7	.	0.0328	0.130	0.082	82	91	0.006
CA	PLACER CO	172,796	2.1	0.00	0.0152	0.112	0.085	39	50	.
CA	PLUMAS CO	19,739	.	.	.	0.071	0.061	66	66	.
CA	RIVERSIDE CO	1,170,413	5.1	0.05	0.0258	0.180	0.135	133	227	0.005
CA	SACRAMENTO CO	1,041,219	6.7	0.01	0.0190	0.136	0.091	104	108	0.006
CA	SAN BENITO CO	36,697	.	.	.	0.092	0.076	33	34	.
CA	SAN BERNARDINO CO	1,418,380	5.4	0.04	0.0362	0.171	0.127	133	208	0.005
CA	SAN DIEGO CO	2,498,016	4.9	0.03	0.0237	0.120	0.093	93	125	0.016
CA	SAN FRANCISCO CO	723,959	3.9	0.01	0.0200	0.067	0.042	65	81	0.006
CA	SAN JOAQUIN CO	480,628	3.9	0.00	0.0216	0.109	0.079	95	130	.
CA	SAN LUIS OBISPO CO	217,162	2.3	.	0.0127	0.085	0.070	68	75	0.026
CA	SAN MATEO CO	649,623	3.8	.	0.0184	0.079	0.053	65	70	.
CA	SANTA BARBARA CO	369,608	3.8	0.00	0.0193	0.108	0.081	63	122	0.005
CA	SANTA CLARA CO	1,497,577	5.6	0.01	0.0249	0.090	0.070	72	95	.
CA	SANTA CRUZ CO	229,734	0.7	.	0.0043	0.078	0.063	88	113	0.002
CA	SHASTA CO	147,036	.	.	.	0.108	0.087	56	63	.
CA	SIERRA CO	3,318	.	.	.	.	.	93	138	.
CA	SISKIYOU CO	43,531	.	.	.	0.070	0.059	30	32	.
CA	SOLANO CO	340,421	4.9	.	0.0130	0.101	0.071	63	85	0.005
CA	SONOMA CO	388,222	3.1	.	0.0131	0.100	0.081	55	85	.
CA	STANISLAUS CO	370,522	4.2	0.00	0.0208	0.113	0.089	115	119	.
CA	SUTTER CO	64,415	3.9	.	0.0140	0.096	0.074	83	98	.
CA	TEHAMA CO	49,625	.	.	.	0.090	0.076	52	58	.
CA	TRINITY CO	13,063	.	.	.	.	.	42	54	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m³)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m³)	PM_{10} 99 Pctile (µg/m³)	SO_2 24-hr (ppm)
CA	TULARE CO	311,921	3.5	.	0.0188	0.117	0.101	86	96	.
CA	TUOLUMNE CO	48,456	1.9	.	.	0.107	0.086	.	.	.
CA	VENTURA CO	669,016	3.2	0.00	0.0199	0.128	0.105	136	253	0.011
CA	YOLO CO	141,092	1.5	.	0.0099	0.095	0.071	60	126	.
CO	ADAMS CO	265,038	4.3	0.03	0.0232	0.089	0.071	98	94	0.016
CO	ALAMOSA CO	13,617	.	.	.	.	.	113	93	.
CO	ARAPAHOE CO	391,511	2.8	.	.	0.082	0.065	.	.	.
CO	ARCHULETA CO	5,345	.	.	.	.	.	96	85	.
CO	BOULDER CO	225,339	5.4	.	.	0.092	0.072	42	43	.
CO	DELTA CO	20,980	.	.	.	.	.	78	90	.
CO	DENVER CO	467,610	6.4	0.03	0.0339	0.083	0.066	93	94	0.026
CO	DOUGLAS CO	60,391	.	.	.	0.094	0.075	54	54	.
CO	EL PASO CO	397,014	4.9	0.01	.	0.070	0.059	79	78	.
CO	FREMONT CO	32,273	.	.	.	.	.	37	41	.
CO	GARFIELD CO	29,974	.	.	.	.	.	36	45	.
CO	GUNNISON CO	10,273	.	.	.	.	.	215	203	.
CO	JEFFERSON CO	438,430	4.9	.	0.0094	0.095	0.076	70	70	.
CO	LAKE CO	6,007	.	0.03	.	.	.	.	.	.
CO	LA PLATA CO	32,284	.	.	.	.	.	106	106	.
CO	LARIMER CO	186,136	5.2	.	.	0.085	0.064	34	40	.
CO	MESA CO	93,145	5.4	.	.	.	.	49	48	.
CO	MONTEZUMA CO	18,672	.	.	.	0.068	.	.	.	.
CO	MONTROSE CO	24,423	.	.	.	.	.	55	65	.
CO	PITKIN CO	12,661	.	.	.	.	.	89	68	.
CO	PROWERS CO	13,347	.	.	.	.	.	98	66	.
CO	PUEBLO CO	123,051	.	.	.	.	.	56	88	.
CO	ROUTT CO	14,088	.	.	.	.	.	112	99	.
CO	SAN MIGUEL CO	3,653	.	.	.	.	.	80	75	.
CO	SUMMIT CO	12,881	.	.	.	.	.	75	95	.
CO	TELLER CO	12,468	.	.	.	.	.	121	120	.
CO	WELD CO	131,821	4.8	.	.	0.095	0.069	56	56	.
CT	FAIRFIELD CO	827,645	5.1	.	0.0226	0.142	0.109	65	90	0.031
CT	HARTFORD CO	851,783	5.9	.	0.0178	0.148	0.097	47	53	0.025
CT	LITCHFIELD CO	174,092	.	.	.	0.124	0.097	38	41	.
CT	MIDDLESEX CO	143,196	.	.	.	0.135	0.103	44	47	.
CT	NEW HAVEN CO	804,219	3.9	.	0.0236	0.145	0.109	64	63	0.032
CT	NEW LONDON CO	254,957	.	.	.	0.150	0.107	45	65	0.022
CT	TOLLAND CO	128,699	.	.	.	0.146	0.097	.	.	0.015
CT	WINDHAM CO	102,525	.	.	.	.	.	37	41	.
DE	KENT CO	110,993	.	.	.	0.124	0.099	.	.	.
DE	NEW CASTLE CO	441,946	4.5	.	0.0178	0.140	0.104	68	92	0.057
DE	SUSSEX CO	113,229	.	.	.	0.127	0.100	49	63	0.023
DC	WASHINGTON	606,900	6.4	0.01	0.0246	0.128	0.096	47	49	0.022
FL	ALACHUA CO	181,596	.	.	.	0.091	.	41	75	.
FL	BAY CO	126,994	.	.	.	.	.	52	62	.
FL	BREVARD CO	398,978	.	.	.	0.086	0.077	38	42	.
FL	BROWARD CO	1,255,488	4.8	0.04	0.0097	0.092	0.073	39	60	0.011
FL	COLLIER CO	152,099	.	.	.	.	.	37	46	.
FL	DADE CO	1,937,094	4.1	.	0.0166	0.106	0.075	52	71	0.004
FL	DUVAL CO	672,971	3.0	0.02	0.0143	0.116	0.087	50	56	0.015
FL	ESCAMBIA CO	262,798	.	.	.	0.110	0.086	56	57	0.033
FL	GULF CO	11,504	.	.	.	.	.	54	65	.
FL	HAMILTON CO	10,930	.	.	.	.	.	43	44	0.026
FL	HILLSBOROUGH CO	834,054	3.7	0.64	0.0096	0.112	0.086	87	92	0.038

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max ($\mu g/m^3$)	PM_{10} 99 Pctile ($\mu g/m^3$)	SO_2 24-hr (ppm)
FL	LAKE CO	152,104	.	.	.	.	.	43	39	.
FL	LEE CO	335,113	.	.	.	0.083	0.072	33	38	.
FL	LEON CO	192,493	.	.	.	0.056	.	43	43	.
FL	MANATEE CO	211,707	.	.	.	0.099	0.077	40	54	.
FL	MARTIN CO	100,900	.	.	.	.	.	32	40	.
FL	NASSAU CO	43,941	.	.	.	.	.	62	64	0.035
FL	ORANGE CO	677,491	4.3	.	0.0129	0.109	0.079	52	53	0.006
FL	OSCEOLA CO	107,728	.	.	.	0.088	0.075	.	.	.
FL	PALM BEACH CO	863,518	3.6	0.00	0.0120	0.086	0.068	39	67	0.013
FL	PASCO CO	281,131	.	.	.	0.092	0.079	.	.	.
FL	PINELLAS CO	851,659	3.7	0.00	0.0115	0.094	0.078	55	62	0.033
FL	POLK CO	405,382	.	.	.	0.102	0.079	.	.	0.017
FL	PUTNAM CO	65,070	.	.	.	.	.	44	44	0.014
FL	ST JOHNS CO	83,829	.	.	.	0.089	0.076	.	.	.
FL	ST LUCIE CO	150,171	.	.	.	0.082	0.067	35	35	.
FL	SARASOTA CO	277,776	5.3	.	.	0.105	0.079	56	52	0.012
FL	SEMINOLE CO	287,529	.	.	.	0.096	0.076	37	42	.
FL	VOLUSIA CO	370,712	.	.	.	0.088	0.073	38	40	.
GA	BARTOW CO	55,911	.	.	.	.	.	.	.	0.018
GA	BIBB CO	149,967	.	.	.	0.122	0.095	77	102	0.011
GA	CHATHAM CO	216,935	.	.	.	0.080	0.071	49	53	0.024
GA	CHATTOOGA CO	22,242	.	.	.	.	.	52	71	.
GA	DE KALB CO	545,837	4.3	0.34	0.0147	0.125	0.092	53	64	.
GA	DOUGHERTY CO	96,311	.	.	.	.	.	57	80	.
GA	DOUGLAS CO	71,120	.	.	.	0.103	.	.	.	.
GA	FANNIN CO	15,992	.	.	.	0.083	0.075	.	.	0.032
GA	FLOYD CO	81,251	.	.	.	.	.	61	71	0.016
GA	FULTON CO	648,951	3.7	0.02	0.0252	0.133	0.104	75	80	0.027
GA	GLYNN CO	62,496	.	.	.	0.091	0.079	55	58	.
GA	GWINNETT CO	352,910	.	.	.	0.105	0.086	.	.	.
GA	MUSCOGEE CO	179,278	.	0.81	.	0.098	0.081	64	127	.
GA	PAULDING CO	41,611	.	.	.	0.103	0.086	.	.	.
GA	RICHMOND CO	189,719	.	.	.	0.118	0.087	54	64	0.013
GA	ROCKDALE CO	54,091	.	.	0.0075	0.139	0.110	.	.	.
GA	SPALDING CO	54,457	.	.	.	.	.	55	59	.
GA	WALKER CO	58,340	.	.	.	.	.	57	57	.
GA	WASHINGTON CO	19,112	.	.	.	.	.	61	61	.
HI	HONOLULU CO	836,231	2.5	0.03	0.0046	0.053	0.047	28	29	0.007
HI	KAUAI CO	51,177	.	.	.	.	.	26	31	.
HI	MAUI CO	100,374	.	.	.	.	.	87	77	.
ID	ADA CO	205,775	4.7	.	0.0194	.	.	91	161	.
ID	BANNOCK CO	66,026	.	.	.	.	.	89	71	0.034
ID	BLAINE CO	13,552	.	.	.	.	.	52	58	.
ID	BONNER CO	26,622	.	.	.	.	.	73	73	.
ID	BONNEVILLE CO	72,207	.	.	.	.	.	56	79	.
ID	BUTTE CO	2,918	.	.	.	0.066	0.060	.	.	.
ID	CANYON CO	90,076	.	.	.	.	.	63	80	.
ID	CARIBOU CO	6,963	.	.	.	.	.	63	63	.
ID	KOOTENAI CO	69,795	.	.	.	.	.	67	91	.
ID	LEMHI CO	6,899	.	.	.	.	.	123	155	.
ID	LEWIS CO	3,516	.	.	.	.	.	62	83	.
ID	MADISON CO	23,674	.	.	.	.	.	43	46	.
ID	MINIDOKA CO	19,361	.	.	.	.	.	49	49	.
ID	NEZ PERCE CO	33,754	4.7	.	.	.	.	66	98	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m^3)	PM_{10} 99 Pctile (µg/m^3)	SO_2 24-hr (ppm)
ID	POWER CO	7,086	.	.	.	.	.	346	259	.
ID	SHOSHONE CO	13,931	.	0.12	.	.	.	96	97	.
ID	TWIN FALLS CO	53,580	.	.	.	.	.	44	45	.
IL	ADAMS CO	66,090	.	.	.	0.078	0.068	40	43	0.024
IL	CHAMPAIGN CO	173,025	.	.	.	0.088	0.076	44	46	0.018
IL	COLES CO	51,644	.	.	.	.	.	43	44	.
IL	COOK CO	5,105,067	5.3	0.33	0.0336	0.113	0.094	99	114	0.041
IL	DU PAGE CO	781,666	.	0.04	.	0.088	0.072	58	59	0.018
IL	EFFINGHAM CO	31,704	.	.	.	0.095	0.077	.	.	.
IL	HAMILTON CO	8,499	.	.	.	0.089	0.074	.	.	.
IL	JACKSON CO	61,067	.	.	.	.	.	45	49	.
IL	JERSEY CO	20,539	.	.	.	0.096	0.082	.	.	.
IL	KANE CO	317,471	.	.	.	0.092	0.076	41	50	.
IL	LAKE CO	516,418	.	.	.	0.110	0.088	.	.	.
IL	LA SALLE CO	106,913	.	.	.	.	.	138	95	.
IL	MC HENRY CO	183,241	.	.	.	0.098	0.080	.	.	.
IL	MACON CO	117,206	.	0.03	.	0.087	0.077	46	56	0.021
IL	MACOUPIN CO	47,679	1.0	0.01	.	0.101	0.076	38	44	0.016
IL	MADISON CO	249,238	3.2	2.11	.	0.120	0.091	108	157	0.050
IL	PEORIA CO	182,827	4.7	0.02	.	0.088	0.073	56	76	0.039
IL	RANDOLPH CO	34,583	.	.	.	0.086	0.072	105	90	0.047
IL	ROCK ISLAND CO	148,723	.	0.02	.	0.079	0.066	43	47	0.011
IL	ST CLAIR CO	262,852	.	0.18	0.0191	0.098	0.080	57	58	0.063
IL	SANGAMON CO	178,386	2.1	.	.	0.085	0.071	44	44	0.043
IL	TAZEWELL CO	123,692	.	.	.	.	.	52	53	0.044
IL	WABASH CO	13,111	.	.	.	.	.	.	.	0.041
IL	WILL CO	357,313	1.0	0.02	0.0093	0.083	0.074	59	66	0.021
IL	WINNEBAGO CO	252,913	3.7	0.03	.	0.084	0.073	62	73	.
IN	ALLEN CO	300,836	6.3	0.03	.	0.095	0.087	46	50	.
IN	CLARK CO	87,777	.	.	.	0.125	0.097	56	72	.
IN	DAVIESS CO	27,533	.	.	.	.	.	.	.	0.038
IN	DEARBORN CO	38,835	.	.	.	.	.	94	111	0.045
IN	DE KALB CO	35,324	0.6	0.01	.	.	.	77	80	0.014
IN	DELAWARE CO	119,659	.	0.90	.	.	.	.	.	.
IN	DUBOIS CO	36,616	.	.	.	.	.	49	71	.
IN	ELKHART CO	156,198	.	.	.	0.108	0.089	.	.	.
IN	FLOYD CO	64,404	.	.	.	0.127	0.084	.	.	0.038
IN	FOUNTAIN CO	17,808	.	.	.	.	.	.	.	0.042
IN	GIBSON CO	31,913	.	.	.	.	.	.	.	0.075
IN	HAMILTON CO	108,936	.	.	.	0.114	0.095	.	.	.
IN	HANCOCK CO	45,527	.	.	.	0.109	0.088	.	.	.
IN	JASPER CO	24,960	.	.	.	.	.	42	50	0.016
IN	JEFFERSON CO	29,797	.	.	.	.	.	.	.	0.024
IN	JOHNSON CO	88,109	.	.	.	0.102	0.084	.	.	.
IN	LAKE CO	475,594	3.8	0.13	.	0.116	0.094	138	132	0.032
IN	LA PORTE CO	107,066	.	0.02	.	0.120	0.096	46	46	0.028
IN	LAWRENCE CO	42,836	.	.	.	0.100	0.087	.	.	.
IN	MADISON CO	130,669	.	.	.	0.091	0.082	45	49	.
IN	MARION CO	797,159	3.9	0.08	0.0150	0.106	0.090	54	64	0.030
IN	MORGAN CO	55,920	.	.	.	0.103	0.088	.	.	0.023
IN	PERRY CO	19,107	.	.	.	.	.	.	.	0.032
IN	PIKE CO	12,509	.	.	.	.	.	.	.	0.037
IN	PORTER CO	128,932	.	.	.	0.122	0.091	76	62	0.027
IN	POSEY CO	25,968	.	.	.	0.099	0.087	.	.	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m^3)	PM_{10} 99 Pctile (µg/m^3)	SO_2 24-hr (ppm)
IN	ST JOSEPH CO	247,052	.	.	0.0124	0.117	0.091	41	48	.
IN	SPENCER CO	19,490	.	.	.	.	.	.	.	0.053
IN	SULLIVAN CO	18,993	.	.	.	.	.	.	.	0.021
IN	VANDERBURGH CO	165,058	5.0	.	.	0.114	0.093	67	70	0.053
IN	VERMILLION CO	16,773	.	.	.	.	.	49	50	.
IN	VIGO CO	106,107	2.5	.	.	0.096	0.083	61	63	0.025
IN	WARRICK CO	44,920	.	.	.	0.109	0.095	.	.	0.083
IN	WAYNE CO	71,951	.	.	.	.	.	.	.	0.030
IA	BLACK HAWK CO	123,798	.	.	.	.	.	53	65	.
IA	CERRO GORDO CO	46,733	.	.	.	.	.	103	94	0.078
IA	CLINTON CO	51,040	.	.	.	.	.	73	71	0.029
IA	DELAWARE CO	18,035	.	.	.	.	.	48	53	.
IA	DUBUQUE CO	86,403	.	.	.	.	.	.	.	0.017
IA	EMMET CO	11,569	.	.	.	.	.	44	44	.
IA	HARRISON CO	14,730	.	.	.	0.079	0.068	.	.	.
IA	LEE CO	38,687	.	.	.	.	.	.	.	0.043
IA	LINN CO	168,767	2.4	.	.	0.075	0.065	50	50	0.073
IA	MUSCATINE CO	39,907	.	.	.	.	.	54	66	0.086
IA	PALO ALTO CO	10,669	.	.	.	0.061	.	.	.	.
IA	POLK CO	327,140	3.8	.	.	0.075	0.063	126	126	.
IA	POTTAWATTAMIE CO	82,628	.	0.19	.	.	.	.	.	.
IA	SCOTT CO	150,979	.	.	.	0.089	0.072	150	160	0.020
IA	STORY CO	74,252	.	.	.	0.087	0.074	.	.	.
IA	UNION CO	12,750	.	.	.	.	.	56	72	.
IA	VAN BUREN CO	7,676	.	.	.	0.079	0.065	.	.	0.008
IA	WARREN CO	36,033	.	.	.	0.074	0.057	.	.	.
IA	WOODBURY CO	98,276	.	.	.	.	.	59	102	.
KS	CLOUD CO	11,023	.	0.01	.	.	.	31	36	.
KS	FORD CO	27,463	.	0.01	.	.	.	38	96	.
KS	GREELEY CO	1,774	.	0.01	.	.	.	.	.	.
KS	JOHNSON CO	355,054	.	0.01	.	.	.	47	72	.
KS	KEARNEY CO	4,027	.	.	.	.	.	117	125	.
KS	MIAMI CO	23,466	.	.	.	0.079	.	.	.	.
KS	MORTON CO	3,480	.	0.01	.	.	.	.	.	.
KS	NORTON CO	5,947	.	0.20	.	.	.	.	.	.
KS	PAWNEE CO	7,555	1.4	.	.	0.080	0.071	56	67	0.004
KS	SEDGWICK CO	403,662	5.3	0.01	.	0.093	0.079	57	71	0.007
KS	SHAWNEE CO	160,976	.	0.01	.	.	.	53	60	.
KS	SHERMAN CO	6,926	.	0.01	.	.	.	52	57	.
KS	WYANDOTTE CO	161,993	2.5	0.45	0.0198	0.106	0.081	75	75	0.014
KY	BELL CO	31,506	4.1	.	.	0.085	0.073	64	68	.
KY	BOONE CO	57,589	.	.	.	0.100	0.081	.	.	.
KY	BOYD CO	51,150	3.8	.	0.0145	0.110	0.086	94	105	0.034
KY	BULLITT CO	47,567	.	.	0.0125	0.112	0.086	.	.	.
KY	CAMPBELL CO	83,866	.	.	0.0197	0.111	0.089	61	69	0.029
KY	CHRISTIAN CO	68,941	.	.	.	0.099	0.082	.	.	.
KY	DAVIESS CO	87,189	1.0	.	0.0119	0.108	0.087	59	56	0.027
KY	EDMONSON CO	10,357	.	.	.	0.104	.	.	.	.
KY	FAYETTE CO	225,366	5.2	.	0.0135	0.096	0.082	62	58	0.016
KY	FLOYD CO	43,586	.	.	.	.	.	38	58	.
KY	GRAVES CO	33,550	.	.	.	0.101	0.077	.	.	.
KY	GREENUP CO	36,742	.	0.02	.	0.114	0.078	.	.	0.022
KY	HANCOCK CO	7,864	.	.	.	0.104	0.085	.	.	0.023
KY	HARDIN CO	89,240	.	.	.	0.083	0.071	38	44	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max ($\mu g/m^3$)	PM_{10} 99 Pctile ($\mu g/m^3$)	SO_2 24-hr (ppm)
KY	HARLAN CO	36,574	.	.	.	.	.	50	58	.
KY	HENDERSON CO	43,044	2.3	.	0.0161	0.100	0.082	59	58	0.036
KY	JEFFERSON CO	664,937	6.3	0.02	0.0199	0.122	0.091	98	133	0.037
KY	JESSAMINE CO	30,508	.	.	.	0.099	0.079	.	.	.
KY	KENTON CO	142,031	2.7	.	0.0182	0.110	0.084	55	52	.
KY	LAWRENCE CO	13,998	.	.	.	0.082	0.065	50	50	.
KY	LIVINGSTON CO	9,062	.	.	.	0.112	0.093	37	49	0.019
KY	MC CRACKEN CO	62,879	2.3	.	0.0120	0.109	0.085	57	64	0.017
KY	MC LEAN CO	9,628	.	.	.	0.103	0.083	.	.	.
KY	MADISON CO	57,508	.	.	.	.	.	47	54	.
KY	MARSHALL CO	27,205	.	.	.	.	.	71	83	.
KY	OLDHAM CO	33,263	.	.	.	0.126	0.085	.	.	.
KY	PERRY CO	30,283	.	.	.	0.073	0.062	43	62	.
KY	PIKE CO	72,583	.	.	.	0.076	0.064	42	47	.
KY	PULASKI CO	49,489	.	.	.	0.090	0.073	43	47	.
KY	SCOTT CO	23,867	.	.	.	0.084	0.072	.	.	.
KY	SIMPSON CO	15,145	.	.	0.0110	0.115	0.087	.	.	.
KY	TRIGG CO	10,361	.	.	.	0.106	.	.	.	.
KY	WARREN CO	76,673	.	.	.	.	.	44	52	.
KY	WHITLEY CO	33,326	.	.	.	.	.	52	57	.
KY	WOODFORD CO	19,955	.	0.02	.	.	.	.	.	.
LA	ASCENSION PAR	58,214	.	.	.	0.127	0.087	.	.	.
LA	BEAUREGARD PAR	30,083	.	.	0.0054	0.117	0.079	.	.	.
LA	BOSSIER PAR	86,088	.	.	.	0.103	0.083	70	99	0.007
LA	CADDO PAR	248,253	.	.	.	0.099	0.084	67	93	.
LA	CALCASIEU PAR	168,134	.	.	0.0055	0.128	0.090	79	89	0.012
LA	EAST BATON ROUGE PAR	380,105	5.4	0.06	0.0202	0.126	0.099	87	93	0.019
LA	GRANT PAR	17,526	.	.	.	0.091	0.075	.	.	.
LA	IBERVILLE PAR	31,049	.	.	0.0126	0.126	0.097	50	57	.
LA	JEFFERSON PAR	448,306	.	.	0.0105	0.099	0.080	.	.	.
LA	LAFAYETTE PAR	164,762	.	.	.	0.105	0.078	70	87	.
LA	LAFOURCHE PAR	85,860	.	.	.	0.103	0.079	.	.	.
LA	LIVINGSTON PAR	70,526	.	.	0.0057	0.127	0.089	.	.	.
LA	ORLEANS PAR	496,938	3.3	0.01	0.0181	0.088	0.066	94	100	.
LA	OUACHITA PAR	142,191	.	.	.	0.086	0.073	78	102	0.009
LA	POINTE COUPEE PAR	22,540	.	.	0.0063	0.120	0.089	.	.	.
LA	RAPIDES PAR	131,556	.	.	.	.	.	76	92	.
LA	ST BERNARD PAR	66,631	.	.	.	0.092	0.076	.	.	0.017
LA	ST CHARLES PAR	42,437	.	.	.	0.108	0.084	78	82	.
LA	ST JAMES PAR	20,879	.	.	0.0113	0.103	0.078	.	.	.
LA	ST JOHN THE BAPTIST PAR	39,996	.	0.05	.	0.108	0.083	.	.	.
LA	ST MARY PAR	58,086	.	.	.	0.101	0.081	.	.	.
LA	WEST BATON ROUGE PAR	19,419	.	0.04	0.0134	0.113	0.084	70	70	0.027
ME	ANDROSCOGGIN CO	105,259	.	.	.	.	.	48	54	0.017
ME	AROOSTOOK CO	86,936	.	.	.	.	.	57	56	0.021
ME	CUMBERLAND CO	243,135	.	.	.	0.130	0.103	81	87	0.023
ME	FRANKLIN CO	29,008	.	.	.	.	.	33	33	.
ME	HANCOCK CO	46,948	.	.	.	0.114	0.085	74	78	.
ME	KENNEBEC CO	115,904	.	.	.	0.102	0.076	81	88	.
ME	KNOX CO	36,310	.	.	.	0.119	0.090	53	53	.
ME	OXFORD CO	52,602	.	.	.	0.067	0.057	42	42	0.012
ME	PENOBSCOT CO	146,601	.	.	.	0.094	0.070	52	52	.
ME	SAGADAHOC CO	33,535	.	.	.	0.125	0.098	.	.	.
ME	YORK CO	164,587	.	.	0.0109	0.125	0.101	33	59	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 2nd Max (ppm)	O$_3$ 4th Max (ppm)	PM$_{10}$ 2nd Max (µg/m^3)	PM$_{10}$ 99 Pctile (µg/m^3)	SO$_2$ 24-hr (ppm)
MD	ALLEGANY CO	74,946	.	.	.	.	.	56	60	0.020
MD	ANNE ARUNDEL CO	427,239	.	.	.	0.144	0.119	58	76	0.023
MD	BALTIMORE CO	692,134	.	.	.	0.131	0.102	53	71	.
MD	CALVERT CO	51,372	.	.	.	0.116	0.087	.	.	.
MD	CARROLL CO	123,372	.	.	.	0.115	0.093	.	.	.
MD	CECIL CO	71,347	.	.	.	0.153	0.122	50	51	.
MD	CHARLES CO	101,154	.	.	.	0.125	0.102	.	.	.
MD	GARRETT CO	28,138	.	.	.	.	.	51	53	.
MD	HARFORD CO	182,132	.	.	.	0.158	0.116	.	.	.
MD	KENT CO	17,842	.	.	.	0.139	0.105	.	.	.
MD	MONTGOMERY CO	757,027	.	.	.	0.117	0.096	.	.	.
MD	PRINCE GEORGES CO	729,268	6.8	.	.	0.139	0.110	52	72	.
MD	WICOMICO CO	74,339	.	.	.	.	.	42	49	.
MD	BALTIMORE	736,014	4.9	0.01	0.0256	0.129	0.107	63	94	0.026
MA	BARNSTABLE CO	186,605	.	.	.	0.116	0.100	.	.	.
MA	BERKSHIRE CO	139,352	.	.	.	0.087	.	.	.	.
MA	BRISTOL CO	506,325	.	.	0.0087	0.123	0.093	43	58	0.024
MA	ESSEX CO	670,080	.	.	0.0147	0.118	0.091	36	42	0.029
MA	HAMPDEN CO	456,310	5.3	.	0.0218	0.126	0.092	58	69	0.021
MA	HAMPSHIRE CO	146,568	.	.	0.0088	0.142	0.110	40	40	0.023
MA	MIDDLESEX CO	1,398,468	3.6	.	.	0.114	0.092	41	43	0.035
MA	NORFOLK CO	616,087	.	.	.	.	.	39	62	.
MA	PLYMOUTH CO	435,276	.	.	.	0.095	0.071	.	.	.
MA	SUFFOLK CO	663,906	4.7	.	0.0304	0.092	0.075	59	86	0.049
MA	WORCESTER CO	709,705	3.4	.	0.0192	0.106	0.092	44	53	0.021
MI	ALLEGAN CO	90,509	.	.	.	0.117	0.096	.	.	.
MI	BENZIE CO	12,200	.	.	.	0.105	0.081	.	.	.
MI	BERRIEN CO	161,378	.	.	.	0.119	0.099	.	.	.
MI	CALHOUN CO	135,982	.	.	.	.	.	48	49	.
MI	CASS CO	49,477	.	.	.	0.102	0.090	.	.	.
MI	CLINTON CO	57,883	.	.	.	0.089	0.078	.	.	.
MI	DELTA CO	37,780	.	.	.	.	.	.	.	0.009
MI	GENESEE CO	430,459	.	0.01	.	0.099	0.084	41	44	0.012
MI	HURON CO	34,951	.	.	.	0.101	0.079	.	.	.
MI	INGHAM CO	281,912	.	.	.	0.086	0.077	.	.	.
MI	KALAMAZOO CO	223,411	.	.	.	0.096	0.085	.	.	.
MI	KENT CO	500,631	2.4	0.01	.	0.099	0.082	60	57	0.008
MI	LENAWEE CO	91,476	.	.	.	0.089	0.076	.	.	.
MI	MACOMB CO	717,400	3.0	.	0.0124	0.123	0.091	.	.	0.018
MI	MARQUETTE CO	70,887	.	.	.	.	.	47	55	.
MI	MASON CO	25,537	.	.	.	0.118	0.091	.	.	.
MI	MONROE CO	133,600	.	.	.	.	.	48	55	.
MI	MUSKEGON CO	158,983	.	0.01	.	0.113	0.086	.	.	.
MI	OAKLAND CO	1,083,592	2.6	.	.	0.088	0.076	.	.	.
MI	OTTAWA CO	187,768	.	.	.	0.103	0.086	.	.	.
MI	ST CLAIR CO	145,607	.	.	.	0.118	0.088	.	.	0.043
MI	WASHTENAW CO	282,937	.	.	.	0.088	0.075	.	.	.
MI	WAYNE CO	2,111,687	4.9	0.09	0.0260	0.114	0.088	106	131	0.044
MN	ANOKA CO	243,641	2.4	.	.	0.091	0.078	.	.	.
MN	CARLTON CO	29,259	.	.	.	.	.	44	44	.
MN	DAKOTA CO	275,227	1.1	0.43	0.0135	0.081	0.070	.	.	0.020
MN	HENNEPIN CO	1,032,431	3.2	0.01	0.0230	.	.	77	74	0.027
MN	KOOCHICHING CO	16,299	.	.	.	.	.	.	.	0.012
MN	LAKE CO	10,415	.	.	.	0.069	0.063	25	28	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m³)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m³)	PM_{10} 99 Pctile (µg/m³)	SO_2 24-hr (ppm)
MN	OLMSTED CO	106,470	.	.	.	.	.	38	39	.
MN	RAMSEY CO	485,765	5.4	0.02	0.0170	.	.	68	72	0.016
MN	ST LOUIS CO	198,213	3.2	.	.	0.080	0.071	47	63	.
MN	SHERBURNE CO	41,945	.	.	.	.	.	.	.	0.007
MN	STEARNS CO	118,791	4.0	.	.	.	.	.	.	.
MN	WASHINGTON CO	145,896	.	.	.	0.059	.	.	.	0.026
MN	WRIGHT CO	68,710	.	.	.	.	.	.	.	0.008
MS	ADAMS CO	35,356	.	.	.	0.101	0.077	.	.	.
MS	CHOCTAW CO	9,071	1.1	0.03	0.0035	0.081	0.071	55	73	0.007
MS	COAHOMA CO	31,665	.	.	.	.	.	51	69	.
MS	DE SOTO CO	67,910	.	.	.	0.122	0.082	.	.	.
MS	HANCOCK CO	31,760	.	.	.	0.092	0.078	.	.	.
MS	HARRISON CO	165,365	.	.	.	.	.	.	.	0.025
MS	HINDS CO	254,441	3.8	.	.	0.097	0.079	111	91	0.007
MS	JACKSON CO	115,243	.	.	.	0.114	0.095	57	59	0.016
MS	JONES CO	62,031	.	.	.	.	.	59	73	.
MS	LAUDERDALE CO	75,555	.	.	.	0.092	0.073	.	.	.
MS	LEE CO	65,581	.	.	0.0094	0.096	0.079	42	43	0.006
MS	MADISON CO	53,794	.	.	.	0.093	0.075	.	.	.
MS	SHARKEY CO	7,066	.	.	.	0.092	0.077	.	.	.
MS	WARREN CO	47,880	.	.	.	0.097	0.077	58	75	.
MS	WASHINGTON CO	67,935	.	.	.	.	.	57	78	.
MO	AUDRAIN CO	23,599	.	.	.	.	.	32	35	.
MO	BUCHANAN CO	83,083	.	.	.	.	.	93	88	0.147
MO	CLAY CO	153,411	4.7	.	0.0120	0.121	0.098	.	.	0.010
MO	GREENE CO	207,949	4.6	.	0.0114	0.084	0.068	95	123	0.054
MO	HOLT CO	6,034	.	1.11	.	.	.	.	.	.
MO	HOWELL CO	31,447	.	.	.	.	.	694	694	.
MO	IRON CO	10,726	.	1.28	.	.	.	.	.	0.073
MO	JACKSON CO	633,232	6.7	0.01	.	0.084	0.072	54	78	0.021
MO	JEFFERSON CO	171,380	.	8.53	.	0.118	0.083	39	41	0.045
MO	MONROE CO	9,104	.	.	.	0.093	0.080	31	37	0.014
MO	PLATTE CO	57,867	.	.	0.0104	0.111	0.090	.	.	0.008
MO	ST CHARLES CO	212,907	.	.	0.0107	0.123	0.090	.	.	0.034
MO	STE GENEVIEVE CO	16,037	.	.	.	0.098	0.080	61	67	.
MO	ST LOUIS CO	993,529	3.8	0.04	0.0215	0.119	0.087	42	42	0.041
MO	TANEY CO	25,561	3.3	.	.	.	.	.	.	.
MO	ST LOUIS	396,685	5.0	.	0.0248	0.105	0.084	75	68	0.032
MT	BIG HORN CO	11,337	.	.	.	.	.	77	96	.
MT	BROADWATER CO	3,318	.	.	.	.	.	63	63	.
MT	CASCADE CO	77,691	6.4	.	.	.	.	.	.	0.012
MT	FERGUS CO	12,083	.	.	.	.	.	24	24	.
MT	FLATHEAD CO	59,218	4.9	.	.	0.045	.	136	115	.
MT	GALLATIN CO	50,463	.	.	.	.	.	69	69	.
MT	JEFFERSON CO	7,939	.	.	.	.	.	56	67	.
MT	LAKE CO	21,041	.	.	.	.	.	71	58	.
MT	LEWIS AND CLARK CO	47,495	.	1.22	.	.	.	71	66	.
MT	LINCOLN CO	17,481	.	.	.	.	.	84	82	.
MT	MADISON CO	5,989	.	.	.	.	.	24	27	.
MT	MISSOULA CO	78,687	4.9	.	.	.	.	91	117	.
MT	PARK CO	14,562	.	.	.	.	.	16	17	.
MT	PHILLIPS CO	5,163	.	.	.	.	.	31	34	.
MT	RAVALLI CO	25,010	.	.	.	.	.	56	61	.
MT	ROSEBUD CO	10,505	.	.	.	.	.	106	106	0.004

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max ($\mu g/m^3$)	PM_{10} 99 Pctile ($\mu g/m^3$)	SO_2 24-hr (ppm)
MT	SANDERS CO	8,669	.	.	.	.	.	76	76	.
MT	SILVER BOW CO	33,941	.	.	.	.	.	56	57	.
MT	STILLWATER CO	6,536	.	.	.	.	.	19	27	.
MT	YELLOWSTONE CO	113,419	6.1	.	.	.	.	95	95	0.043
NE	BUFFALO CO	37,447	.	.	.	.	.	55	107	.
NE	CASS CO	21,318	.	.	.	.	.	98	102	.
NE	DAWSON CO	19,940	.	.	.	.	.	57	68	.
NE	DOUGLAS CO	416,444	5.4	1.95	.	0.080	0.071	98	102	0.050
NE	LANCASTER CO	213,641	6.9	.	.	0.063	0.054	44	57	.
NV	CHURCHILL CO	17,938	.	.	.	.	.	53	53	.
NV	CLARK CO	741,459	8.1	.	.	0.091	0.079	186	138	.
NV	DOUGLAS CO	27,637	1.7	.	0.0091	0.083	0.068	49	59	.
NV	ELKO CO	33,530	.	.	.	.	.	48	49	.
NV	LANDER CO	6,266	.	.	.	.	.	64	83	.
NV	PERSHING CO	4,336	.	.	.	.	.	69	99	.
NV	WASHOE CO	254,667	7.7	.	.	0.084	0.069	115	134	.
NV	WHITE PINE CO	9,264	.	.	.	0.081	0.074	25	25	.
NV	CARSON CITY	40,443	4.4	.	.	0.077	0.073	53	80	.
NH	BELKNAP CO	49,216	.	.	.	0.089	0.067	.	.	.
NH	CARROLL CO	35,410	.	.	.	0.075	0.065	.	.	.
NH	CHESHIRE CO	70,121	.	.	.	0.092	0.075	47	53	0.022
NH	COOS CO	34,828	.	.	.	0.094	.	81	108	0.029
NH	GRAFTON CO	74,929	.	.	.	0.073	0.064	.	.	.
NH	HILLSBOROUGH CO	336,073	5.3	.	0.0155	0.115	0.094	42	61	0.036
NH	MERRIMACK CO	120,005	.	.	.	0.102	0.075	45	52	0.053
NH	ROCKINGHAM CO	245,845	.	.	0.0133	0.137	0.102	37	48	0.018
NH	STRAFFORD CO	104,233	.	.	.	0.101	0.080	33	48	.
NH	SULLIVAN CO	38,592	.	.	.	0.094	0.075	32	56	0.019
NJ	ATLANTIC CO	224,327	3.5	.	.	0.131	0.106	.	.	0.011
NJ	BERGEN CO	825,380	6.1	.	0.0277	0.120	0.096	53	78	0.024
NJ	BURLINGTON CO	395,066	4.3	.	.	.	.	.	.	0.023
NJ	CAMDEN CO	502,824	3.3	0.06	0.0217	0.137	0.117	58	89	0.030
NJ	CUMBERLAND CO	138,053	.	.	.	0.115	0.104	.	.	0.018
NJ	ESSEX CO	778,206	3.8	.	0.0306	0.109	0.097	81	90	0.024
NJ	GLOUCESTER CO	230,082	.	.	.	0.128	0.105	45	69	0.019
NJ	HUDSON CO	553,099	6.7	.	0.0257	0.119	0.105	77	103	0.031
NJ	HUNTERDON CO	107,776	.	.	.	0.120	0.103	.	.	.
NJ	MERCER CO	325,824	.	.	0.0166	0.126	0.106	59	87	.
NJ	MIDDLESEX CO	671,780	3.8	0.08	0.0184	0.139	0.106	.	.	0.019
NJ	MONMOUTH CO	553,124	3.2	.	.	0.132	0.095	.	.	.
NJ	MORRIS CO	421,353	4.9	.	0.0114	0.111	0.097	.	.	0.027
NJ	OCEAN CO	433,203	4.1	.	.	0.150	0.113	.	.	.
NJ	PASSAIC CO	453,060	.	.	.	.	.	65	76	.
NJ	SALEM CO	65,294	.	0.03	.	.	.	.	.	.
NJ	UNION CO	493,819	5.1	.	0.0411	0.108	0.089	61	91	0.022
NJ	WARREN CO	91,607	.	.	.	.	.	54	83	.
NM	BERNALILLO CO	480,577	5.9	.	0.0187	0.091	0.071	93	97	.
NM	CHAVES CO	57,849	.	.	.	.	.	30	34	.
NM	DONA ANA CO	135,510	4.8	0.08	0.0096	0.102	0.077	144	135	0.022
NM	EDDY CO	48,605	.	.	0.0061	0.066	.	.	.	0.007
NM	GRANT CO	27,676	.	.	.	.	.	49	52	0.017
NM	HIDALGO CO	5,958	.	.	.	.	.	28	83	0.051
NM	LEA CO	55,765	.	.	.	.	.	38	39	.
NM	LUNA CO	18,110	.	.	.	.	.	35	40	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 2nd Max (ppm)	O$_3$ 4th Max (ppm)	PM$_{10}$ 2nd Max (µg/m^3)	PM$_{10}$ 99 Pctile (µg/m^3)	SO$_2$ 24-hr (ppm)
NM	OTERO CO	51,928	.	.	.	.	.	61	71	.
NM	SANDOVAL CO	63,319	1.7	.	0.0083	0.088	0.076	51	53	.
NM	SAN JUAN CO	91,605	2.7	.	0.0098	0.073	0.067	34	79	0.061
NM	SANTA FE CO	98,928	2.1	.	.	.	.	33	33	.
NM	TAOS CO	23,118	.	.	.	.	.	67	68	.
NM	VALENCIA CO	45,235	.	.	.	0.067	0.060	.	.	.
NY	ALBANY CO	292,594	2.7	0.03	0.0138	0.099	0.076	45	61	0.020
NY	BRONX CO	1,203,789	3.5	.	0.0352	0.123	0.096	55	75	0.043
NY	BROOME CO	212,160	.	.	.	.	.	48	53	.
NY	CHAUTAUQUA CO	141,895	.	.	.	0.105	0.087	49	56	0.039
NY	CHEMUNG CO	95,195	.	.	.	0.081	0.073	.	.	0.015
NY	DUTCHESS CO	259,462	.	.	.	0.111	0.089	.	.	.
NY	ERIE CO	968,532	3.3	0.04	0.0203	0.088	0.073	51	82	0.094
NY	ESSEX CO	37,152	.	.	.	0.097	0.082	33	42	0.007
NY	GREENE CO	44,739	.	.	.	.	.	38	51	.
NY	HAMILTON CO	5,279	.	.	.	0.091	0.078	.	.	0.007
NY	HERKIMER CO	65,797	.	.	.	0.084	0.072	33	36	0.006
NY	JEFFERSON CO	110,943	.	.	.	0.105	0.094	.	.	.
NY	KINGS CO	2,300,664	4.3	0.16	.	.	.	52	91	0.034
NY	MADISON CO	69,120	.	.	.	0.089	0.076	.	.	0.020
NY	MONROE CO	713,968	1.9	.	.	0.097	0.085	47	55	0.050
NY	NASSAU CO	1,287,348	4.7	.	0.0248	.	.	68	73	0.029
NY	NEW YORK CO	1,487,536	6.1	0.06	0.0399	0.121	0.082	101	105	0.042
NY	NIAGARA CO	220,756	1.4	0.03	.	0.093	0.081	45	50	0.025
NY	ONEIDA CO	250,836	.	.	.	0.085	0.074	44	49	.
NY	ONONDAGA CO	468,973	4.0	.	.	0.102	0.079	55	57	0.014
NY	ORANGE CO	307,647	.	0.28	.	0.102	0.088	.	.	.
NY	PUTNAM CO	83,941	.	.	.	0.119	0.095	39	43	0.014
NY	QUEENS CO	1,951,598	.	.	.	0.135	0.095	.	.	0.022
NY	RENSSELAER CO	154,429	.	.	.	.	.	39	43	0.014
NY	RICHMOND CO	378,977	.	0.02	.	0.156	0.122	57	89	0.024
NY	ROCKLAND CO	265,475	.	.	.	.	.	50	52	.
NY	SARATOGA CO	181,276	.	.	.	0.104	0.083	40	48	.
NY	SCHENECTADY CO	149,285	4.5	.	.	0.089	0.077	42	55	0.017
NY	SUFFOLK CO	1,321,864	.	.	.	0.137	0.106	39	43	0.029
NY	ULSTER CO	165,304	.	.	.	0.097	0.086	43	56	0.013
NY	WAYNE CO	89,123	.	.	.	0.101	0.085	.	.	.
NY	WESTCHESTER CO	874,866	.	.	.	0.115	0.096	.	.	.
NC	ALAMANCE CO	108,213	.	.	.	.	.	57	60	.
NC	ALEXANDER CO	27,544	.	.	.	0.099	0.080	60	100	.
NC	BEAUFORT CO	42,283	.	.	.	.	.	32	43	0.015
NC	BUNCOMBE CO	174,821	.	.	.	0.090	0.075	48	48	.
NC	CABARRUS CO	98,935	.	.	.	.	.	52	53	.
NC	CALDWELL CO	70,709	.	.	.	0.097	0.079	.	.	.
NC	CAMDEN CO	5,904	.	.	.	0.093	0.084	.	.	.
NC	CASWELL CO	20,693	.	.	.	0.117	0.095	.	.	.
NC	CATAWBA CO	118,412	.	0.04	.	.	.	47	55	.
NC	CHATHAM CO	38,759	.	.	.	0.106	0.089	.	.	.
NC	CUMBERLAND CO	274,566	6.0	0.05	.	0.098	0.085	48	59	.
NC	DAVIDSON CO	126,677	.	.	.	.	.	59	67	.
NC	DAVIE CO	27,859	.	.	.	0.105	0.092	.	.	0.018
NC	DUPLIN CO	39,995	.	.	.	0.092	0.078	.	.	.
NC	DURHAM CO	181,835	6.9	.	.	0.097	0.080	59	68	.
NC	EDGECOMBE CO	56,558	.	.	.	0.106	0.089	54	56	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 2nd Max (ppm)	O$_3$ 4th Max (ppm)	PM$_{10}$ 2nd Max (µg/m^3)	PM$_{10}$ 99 Pctile (µg/m^3)	SO$_2$ 24-hr (ppm)
NC	FORSYTH CO	265,878	4.7	.	0.0173	0.115	0.093	61	73	0.023
NC	FRANKLIN CO	36,414	.	.	.	0.116	0.097	.	.	.
NC	GASTON CO	175,093	3.3	.	.	.	.	44	55	.
NC	GRANVILLE CO	38,345	.	.	.	0.116	0.099	42	47	.
NC	GUILFORD CO	347,420	4.8	0.00	.	0.104	0.084	60	69	.
NC	HALIFAX CO	55,516	.	.	.	.	.	55	61	.
NC	HARNETT CO	67,822	.	.	.	.	.	49	51	.
NC	HAYWOOD CO	46,942	.	.	.	0.106	0.087	49	70	.
NC	HENDERSON CO	69,285	.	.	.	.	.	44	53	.
NC	JOHNSTON CO	81,306	.	.	.	0.110	0.092	.	.	.
NC	LINCOLN CO	50,319	.	.	.	0.102	0.085	.	.	0.016
NC	MC DOWELL CO	35,681	.	.	.	.	.	49	61	.
NC	MARTIN CO	25,078	.	.	.	0.092	0.082	.	.	.
NC	MECKLENBURG CO	511,433	6.0	.	0.0176	0.120	0.105	61	68	0.016
NC	MITCHELL CO	14,433	.	.	.	.	.	56	58	.
NC	NEW HANOVER CO	120,284	.	.	.	0.102	0.083	39	41	0.028
NC	NORTHAMPTON CO	20,798	.	.	.	0.097	0.088	.	.	0.014
NC	ONSLOW CO	149,838	.	.	.	.	.	46	52	.
NC	ORANGE CO	93,851	6.1	.	.	.	.	.	.	.
NC	PASQUOTANK CO	31,298	.	.	.	.	.	46	50	.
NC	PERSON CO	30,180	.	.	.	0.100	0.088	.	.	.
NC	PITT CO	107,924	.	.	.	0.122	0.097	42	51	0.008
NC	ROBESON CO	105,179	.	.	.	.	.	54	59	.
NC	ROCKINGHAM CO	86,064	.	.	.	0.109	0.089	.	.	.
NC	ROWAN CO	110,605	.	.	.	0.126	0.092	54	63	0.052
NC	SWAIN CO	11,268	.	.	.	0.081	0.070	38	47	.
NC	WAKE CO	423,380	6.6	0.00	.	0.112	0.097	59	59	.
NC	WASHINGTON CO	13,997	.	0.04	.	.	.	.	.	.
NC	WATAUGA CO	36,952	.	.	.	.	.	45	50	.
NC	WAYNE CO	104,666	.	.	.	.	.	49	54	.
NC	WILSON CO	66,061	.	.	.	.	.	38	60	.
NC	YANCEY CO	15,419	.	.	.	0.085	0.076	.	.	.
ND	BILLINGS CO	1,108	.	.	.	.	.	.	.	0.005
ND	BURLEIGH CO	60,131	.	.	.	.	.	26	27	.
ND	CASS CO	102,874	.	.	0.0080	0.074	0.067	63	67	0.008
ND	DUNN CO	4,005	.	.	.	.	.	.	.	0.005
ND	GRAND FORKS CO	70,683	.	.	.	.	.	64	82	.
ND	MC KENZIE CO	6,383	.	.	.	0.078	0.071	.	.	0.023
ND	MC LEAN CO	10,457	.	.	.	.	.	.	.	0.008
ND	MERCER CO	9,808	.	.	0.0042	0.071	0.064	30	32	0.027
ND	MORTON CO	23,700	.	.	.	.	.	.	.	0.060
ND	OLIVER CO	2,381	.	.	0.0029	0.073	0.062	.	.	0.010
ND	STARK CO	22,832	.	.	.	.	.	24	29	.
ND	STEELE CO	2,420	.	.	0.0026	0.067	0.062	37	48	0.004
ND	WILLIAMS CO	21,129	.	.	.	.	.	34	36	0.022
OH	ADAMS CO	25,371	.	.	.	.	.	.	.	0.029
OH	ALLEN CO	109,755	.	.	.	0.091	0.083	48	50	0.016
OH	ASHTABULA CO	99,821	.	.	.	0.101	0.090	.	.	0.029
OH	ATHENS CO	59,549	.	.	.	.	.	37	38	.
OH	BELMONT CO	71,074	.	.	.	.	.	46	49	0.033
OH	BUTLER CO	291,479	.	0.04	.	0.118	0.092	76	99	0.035
OH	CLARK CO	147,548	.	.	.	0.113	0.091	.	.	0.022
OH	CLERMONT CO	150,187	.	.	.	0.116	0.087	.	.	0.020
OH	CLINTON CO	35,415	.	.	.	0.114	0.095	.	.	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (μg/m^3)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (μg/m^3)	PM_{10} 99 Pctile (μg/m^3)	SO_2 24-hr (ppm)
OH	COLUMBIANA CO	108,276	.	0.04	0.0155	.	.	61	61	0.048
OH	CUYAHOGA CO	1,412,140	6.1	1.47	0.0281	0.104	0.082	133	117	0.034
OH	DELAWARE CO	66,929	.	.	.	0.099	0.087	.	.	.
OH	FRANKLIN CO	961,437	2.9	0.05	.	0.100	0.086	73	75	0.025
OH	FULTON CO	38,498	.	0.42	.	.	.	.	.	.
OH	GEAUGA CO	81,129	.	.	.	0.112	0.091	.	.	.
OH	GREENE CO	136,731	.	.	.	0.111	0.091	40	45	.
OH	HAMILTON CO	866,228	3.1	0.03	0.0279	0.124	0.093	78	81	0.038
OH	HANCOCK CO	65,536	.	.	.	.	.	48	48	.
OH	JEFFERSON CO	80,298	2.2	.	0.0172	0.088	0.078	70	63	0.051
OH	KNOX CO	47,473	.	.	.	0.099	0.088	.	.	.
OH	LAKE CO	215,499	2.2	.	.	0.121	0.094	57	57	0.057
OH	LAWRENCE CO	61,834	.	.	.	0.099	0.082	61	69	0.024
OH	LICKING CO	128,300	.	.	.	0.108	0.092	46	53	.
OH	LOGAN CO	42,310	.	0.25	.	0.099	0.087	.	.	.
OH	LORAIN CO	271,126	.	.	.	0.095	0.086	55	70	0.021
OH	LUCAS CO	462,361	1.9	.	.	0.106	0.085	61	60	0.023
OH	MADISON CO	37,068	.	.	.	0.104	0.089	.	.	.
OH	MAHONING CO	264,806	.	.	.	0.098	0.084	55	59	0.029
OH	MEDINA CO	122,354	.	.	.	0.105	0.089	.	.	.
OH	MEIGS CO	22,987	.	.	.	.	.	.	.	0.034
OH	MIAMI CO	93,182	.	.	.	0.104	0.087	.	.	.
OH	MONROE CO	15,497	.	.	.	.	.	55	64	.
OH	MONTGOMERY CO	573,809	4.0	0.04	.	0.097	0.088	63	67	0.032
OH	MORGAN CO	14,194	.	.	.	.	.	.	.	0.049
OH	NOBLE CO	11,336	.	.	.	.	.	65	67	.
OH	OTTAWA CO	40,029	.	.	.	.	.	51	51	.
OH	PORTAGE CO	142,585	.	.	.	0.096	0.084	.	.	.
OH	PREBLE CO	40,113	.	.	.	0.103	0.085	.	.	.
OH	RICHLAND CO	126,137	.	.	.	.	.	63	63	.
OH	SANDUSKY CO	61,963	.	.	.	.	.	98	145	.
OH	SCIOTO CO	80,327	.	.	.	.	.	63	70	0.026
OH	SENECA CO	59,733	.	.	.	.	.	61	61	.
OH	STARK CO	367,585	2.5	.	.	0.101	0.084	58	58	0.025
OH	SUMMIT CO	514,990	3.2	0.04	.	0.109	0.090	63	56	0.072
OH	TRUMBULL CO	227,813	.	.	.	0.110	0.091	53	57	.
OH	TUSCARAWAS CO	84,090	.	.	.	.	.	.	.	0.037
OH	UNION CO	31,969	.	.	.	0.075	0.061	.	.	.
OH	WARREN CO	113,909	.	.	.	0.124	0.094	.	.	.
OH	WASHINGTON CO	62,254	.	.	.	0.106	0.084	88	88	.
OH	WOOD CO	113,269	.	.	.	0.094	0.084	.	.	.
OH	WYANDOT CO	22,254	.	.	.	.	.	59	80	.
OK	CLEVELAND CO	174,253	2.6	.	0.0120	0.095	0.079	52	59	.
OK	COMANCHE CO	111,486	.	.	.	0.022	.	63	71	.
OK	GARFIELD CO	56,735	.	.	0.0088	.	.	.	.	.
OK	KAY CO	48,056	.	.	.	.	.	43	71	0.027
OK	LATIMER CO	10,333	.	.	.	0.096	.	.	.	.
OK	MC CLAIN CO	22,795	.	.	.	0.092	0.075	.	.	.
OK	MUSKOGEE CO	68,078	.	.	0.0082	.	.	88	106	0.011
OK	OKLAHOMA CO	599,611	5.4	0.00	0.0154	0.103	0.084	58	59	.
OK	OKMULGEE CO	36,490	.	.	.	0.094	0.076	.	.	.
OK	TULSA CO	503,341	6.3	0.02	0.0151	0.114	0.083	77	90	0.049
OR	CLACKAMAS CO	278,850	.	.	.	0.097	0.062	33	37	.
OR	COLUMBIA CO	37,557	.	.	.	0.071	0.053	.	.	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max ($\mu g/m^3$)	PM_{10} 99 Pctile ($\mu g/m^3$)	SO_2 24-hr (ppm)
OR	DESCHUTES CO	74,958	5.6	.	.	.	.	87	81	.
OR	JACKSON CO	146,389	5.7	0.02	.	0.074	0.063	85	85	.
OR	JOSEPHINE CO	62,649	5.1	.	.	.	.	88	88	.
OR	KLAMATH CO	57,702	5.1	.	.	.	.	82	82	.
OR	LAKE CO	7,186	.	.	.	.	.	87	76	.
OR	LANE CO	282,912	5.2	0.02	.	0.073	0.059	91	91	.
OR	MARION CO	228,483	5.3	.	.	0.081	0.061	.	.	.
OR	MULTNOMAH CO	583,887	4.8	0.06	.	.	.	48	55	.
OR	UMATILLA CO	59,249	.	.	.	.	.	65	60	.
OR	UNION CO	23,598	.	.	.	.	.	79	79	.
OR	YAMHILL CO	65,551	.	0.08	.	.	.	.	.	.
PA	ADAMS CO	78,274	.	.	0.0040	.	.	.	.	.
PA	ALLEGHENY CO	1,336,449	3.8	0.06	0.0294	0.129	0.109	133	113	0.062
PA	ARMSTRONG CO	73,478	.	.	.	0.078	.	.	.	.
PA	BEAVER CO	186,093	1.9	0.08	0.0170	0.101	0.086	87	80	0.078
PA	BERKS CO	336,523	3.0	0.76	0.0205	0.120	0.095	67	81	0.031
PA	BLAIR CO	130,542	1.5	.	0.0140	0.114	0.096	67	59	0.046
PA	BUCKS CO	541,174	3.8	.	0.0196	0.119	0.102	61	59	0.029
PA	CAMBRIA CO	163,029	2.7	0.04	0.0159	0.104	0.092	67	66	0.030
PA	CARBON CO	56,846	.	0.09	.	.	.	.	.	.
PA	CHESTER CO	376,396	.	.	.	.	.	79	105	.
PA	DAUPHIN CO	237,813	3.3	0.04	0.0185	0.116	0.092	67	62	0.022
PA	DELAWARE CO	547,651	.	0.05	0.0204	0.127	0.101	76	60	0.033
PA	ERIE CO	275,572	4.9	.	0.0151	0.103	0.087	68	59	0.035
PA	FRANKLIN CO	121,082	.	.	.	0.114	0.091	.	.	.
PA	LACKAWANNA CO	219,039	2.8	.	0.0176	0.106	0.087	69	77	0.031
PA	LANCASTER CO	422,822	3.3	0.04	0.0159	0.133	0.102	83	89	0.023
PA	LAWRENCE CO	96,246	3.0	.	0.0197	0.109	0.086	94	90	0.033
PA	LEHIGH CO	291,130	2.7	.	0.0157	0.116	0.101	59	55	0.030
PA	LUZERNE CO	328,149	3.3	.	0.0144	0.111	0.096	67	82	0.026
PA	LYCOMING CO	118,710	.	.	.	0.086	0.076	48	57	0.028
PA	MERCER CO	121,003	.	0.04	.	0.111	0.092	49	60	0.032
PA	MONTGOMERY CO	678,111	2.2	0.04	0.0193	0.131	0.107	79	66	0.025
PA	NORTHAMPTON CO	247,105	2.8	0.04	0.0177	0.116	0.092	51	59	0.027
PA	PERRY CO	41,172	.	.	0.0069	0.103	0.090	56	67	0.021
PA	PHILADELPHIA CO	1,585,577	5.3	7.00	0.0324	0.125	0.101	264	325	0.048
PA	SCHUYLKILL CO	152,585	1.7	.	.	.	.	.	.	0.035
PA	WARREN CO	45,050	.	.	.	.	.	.	.	0.069
PA	WASHINGTON CO	204,584	1.6	.	0.0180	0.118	0.099	60	57	0.050
PA	WESTMORELAND CO	370,321	.	0.05	0.0168	0.123	0.088	62	75	0.029
PA	YORK CO	339,574	3.4	0.04	0.0189	0.109	0.094	75	82	0.026
RI	KENT CO	161,135	.	.	.	0.115	0.098	45	52	.
RI	PROVIDENCE CO	596,270	5.6	.	0.0247	0.108	0.085	62	64	0.037
RI	WASHINGTON CO	110,006	.	.	.	0.113	.	.	.	.
SC	ABBEVILLE CO	23,862	.	.	.	0.090	0.078	.	.	.
SC	AIKEN CO	120,940	.	0.01	.	0.104	0.086	45	46	.
SC	ANDERSON CO	145,196	.	0.00	.	0.100	0.087	.	.	.
SC	BARNWELL CO	20,293	.	.	.	0.108	0.084	44	62	.
SC	BERKELEY CO	128,776	.	.	.	0.090	0.073	.	.	.
SC	CHARLESTON CO	295,039	3.9	0.01	0.0109	0.102	0.082	49	49	0.022
SC	CHEROKEE CO	44,506	.	.	.	0.104	0.091	.	.	.
SC	CHESTER CO	32,170	.	.	.	0.107	0.089	.	.	.
SC	COLLETON CO	34,377	.	.	.	0.087	0.079	.	.	.
SC	DARLINGTON CO	61,851	.	.	.	0.096	0.085	.	.	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 2nd Max (ppm)	O$_3$ 4th Max (ppm)	PM$_{10}$ 2nd Max (µg/m^3)	PM$_{10}$ 99 Pctile (µg/m^3)	SO$_2$ 24-hr (ppm)
SC	DILLON CO	29,114	.	0.01	.	.	.	.	.	.
SC	EDGEFIELD CO	18,375	.	.	.	0.093	0.078	.	.	.
SC	FAIRFIELD CO	22,295	.	.	.	.	.	53	65	.
SC	GEORGETOWN CO	46,302	.	0.02	.	.	.	98	78	0.006
SC	GREENVILLE CO	320,167	5.6	0.01	0.0170	.	.	53	51	0.014
SC	GREENWOOD CO	59,567	.	0.02	.	.	.	.	.	.
SC	LEXINGTON CO	167,611	.	.	.	.	.	122	117	0.020
SC	OCONEE CO	57,494	.	.	.	0.090	0.080	.	.	0.007
SC	PICKENS CO	93,894	.	.	.	0.097	0.081	.	.	.
SC	RICHLAND CO	285,720	2.9	0.01	0.0112	0.110	0.089	130	123	0.009
SC	SPARTANBURG CO	226,800	.	0.00	.	0.107	0.088	43	56	.
SC	UNION CO	30,337	.	.	.	0.098	0.082	.	.	.
SC	WILLIAMSBURG CO	36,815	.	.	.	0.084	0.071	.	.	.
SC	YORK CO	131,497	.	0.01	.	0.098	0.081	46	50	.
SD	BROOKINGS CO	25,207	.	.	.	.	.	52	58	.
SD	MINNEHAHA CO	123,809	.	.	.	.	.	46	52	.
SD	PENNINGTON CO	81,343	.	.	.	.	.	141	141	.
TN	ANDERSON CO	68,250	.	.	.	0.107	0.084	.	.	0.025
TN	BLOUNT CO	85,969	.	.	.	0.115	0.098	43	49	0.048
TN	BRADLEY CO	73,712	.	.	0.0143	0.106	0.082	45	49	0.038
TN	DAVIDSON CO	510,784	6.3	0.08	0.0124	0.125	0.097	69	76	0.032
TN	DICKSON CO	35,061	.	.	.	.	.	42	42	.
TN	HAMBLEN CO	50,480	.	.	.	0.096	0.086	41	43	0.037
TN	HAMILTON CO	285,536	.	.	.	0.107	0.089	63	66	.
TN	HAWKINS CO	44,565	.	.	.	.	.	.	.	0.069
TN	HAYWOOD CO	19,437	.	.	.	0.094	0.082	.	.	.
TN	HENRY CO	27,888	.	.	.	.	.	53	59	.
TN	HUMPHREYS CO	15,795	.	.	.	0.080	.	.	.	0.016
TN	JEFFERSON CO	33,016	.	.	.	0.124	0.094	.	.	.
TN	KNOX CO	335,749	4.8	0.00	.	0.120	0.096	67	69	.
TN	LAWRENCE CO	35,303	.	.	.	0.093	0.079	.	.	.
TN	LOUDON CO	31,255	.	.	.	.	.	.	.	0.016
TN	MC MINN CO	42,383	.	.	0.0147	.	.	74	75	0.047
TN	MADISON CO	77,982	.	0.01	.	.	.	44	52	.
TN	MAURY CO	54,812	.	.	.	.	.	54	64	.
TN	MONTGOMERY CO	100,498	.	.	.	.	.	49	50	0.026
TN	POLK CO	13,643	.	.	.	.	.	.	.	0.067
TN	PUTNAM CO	51,373	.	.	.	0.099	0.085	.	.	.
TN	ROANE CO	47,227	.	0.17	.	.	.	58	75	0.024
TN	RUTHERFORD CO	118,570	.	.	.	0.101	0.087	.	.	.
TN	SEVIER CO	51,043	.	.	.	0.110	0.095	.	.	.
TN	SHELBY CO	826,330	5.5	1.30	0.0277	0.122	0.089	76	81	0.033
TN	STEWART CO	9,479	.	.	.	.	.	.	.	0.017
TN	SULLIVAN CO	143,596	3.5	0.20	0.0183	0.111	0.089	56	63	0.042
TN	SUMNER CO	103,281	.	.	.	0.127	0.100	.	.	0.086
TN	UNION CO	13,694	.	.	.	.	.	141	137	.
TN	WASHINGTON CO	92,315	.	.	.	.	.	41	56	.
TN	WILLIAMSON CO	81,021	.	0.98	.	0.110	0.092	.	.	.
TN	WILSON CO	67,675	.	.	.	0.104	0.084	.	.	.
TX	BEXAR CO	1,185,394	4.4	.	0.0220	0.103	0.084	41	58	.
TX	BRAZORIA CO	191,707	.	.	.	0.137	0.085	.	.	.
TX	BREWSTER CO	8,681	.	.	.	0.066	0.063	.	.	.
TX	CAMERON CO	260,120	3.2	.	.	0.080	0.065	103	91	0.001
TX	COLLIN CO	264,036	.	0.45	.	0.133	0.102	47	67	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m³)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m³)	PM_{10} 99 Pctile (µg/m³)	SO_2 24-hr (ppm)
TX	DALLAS CO	1,852,810	4.6	0.09	0.0180	0.134	0.097	66	77	0.005
TX	DENTON CO	273,525	.	.	0.0090	0.138	0.105	.	.	.
TX	ELLIS CO	85,167	.	0.26	.	0.111	.	104	126	0.022
TX	EL PASO CO	591,610	7.9	0.12	0.0336	0.115	0.075	209	244	0.030
TX	GALVESTON CO	217,399	.	.	0.0050	0.175	0.103	82	116	0.053
TX	GREGG CO	104,948	.	.	.	0.124	0.091	.	.	.
TX	HARRIS CO	2,818,199	6.7	0.00	0.0246	0.210	0.134	134	137	0.025
TX	HIDALGO CO	383,545	.	.	.	0.078	0.067	45	58	.
TX	JEFFERSON CO	239,397	.	.	0.0103	0.133	0.093	.	.	0.038
TX	LUBBOCK CO	222,636	.	.	.	.	.	38	38	.
TX	NUECES CO	291,145	.	.	.	0.094	0.077	74	78	0.020
TX	ORANGE CO	80,509	.	.	0.0093	0.156	0.090	.	.	.
TX	SMITH CO	151,309	.	.	.	0.101	0.087	.	.	.
TX	TARRANT CO	1,170,103	2.8	.	0.0156	0.133	0.097	47	58	.
TX	TRAVIS CO	576,407	1.3	.	.	0.112	0.087	.	.	.
TX	VICTORIA CO	74,361	.	.	.	0.092	0.078	.	.	.
TX	WEBB CO	133,239	6.2	.	.	0.090	0.063	84	84	.
UT	CACHE CO	70,183	4.4	.	.	0.072	0.063	89	92	.
UT	DAVIS CO	187,941	3.5	.	0.0207	0.103	0.079	61	94	0.009
UT	GRAND CO	6,620	.	.	.	.	.	43	52	.
UT	IRON CO	20,789	.	.	.	.	.	31	32	.
UT	SALT LAKE CO	725,956	6.5	0.10	0.0265	0.101	0.075	108	101	0.011
UT	SAN JUAN CO	12,621	.	.	.	0.073	0.067	.	.	.
UT	TOOELE CO	26,601	.	.	.	.	.	32	45	0.002
UT	UTAH CO	263,590	6.2	.	0.0233	0.097	0.075	115	101	.
UT	WASHINGTON CO	48,560	.	.	.	0.081	.	44	44	.
UT	WEBER CO	158,330	6.4	.	0.0239	0.098	0.075	67	67	.
VT	BENNINGTON CO	35,845	.	.	.	0.105	0.082	40	56	.
VT	CHITTENDEN CO	131,761	1.9	.	0.0166	0.081	0.072	42	46	0.012
VT	RUTLAND CO	62,142	2.9	.	0.0116	.	.	43	49	0.037
VT	WASHINGTON CO	54,928	.	.	.	.	.	39	39	.
VT	WINDHAM CO	41,588	.	.	.	.	.	38	50	.
VA	ARLINGTON CO	170,936	2.4	.	0.0224	0.126	0.094	.	.	.
VA	CAROLINE CO	19,217	.	.	0.0068	0.111	0.091	.	.	.
VA	CARROLL CO	26,594	.	.	.	.	.	42	54	.
VA	CHARLES CITY CO	6,282	.	.	0.0119	0.123	0.100	.	.	0.017
VA	CHESTERFIELD CO	209,274	.	.	.	0.105	0.090	59	70	.
VA	CULPEPER CO	27,791	.	.	.	.	.	43	86	.
VA	FAIRFAX CO	818,584	4.6	0.02	0.0236	0.119	0.093	51	69	0.023
VA	FAUQUIER CO	48,741	.	.	.	0.099	0.083	.	.	.
VA	FREDERICK CO	45,723	.	.	.	0.102	0.088	.	.	.
VA	HANOVER CO	63,306	.	.	.	0.134	0.099	.	.	.
VA	HENRICO CO	217,881	.	.	.	0.116	0.098	51	66	.
VA	HENRY CO	56,942	.	.	.	0.092	0.080	.	.	.
VA	KING WILLIAM CO	10,913	.	.	.	.	.	51	72	.
VA	MADISON CO	11,949	.	.	.	0.101	0.089	.	.	.
VA	NORTHUMBERLAND CO	10,524	.	.	.	.	.	48	57	.
VA	PRINCE WILLIAM CO	215,686	.	.	0.0097	0.106	0.086	48	81	.
VA	ROANOKE CO	79,332	.	.	0.0126	0.102	0.084	.	.	0.013
VA	ROCKINGHAM CO	57,482	.	.	.	.	.	.	.	0.011
VA	SMYTH CO	32,370	.	.	.	.	.	44	65	.
VA	STAFFORD CO	61,236	.	.	.	0.108	0.091	.	.	.
VA	TAZEWELL CO	45,960	.	.	.	.	.	44	48	.
VA	WARREN CO	26,142	.	.	.	.	.	43	78	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max ($\mu g/m^3$)	PM_{10} 99 Pctile ($\mu g/m^3$)	SO_2 24-hr (ppm)
VA	WISE CO	39,573	.	.	.	.	.	47	49	.
VA	WYTHE CO	25,466	.	.	.	0.093	0.080	.	.	.
VA	ALEXANDRIA	111,183	3.3	.	0.0259	0.124	0.085	.	.	0.024
VA	BRISTOL	18,426	.	.	.	.	.	43	65	.
VA	CHARLOTTESVILLE	40,341	.	.	.	.	.	42	51	.
VA	CHESAPEAKE	151,976	.	0.01	.	.	.	68	68	.
VA	COVINGTON	6,991	.	.	.	.	.	45	59	.
VA	FREDERICKSBURG	19,027	.	.	.	.	.	54	77	.
VA	HAMPTON	133,793	.	.	.	0.113	0.097	55	64	0.026
VA	LYNCHBURG	66,049	.	.	.	.	.	51	55	.
VA	MARTINSVILLE	16,162	.	.	.	.	.	42	77	.
VA	NEWPORT NEWS	170,045	4.7	.	.	.	.	.	.	.
VA	NORFOLK	261,229	3.8	.	0.0187	.	.	.	.	0.023
VA	RICHMOND	203,056	3.9	0.01	0.0212	.	.	50	69	0.024
VA	ROANOKE	96,397	4.3	.	.	.	.	95	113	.
VA	SUFFOLK	52,141	.	.	.	0.114	0.091	55	62	.
VA	WINCHESTER	21,947	.	.	.	.	.	52	87	.
WA	ASOTIN CO	17,605	.	.	.	.	.	122	142	.
WA	BENTON CO	112,560	.	.	.	.	.	77	52	.
WA	CLALLAM CO	56,464	.	.	.	0.057	0.045	43	46	0.020
WA	CLARK CO	238,053	6.0	.	0.0124	0.077	0.053	41	42	.
WA	COWLITZ CO	82,119	.	.	.	.	.	46	53	.
WA	KING CO	1,507,319	6.5	0.87	0.0194	0.095	0.072	115	122	0.012
WA	KITSAP CO	189,731	.	.	.	.	.	48	49	.
WA	PIERCE CO	586,203	6.8	.	.	0.083	0.066	97	85	0.029
WA	SKAGIT CO	79,555	.	.	.	0.047	0.038	.	.	0.059
WA	SNOHOMISH CO	465,642	5.3	.	.	0.070	0.054	63	63	0.009
WA	SPOKANE CO	361,364	6.3	.	.	0.083	0.068	79	73	.
WA	THURSTON CO	161,238	7.3	.	.	.	.	58	58	.
WA	WALLA WALLA CO	48,439	.	.	.	.	.	127	210	.
WA	WHATCOM CO	127,780	.	.	.	0.070	0.052	48	48	0.012
WA	YAKIMA CO	188,823	.	.	.	.	.	95	110	.
WV	BERKELEY CO	59,253	.	0.01	.	.	.	.	.	.
WV	BROOKE CO	26,992	.	.	.	.	.	63	63	0.059
WV	CABELL CO	96,827	.	0.02	.	0.124	0.086	.	.	0.028
WV	FAYETTE CO	47,952	.	.	.	.	.	45	46	.
WV	GREENBRIER CO	34,693	.	.	0.0058	0.092	0.085	.	.	0.018
WV	HANCOCK CO	35,233	8.8	.	0.0153	0.097	0.083	113	99	0.061
WV	HARRISON CO	69,371	.	0.01	.	.	.	.	.	.
WV	KANAWHA CO	207,619	1.9	0.01	0.0197	0.103	0.075	43	46	0.032
WV	MARION CO	57,249	.	0.01	.	.	.	.	.	.
WV	MARSHALL CO	37,356	.	.	.	.	.	51	67	0.061
WV	MONONGALIA CO	75,509	.	0.01	.	.	.	57	57	0.037
WV	OHIO CO	50,871	3.1	.	.	0.110	0.082	48	49	0.034
WV	PUTNAM CO	42,835	.	.	.	.	.	57	65	.
WV	WAYNE CO	41,636	.	.	.	.	.	49	49	0.046
WV	WOOD CO	86,915	.	0.01	.	0.106	0.085	50	55	0.052
WI	BROWN CO	194,594	.	.	.	0.091	0.073	.	.	0.017
WI	COLUMBIA CO	45,088	.	.	.	0.088	0.073	.	.	.
WI	DANE CO	367,085	4.0	.	.	0.088	0.079	42	54	0.017
WI	DODGE CO	76,559	.	.	.	0.093	0.078	.	.	.
WI	DOOR CO	25,690	.	.	.	0.127	0.100	.	.	.
WI	DOUGLAS CO	41,758	.	.	.	.	.	44	71	.
WI	FLORENCE CO	4,590	.	.	.	0.075	0.064	.	.	.

Table A-12. Maximum Air Quality Concentrations by County, 1997 (continued)

State	County	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 2nd Max (ppm)	O_3 4th Max (ppm)	PM_{10} 2nd Max (µg/m^3)	PM_{10} 99 Pctile (µg/m^3)	SO_2 24-hr (ppm)
WI	FOND DU LAC CO	90,083	.	.	.	0.089	0.077	.	.	.
WI	JEFFERSON CO	67,783	.	.	.	0.093	0.078	.	.	.
WI	KENOSHA CO	128,181	.	.	.	0.120	0.092	.	.	.
WI	KEWAUNEE CO	18,878	.	.	.	0.121	0.099	.	.	.
WI	MANITOWOC CO	80,421	.	.	0.0037	0.132	0.099	.	.	.
WI	MARATHON CO	115,400	.	.	.	0.080	0.069	44	45	0.013
WI	MILWAUKEE CO	959,275	2.5	0.03	0.0207	0.127	0.095	58	59	0.028
WI	ONEIDA CO	31,679	.	.	.	0.075	0.065	.	.	0.050
WI	OUTAGAMIE CO	140,510	.	.	.	0.094	0.079	.	.	.
WI	OZAUKEE CO	72,831	.	.	.	0.129	0.099	.	.	.
WI	POLK CO	34,773	0.5	.	.	0.077	0.066	.	.	.
WI	RACINE CO	175,034	3.1	.	.	0.117	0.098	.	.	.
WI	ROCK CO	139,510	.	.	.	0.097	0.085	.	.	.
WI	ST CROIX CO	50,251	.	.	.	0.085	0.073	.	.	.
WI	SAUK CO	46,975	.	.	0.0043	0.085	0.071	.	.	.
WI	SHEBOYGAN CO	103,877	.	.	.	0.123	0.092	.	.	.
WI	VERNON CO	25,617	.	.	.	0.085	0.071	28	29	.
WI	VILAS CO	17,707	.	.	.	.	.	21	24	.
WI	WALWORTH CO	75,000	.	.	.	0.098	0.081	.	.	.
WI	WASHINGTON CO	95,328	.	.	.	0.106	0.074	.	.	.
WI	WAUKESHA CO	304,715	2.1	.	.	0.111	0.079	61	61	.
WI	WINNEBAGO CO	140,320	.	.	.	0.090	0.080	.	.	.
WI	WOOD CO	73,605	.	.	.	.	.	.	.	0.021
WY	ALBANY CO	30,797	.	.	.	.	.	53	57	.
WY	CAMPBELL CO	29,370	.	.	.	.	.	44	120	.
WY	FREMONT CO	33,662	.	.	.	.	.	73	69	.
WY	LARAMIE CO	73,142	.	.	.	.	.	26	27	.
WY	NATRONA CO	61,226	.	.	.	.	.	33	34	.
WY	SHERIDAN CO	23,562	.	.	.	.	.	100	96	.
WY	SWEETWATER CO	38,823	.	.	.	.	.	52	62	.
WY	TETON CO	11,172	.	.	.	0.067	0.061	77	77	.

CO = Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb = Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 ug/m^3)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
= Highest fourth daily maximum 8-hour concentration *(Applicable NAAQS is 0.08 ppm)*
PM_{10} = Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 ug/m^3)*
= Highest 99th percentile 24-hour concentration *(Applicable NAAQS is 150 ug/m^3)*
Data from exceptional events not included.
SO_2 = Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14ppm)*
WTD = Weighted
AM = Annual mean
PPM = Units are parts per million
µg/m^3 = Units are micrograms per cubic meter

Note: The reader is cautioned that this summary is not adequate in itself to numerically rank counties according to their air quality. The monitoring data represent the quality of air in the vicinity of the monitoring site but may not necessarily represent urban-wide air quality.

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax ($\mu g/m^3$)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM ($\mu g/m^3$)	PM_{10} 2nd Max ($\mu g/m^3$)	PM_{10} 99 Pctile ($\mu g/m^3$)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
ABILENE, TX	119,655	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AGUADILLA, PR	128,172	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AKRON, OH	657,575	3	0.04	ND	0.11	**0.09**	24	63	56	0.012	0.072
ALBANY, GA	112,561	ND	ND	ND	ND	ND	26	57	80	ND	ND
ALBANY-SCHENECTADY-TROY, NY	861,424	5	0.03	0.014	0.10	0.08	23	45	61	0.004	0.020
ALBUQUERQUE, NM	589,131	6	ND	0.019	0.09	0.08	29	93	97	ND	ND
ALEXANDRIA, LA	131,556	ND	ND	ND	ND	ND	23	76	92	ND	ND
ALLENTOWN-BETHLEHEM-EASTON, PA	595,081	3	0.09	0.018	0.12	**0.10**	19	59	59	0.010	0.030
ALTOONA, PA	130,542	2	ND	0.014	0.11	**0.10**	22	67	59	0.010	0.046
AMARILLO, TX	187,547	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ANCHORAGE, AK	226,338	7	ND	ND	ND	ND	32	127	113	ND	ND
ANN ARBOR, MI	490,058	ND	ND	ND	0.09	0.08	ND	ND	ND	ND	ND
ANNISTON, AL	116,034	ND	ND	ND	ND	ND	23	49	51	ND	ND
APPLETON-OSHKOSH-NEENAH, WI	315,121	ND	ND	ND	0.09	0.08	ND	ND	ND	ND	ND
ARECIBO, PR	155,005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ASHEVILLE, NC	191,774	ND	ND	ND	0.09	0.08	21	48	48	ND	ND
ATHENS, GA	126,262	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ATLANTA, GA	2,959,950	4	0.34	0.025	**0.14**	**0.11**	32	75	80	0.005	0.027
ATLANTIC-CAPE MAY, NJ	319,416	4	ND	ND	**0.13**	**0.11**	IN	IN	IN	0.003	0.011
AUGUSTA-AIKEN, GA-SC	415,184	ND	0.01	ND	0.12	**0.09**	26	54	64	0.003	0.013
AURORA-ELGIN, IL	356,884	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUSTIN-SAN MARCOS, TX	846,227	1	ND	IN	0.11	**0.09**	ND	ND	ND	ND	ND
BAKERSFIELD, CA	543,477	3	0.00	0.024	**0.14**	**0.11**	47	96	137	IN	IN
BALTIMORE, MD	2,382,172	5	0.01	0.026	**0.16**	**0.12**	30	63	94	0.008	0.026
BANGOR, ME	91,629	ND	ND	ND	0.09	0.07	21	52	52	ND	ND
BARNSTABLE-YARMOUTH, MA	134,954	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BATON ROUGE, LA	528,264	5	0.06	0.020	**0.13**	**0.10**	28	87	93	0.006	0.027
BEAUMONT-PORT ARTHUR, TX	361,226	ND	ND	0.010	**0.16**	**0.09**	ND	ND	ND	0.008	0.038
BELLINGHAM, WA	127,780	ND	ND	ND	0.07	0.05	16	48	48	IN	IN
BENTON HARBOR, MI	161,378	ND	ND	ND	0.12	**0.10**	ND	ND	ND	ND	ND
BERGEN-PASSAIC, NJ	1,278,440	6	ND	0.028	0.12	**0.10**	IN	65	78	0.004	0.018
BILLINGS, MT	113,419	6	ND	ND	ND	ND	24	95	95	0.007	0.032
BILOXI-GULFPORT-PASCAGOULA, MS	312,368	ND	ND	ND	0.11	**0.10**	21	57	59	0.003	0.025
BINGHAMTON, NY	264,497	ND	ND	ND	ND	ND	18	48	53	ND	ND
BIRMINGHAM, AL	840,140	6	ND	0.010	0.12	**0.09**	35	111	111	0.006	0.018
BISMARCK, ND	83,831	ND	ND	ND	ND	ND	13	26	27	0.008	0.060
BLOOMINGTON, IN	108,978	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BLOOMINGTON-NORMAL, IL	129,180	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BOISE CITY, ID	295,851	5	ND	0.019	ND	ND	35	91	161	ND	ND
BOSTON, MA-NH	3,227,707	5	ND	0.030	0.12	**0.09**	26	59	86	0.009	0.049
BOULDER-LONGMONT, CO	225,339	5	ND	ND	0.09	0.07	21	42	43	ND	ND
BRAZORIA, TX	191,707	ND	ND	ND	**0.14**	**0.09**	ND	ND	ND	ND	ND
BREMERTON, WA	189,731	ND	ND	ND	ND	ND	17	48	49	ND	ND
BRIDGEPORT, CT	443,722	4	ND	0.023	**0.14**	**0.11**	IN	51	61	0.007	0.031
BROCKTON, MA	236,409	ND	ND	0.009	0.11	**0.09**	ND	ND	ND	ND	ND
BROWNSVILLE-HARLINGEN-SAN BENITO, TX	260,120	3	ND	ND	0.08	0.07	21	103	91	0.001	0.001
BRYAN-COLLEGE STATION, TX	121,862	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BUFFALO-NIAGARA FALLS, NY	1,189,288	3	0.04	0.020	0.09	0.08	21	51	82	0.012	0.094
BURLINGTON, VT	151,506	2	ND	0.017	ND	ND	IN	42	46	0.002	0.012
CAGUAS, PR	279,501	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CANTON-MASSILLON, OH	394,106	3	ND	ND	0.10	0.08	27	58	58	0.007	0.025
CASPER, WY	61,226	ND	ND	ND	ND	ND	16	33	34	ND	ND

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	PM$_{10}$ 99 Pctile (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
CEDAR RAPIDS, IA	168,767	2	ND	ND	0.08	0.07	26	50	50	0.007	0.073
CHAMPAIGN-URBANA, IL	173,025	ND	ND	ND	0.09	0.08	23	44	46	0.004	0.018
CHARLESTON-NORTH CHARLESTON, SC	506,875	4	0.01	0.011	0.10	0.08	22	49	49	0.003	0.022
CHARLESTON, WV	250,454	2	0.01	0.020	0.10	0.08	25	57	65	0.010	0.032
CHARLOTTE-GASTONIA-ROCKHILL, NC-SC	1,162,093	6	0.01	0.018	**0.13**	**0.11**	31	61	68	0.006	0.016
CHARLOTTESVILLE, VA	131,107	ND	ND	ND	ND	ND	21	42	51	ND	ND
CHATTANOOGA, TN-GA	424,347	ND	ND	ND	0.11	**0.09**	26	63	66	ND	ND
CHEYENNE, WY	73,142	ND	ND	ND	ND	ND	IN	26	27	ND	ND
CHICAGO, IL	7,410,858	5	0.33a	0.034	0.11	0.09	38	99	114	0.008	0.041
CHICO-PARADISE, CA	182,120	5	0.00	0.013	0.07	0.07	26	84	108	ND	ND
CINCINNATI, OH-KY-IN	1,526,092	3	0.03	0.028	0.12	0.09	34	94	111	0.010	0.045
CLARKSVILLE-HOPKINSVILLE, TN-KY	169,439	ND	ND	ND	0.10	0.08	21	49	50	0.006	0.026
CLEVELAND-LORAIN-ELYRIA, OH	2,202,069	6	1.47[b]	0.028	0.12	0.09	43	133	117	0.010	0.057
COLORADO SPRINGS, CO	397,014	5	0.01	ND	0.07	0.06	24	79	78	ND	ND
COLUMBIA, MO	112,379	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
COLUMBIA, SC	453,331	3	0.01	0.011	0.11	0.09	43	130	123	0.004	0.020
COLUMBUS, GA-AL	260,860	ND	0.81[c]	ND	0.10	0.08	26	64	127	ND	ND
COLUMBUS, OH	1,345,450	3	0.05	ND	0.11	0.09	31	73	75	0.005	0.025
CORPUS CHRISTI, TX	349,894	ND	ND	ND	0.09	0.08	31	74	78	0.003	0.020
CUMBERLAND, MD-WV	101,643	ND	ND	ND	ND	ND	26	56	60	0.006	0.020
DALLAS, TX	2,676,248	5	0.45[d]	0.018	0.14	0.11	48	104	126	0.003	0.022
DANBURY, CT	193,597	ND	ND	ND	0.14	0.11	21	46	47	0.005	0.024
DANVILLE, VA	108,711	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL	350,861	ND	0.02	ND	0.09	0.07	50	150	160	0.005	0.020
DAYTON-SPRINGFIELD, OH	951,270	4	0.04	ND	0.11	0.09	25	63	67	0.006	0.032
DAYTONA BEACH, FL	399,413	ND	ND	ND	0.09	0.07	21	38	40	ND	ND
DECATUR, AL	131,556	ND	ND	ND	0.09	0.08	23	48	55	ND	ND
DECATUR, IL	117,206	ND	0.03	ND	0.09	0.08	27	46	56	0.006	0.021
DENVER, CO	1,622,980	6	0.03	0.034	0.10	0.08	35	98	94	0.006	0.026
DES MOINES, IA	392,928	4	ND	ND	0.08	0.06	IN	126	126	ND	ND
DETROIT, MI	4,266,654	5	0.09	0.026	0.12	0.09	38	106	131	0.009	0.044
DOTHAN, AL	130,964	ND	ND	ND	ND	ND	25	50	58	ND	ND
DOVER, DE	110,993	ND	ND	ND	0.12	0.10	ND	ND	ND	ND	ND
DUBUQUE, IA	86,403	ND	ND	ND	ND	ND	ND	ND	ND	IN	IN
DULUTH-SUPERIOR, MN-WI	239,971	3	ND	ND	0.08	0.07	19	47	71	ND	ND
DUTCHESS COUNTY, NY	259,462	ND	ND	ND	0.11	0.09	ND	ND	ND	ND	ND
EAU CLAIRE, WI	137,543	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EL PASO, TX	591,610	8	0.12	0.034	0.12	0.08	35	209	244	0.006	0.030
ELKHART-GOSHEN, IN	156,198	ND	ND	ND	0.11	0.09	ND	ND	ND	ND	ND
ELMIRA, NY	95,195	ND	ND	ND	0.08	0.07	ND	ND	ND	0.003	0.015
ENID, OK	56,735	ND	ND	0.009	ND	ND	ND	ND	ND	ND	ND
ERIE, PA	275,572	5	ND	0.015	0.10	0.09	20	68	59	0.009	0.035
EUGENE-SPRINGFIELD, OR	282,912	5	0.02	ND	0.07	0.06	22	91	91	ND	ND
EVANSVILLE-HENDERSON, IN-KY	278,990	5	ND	0.016	0.11	0.10	28	67	70	0.017	0.083
FARGO-MOORHEAD, ND-MN	153,296	ND	ND	0.008	0.07	0.07	18	63	67	0.002	0.008
FAYETTEVILLE, NC	274,566	6	0.05	ND	0.10	0.09	25	48	59	ND	ND
FAYETTEVILLE-SPRINGDALE-ROGERS, AR	259,462	ND	ND	ND	ND	ND	IN	36	54	ND	ND
FITCHBURG-LEOMINSTER, MA	138,165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FLAGSTAFF, AZ-UT	101,760	ND	ND	ND	0.08	0.07	IN	IN	IN	ND	ND
FLINT, MI	430,459	ND	0.01	ND	0.10	0.08	20	41	44	0.002	0.012
FLORENCE, AL	131,327	ND	ND	ND	ND	ND	19	41	44	0.003	0.020
FLORENCE, SC	114,344	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (μg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (μg/m^3)	PM$_{10}$ 2nd Max (μg/m^3)	PM$_{10}$ 99 Pctile (μg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
FORT COLLINS-LOVELAND, CO	186,136	5	ND	ND	0.09	0.06	16	34	40	ND	ND
FORT LAUDERDALE, FL	1,255,488	5	0.04	0.010	0.09	0.07	20	39	60	0.002	0.011
FORT MYERS-CAPE CORAL, FL	335,113	ND	ND	ND	0.08	0.07	18	33	38	ND	ND
FORT PIERCE-PORT ST. LUCIE, FL	251,071	ND	ND	ND	0.08	0.07	18	35	40	ND	ND
FORT SMITH, AR-OK	175,911	ND	ND	ND	ND	ND	22	59	68	ND	ND
FORT WALTON BEACH, FL	143,776	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FORT WAYNE, IN	456,281	6	0.03	IN	0.10	**0.09**	33	77	80	IN	IN
FORT WORTH-ARLINGTON, TX	1,361,034	3	ND	0.016	**0.13**	**0.10**	20	47	58	ND	ND
FRESNO, CA	755,580	7	0.00	0.021	**0.14**	**0.12**	47	111	125	IN	IN
GADSDEN, AL	99,840	ND	ND	ND	ND	ND	28	58	63	ND	ND
GAINESVILLE, FL	181,596	ND	ND	ND	0.09	0.08	20	41	75	ND	ND
GALVESTON-TEXAS CITY, TX	217,399	ND	ND	0.005	**0.18**	**0.10**	23	82	116	0.006	0.053
GARY, IN	604,526	4	0.13[e]	IN	0.12	**0.09**	37	138	132	0.008	0.032
GLENS FALLS, NY	118,539	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GOLDSBORO, NC	104,666	ND	ND	ND	ND	ND	23	49	54	ND	ND
GRAND FORKS, ND-MN	103,181	ND	ND	ND	ND	ND	23	64	82	ND	ND
GRAND JUNCTION, CO	93,145	5	ND	ND	ND	ND	20	49	48	ND	ND
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	937,891	2	0.01	IN	0.12	**0.10**	21	60	57	0.002	0.008
GREAT FALLS, MT	77,691	6	ND	ND	ND	ND	IN	IN	IN	IN	IN
GREELEY, CO	131,821	5	ND	ND	0.10	0.07	IN	56	56	ND	ND
GREEN BAY, WI	194,594	ND	ND	ND	0.09	0.07	ND	ND	ND	0.003	0.017
GREENSBORO-WINSTON-SALEM-HIGH POINT NC	1,050,304	5	0.00	0.017	0.12	**0.09**	27	61	73	0.007	0.023
GREENVILLE, NC	107,924	ND	ND	ND	0.12	**0.10**	20	42	51	0.005	0.008
GREENVILLE-SPARTANBURG-ANDERSON, SC	830,563	6	0.01	0.017	0.11	**0.09**	IN	53	56	0.003	0.014
HAGERSTOWN, MD	121,393	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HAMILTON-MIDDLETOWN, OH	291,479	ND	0.04	ND	0.12	**0.09**	35	76	99	0.007	0.035
HARRISBURG-LEBANON-CARLISLE, PA	587,986	3	0.04	0.019	0.12	**0.09**	22	67	67	0.007	0.022
HARTFORD, CT	1,157,585	6	ND	0.018	**0.15**	**0.10**	22	47	53	0.005	0.025
HATTIESBURG, MS	98,738	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HICKORY-MORGANTON-LENOIR, NC	292,409	ND	0.04	ND	0.10	0.08	24	60	100	ND	ND
HONOLULU, HI	836,231	3	0.03	0.005	0.05	0.05	17	28	29	0.002	0.007
HOUMA, LA	182,842	ND	ND	ND	0.10	0.08	ND	ND	ND	ND	ND
HOUSTON, TX	3,322,025	7	0.00	0.025	**0.21**	**0.13**	27	134	137	0.004	0.025
HUNTINGTON-ASHLAND, WV-KY-OH	312,529	4	0.02	0.015	0.12	**0.09**	39	94	105	0.012	0.046
HUNTSVILLE, AL	293,047	3	ND	ND	0.10	**0.09**	21	48	50	ND	ND
INDIANAPOLIS, IN	1,380,491	4	0.08	0.015	0.11	**0.10**	28	54	64	0.006	0.030
IOWA CITY, IA	96,119	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JACKSON, MI	149,756	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JACKSON, MS	395,396	4	ND	ND	0.10	0.08	26	111	91	0.002	0.007
JACKSON, TN	90,801	ND	0.01	ND	ND	ND	23	44	52	ND	ND
JACKSONVILLE, FL	906,727	3	0.02	0.014	0.12	**0.09**	26	62	64	0.004	0.035
JACKSONVILLE, NC	149,838	ND	ND	ND	ND	ND	20	46	52	ND	ND
JAMESTOWN, NY	141,895	ND	ND	ND	0.11	**0.09**	15	49	56	0.008	0.039
JANESVILLE-BELOIT, WI	139,510	ND	ND	ND	0.10	**0.09**	ND	ND	ND	ND	ND
JERSEY CITY, NJ	553,099	7	ND	0.026	0.12	**0.11**	44	77	103	0.010	0.031
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA	436,047	4	0.20	0.018	0.11	**0.09**	30	56	65	0.011	0.069
JOHNSTOWN, PA	241,247	3	0.04	0.016	0.10	**0.09**	24	67	66	0.009	0.030
JONESBORO, AR	68,956	ND	ND	ND	ND	ND	24	60	75	ND	ND
JOPLIN, MO	134,910	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
KALAMAZOO-BATTLE CREEK, MI	429,453	ND	ND	ND	0.10	**0.09**	23	48	49	ND	ND
KANKAKEE, IL	96,255	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
KANSAS CITY, MO-KS	1,582,875	7	0.45	0.020	0.12	**0.10**	33	75	78	0.005	0.021

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (μg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (μg/m^3)	PM$_{10}$ 2nd Max (μg/m^3)	PM$_{10}$ 99 Pctile (μg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
KENOSHA, WI	128,181	ND	ND	ND	0.12	**0.09**	ND	ND	ND	ND	ND
KILLEEN-TEMPLE, TX	255,301	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
KNOXVILLE, TN	585,960	5	0.00	IN	0.12	**0.10**	22	141	137	0.008	0.048
KOKOMO, IN	96,946	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LA CROSSE, WI-MN	116,401	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LAFAYETTE, LA	344,853	ND	ND	ND	0.11	0.08	22	70	87	ND	ND
LAFAYETTE, IN	161,572	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LAKE CHARLES, LA	168,134	ND	ND	0.006	**0.13**	**0.09**	25	79	89	0.003	0.012
LAKELAND-WINTER HAVEN, FL	405,382	ND	ND	ND	0.10	0.08	IN	IN	IN	0.007	0.017
LANCASTER, PA	422,822	3	0.04	0.016	**0.13**	**0.10**	34	83	89	0.007	0.023
LANSING-EAST LANSING, MI	432,674	ND	ND	ND	0.09	0.08	ND	ND	ND	ND	ND
LAREDO, TX	133,239	6	ND	ND	0.09	0.06	IN	84	84	ND	ND
LAS CRUCES, NM	135,510	5	0.08	0.010	0.10	0.08	42	144	135	0.005	0.022
LAS VEGAS, NV-AZ	852,737	8	ND	IN	0.09	0.08	49	186	138	ND	ND
LAWRENCE, KS	81,798	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LAWRENCE, MA-NH	353,232	ND	ND	ND	0.10	0.08	15	36	42	0.005	0.027
LAWTON, OK	111,486	IN	ND	IN	0.02	ND	26	63	71	ND	ND
LEWISTON-AUBURN, ME	93,679	ND	ND	ND	ND	ND	21	48	54	0.004	0.017
LEXINGTON, KY	405,936	5	0.02	0.014	0.10	0.08	24	62	58	0.006	0.016
LIMA, OH	154,340	ND	ND	ND	0.09	0.08	24	48	50	0.003	0.016
LINCOLN, NE	213,641	7	ND	ND	0.06	0.05	25	44	57	ND	ND
LITTLE ROCK-NORTH LITTLE ROCK, AR	513,117	5	ND	0.010	0.10	0.08	27	61	86	0.002	0.006
LONGVIEW-MARSHALL, TX	193,801	ND	ND	ND	0.12	**0.09**	ND	ND	ND	ND	ND
LOS ANGELES-LONG BEACH, CA	8,863,164	**15**	0.07	0.043	**0.17**	**0.12**	46	93	116	0.004	0.010
LOUISVILLE, KY-IN	948,829	6	0.02	0.020	**0.13**	**0.10**	34	98	133	0.009	0.038
LOWELL, MA-NH	280,578	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
LUBBOCK, TX	222,636	ND	ND	ND	ND	ND	IN	38	38	ND	ND
LYNCHBURG, VA	193,928	ND	ND	ND	ND	ND	23	51	55	ND	ND
MACON, GA	290,909	ND	ND	ND	0.12	**0.10**	31	77	102	IN	IN
MADISON, WI	367,085	4	ND	ND	0.09	0.08	20	42	54	0.003	0.017
MANCHESTER, NH	50,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MANSFIELD, OH	174,007	ND	ND	ND	ND	ND	IN	63	63	ND	ND
MAYAGUEZ, PR	237,143	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MCALLEN-EDINBURG-MISSION, TX	383,545	ND	ND	ND	0.08	0.07	IN	45	58	ND	ND
MEDFORD-ASHLAND, OR	146,389	6	0.02	ND	0.07	0.06	IN	85	85	ND	ND
MELBOURNE-TITUSVILLE-PALM BAY, FL	398,978	ND	ND	ND	0.09	0.08	19	38	42	ND	ND
MEMPHIS, TN-AR-MS	1,007,306	6	1.30[f]	0.028	0.12	**0.09**	30	76	81	0.005	0.033
MERCED, CA	178,403	ND	ND	0.013	0.09	0.07	ND	ND	ND	ND	ND
MIAMI, FL	1,937,094	4	ND	0.017	0.11	0.08	26	52	71	0.001	0.004
MIDDLESEX-SOMERSET-HUNTERDON, NJ	1,019,835	4	0.08	0.018	**0.14**	**0.11**	ND	ND	ND	0.005	0.019
MILWAUKEE-WAUKESHA, WI	1,432,149	3	0.03	0.021	**0.13**	**0.10**	27	61	61	0.004	0.028
MINNEAPOLIS-ST. PAUL, MN-WI	2,538,834	5	0.43[g]	0.023	0.09	0.08	IN	77	74	0.004	0.027
MOBILE, AL	476,923	ND	ND	ND	0.12	0.08	30	142	**166**	0.008	0.049
MODESTO, CA	370,522	4	0.00	0.021	0.11	**0.09**	37	115	119	ND	ND
MONMOUTH-OCEAN, NJ	986,327	4	ND	ND	**0.15**	**0.11**	ND	ND	ND	ND	ND
MONROE, LA	142,191	ND	ND	ND	0.09	0.07	IN	78	102	0.004	0.009
MONTGOMERY, AL	292,517	1	ND	0.008	0.09	0.07	24	53	57	0.001	0.005
MUNCIE, IN	119,659	ND	0.90[h]	ND	ND	ND	ND	ND	ND	ND	ND
MYRTLE BEACH, SC	144,053	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NAPLES, FL	152,099	ND	ND	ND	ND	ND	18	37	46	ND	ND
NASHUA, NH	168,233	5	ND	0.016	0.12	**0.09**	19	42	61	0.008	0.036
NASHVILLE, TN	985,026	6	0.98[i]	0.012	**0.13**	**0.10**	34	69	76	0.007	0.086

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997 (continued)

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NASSAU-SUFFOLK, NY	2,609,212	5	ND	0.025	**0.14**	0.11	23	68	73	0.006	0.029
NEW BEDFORD, MA	175,641	ND	ND	ND	0.12	**0.09**	18	35	51	ND	ND
NEW HAVEN-MERIDEN, CT	530,180	4	ND	0.024	**0.15**	**0.11**	24	64	63	0.006	0.032
NEW LONDON-NORWICH, CT-RI	290,734	ND	ND	ND	**0.15**	**0.11**	19	41	65	0.004	0.022
NEW ORLEANS, LA	1,285,270	3	0.05	0.018	0.11	0.08	31	94	100	0.005	0.017
NEW YORK, NY	8,546,846	6	0.16	0.040	**0.16**	**0.12**	31	101	105	0.013	0.043
NEWARK, NJ	1,915,928	5	ND	0.041	0.11	**0.10**	35	81	91	0.007	0.027
NEWBURGH, NY-PA	335,613	ND	0.28	ND	0.10	**0.09**	ND	ND	ND	ND	ND
NORFOLK-VABEACH-NEWPORT NEWS,VA	1,443,244	5	0.01	0.019	0.11	**0.10**	22	68	68	0.007	0.026
OAKLAND, CA	2,082,914	4	0.01	0.020	0.11	0.07	24	71	77	0.003	0.012
OCALA, FL	194,833	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ODESSA-MIDLAND, TX	255,545	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OKLAHOMA CITY, OK	958,839	5	0.00	0.015	0.10	0.08	24	58	59	ND	ND
OLYMPIA, WA	161,238	7	ND	ND	ND	ND	IN	58	58	ND	ND
OMAHA, NE-IA	639,580	5	**1.95**[j]	ND	0.08	0.07	42	98	102	0.004	0.050
ORANGE COUNTY, CA	2,410,556	6	ND	0.033	0.13	0.08	39	82	91	0.001	0.006
ORLANDO, FL	1,224,852	4	ND	0.013	0.11	0.08	26	52	53	0.002	0.006
OWENSBORO, KY	87,189	1	ND	0.012	0.11	**0.09**	26	59	56	0.007	0.027
PANAMA CITY, FL	126,994	ND	ND	ND	ND	ND	26	52	62	ND	ND
PARKERSBURG-MARIETTA, WV-OH	149,169	ND	0.01	ND	0.11	**0.09**	28	88	88	0.010	0.052
PENSACOLA, FL	344,406	ND	ND	ND	0.11	**0.09**	24	56	57	0.005	0.033
PEORIA-PEKIN, IL	339,172	5	0.02	ND	0.09	0.07	27	56	76	0.007	0.044
PHILADELPHIA, PA-NJ	4,922,175	5	**7.00**[k]	0.032	**0.14**	**0.12**	**64**	**264**	**325**	0.012	0.048
PHOENIX-MESA, AZ	2,238,480	8	0.03	0.032	**0.11**	**0.09**	**87**	**308**	**301**	0.005	0.024
PINE BLUFF, AR	85,487	ND	ND	ND	ND	ND	25	61	78	ND	ND
PITTSBURGH, PA	2,384,811	4	0.08	0.029	**0.13**	**0.11**	38	133	113	0.017	0.078
PITTSFIELD, MA	88,695	ND	ND	ND	0.09	0.08	ND	ND	ND	ND	ND
POCATELLO, ID	66,026	ND	ND	IN	ND	ND	21	89	71	0.005	0.034
PONCE, PR	3,442,660	ND	ND	ND	ND	ND	IN	87	91	ND	ND
PORTLAND, ME	221,095	ND	ND	ND	**0.13**	**0.10**	23	81	87	0.005	0.023
PORTLAND-VANCOUVER, OR-WA	1,515,452	6	0.08	0.012	0.10	0.06	30	48	55	ND	ND
PORTSMOUTH-ROCHESTER, NH-ME	223,271	ND	ND	0.013	**0.14**	**0.10**	IN	37	48	0.004	0.018
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	1,134,350	6	ND	0.025	0.12	**0.10**	25	62	64	0.008	0.037
PROVO-OREM, UT	263,590	6	ND	0.023	0.10	0.08	27	115	101	ND	ND
PUEBLO, CO	123,051	ND	ND	ND	ND	ND	27	56	88	ND	ND
PUNTA GORDA, FL	110,975	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RACINE, WI	175,034	3	ND	ND	0.12	**0.10**	ND	ND	ND	ND	ND
RALEIGH-DURHAM-CHAPEL HILL, NC	855,545	7	0.00	ND	0.12	**0.10**	24	59	68	ND	ND
RAPID CITY, SD	81,343	ND	ND	ND	ND	ND	40	141	141	ND	ND
READING, PA	336,523	3	0.76[l]	0.021	0.12	**0.10**	30	67	81	0.009	0.031
REDDING, CA	147,036	ND	ND	ND	0.11	**0.09**	22	56	63	ND	ND
RENO, NV	254,667	8	ND	ND	0.08	0.07	47	115	134	ND	ND
RICHLAND-KENNEWICK-PASCO, WA	150,033	ND	ND	ND	ND	ND	IN	77	52	ND	ND
RICHMOND-PETERSBURG, VA	865,640	4	0.01	0.021	**0.13**	**0.10**	25	59	70	0.006	0.024
RIVERSIDE-SAN BERNARDINO, CA	2,588,793	5	0.05	0.036	**0.18**	**0.14**	**66**	133	**227**	0.002	0.005
ROANOKE, VA	224,477	4	ND	0.013	0.10	0.08	35	95	113	0.003	0.013
ROCHESTER, MN	106,470	ND	ND	ND	ND	ND	IN	38	39	ND	ND
ROCHESTER, NY	1,062,470	2	ND	ND	0.10	**0.09**	21	47	55	0.010	0.050
ROCKFORD, IL	329,676	4	0.03	ND	0.08	0.07	26	62	73	ND	ND
ROCKY MOUNT, NC	133,235	ND	ND	ND	0.11	**0.09**	22	54	56	ND	ND
SACRAMENTO, CA	1,340,010	7	0.01	0.019	**0.14**	**0.09**	25	104	108	0.002	0.006
SAGINAW-BAY CITY-MIDLAND, MI	399,320	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ST. CLOUD, MN	190,921	4	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO$_2$ AM (ppm)	O$_3$ 1-hr (ppm)	O$_3$ 8-hr (ppm)	PM$_{10}$ Wtd AM (µg/m^3)	PM$_{10}$ 2nd Max (µg/m^3)	PM$_{10}$ 99 Pctile (µg/m^3)	SO$_2$ AM (ppm)	SO$_2$ 24-hr (ppm)
ST. JOSEPH, MO	83,083	ND	ND	ND	ND	ND	31	93	88	0.008	**0.147**
ST. LOUIS, MO-IL	1,836,302	5	**8.53**[m]	0.025	0.12	**0.09**	47	108	**157**	0.010	0.063
SALEM, OR	278,024	5	ND	ND	0.08	0.06	ND	ND	ND	ND	ND
SALINAS, CA	355,660	2	ND	0.010	0.08	0.06	21	70	91	ND	ND
SALT LAKE CITY-OGDEN, UT	1,072,227	7	0.10	0.027	0.10	0.08	35	108	101	0.004	0.011
SAN ANGELO, TX	98,458	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SAN ANTONIO, TX	1,324,749	4	ND	0.022	0.10	0.08	21	41	58	ND	ND
SAN DIEGO, CA	2,498,016	5	0.03	0.024	0.12	**0.09**	47	93	125	0.004	0.016
SAN FRANCISCO, CA	1,603,678	4	0.01	0.020	0.08	0.05	25	65	81	0.002	0.006
SAN JOSE, CA	1,497,577	6	0.01	0.025	0.09	0.07	26	72	95	ND	ND
SAN JUAN-BAYAMON, PR	1,836,302	6	ND	IN	0.05	0.04	38	110	109	0.005	0.021
SAN LUIS OBISPO-ATASCADERO-PASO ROBLE CA	217,162	2	ND	0.013	0.09	0.07	24	68	75	0.005	0.026
SANTA BARBARA-SANTA MARIA-LOMPOC, CA	369,608	4	0.00	0.019	0.11	0.08	30	63	122	0.002	0.005
SANTA CRUZ-WATSONVILLE, CA	229,734	1	ND	0.004	0.08	0.06	37	88	113	0.001	0.002
SANTA FE, NM	117,043	2	ND	ND	ND	ND	IN	33	33	ND	ND
SANTA ROSA, CA	388,222	3	ND	0.013	0.10	0.08	19	55	85	ND	ND
SARASOTA-BRADENTON, FL	489,483	5	ND	ND	0.11	0.08	28	56	54	0.002	0.012
SAVANNAH, GA	258,060	ND	ND	ND	0.08	0.07	26	49	53	0.004	0.024
SCRANTON–WILKES-BARRE–HAZLETON, PA	638,466	3	ND	0.018	0.11	**0.10**	26	69	82	0.007	0.031
SEATTLE-BELLEVUE-EVERETT, WA	2,033,156	7	0.87[n]	0.019	0.10	0.07	29	115	122	0.005	0.012
SHARON, PA	121,003	ND	0.04	ND	0.11	**0.09**	28	49	60	0.007	0.032
SHEBOYGAN, WI	103,877	ND	ND	ND	0.12	**0.09**	ND	ND	ND	ND	ND
SHERMAN-DENISON, TX	95,021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SHREVEPORT-BOSSIER CITY, LA	376,330	ND	ND	ND	0.10	0.08	23	70	99	0.002	0.007
SIOUX CITY, IA-NE	115,018	ND	ND	ND	ND	ND	28	59	102	ND	ND
SIOUX FALLS, SD	139,236	ND	ND	ND	ND	ND	23	46	52	ND	ND
SOUTH BEND, IN	247,052	ND	ND	0.012	0.12	**0.09**	17	41	48	ND	ND
SPOKANE, WA	361,364	6	ND	ND	0.08	0.07	26	79	73	ND	ND
SPRINGFIELD, IL	189,550	2	ND	ND	0.09	0.07	23	44	44	0.006	0.043
SPRINGFIELD, MO	264,346	5	ND	0.011	0.08	0.07	16	95	123	0.004	0.054
SPRINGFIELD, MA	587,884	5	ND	0.022	**0.14**	**0.11**	29	58	69	0.005	0.021
STAMFORD-NORWALK, CT	329,935	5	ND	ND	**0.14**	**0.10**	31	65	90	0.006	0.030
STATE COLLEGE, PA	123,786	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
STEUBENVILLE-WEIRTON, OH-WV	142,523	9	ND	0.017	0.10	0.08	32	113	99	0.017	0.061
STOCKTON-LODI, CA	480,628	4	0.00	0.022	0.11	0.08	30	95	130	ND	ND
SUMTER, SC	102,637	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SYRACUSE, NY	742,177	4	ND	ND	0.10	0.08	20	55	57	0.003	0.020
TACOMA, WA	586,203	7	ND	ND	0.08	0.07	20	97	85	0.006	0.029
TALLAHASSEE, FL	233,598	ND	ND	ND	0.06	ND	16	43	43	ND	ND
TAMPA-ST. PETERSBURG-CLEARWATER, FL	2,067,959	4	0.64[o]	0.012	0.11	**0.09**	36	87	92	0.008	0.038
TERRE HAUTE, IN	147,585	3	ND	ND	0.10	0.08	27	61	63	0.007	0.025
TEXARKANA, TX-TEXARKANA, AR	120,132	ND	ND	ND	ND	ND	22	64	78	ND	ND
TOLEDO, OH	614,128	2	0.42 [p]	ND	0.11	**0.09**	23	61	60	0.004	0.023
TOPEKA, KS	160,976	ND	0.01	ND	ND	ND	28	53	60	ND	ND
TRENTON, NJ	325,824	ND	ND	0.017	**0.13**	**0.11**	27	59	87	ND	ND
TUSCON, AZ	666,880	4	0.01	0.018	0.10	0.08	42	129	134	0.002	0.004
TULSA, OK	708,954	6	0.02	0.015	0.11	0.08	27	77	90	0.008	0.049
TUSCALOOSA, AL	150,522	ND	ND	ND	ND	ND	25	55	70	ND	ND
TYLER, TX	151,309	ND	ND	ND	0.10	**0.09**	ND	ND	ND	ND	ND
UTICA-ROME, NY	316,633	ND	ND	ND	0.09	0.07	11	44	49	0.002	0.006
VALLEJO-FAIRFIELD-NAPA, CA	451,186	5	ND	0.013	0.10	0.07	19	71	85	0.002	0.005
VENTURA, CA	669,016	3	0.00	0.020	**0.13**	**0.11**	32	136	**253**	0.003	0.011
VICTORIA, TX	74,361	ND	ND	ND	0.09	0.08	ND	ND	ND	ND	ND

Table A-13. Maximum Air Quality Concentrations by Metropolitan Statistical Area, 1997 (continued)

Metropolitan Statistical Area	1990 Population	CO 8-hr (ppm)	Pb QMax (µg/m^3)	NO_2 AM (ppm)	O_3 1-hr (ppm)	O_3 8-hr (ppm)	PM_{10} Wtd AM (µg/m^3)	PM_{10} 2nd Max (µg/m^3)	PM_{10} 99 Pctile (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
VINELAND-MILLVILLE-BRIDGETON, NJ	138,053	ND	ND	ND	0.12	**0.10**	ND	ND	ND	0.004	0.018
VISALIA-TULARE-PORTERVILLE, CA	311,921	4	ND	0.019	0.12	**0.10**	42	86	96	ND	ND
WACO, TX	189,123	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WASHINGTON, DC-MD-VA-WV	4,223,485	7	0.02	0.026	**0.14**	**0.11**	22	54	86	0.008	0.024
WATERBURY, CT	221,629	ND	ND	ND	ND	ND	24	63	59	0.005	0.020
WATERLOO-CEDAR FALLS, IA	123,798	ND	ND	ND	ND	ND	31	53	65	ND	ND
WAUSAU, WI	115,400	ND	ND	ND	0.08	0.07	20	44	45	0.002	0.013
WEST PALM BEACH-BOCA RATON, FL	863,518	4	0.00	0.012	0.09	0.07	21	39	67	0.002	0.013
WHEELING, WV-OH	159,301	3	ND	ND	0.11	0.08	23	51	67	0.015	0.061
WICHITA, KS	485,270	5	0.01	ND	0.09	0.08	23	57	71	0.005	0.007
WICHITA FALLS, TX	130,351	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WILLIAMSPORT, PA	118,710	ND	ND	ND	0.09	0.08	26	48	57	0.008	0.028
WILMINGTON-NEWARK, DE-MD	513,293	5	ND	0.018	**0.15**	**0.12**	32	68	92	0.010	0.057
WILMINGTON, NC	171,269	ND	ND	ND	0.10	0.08	IN	39	41	0.007	0.028
WORCESTER, MA-CT	478,384	3	ND	0.019	0.11	**0.09**	19	44	53	0.004	0.021
YAKIMA, WA	188,823	IN	ND	ND	ND	ND	IN	95	110	ND	ND
YOLO, CA	141,092	2	ND	0.010	0.10	0.07	28	60	126	ND	ND
YORK, PA	339,574	3	0.04	0.019	0.11	**0.09**	31	75	82	0.009	0.026
YOUNGSTOWN-WARREN, OH	600,859	ND	0.04	0.016	0.11	**0.09**	27	61	61	0.010	0.048
YUBA CITY, CA	122,643	4	ND	0.014	0.10	0.07	29	83	98	ND	ND
YUMA, AZ	106,895	ND	ND	ND	0.07	0.06	IN	IN	IN	ND	ND

CO = Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb = Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 ug/m^3)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 (1hr) = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
O_3 (8hr) = Highest fourth daily maximum 8-hour concentration *(Applicable NAAQS is 0.08 ppm)*
PM_{10} = Highest weighted annual mean concentration *(Applicable NAAQS is 50 ug/m^3)*
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 ug/m^3)*
= Highest 99th percentile concentration *(Applicable NAAQS is 150 ug/m^3)*
Data from exceptional events not included.
SO_2 = Highest annual mean concentration *(Applicable NAAQS is 0.03 ppm)*
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*
ND = Indicates data not available
IN = Indicates insufficient data to calculate summary statistic
Wtd = Weighted
AM = Annual mean
µg/m^3 = Units are micrograms per cubic meter
PPM = Units are parts per million

(a) – Localized impact from an industrial source in Chicago, IL. Highest population-oriented site in Chicago, IL is 0.08 µg/m^3.
(b) – Localized impact from an industrial source in Cleveland, OH. This facility has been shut down. Highest population-oriented site in Cleveland, OH is 0.05 µg/m^3.
(c) – Localized impact from an industrial source in Columbus, GA. Highest population-oriented site in Columbus, GA is 0.16 µg/m^3.
(d) – Localized impact from an industrial source in Collin Co., TX. Highest population-oriented site in Dallas, TX is 0.04 µg/m^3.
(e) – Localized impact from an industrial source in Hammond, IN. Highest population-oriented site in Hammond is 0.04 µg/m^3.
(f) – Localized impact from an industrial source in Memphis, TN. Highest population-oriented site in Memphis, TN is 0.03 µg/m^3.
(g) – Localized impact from an industrial source in Eagan, MN. Highest population-oriented site in Minneapolis, MN is 0.01 µg/m^3.
(h) – Localized impact from an industrial source in Muncie, IN.
(i) – Localized impact from an industrial source in Williamston, Co., TN. Highest population-oriented site in Nashville, TN is 0.08 µg/m^3.
(j) – Localized impact from an industrial source in Omaha, NE. Highest population-oriented site in Omaha, NE is 0.12 µg/m^3.
(k) – Localized impact from an industrial source in Philadelphia, PA. Highest population-oriented site in Philadelphia, PA is 0.81 µg/m^3.
(l) – Localized impact from an industrial source in Laureldale, PA.
(m) – Localized impact from an industrial source in Herculaneum, MO. Highest population-oriented site in St. Louis, MO is 0.03 µg/m^3.
(n) – Localized impact from an industrial source in Seattle.
(o) – Localized impact from an industrial source in Tampa, FL.
(p) – Localized impact from an industrial source in Toledo, OH.

Note: The reader is cautioned that this summary is not adequate in itself to numerically rank MSAs according to their air quality. The monitoring data represent the quality of air in the vicinity of the monitoring site but may not necessarily represent urban-wide air quality.

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AKRON, OH													
CO	2nd Max. 8-hr	NS	1	4.6	5.2	5.7	3.3	4.1	3.1	5.3	3.3	3.4	3.2
LEAD	Max. Quarterly Mean	DOWN	2	0.07	0.10	0.04	0.06	0.05	0.06	0.06	0.03	0.04	0.04
OZONE	4th Max. 8-hr	DOWN	2	0.13	0.10	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	DOWN	2	0.16	0.13	0.11	0.12	0.11	0.11	0.10	0.12	0.11	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	34	34	26	28	27	25	28	26	25	24
	99th Percentile	NS	1	86	86	72	62	60	63	71	63	72	56
SO_2	Arithmetic Mean	DOWN	1	0.015	0.015	0.015	0.015	0.013	0.015	0.012	0.009	0.010	0.012
	2nd Max. 24-hr	NS	1	0.056	0.053	0.061	0.051	0.064	0.056	0.042	0.046	0.042	0.072
ALBANY-SCHENECTADY-TROY, NY													
CO	2nd Max. 8-hr	DOWN	1	6.2	5.7	6.2	5.4	4.7	3.8	5.2	4.3	3.7	4.5
LEAD	Max. Quarterly Mean	DOWN	1	0.05	0.04	0.13	0.04	0.03	0.03	0.04	0.04	0.03	0.03
OZONE	4th Max. 8-hr	DOWN	3	0.11	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.07	0.08
	2nd Daily Max. 1-hr	NS	3	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.10
PM_{10}	Weighted Annual Mean	NS	2	22	22	22	22	21	20	22	19	19	21
	99th Percentile	NS	2	54	54	54	62	67	56	69	51	56	60
SO_2	Arithmetic Mean	DOWN	1	0.006	0.005	0.006	0.007	0.006	0.006	0.006	0.005	0.005	0.004
	2nd Max. 24-hr	DOWN	1	0.039	0.022	0.028	0.030	0.022	0.026	0.027	0.016	0.021	0.017
ALBUQUERQUE, NM													
CO	2nd Max. 8-hr	DOWN	6	6.7	6.4	6.1	5.5	5.0	5.1	4.9	5.0	4.3	3.7
NO2	Arithmetic Mean	NS	1	0.018	0.019	0.018	0.004	0.021	0.024	0.023	0.018	0.022	0.019
OZONE	4th Max. 8-hr	NS	7	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	DOWN	7	0.09	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.08
PM_{10}	Weighted Annual Mean	DOWN	8	35	33	24	22	23	23	22	24	24	21
	99th Percentile	NS	8	83	80	57	56	53	72	62	66	53	55
ALEXANDRIA, LA													
PM_{10}	Weighted Annual Mean	NS	1	23	23	23	22	25	21	23	21	19	23
	99th Percentile	NS	1	49	49	49	80	106	66	57	51	44	92
ALLENTOWN-BETHLEHEM-EASTON, PA													
CO	2nd Max. 8-hr	DOWN	2	6.8	4.8	5.3	5.3	3.8	3.6	6.6	4.7	3.2	2.9
LEAD	Max. Quarterly Mean	DOWN	2	0.84	0.44	0.24	0.27	0.18	0.12	0.11	0.06	0.06	0.07
NO2	Arithmetic Mean	NS	1	0.020	0.020	0.017	0.018	0.018	0.020	0.021	0.018	0.018	0.016
OZONE	4th Max. 8-hr	NS	3	0.12	0.09	0.09	0.10	0.08	0.08	0.08	0.10	0.09	0.10
	2nd Daily Max. 1-hr	NS	3	0.15	0.10	0.11	0.12	0.10	0.11	0.11	0.11	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	1	31	30	30	30	19	23	24	23	23	23
	99th Percentile	NS	1	83	89	93	86	38	65	72	74	74	74
SO_2	Arithmetic Mean	NS	1	0.012	0.010	0.010	0.008	0.008	0.009	0.010	0.010	0.010	0.010
	2nd Max. 24-hr	DOWN	1	0.049	0.047	0.044	0.033	0.030	0.027	0.042	0.027	0.033	0.033
ALTOONA, PA													
OZONE	4th Max. 8-hr	NS	1	0.11	0.07	0.08	0.09	0.08	0.09	0.09	0.09	0.08	0.10
	2nd Daily Max. 1-hr	NS	1	0.14	0.10	0.10	0.11	0.10	0.10	0.11	0.11	0.10	0.11
PM_{10}	Weighted Annual Mean	NS	1	31	25	21	26	21	23	26	25	25	25
	99th Percentile	NS	1	96	64	55	71	38	65	76	58	58	58
SO_2	Arithmetic Mean	DOWN	1	0.011	0.011	0.011	0.011	0.009	0.009	0.010	0.008	0.008	0.010
	2nd Max. 24-hr	NS	1	0.051	0.059	0.062	0.044	0.046	0.052	0.058	0.037	0.033	0.046
ANCHORAGE, AK													
PM_{10}	Weighted Annual Mean	DOWN	3	28	26	31	30	31	28	27	26	25	25
	99th Percentile	NS	3	98	80	107	104	136	100	103	108	100	90
ANN ARBOR, MI													
OZONE	4th Max. 8-hr	NS	1	0.11	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.09
	2nd Daily Max. 1-hr	NS	1	0.13	0.10	0.09	0.11	0.10	0.10	0.09	0.11	0.10	0.10
ANNISTON, AL													
PM_{10}	Weighted Annual Mean	DOWN	1	28	28	28	29	25	25	24	23	19	23
	99th Percentile	NS	1	73	73	73	82	46	90	46	68	40	51
ASHEVILLE, NC													
OZONE	4th Max. 8-hr	NS	1	0.07	0.07	0.07	0.06	0.06	0.07	0.07	0.08	0.07	0.08
	2nd Daily Max. 1-hr	NS	1	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.09
PM_{10}	Weighted Annual Mean	DOWN	1	29	29	25	24	23	22	19	18	19	21
	99th Percentile	NS	1	78	55	53	62	41	56	34	41	44	47
ATLANTA, GA													
CO	2nd Max. 8-hr	DOWN	1	5.3	6.2	5.4	6.5	5.1	4.9	5.3	4.5	3.7	4.3
LEAD	Max. Quarterly Mean	NS	2	0.05	0.04	0.03	0.04	0.03	0.02	0.03	0.05	0.03	0.18
NO2	Arithmetic Mean	DOWN	2	0.024	0.023	0.021	0.020	0.020	0.020	0.018	0.017	0.021	0.020
OZONE	4th Max. 8-hr	NS	4	0.11	0.09	0.11	0.09	0.09	0.10	0.09	0.11	0.10	0.10
	2nd Daily Max. 1-hr	NS	4	0.15	0.11	0.14	0.12	0.12	0.14	0.11	0.14	0.12	0.13
PM_{10}	Weighted Annual Mean	DOWN	2	41	37	46	36	31	31	30	31	29	29
	99th Percentile	DOWN	2	93	87	119	87	65	76	66	65	64	72
SO_2	Arithmetic Mean	DOWN	2	0.007	0.007	0.007	0.006	0.006	0.006	0.004	0.004	0.004	0.004
	2nd Max. 24-hr	DOWN	2	0.041	0.043	0.026	0.032	0.028	0.036	0.023	0.018	0.018	0.023
ATLANTIC-CAPE MAY, NJ													
LEAD	Max. Quarterly Mean	NS	1	0.04	0.07	0.02	0.03	0.02	0.03	0.04	0.03	0.03	0.03

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	NS	1	0.11	0.10	0.11	0.11	0.09	0.09	0.08	0.10	0.10	0.11
	2nd Daily Max. 1-hr	DOWN	1	0.15	0.12	0.16	0.14	0.12	0.12	0.10	0.12	0.11	0.13
PM_{10}	Weighted Annual Mean	DOWN	1	41	37	34	34	31	30	33	32	32	32
	99th Percentile	NS	1	97	73	59	71	80	64	59	67	67	67
SO_2	Arithmetic Mean	DOWN	1	0.006	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
	2nd Max. 24-hr	NS	1	0.025	0.029	0.012	0.011	0.016	0.014	0.019	0.011	0.014	0.011
AUGUSTA-AIKEN, GA-SC													
LEAD	Max. Quarterly Mean	DOWN	1	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01
OZONE	4th Max. 8-hr	NS	2	0.09	0.07	0.08	0.07	0.07	0.09	0.08	0.08	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.11	0.09	0.10	0.10	0.09	0.10	0.09	0.11	0.10	0.11
PM_{10}	Weighted Annual Mean	DOWN	1	27	21	22	23	22	22	21	19	19	21
	99th Percentile	DOWN	1	86	53	62	55	67	57	52	62	51	46
AUSTIN-SAN MARCOS, TX													
CO	2nd Max. 8-hr	NS	1	4.2	4.2	5.9	3.4	3.7	3.0	5.8	3.5	3.2	3.2
NO2	Arithmetic Mean	UP	1	0.017	0.017	0.017	0.016	0.017	0.017	0.018	0.021	0.018	0.018
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.07
	2nd Daily Max. 1-hr	DOWN	2	0.11	0.11	0.11	0.10	0.09	0.09	0.10	0.11	0.10	0.09
PM_{10}	Weighted Annual Mean	DOWN	2	26	25	21	24	23	19	20	22	19	19
	99th Percentile	DOWN	2	77	82	44	85	78	53	46	58	36	36
BAKERSFIELD, CA													
NO2	Arithmetic Mean	DOWN	4	0.018	0.017	0.017	0.017	0.016	0.015	0.015	0.013	0.013	0.013
OZONE	4th Max. 8-hr	NS	5	0.11	0.11	0.10	0.11	0.10	0.11	0.10	0.11	0.11	0.10
	2nd Daily Max. 1-hr	NS	5	0.14	0.13	0.13	0.13	0.12	0.13	0.13	0.13	0.14	0.12
PM_{10}	Weighted Annual Mean	DOWN	1	74	65	69	70	55	44	40	46	36	40
	99th Percentile	DOWN	1	206	191	251	189	153	96	133	195	138	125
SO_2	Arithmetic Mean	NS	1	0.006	0.004	0.004	0.002	0.003	0.002	0.003	0.003	0.003	0.003
	2nd Max. 24-hr	DOWN	1	0.016	0.014	0.011	0.010	0.010	0.010	0.007	0.008	0.009	0.009
BALTIMORE, MD													
CO	2nd Max. 8-hr	DOWN	4	7.7	6.7	6.9	6.1	5.4	5.2	5.5	4.3	3.5	4.3
LEAD	Max. Quarterly Mean	DOWN	2	0.08	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02
NO2	Arithmetic Mean	DOWN	1	0.034	0.035	0.034	0.033	0.031	0.033	0.032	0.026	0.027	0.026
OZONE	4th Max. 8-hr	NS	7	0.13	0.09	0.10	0.11	0.09	0.11	0.10	0.10	0.09	0.11
	2nd Daily Max. 1-hr	NS	7	0.17	0.12	0.13	0.14	0.12	0.13	0.13	0.14	0.12	0.14
PM_{10}	Weighted Annual Mean	DOWN	3	36	36	30	35	30	29	30	28	27	28
	99th Percentile	DOWN	3	86	82	76	77	61	69	73	69	61	75
SO_2	Arithmetic Mean	DOWN	2	0.012	0.012	0.008	0.009	0.009	0.008	0.009	0.006	0.007	0.008
	2nd Max. 24-hr	DOWN	2	0.041	0.042	0.030	0.030	0.027	0.026	0.030	0.022	0.026	0.027
BANGOR, ME													
PM_{10}	Weighted Annual Mean	DOWN	1	31	26	21	25	22	22	22	20	19	21
	99th Percentile	NS	1	67	59	38	51	76	67	77	52	41	52
BATON ROUGE, LA													
LEAD	Max. Quarterly Mean	DOWN	2	0.10	0.09	0.06	0.03	0.03	0.02	0.02	0.04	0.03	0.03
NO2	Arithmetic Mean	NS	1	0.017	0.015	0.014	0.015	0.016	0.012	0.016	0.016	0.015	0.013
OZONE	4th Max. 8-hr	NS	3	0.10	0.09	0.11	0.09	0.08	0.08	0.08	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	3	0.15	0.14	0.15	0.13	0.11	0.11	0.12	0.12	0.11	0.12
PM_{10}	Weighted Annual Mean	DOWN	2	28	28	28	28	27	22	26	24	24	27
	99th Percentile	NS	2	57	59	65	76	91	61	55	57	55	82
SO_2	Arithmetic Mean	NS	1	0.007	0.007	0.005	0.009	0.008	0.006	0.008	0.006	0.006	0.006
	2nd Max. 24-hr	NS	1	0.029	0.056	0.022	0.036	0.033	0.021	0.025	0.034	0.024	0.027
BEAUMONT-PORT ARTHUR, TX													
CO	2nd Max. 8-hr	NS	1	3.0	2.0	2.3	2.3	2.4	3.3	2.0	1.7	2.1	2.1
LEAD	Max. Quarterly Mean	NS	1	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
NO2	Arithmetic Mean	NS	2	0.010	0.010	0.009	0.010	0.011	0.009	0.010	0.010	0.010	0.010
OZONE	4th Max. 8-hr	NS	3	0.10	0.09	0.09	0.10	0.09	0.09	0.08	0.10	0.08	0.09
	2nd Daily Max. 1-hr	NS	3	0.14	0.13	0.12	0.13	0.13	0.12	0.11	0.13	0.12	0.14
SO_2	Arithmetic Mean	DOWN	2	0.008	0.008	0.009	0.008	0.006	0.006	0.006	0.005	0.005	0.006
	2nd Max. 24-hr	DOWN	2	0.046	0.088	0.042	0.059	0.044	0.047	0.039	0.025	0.041	0.037
BELLINGHAM, WA													
OZONE	4th Max. 8-hr	NS	1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.05
	2nd Daily Max. 1-hr	NS	1	0.08	0.08	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.07
SO_2	Arithmetic Mean	NS	1	0.005	0.006	0.007	0.006	0.007	0.006	0.007	0.006	0.005	0.005
	2nd Max. 24-hr	DOWN	1	0.026	0.018	0.028	0.021	0.022	0.017	0.019	0.018	0.013	0.012
BERGEN-PASSAIC, NJ													
CO	2nd Max. 8-hr	DOWN	2	6.8	7.5	6.8	6.6	4.5	5.2	6.2	4.9	3.8	4.8
LEAD	Max. Quarterly Mean	NS	1	0.09	0.05	0.04	0.03	0.02	0.03	0.08	0.03	0.03	0.03
NO2	Arithmetic Mean	DOWN	1	0.036	0.035	0.031	0.031	0.030	0.029	0.031	0.029	0.028	0.028
OZONE	4th Max. 8-hr	NS	1	0.13	0.10	0.10	0.10	0.08	0.08	0.09	0.10	0.08	0.10
	2nd Daily Max. 1-hr	NS	1	0.19	0.12	0.13	0.14	0.10	0.11	0.11	0.12	0.11	0.12
PM_{10}	Weighted Annual Mean	DOWN	3	38	35	37	39	33	31	35	31	31	31
	99th Percentile	NS	3	87	76	95	84	63	79	101	76	73	84

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area			Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	SO_2	Arithmetic Mean	DOWN	2	0.012	0.011	0.010	0.010	0.009	0.008	0.007	0.005	0.006	0.005
		2nd Max. 24-hr	DOWN	2	0.053	0.045	0.041	0.035	0.040	0.026	0.037	0.027	0.022	0.021
BILLINGS, MT														
	SO_2	Arithmetic Mean	DOWN	4	0.020	0.018	0.016	0.016	0.020	0.021	0.015	0.013	0.009	0.006
		2nd Max. 24-hr	DOWN	4	0.095	0.078	0.066	0.069	0.081	0.104	0.066	0.059	0.056	0.032
BILOXI-GULFPORT-PASCAGOULA, MS														
	SO_2	Arithmetic Mean	DOWN	1	0.006	0.006	0.007	0.006	0.006	0.004	0.003	0.003	0.003	0.002
		2nd Max. 24-hr	NS	1	0.022	0.029	0.037	0.034	0.020	0.029	0.022	0.024	0.043	0.025
BIRMINGHAM, AL														
	CO	2nd Max. 8-hr	DOWN	4	7.4	7.4	6.9	7.0	6.6	6.6	6.6	6.2	5.4	5.8
	LEAD	Max. Quarterly Mean	DOWN	2	2.51	1.23	0.91	1.34	0.62	0.19	0.09	0.08	0.10	0.10
	OZONE	4th Max. 8-hr	NS	6	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.10	0.09	0.08
		2nd Daily Max. 1-hr	NS	6	0.12	0.10	0.12	0.10	0.11	0.11	0.10	0.12	0.13	0.11
	PM_{10}	Weighted Annual Mean	DOWN	6	37	31	35	32	29	27	25	26	25	26
		99th Percentile	NS	6	84	71	79	85	57	72	58	58	54	72
	SO_2	Arithmetic Mean	DOWN	1	0.008	0.008	0.008	0.007	0.007	0.009	0.007	0.006	0.004	0.006
		2nd Max. 24-hr	NS	1	0.025	0.025	0.025	0.020	0.027	0.050	0.037	0.016	0.015	0.018
BISMARCK, ND														
	PM_{10}	Weighted Annual Mean	NS	1	19	21	24	21	21	19	18	20	20	20
		99th Percentile	DOWN	1	56	65	107	84	86	56	49	37	37	37
BOISE CITY, ID														
	PM_{10}	Weighted Annual Mean	DOWN	3	40	42	29	35	34	37	35	30	28	29
		99th Percentile	NS	3	134	122	73	148	81	82	105	94	76	69
BOSTON, MA-NH														
	CO	2nd Max. 8-hr	DOWN	4	5.1	5.0	5.6	4.1	4.7	4.0	4.9	3.6	3.6	3.8
	NO2	Arithmetic Mean	DOWN	6	0.029	0.028	0.027	0.027	0.026	0.027	0.027	0.024	0.025	0.024
	OZONE	4th Max. 8-hr	DOWN	4	0.11	0.09	0.08	0.09	0.09	0.09	0.08	0.09	0.07	0.08
		2nd Daily Max. 1-hr	DOWN	4	0.15	0.12	0.10	0.13	0.11	0.11	0.11	0.11	0.09	0.10
	PM_{10}	Weighted Annual Mean	DOWN	7	27	26	25	24	22	22	23	21	23	21
		99th Percentile	NS	7	58	56	69	53	66	60	60	56	72	60
	SO_2	Arithmetic Mean	DOWN	10	0.012	0.011	0.010	0.009	0.009	0.009	0.008	0.006	0.006	0.007
		2nd Max. 24-hr	DOWN	10	0.050	0.044	0.039	0.031	0.038	0.033	0.033	0.024	0.026	0.030
BOULDER-LONGMONT, CO														
	CO	2nd Max. 8-hr	DOWN	2	6.3	6.6	5.7	5.7	5.9	5.3	4.5	4.2	4.0	4.4
	OZONE	4th Max. 8-hr	DOWN	1	0.08	0.08	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.07
		2nd Daily Max. 1-hr	DOWN	1	0.12	0.11	0.10	0.10	0.09	0.10	0.09	0.10	0.09	0.09
	PM_{10}	Weighted Annual Mean	DOWN	2	28	29	23	23	23	24	19	16	17	17
		99th Percentile	DOWN	2	88	93	77	74	64	71	43	42	44	35
BRAZORIA, TX														
	OZONE	4th Max. 8-hr	DOWN	1	0.10	0.10	0.10	0.09	0.10	0.09	0.09	0.11	0.08	0.09
		2nd Daily Max. 1-hr	NS	1	0.14	0.15	0.15	0.13	0.13	0.13	0.11	0.15	0.11	0.14
BRIDGEPORT, CT														
	CO	2nd Max. 8-hr	DOWN	1	6.5	5.2	5.0	5.5	4.7	3.7	5.8	4.9	3.0	4.0
	NO2	Arithmetic Mean	DOWN	1	0.027	0.026	0.026	0.025	0.024	0.024	0.026	0.024	0.024	0.023
	OZONE	4th Max. 8-hr	DOWN	2	0.14	0.11	0.10	0.11	0.08	0.10	0.09	0.10	0.09	0.10
		2nd Daily Max. 1-hr	DOWN	2	0.22	0.16	0.15	0.15	0.12	0.16	0.15	0.13	0.11	0.13
	PM_{10}	Weighted Annual Mean	DOWN	1	29	27	25	28	22	21	26	22	21	21
		99th Percentile	NS	1	71	61	85	60	59	53	69	71	61	61
	SO_2	Arithmetic Mean	DOWN	2	0.012	0.012	0.011	0.010	0.010	0.009	0.009	0.006	0.006	0.007
		2nd Max. 24-hr	DOWN	2	0.060	0.047	0.048	0.042	0.037	0.033	0.051	0.031	0.029	0.033
BROCKTON, MA														
	OZONE	4th Max. 8-hr	NS	1	0.09	0.09	0.09	0.10	0.09	0.09	0.10	0.10	0.08	0.08
		2nd Daily Max. 1-hr	DOWN	1	0.13	0.13	0.12	0.15	0.11	0.11	0.12	0.13	0.10	0.10
BROWNSVILLE-HARLINGEN-SAN BENITO, TX														
	PM_{10}	Weighted Annual Mean	NS	1	22	22	22	24	24	22	23	21	19	21
		99th Percentile	NS	1	54	54	54	70	73	69	62	49	41	66
BUFFALO-NIAGARA FALLS, NY														
	CO	2nd Max. 8-hr	DOWN	3	4.1	4.4	3.4	3.1	4.6	3.4	3.2	2.6	2.9	2.2
	LEAD	Max. Quarterly Mean	NS	2	0.07	0.04	0.04	0.03	0.03	0.04	0.05	0.04	0.04	0.04
	NO2	Arithmetic Mean	NS	2	0.021	0.022	0.020	0.018	0.018	0.017	0.019	0.019	0.019	0.018
	OZONE	4th Max. 8-hr	DOWN	2	0.12	0.08	0.09	0.09	0.08	0.08	0.08	0.09	0.08	0.08
		2nd Daily Max. 1-hr	NS	2	0.14	0.10	0.11	0.11	0.11	0.09	0.09	0.10	0.10	0.09
	PM_{10}	Weighted Annual Mean	DOWN	12	26	25	20	25	22	19	19	19	20	19
		99th Percentile	NS	12	71	68	55	69	62	70	43	47	73	49
	SO_2	Arithmetic Mean	DOWN	4	0.013	0.012	0.011	0.012	0.011	0.010	0.010	0.008	0.007	0.007
		2nd Max. 24-hr	DOWN	4	0.062	0.051	0.054	0.062	0.058	0.042	0.039	0.040	0.034	0.040
BURLINGTON, VT														
	CO	2nd Max. 8-hr	NS	1	3.7	3.7	4.6	3.8	3.9	3.9	3.9	2.5	3.3	1.9
	NO2	Arithmetic Mean	DOWN	1	0.019	0.019	0.018	0.017	0.016	0.017	0.017	0.017	0.017	0.017
	PM_{10}	Weighted Annual Mean	DOWN	2	23	25	24	23	23	21	21	20	20	20
		99th Percentile	NS	2	76	63	77	67	51	48	53	85	39	46

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SO_2	Arithmetic Mean	DOWN	1	0.007	0.007	0.008	0.008	0.003	0.003	0.003	0.002	0.002	0.002
	2nd Max. 24-hr	DOWN	1	0.027	0.031	0.021	0.022	0.013	0.011	0.013	0.006	0.014	0.012
CANTON-MASSILLON, OH													
OZONE	4th Max. 8-hr	DOWN	2	0.13	0.09	0.09	0.10	0.08	0.09	0.08	0.09	0.09	0.08
	2nd Daily Max. 1-hr	DOWN	2	0.14	0.11	0.10	0.11	0.09	0.10	0.10	0.10	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	2	34	35	30	31	28	26	28	29	25	26
	99th Percentile	NS	2	98	94	72	64	68	66	72	73	77	56
SO_2	Arithmetic Mean	DOWN	1	0.011	0.012	0.011	0.010	0.010	0.010	0.009	0.006	0.006	0.007
	2nd Max. 24-hr	NS	1	0.039	0.041	0.036	0.037	0.040	0.046	0.052	0.033	0.032	0.025
CEDAR RAPIDS, IA													
CO	2nd Max. 8-hr	NS	2	3.9	3.2	4.2	4.3	4.6	3.7	3.8	2.6	5.2	2.5
OZONE	4th Max. 8-hr	NS	2	0.07	0.07	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06
	2nd Daily Max. 1-hr	NS	2	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.07	0.07	0.07
PM_{10}	Weighted Annual Mean	DOWN	3	35	33	28	29	27	22	23	23	23	23
	99th Percentile	NS	3	70	79	104	63	71	64	50	56	71	53
SO_2	Arithmetic Mean	DOWN	5	0.006	0.007	0.006	0.006	0.005	0.004	0.004	0.004	0.003	0.004
	2nd Max. 24-hr	DOWN	5	0.047	0.049	0.048	0.040	0.036	0.037	0.029	0.028	0.023	0.024
CHAMPAIGN-URBANA, IL													
OZONE	4th Max. 8-hr	NS	2	0.10	0.08	0.08	0.09	0.08	0.07	0.09	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.11	0.09	0.10	0.10	0.09	0.08	0.10	0.10	0.09	0.09
PM_{10}	Weighted Annual Mean	DOWN	1	32	32	28	30	31	22	25	22	19	23
	99th Percentile	DOWN	1	86	86	68	70	75	51	53	53	49	46
SO_2	Arithmetic Mean	DOWN	1	0.005	0.005	0.004	0.005	0.004	0.004	0.004	0.003	0.003	0.004
	2nd Max. 24-hr	DOWN	1	0.025	0.025	0.030	0.038	0.018	0.015	0.024	0.011	0.013	0.018
CHARLESTON-NORTH CHARLESTON, SC													
CO	2nd Max. 8-hr	NS	1	7.5	5.9	4.7	4.9	5.2	5.8	4.0	6.4	4.7	3.9
LEAD	Max. Quarterly Mean	NS	1	0.03	0.02	0.03	0.04	0.01	0.01	0.01	0.01	0.01	0.01
OZONE	4th Max. 8-hr	NS	3	0.09	0.08	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	NS	3	0.11	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.10	0.09
PM_{10}	Weighted Annual Mean	DOWN	3	28	29	28	25	23	21	20	19	19	19
	99th Percentile	DOWN	3	87	74	72	90	73	52	59	63	63	43
SO_2	Arithmetic Mean	DOWN	1	0.005	0.005	0.003	0.005	0.005	0.004	0.004	0.003	0.003	0.003
	2nd Max. 24-hr	DOWN	1	0.063	0.044	0.027	0.030	0.035	0.025	0.038	0.019	0.021	0.022
CHARLESTON, WV													
CO	2nd Max. 8-hr	NS	1	2.8	2.9	2.8	3.1	3.3	2.2	3.5	2.4	2.3	1.9
LEAD	Max. Quarterly Mean	DOWN	2	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2	Arithmetic Mean	NS	1	0.024	0.021	0.020	0.020	0.017	0.018	0.019	0.020	0.020	0.020
OZONE	4th Max. 8-hr	NS	1	0.12	0.07	0.08	0.09	0.06	0.06	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	1	0.16	0.10	0.12	0.12	0.07	0.08	0.10	0.11	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	37	35	36	29	28	29	28	26	24	21
	99th Percentile	DOWN	1	104	89	115	68	60	70	59	96	68	46
SO_2	Arithmetic Mean	DOWN	2	0.013	0.014	0.012	0.009	0.009	0.009	0.010	0.007	0.008	0.009
	2nd Max. 24-hr	DOWN	2	0.049	0.062	0.056	0.036	0.031	0.034	0.037	0.023	0.031	0.031
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC													
CO	2nd Max. 8-hr	DOWN	5	6.7	7.0	7.1	6.3	6.0	5.6	5.8	4.7	4.4	4.8
LEAD	Max. Quarterly Mean	DOWN	1	0.07	0.03	0.04	0.01	0.08	0.02	0.03	0.01	0.01	0.01
NO2	Arithmetic Mean	NS	1	0.017	0.017	0.017	0.016	0.016	0.017	0.016	0.016	0.016	0.018
OZONE	4th Max. 8-hr	NS	3	0.12	0.09	0.10	0.09	0.09	0.10	0.09	0.09	0.10	0.10
	2nd Daily Max. 1-hr	NS	3	0.16	0.12	0.12	0.12	0.10	0.13	0.11	0.11	0.13	0.12
PM_{10}	Weighted Annual Mean	DOWN	2	35	34	33	30	30	29	29	26	28	27
	99th Percentile	DOWN	2	74	68	63	91	60	58	55	50	52	56
CHARLOTTESVILLE, VA													
PM_{10}	Weighted Annual Mean	DOWN	1	40	30	27	28	22	24	22	23	21	21
	99th Percentile	DOWN	1	106	64	73	58	38	60	40	57	39	51
CHATTANOOGA, TN-GA													
OZONE	4th Max. 8-hr	NS	2	0.10	0.08	0.09	0.08	0.08	0.09	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	2	0.12	0.10	0.12	0.10	0.09	0.10	0.11	0.11	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	2	39	36	38	38	34	32	33	32	32	27
	99th Percentile	DOWN	2	80	69	75	87	79	69	65	60	64	60
CHICAGO, IL													
CO	2nd Max. 8-hr	DOWN	6	5.0	4.8	5.3	4.3	4.8	4.7	6.5	3.7	3.2	3.3
LEAD	Max. Quarterly Mean	DOWN	8	0.15	0.10	0.08	0.06	0.07	0.06	0.06	0.05	0.04	0.04
NO2	Arithmetic Mean	NS	4	0.030	0.029	0.025	0.023	0.027	0.027	0.030	0.030	0.030	0.030
OZONE	4th Max. 8-hr	NS	16	0.10	0.08	0.07	0.09	0.07	0.07	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	16	0.14	0.11	0.09	0.11	0.10	0.09	0.10	0.12	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	12	39	39	36	34	33	32	36	33	30	30
	99th Percentile	DOWN	12	97	94	105	83	84	84	112	80	65	70
SO_2	Arithmetic Mean	DOWN	8	0.008	0.007	0.006	0.007	0.005	0.006	0.006	0.005	0.005	0.005
	2nd Max. 24-hr	NS	8	0.030	0.027	0.024	0.029	0.025	0.028	0.030	0.022	0.021	0.021
CHICO-PARADISE, CA													
CO	2nd Max. 8-hr	DOWN	2	7.2	6.4	6.2	7.4	5.9	4.7	4.6	4.1	4.4	4.0
NO2	Arithmetic Mean	DOWN	1	0.016	0.016	0.015	0.016	0.016	0.016	0.015	0.014	0.013	0.013

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	DOWN	1	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.07
	2nd Daily Max. 1-hr	NS	1	0.10	0.10	0.12	0.09	0.09	0.09	0.10	0.09	0.10	0.07
CINCINNATI, OH-KY-IN													
CO	2nd Max. 8-hr	NS	3	3.8	4.9	4.2	4.2	4.5	4.7	4.3	3.4	2.9	2.7
LEAD	Max. Quarterly Mean	DOWN	1	0.09	0.07	0.04	0.04	0.04	0.05	0.04	0.06	0.04	0.03
NO2	Arithmetic Mean	NS	2	0.023	0.024	0.022	0.022	0.021	0.022	0.022	0.021	0.022	0.023
OZONE	4th Max. 8-hr	NS	7	0.11	0.09	0.09	0.09	0.08	0.08	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	7	0.14	0.11	0.11	0.12	0.09	0.10	0.11	0.12	0.11	0.11
PM$_{10}$	Weighted Annual Mean	DOWN	7	40	41	36	32	30	31	30	31	28	29
	99th Percentile	DOWN	7	107	98	98	71	67	71	80	72	67	68
SO$_2$	Arithmetic Mean	DOWN	5	0.011	0.011	0.012	0.011	0.010	0.011	0.008	0.006	0.008	0.008
	2nd Max. 24-hr	DOWN	5	0.049	0.046	0.058	0.041	0.041	0.039	0.041	0.025	0.033	0.035
CLARKSVILLE-HOPKINSVILLE, TN-KY													
SO$_2$	Arithmetic Mean	DOWN	1	0.010	0.007	0.007	0.006	0.009	0.010	0.007	0.006	0.006	0.005
	2nd Max. 24-hr	DOWN	1	0.066	0.042	0.038	0.029	0.036	0.058	0.037	0.019	0.023	0.026
CLEVELAND-LORAIN-ELYRIA, OH													
CO	2nd Max. 8-hr	NS	2	5.7	5.9	4.7	4.7	5.1	4.3	5.3	5.7	3.7	3.5
LEAD	Max. Quarterly Mean	DOWN	4	0.26	0.19	0.32	0.18	0.21	0.21	0.14	0.11	0.06	0.06
NO2	Arithmetic Mean	DOWN	1	0.023	0.025	0.022	0.022	0.021	0.022	0.021	0.021	0.020	0.020
OZONE	4th Max. 8-hr	NS	6	0.11	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	6	0.14	0.10	0.11	0.11	0.10	0.11	0.11	0.11	0.11	0.10
PM$_{10}$	Weighted Annual Mean	NS	7	42	41	36	38	33	32	39	36	33	34
	99th Percentile	DOWN	7	118	119	97	90	94	85	102	114	89	84
SO$_2$	Arithmetic Mean	DOWN	9	0.011	0.012	0.010	0.010	0.009	0.008	0.008	0.006	0.006	0.006
	2nd Max. 24-hr	DOWN	9	0.044	0.042	0.041	0.039	0.038	0.039	0.040	0.023	0.030	0.029
COLORADO SPRINGS, CO													
CO	2nd Max. 8-hr	DOWN	8	6.1	5.0	4.0	4.3	3.5	3.3	3.2	3.3	3.1	3.1
LEAD	Max. Quarterly Mean	DOWN	1	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01
NO2	Arithmetic Mean	NS	6	0.014	0.014	0.013	0.014	0.015	0.014	0.015	0.015	0.014	0.014
OZONE	4th Max. 8-hr	DOWN	1	0.06	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.05
	2nd Daily Max. 1-hr	DOWN	1	0.08	0.08	0.07	0.08	0.07	0.06	0.07	0.07	0.07	0.06
PM$_{10}$	Weighted Annual Mean	DOWN	13	28	27	22	25	22	22	21	19	20	20
	99th Percentile	DOWN	13	81	77	80	77	59	60	58	49	52	53
SO$_2$	Arithmetic Mean	NS	6	0.003	0.003	0.003	0.003	0.004	0.003	0.004	0.004	0.003	0.003
	2nd Max. 24-hr	NS	6	0.013	0.012	0.012	0.013	0.012	0.014	0.015	0.013	0.010	0.010
COLUMBIA, SC													
CO	2nd Max. 8-hr	DOWN	1	7.4	6.5	5.8	6.0	6.3	5.6	4.7	4.0	3.4	2.9
LEAD	Max. Quarterly Mean	DOWN	2	0.06	0.03	0.03	0.05	0.04	0.02	0.02	0.01	0.01	0.01
OZONE	4th Max. 8-hr	NS	2	0.10	0.09	0.09	0.08	0.08	0.09	0.08	0.08	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.12	0.11	0.11	0.10	0.10	0.12	0.10	0.10	0.09	0.11
PM$_{10}$	Weighted Annual Mean	DOWN	4	31	30	29	25	26	24	24	20	23	23
	99th Percentile	DOWN	4	76	75	60	53	60	50	60	48	54	50
SO$_2$	Arithmetic Mean	DOWN	2	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.003	0.003
	2nd Max. 24-hr	NS	2	0.019	0.016	0.015	0.019	0.018	0.014	0.013	0.010	0.016	0.015
COLUMBUS, GA-AL													
OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.10	0.09	0.10	0.09	0.09	0.10	0.10	0.11	0.09	0.10
PM$_{10}$	Weighted Annual Mean	NS	1	26	26	29	27	26	25	27	28	22	26
	99th Percentile	NS	1	49	49	68	75	56	74	52	62	63	68
COLUMBUS, OH													
CO	2nd Max. 8-hr	DOWN	3	6.0	5.7	4.1	4.8	4.9	3.9	4.5	3.8	2.5	2.4
LEAD	Max. Quarterly Mean	DOWN	2	0.08	0.08	0.06	0.06	0.06	0.04	0.04	0.04	0.03	0.04
OZONE	4th Max. 8-hr	NS	2	0.11	0.09	0.08	0.09	0.07	0.08	0.09	0.09	0.09	0.08
	2nd Daily Max. 1-hr	NS	2	0.14	0.11	0.11	0.12	0.09	0.10	0.10	0.11	0.11	0.10
PM$_{10}$	Weighted Annual Mean	DOWN	3	31	34	32	31	27	27	27	29	26	28
	99th Percentile	DOWN	3	81	86	85	71	70	69	69	80	70	69
SO$_2$	Arithmetic Mean	DOWN	1	0.008	0.008	0.008	0.007	0.006	0.007	0.007	0.004	0.004	0.004
	2nd Max. 24-hr	NS	1	0.035	0.038	0.038	0.033	0.030	0.034	0.041	0.019	0.021	0.025
CORPUS CHRISTI, TX													
OZONE	4th Max. 8-hr	NS	2	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.09	0.08	0.07
	2nd Daily Max. 1-hr	NS	2	0.10	0.10	0.10	0.11	0.09	0.12	0.11	0.12	0.10	0.09
PM$_{10}$	Weighted Annual Mean	NS	2	28	30	27	31	29	29	28	28	23	25
	99th Percentile	NS	2	77	77	63	86	98	83	67	57	49	61
SO$_2$	Arithmetic Mean	NS	2	0.003	0.003	0.002	0.003	0.003	0.003	0.002	0.002	0.002	0.002
	2nd Max. 24-hr	DOWN	2	0.025	0.019	0.013	0.027	0.018	0.024	0.012	0.016	0.013	0.012
CUMBERLAND, MD-WV													
SO$_2$	Arithmetic Mean	DOWN	1	0.013	0.011	0.010	0.009	0.006	0.008	0.010	0.005	0.003	0.006
	2nd Max. 24-hr	DOWN	1	0.055	0.049	0.031	0.028	0.024	0.027	0.037	0.015	0.019	0.020
DALLAS, TX													
CO	2nd Max. 8-hr	NS	1	8.0	4.5	4.7	3.8	5.6	5.4	5.3	5.9	5.5	3.7
LEAD	Max. Quarterly Mean	DOWN	9	0.23	0.20	0.21	0.16	0.18	0.19	0.11	0.13	0.08	0.07
NO2	Arithmetic Mean	UP	1	0.014	0.012	0.012	0.013	0.015	0.014	0.016	0.019	0.019	0.018

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		**Trend**	**#Trend Sites**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
OZONE	4th Max. 8-hr	NS	2	0.10	0.10	0.10	0.06	0.09	0.10	0.09	0.11	0.09	0.09
	2nd Daily Max. 1-hr	NS	2	0.13	0.13	0.14	0.10	0.12	0.13	0.12	0.14	0.12	0.12
PM_{10}	Weighted Annual Mean	NS	5	29	29	28	26	26	27	26	30	30	26
	99th Percentile	NS	5	60	61	65	63	81	75	54	80	79	68
DANBURY, CT													
OZONE	4th Max. 8-hr	NS	1	0.14	0.10	0.11	0.10	0.08	0.10	0.09	0.09	0.08	0.11
	2nd Daily Max. 1-hr	NS	1	0.20	0.13	0.15	0.14	0.12	0.14	0.13	0.13	0.11	0.14
PM_{10}	Weighted Annual Mean	DOWN	1	26	25	22	26	22	19	26	22	22	21
	99th Percentile	NS	1	65	52	59	59	58	58	56	69	48	47
SO_2	Arithmetic Mean	DOWN	1	0.009	0.008	0.007	0.008	0.007	0.006	0.006	0.004	0.005	0.005
	2nd Max. 24-hr	DOWN	1	0.051	0.036	0.033	0.032	0.027	0.024	0.037	0.020	0.020	0.024
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL													
LEAD	Max. Quarterly Mean	NS	1	0.01	0.02	0.03	0.01	0.02	0.02	0.02	0.01	0.02	0.02
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.07	0.08	0.08	0.07	0.07	0.08	0.08	0.07
	2nd Daily Max. 1-hr	NS	2	0.11	0.10	0.08	0.09	0.10	0.08	0.09	0.09	0.09	0.08
PM_{10}	Weighted Annual Mean	NS	3	33	32	31	30	29	28	32	34	31	32
	99th Percentile	NS	3	106	106	115	62	67	73	81	84	101	85
SO_2	Arithmetic Mean	DOWN	3	0.004	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.003	0.003
	2nd Max. 24-hr	DOWN	3	0.023	0.025	0.022	0.020	0.019	0.018	0.023	0.017	0.016	0.015
DAYTON-SPRINGFIELD, OH													
CO	2nd Max. 8-hr	DOWN	2	4.0	4.8	3.2	3.5	3.6	3.6	3.4	3.0	2.4	3.0
LEAD	Max. Quarterly Mean	DOWN	2	0.08	0.06	0.05	0.04	0.04	0.06	0.04	0.05	0.04	0.04
OZONE	4th Max. 8-hr	NS	3	0.11	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.10	0.09
	2nd Daily Max. 1-hr	NS	3	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	3	32	31	26	28	25	25	24	26	23	24
	99th Percentile	NS	3	83	80	86	60	63	60	61	68	65	58
SO_2	Arithmetic Mean	NS	2	0.006	0.006	0.006	0.005	0.005	0.006	0.006	0.004	0.005	0.005
	2nd Max. 24-hr	NS	2	0.026	0.031	0.023	0.022	0.020	0.031	0.032	0.016	0.027	0.027
DECATUR, AL													
PM_{10}	Weighted Annual Mean	NS	1	25	25	25	28	25	25	22	25	21	23
	99th Percentile	NS	1	62	62	62	68	50	64	66	65	53	55
DECATUR, IL													
LEAD	Max. Quarterly Mean	DOWN	1	0.10	0.07	0.03	0.03	0.03	0.03	0.05	0.03	0.02	0.03
OZONE	4th Max. 8-hr	NS	1	0.09	0.08	0.08	0.09	0.08	0.07	0.08	0.08	0.09	0.08
	2nd Daily Max. 1-hr	NS	1	0.11	0.09	0.09	0.10	0.09	0.08	0.10	0.10	0.10	0.09
PM_{10}	Weighted Annual Mean	DOWN	1	40	40	34	36	38	28	29	30	28	27
	99th Percentile	DOWN	1	99	98	88	85	75	64	66	59	55	56
SO_2	Arithmetic Mean	DOWN	1	0.015	0.012	0.008	0.007	0.005	0.006	0.007	0.005	0.005	0.006
	2nd Max. 24-hr	DOWN	1	0.162	0.108	0.060	0.039	0.023	0.025	0.030	0.024	0.022	0.021
DENVER, CO													
CO	2nd Max. 8-hr	DOWN	6	9.9	7.8	7.2	7.0	8.3	6.6	6.1	5.6	4.8	4.7
LEAD	Max. Quarterly Mean	DOWN	3	0.07	0.05	0.06	0.05	0.06	0.06	0.04	0.05	0.03	0.02
NO2	Arithmetic Mean	DOWN	2	0.033	0.033	0.032	0.032	0.032	0.027	0.032	0.029	0.027	0.029
OZONE	4th Max. 8-hr	DOWN	5	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	DOWN	5	0.11	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09
PM_{10}	Weighted Annual Mean	DOWN	10	28	27	26	26	26	29	25	21	22	23
	99th Percentile	NS	10	75	96	87	89	115	99	74	55	56	72
SO_2	Arithmetic Mean	DOWN	2	0.007	0.006	0.006	0.006	0.007	0.006	0.006	0.004	0.005	0.005
	2nd Max. 24-hr	NS	2	0.022	0.023	0.020	0.026	0.038	0.025	0.025	0.016	0.020	0.021
DES MOINES, IA													
CO	2nd Max. 8-hr	NS	3	3.9	4.4	4.6	4.6	3.9	4.5	3.9	4.0	3.2	3.0
OZONE	4th Max. 8-hr	UP	2	0.04	0.05	0.04	0.04	0.07	0.05	0.05	0.07	0.06	0.06
	2nd Daily Max. 1-hr	UP	2	0.06	0.06	0.07	0.06	0.08	0.08	0.07	0.08	0.08	0.08
PM_{10}	Weighted Annual Mean	NS	3	35	33	32	29	28	29	30	30	31	33
	99th Percentile	NS	3	86	89	94	67	84	79	99	80	91	93
DETROIT, MI													
CO	2nd Max. 8-hr	NS	6	5.4	6.0	4.5	5.1	4.2	4.5	6.6	4.5	3.9	3.3
LEAD	Max. Quarterly Mean	DOWN	5	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.03	0.04
NO2	Arithmetic Mean	NS	1	0.023	0.025	0.024	0.022	0.021	0.022	0.025	0.022	0.020	0.026
OZONE	4th Max. 8-hr	NS	8	0.10	0.09	0.08	0.09	0.08	0.08	0.09	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	8	0.14	0.12	0.10	0.12	0.10	0.10	0.12	0.12	0.10	0.11
PM_{10}	Weighted Annual Mean	DOWN	6	38	39	36	33	28	33	38	35	31	28
	99th Percentile	NS	6	100	91	93	83	77	95	102	91	74	81
SO_2	Arithmetic Mean	DOWN	10	0.010	0.010	0.010	0.008	0.007	0.007	0.007	0.006	0.006	0.005
	2nd Max. 24-hr	DOWN	10	0.039	0.037	0.038	0.033	0.030	0.030	0.032	0.030	0.034	0.027
DOTHAN, AL													
PM_{10}	Weighted Annual Mean	NS	1	26	26	31	28	25	26	28	28	22	25
	99th Percentile	NS	1	54	54	82	68	70	64	97	57	65	58
DUBUQUE, IA													
SO_2	Arithmetic Mean	NS	1	0.005	0.005	0.005	0.004	0.004	0.003	0.005	0.006	0.003	0.003
	2nd Max. 24-hr	DOWN	1	0.052	0.030	0.037	0.028	0.029	0.014	0.037	0.027	0.022	0.022

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area			Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
DULUTH-SUPERIOR, MN-WI														
	CO	2nd Max. 8-hr	NS	1	5.1	9.9	4.4	5.2	4.0	4.1	4.3	4.5	4.5	3.2
	PM_{10}	Weighted Annual Mean	DOWN	6	27	26	22	23	20	19	19	19	19	19
		99th Percentile	NS	6	65	58	61	69	64	45	55	59	55	51
EL PASO, TX														
	CO	2nd Max. 8-hr	DOWN	5	9.1	9.8	10.9	9.1	8.1	8.0	6.6	6.8	8.4	6.9
	LEAD	Max. Quarterly Mean	DOWN	4	0.26	0.30	0.27	0.27	0.19	0.18	0.12	0.13	0.20	0.09
	NO2	Arithmetic Mean	NS	1	0.021	0.022	0.017	0.019	0.021	0.021	0.023	0.023	0.023	0.021
	OZONE	4th Max. 8-hr	NS	3	0.08	0.08	0.08	0.07	0.07	0.07	0.08	0.08	0.08	0.07
		2nd Daily Max. 1-hr	DOWN	3	0.14	0.13	0.12	0.12	0.12	0.11	0.13	0.11	0.12	0.11
	PM_{10}	Weighted Annual Mean	DOWN	6	47	42	36	30	30	27	28	31	29	25
		99th Percentile	NS	6	122	116	109	83	89	64	84	100	96	94
	SO_2	Arithmetic Mean	DOWN	3	0.014	0.013	0.010	0.010	0.012	0.009	0.007	0.008	0.008	0.007
		2nd Max. 24-hr	DOWN	3	0.059	0.055	0.055	0.047	0.053	0.049	0.029	0.038	0.036	0.031
ELMIRA, NY														
	OZONE	4th Max. 8-hr	NS	1	0.10	0.07	0.08	0.09	0.07	0.08	0.07	0.08	0.07	0.07
		2nd Daily Max. 1-hr	DOWN	1	0.12	0.09	0.10	0.10	0.09	0.09	0.08	0.09	0.09	0.08
	SO_2	Arithmetic Mean	DOWN	1	0.007	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003
		2nd Max. 24-hr	DOWN	1	0.027	0.026	0.021	0.022	0.021	0.019	0.023	0.014	0.016	0.015
ERIE, PA														
	CO	2nd Max. 8-hr	DOWN	1	4.9	4.4	5.1	3.8	3.6	4.4	3.7	3.2	3.2	3.2
	NO2	Arithmetic Mean	NS	1	0.016	0.015	0.015	0.013	0.014	0.014	0.015	0.015	0.015	0.015
	OZONE	4th Max. 8-hr	DOWN	1	0.12	0.09	0.08	0.09	0.08	0.08	0.09	0.09	0.08	0.09
		2nd Daily Max. 1-hr	NS	1	0.15	0.12	0.10	0.11	0.10	0.11	0.10	0.11	0.10	0.10
	PM_{10}	Weighted Annual Mean	NS	1	35	27	27	29	22	26	29	29	29	29
		99th Percentile	NS	1	111	73	75	81	57	72	57	115	115	115
	SO_2	Arithmetic Mean	DOWN	1	0.014	0.014	0.014	0.010	0.011	0.011	0.010	0.009	0.011	0.009
		2nd Max. 24-hr	NS	1	0.050	0.074	0.057	0.044	0.056	0.072	0.076	0.050	0.066	0.035
EUGENE-SPRINGFIELD, OR														
	CO	2nd Max. 8-hr	DOWN	1	7.1	6.0	4.8	5.4	6.0	4.7	5.3	4.7	4.6	4.7
	LEAD	Max. Quarterly Mean	NS	1	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	OZONE	4th Max. 8-hr	NS	2	0.09	0.06	0.07	0.07	0.07	0.05	0.07	0.06	0.09	0.06
		2nd Daily Max. 1-hr	NS	2	0.12	0.08	0.09	0.09	0.10	0.08	0.09	0.08	0.11	0.07
	PM_{10}	Weighted Annual Mean	DOWN	4	35	31	28	33	29	29	25	23	20	21
		99th Percentile	DOWN	4	102	109	88	121	89	89	91	72	64	64
EVANSVILLE-HENDERSON, IN-KY														
	CO	2nd Max. 8-hr	NS	1	3.1	2.3	2.5	2.0	2.3	2.6	2.7	2.7	2.0	2.3
	NO2	Arithmetic Mean	DOWN	1	0.022	0.020	0.018	0.021	0.018	0.017	0.018	0.017	0.017	0.016
	OZONE	4th Max. 8-hr	NS	4	0.10	0.09	0.09	0.09	0.08	0.08	0.10	0.09	0.09	0.09
		2nd Daily Max. 1-hr	NS	4	0.12	0.10	0.10	0.10	0.09	0.10	0.11	0.11	0.10	0.11
	PM_{10}	Weighted Annual Mean	DOWN	3	38	36	32	34	30	30	33	32	26	27
		99th Percentile	NS	3	86	86	85	65	61	70	110	74	53	61
	SO_2	Arithmetic Mean	DOWN	7	0.012	0.013	0.014	0.013	0.012	0.012	0.012	0.010	0.011	0.011
		2nd Max. 24-hr	DOWN	7	0.059	0.056	0.062	0.061	0.068	0.051	0.048	0.042	0.048	0.048
FARGO-MOORHEAD, ND-MN														
	PM_{10}	Weighted Annual Mean	NS	1	21	21	21	19	21	18	18	20	20	20
		99th Percentile	NS	1	57	51	76	59	58	46	44	56	56	56
FAYETTEVILLE-SPRINGDALE-ROGERS, AR														
	PM_{10}	Weighted Annual Mean	NS	1	26	26	23	24	22	24	25	24	23	20
		99th Percentile	DOWN	1	66	66	60	47	64	60	53	52	57	54
FAYETTEVILLE, NC														
	OZONE	4th Max. 8-hr	NS	2	0.08	0.08	0.09	0.08	0.08	0.09	0.08	0.08	0.09	0.09
		2nd Daily Max. 1-hr	NS	2	0.10	0.10	0.10	0.10	0.09	0.11	0.10	0.10	0.10	0.10
	PM_{10}	Weighted Annual Mean	DOWN	1	33	29	31	27	26	27	25	23	25	25
		99th Percentile	NS	1	79	55	59	53	56	59	58	44	53	59
FLINT, MI														
	OZONE	4th Max. 8-hr	NS	1	0.11	0.08	0.08	0.09	0.07	0.07	0.07	0.08	0.08	0.08
		2nd Daily Max. 1-hr	NS	1	0.13	0.10	0.10	0.10	0.09	0.10	0.09	0.09	0.10	0.10
FLORENCE, AL														
	PM_{10}	Weighted Annual Mean	DOWN	1	24	24	24	24	21	23	20	22	18	19
		99th Percentile	DOWN	1	77	77	77	61	43	55	57	55	48	44
	SO_2	Arithmetic Mean	DOWN	1	0.007	0.005	0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.003
		2nd Max. 24-hr	DOWN	1	0.050	0.036	0.027	0.025	0.019	0.022	0.022	0.018	0.019	0.020
FORT COLLINS-LOVELAND, CO														
	CO	2nd Max. 8-hr	DOWN	1	11.3	8.3	7.0	9.8	6.9	6.6	6.0	5.2	5.1	5.2
	OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
		2nd Daily Max. 1-hr	NS	2	0.10	0.09	0.08	0.09	0.09	0.09	0.10	0.09	0.09	0.09
	PM_{10}	Weighted Annual Mean	DOWN	1	28	29	23	25	23	22	22	22	20	16
		99th Percentile	NS	1	84	60	52	59	41	62	51	57	61	40
FORT LAUDERDALE, FL														
	CO	2nd Max. 8-hr	NS	4	3.5	4.4	3.4	3.6	4.0	3.6	3.5	3.5	3.0	3.1
	LEAD	Max. Quarterly Mean	NS	1	0.04	0.03	0.01	0.02	0.04	0.03	0.03	0.02	0.05	0.04

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	NS	3	0.07	0.08	0.07	0.06	0.08	0.08	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	DOWN	3	0.11	0.11	0.09	0.09	0.10	0.10	0.09	0.09	0.09	0.09
FORT MYERS-CAPE CORAL, FL													
OZONE	4th Max. 8-hr	DOWN	1	0.08	0.08	0.07	0.06	0.07	0.07	0.08	0.07	0.06	0.07
	2nd Daily Max. 1-hr	DOWN	1	0.10	0.10	0.08	0.08	0.08	0.08	0.09	0.09	0.07	0.08
FORT SMITH, AR-OK													
PM_{10}	Weighted Annual Mean	DOWN	1	28	28	26	25	24	25	24	26	25	22
	99th Percentile	NS	1	57	57	65	61	61	61	47	57	67	68
FORT WAYNE, IN													
OZONE	4th Max. 8-hr	NS	1	0.10	0.09	0.08	0.09	0.09	0.08	0.10	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	1	0.12	0.12	0.09	0.10	0.09	0.10	0.11	0.11	0.11	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	29	29	27	27	23	23	24	24	17	20
	99th Percentile	DOWN	1	75	75	81	57	51	63	50	54	49	50
FORT WORTH-ARLINGTON, TX													
CO	2nd Max. 8-hr	DOWN	2	5.1	4.8	4.2	3.7	4.0	3.4	3.2	3.2	3.0	3.0
LEAD	Max. Quarterly Mean	DOWN	2	0.05	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02
NO2	Arithmetic Mean	UP	1	0.014	0.013	0.012	0.014	0.015	0.013	0.017	0.017	0.015	0.016
OZONE	4th Max. 8-hr	NS	2	0.10	0.10	0.10	0.11	0.08	0.09	0.10	0.10	0.09	0.09
	2nd Daily Max. 1-hr	NS	2	0.14	0.13	0.14	0.15	0.12	0.11	0.13	0.14	0.13	0.12
PM_{10}	Weighted Annual Mean	NS	3	25	24	24	23	21	21	20	24	25	22
	99th Percentile	NS	3	64	63	52	76	57	64	43	62	61	55
SO_2	Arithmetic Mean	NS	1	0.002	0.001	0.002	0.002	0.003	0.001	0.002	0.001	0.001	0.001
	2nd Max. 24-hr	NS	1	0.010	0.007	0.008	0.006	0.013	0.005	0.006	0.004	0.011	0.011
FRESNO, CA													
CO	2nd Max. 8-hr	DOWN	3	6.1	6.0	6.0	6.6	4.9	4.4	5.3	4.4	4.4	3.7
NO2	Arithmetic Mean	DOWN	3	0.021	0.022	0.021	0.022	0.020	0.021	0.020	0.020	0.019	0.019
OZONE	4th Max. 8-hr	NS	4	0.11	0.10	0.10	0.11	0.10	0.11	0.10	0.10	0.11	0.10
	2nd Daily Max. 1-hr	DOWN	4	0.15	0.14	0.14	0.15	0.14	0.14	0.13	0.13	0.14	0.13
PM_{10}	Weighted Annual Mean	DOWN	4	57	57	57	56	45	43	41	41	35	41
	99th Percentile	DOWN	4	196	196	196	138	102	129	114	118	99	123
GADSDEN, AL													
PM_{10}	Weighted Annual Mean	DOWN	2	36	28	33	32	31	33	30	30	23	26
	99th Percentile	NS	2	76	60	67	88	74	83	71	69	56	60
GALVESTON-TEXAS CITY, TX													
LEAD	Max. Quarterly Mean	DOWN	1	0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02
OZONE	4th Max. 8-hr	NS	1	0.10	0.10	0.09	0.09	0.07	0.11	0.09	0.14	0.08	0.10
	2nd Daily Max. 1-hr	NS	1	0.14	0.14	0.15	0.15	0.10	0.18	0.13	0.20	0.11	0.18
PM_{10}	Weighted Annual Mean	DOWN	3	27	28	24	22	24	24	23	25	19	20
	99th Percentile	NS	3	58	66	60	86	88	81	49	72	56	86
SO_2	Arithmetic Mean	NS	1	0.008	0.008	0.007	0.007	0.005	0.005	0.006	0.006	0.014	0.006
	2nd Max. 24-hr	NS	1	0.045	0.045	0.063	0.050	0.039	0.056	0.052	0.089	0.067	0.053
GARY, IN													
CO	2nd Max. 8-hr	NS	2	4.4	4.3	4.2	4.1	4.4	4.7	5.6	3.9	3.3	3.7
LEAD	Max. Quarterly Mean	DOWN	4	0.47	0.23	0.21	0.11	0.11	0.08	0.17	0.12	0.13	0.10
OZONE	4th Max. 8-hr	NS	4	0.12	0.08	0.08	0.09	0.08	0.07	0.08	0.10	0.09	0.09
	2nd Daily Max. 1-hr	NS	4	0.15	0.10	0.10	0.11	0.11	0.09	0.11	0.12	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	8	35	33	33	29	26	24	26	25	21	21
	99th Percentile	DOWN	8	105	88	88	73	72	66	63	59	50	53
SO_2	Arithmetic Mean	DOWN	5	0.010	0.011	0.010	0.008	0.007	0.007	0.006	0.005	0.005	0.005
	2nd Max. 24-hr	DOWN	5	0.052	0.047	0.048	0.028	0.028	0.032	0.032	0.022	0.023	0.024
GLENS FALLS, NY													
SO_2	Arithmetic Mean	DOWN	1	0.005	0.004	0.005	0.004	0.004	0.004	0.004	0.003	0.002	0.002
	2nd Max. 24-hr	DOWN	1	0.040	0.023	0.040	0.020	0.017	0.018	0.027	0.011	0.013	0.013
GRAND FORKS, ND-MN													
PM_{10}	Weighted Annual Mean	DOWN	1	24	24	25	20	18	17	16	18	15	15
	99th Percentile	DOWN	1	54	54	139	84	64	41	39	50	41	41
GRAND RAPIDS-MUSKEGON-HOLLAND, MI													
CO	2nd Max. 8-hr	NS	1	4.1	4.5	3.5	4.0	3.2	3.2	4.0	4.6	3.3	2.4
LEAD	Max. Quarterly Mean	DOWN	3	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
OZONE	4th Max. 8-hr	NS	3	0.11	0.09	0.10	0.10	0.08	0.08	0.09	0.09	0.09	0.08
	2nd Daily Max. 1-hr	DOWN	3	0.14	0.13	0.12	0.12	0.10	0.10	0.11	0.12	0.12	0.10
PM_{10}	Weighted Annual Mean	DOWN	2	28	29	30	26	35	22	27	21	20	19
	99th Percentile	DOWN	2	78	80	79	65	129	63	73	66	53	47
SO_2	Arithmetic Mean	DOWN	1	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.002
	2nd Max. 24-hr	DOWN	1	0.016	0.016	0.012	0.014	0.015	0.012	0.013	0.011	0.011	0.008
GREAT FALLS, MT													
CO	2nd Max. 8-hr	NS	1	5.6	5.6	5.6	6.6	5.8	6.9	4.8	6.2	5.4	6.4
PM_{10}	Weighted Annual Mean	NS	1	20	20	24	21	21	21	21	18	19	20
	99th Percentile	NS	1	69	69	109	124	53	61	48	52	69	62
GREELEY, CO													
CO	2nd Max. 8-hr	DOWN	1	9.2	7.3	7.1	7.8	7.5	5.8	5.2	5.3	7.0	4.8

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	NS	1	0.07	0.07	0.08	0.08	0.06	0.06	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	NS	1	0.10	0.10	0.11	0.10	0.08	0.09	0.09	0.09	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	40	30	25	26	25	23	23	20	18	18
	99th Percentile	DOWN	1	84	73	66	80	60	99	57	59	56	56
GREEN BAY, WI													
SO_2	Arithmetic Mean	DOWN	1	0.007	0.006	0.005	0.005	0.004	0.003	0.003	0.004	0.003	0.003
	2nd Max. 24-hr	DOWN	1	0.039	0.024	0.020	0.042	0.021	0.018	0.015	0.017	0.011	0.017
GREENSBORO—WINSTON-SALEM—HIGH POINT, N													
CO	2nd Max. 8-hr	DOWN	1	9.7	9.7	6.8	6.6	5.7	5.5	6.0	6.2	4.3	4.7
NO2	Arithmetic Mean	NS	1	0.018	0.016	0.017	0.016	0.015	0.017	0.017	0.016	0.016	0.017
OZONE	4th Max. 8-hr	NS	3	0.11	0.08	0.09	0.08	0.08	0.09	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	3	0.14	0.10	0.12	0.10	0.10	0.11	0.11	0.11	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	3	34	32	31	31	27	27	25	26	24	24
	99th Percentile	NS	3	76	66	58	83	53	59	46	64	46	67
SO_2	Arithmetic Mean	NS	1	0.007	0.007	0.008	0.007	0.006	0.006	0.007	0.007	0.007	0.007
	2nd Max. 24-hr	NS	1	0.031	0.024	0.023	0.027	0.019	0.022	0.021	0.025	0.026	0.023
GREENVILLE-SPARTANBURG-ANDERSON, SC													
LEAD	Max. Quarterly Mean	DOWN	3	0.06	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.01	0.01
OZONE	4th Max. 8-hr	NS	3	0.10	0.08	0.08	0.08	0.08	0.09	0.08	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	3	0.12	0.10	0.10	0.10	0.10	0.11	0.10	0.11	0.11	0.10
SO_2	Arithmetic Mean	NS	1	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.001	0.002	0.003
	2nd Max. 24-hr	NS	1	0.011	0.011	0.011	0.017	0.013	0.012	0.016	0.007	0.012	0.014
GREENVILLE, NC													
OZONE	4th Max. 8-hr	NS	1	0.10	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.10
	2nd Daily Max. 1-hr	NS	1	0.12	0.10	0.10	0.09	0.10	0.11	0.09	0.10	0.10	0.12
HAMILTON-MIDDLETOWN, OH													
OZONE	4th Max. 8-hr	NS	3	0.11	0.09	0.10	0.09	0.08	0.09	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	3	0.14	0.11	0.12	0.11	0.10	0.12	0.11	0.12	0.11	0.11
PM_{10}	Weighted Annual Mean	NS	1	27	27	27	33	27	29	27	29	26	27
	99th Percentile	NS	1	76	76	76	80	53	78	61	77	66	57
SO_2	Arithmetic Mean	DOWN	2	0.010	0.010	0.010	0.009	0.007	0.008	0.008	0.005	0.007	0.007
	2nd Max. 24-hr	DOWN	2	0.041	0.040	0.037	0.040	0.033	0.035	0.038	0.019	0.025	0.034
HARRISBURG-LEBANON-CARLISLE, PA													
NO2	Arithmetic Mean	NS	2	0.014	0.014	0.013	0.014	0.013	0.011	0.015	0.014	0.015	0.013
OZONE	4th Max. 8-hr	NS	3	0.11	0.09	0.09	0.10	0.08	0.09	0.09	0.09	0.08	0.09
	2nd Daily Max. 1-hr	NS	3	0.14	0.10	0.11	0.11	0.09	0.11	0.12	0.11	0.10	0.11
PM_{10}	Weighted Annual Mean	NS	2	27	25	23	25	21	24	27	25	24	26
	99th Percentile	NS	2	84	69	62	68	41	65	87	67	57	70
SO_2	Arithmetic Mean	NS	2	0.006	0.006	0.005	0.006	0.005	0.006	0.007	0.005	0.005	0.005
	2nd Max. 24-hr	NS	2	0.024	0.029	0.021	0.021	0.022	0.021	0.035	0.017	0.021	0.022
HARTFORD, CT													
CO	2nd Max. 8-hr	DOWN	2	8.3	6.7	6.7	6.1	6.1	5.6	6.4	5.8	5.0	4.8
NO2	Arithmetic Mean	DOWN	1	0.020	0.020	0.019	0.020	0.017	0.018	0.020	0.017	0.016	0.018
OZONE	4th Max. 8-hr	DOWN	3	0.13	0.11	0.10	0.11	0.09	0.10	0.10	0.10	0.08	0.10
	2nd Daily Max. 1-hr	DOWN	3	0.17	0.15	0.15	0.16	0.12	0.15	0.13	0.13	0.10	0.14
PM_{10}	Weighted Annual Mean	DOWN	6	23	23	20	23	20	18	20	16	17	18
	99th Percentile	NS	6	62	53	54	58	72	45	68	58	60	48
SO_2	Arithmetic Mean	DOWN	3	0.009	0.008	0.008	0.008	0.007	0.006	0.006	0.005	0.005	0.004
	2nd Max. 24-hr	DOWN	3	0.040	0.039	0.033	0.034	0.029	0.021	0.029	0.020	0.020	0.023
HONOLULU, HI													
CO	2nd Max. 8-hr	DOWN	2	3.3	3.4	2.9	2.6	2.8	3.1	3.1	2.5	2.4	2.3
LEAD	Max. Quarterly Mean	NS	2	0.01	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02
OZONE	4th Max. 8-hr	UP	1	0.01	0.02	0.03	0.04	0.05	0.05	0.05	0.05	0.04	0.05
	2nd Daily Max. 1-hr	NS	1	0.03	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.05	0.05
PM_{10}	Weighted Annual Mean	NS	1	16	16	16	17	17	16	19	15	16	18
	99th Percentile	DOWN	1	36	36	35	41	28	32	30	29	30	29
HOUMA, LA													
OZONE	4th Max. 8-hr	NS	1	0.08	0.08	0.08	0.08	0.07	0.08	0.09	0.10	0.08	0.08
	2nd Daily Max. 1-hr	NS	1	0.11	0.11	0.12	0.10	0.09	0.10	0.10	0.14	0.09	0.10
HOUSTON, TX													
CO	2nd Max. 8-hr	DOWN	4	6.5	5.8	6.8	6.0	6.8	5.6	4.9	4.0	5.3	4.3
LEAD	Max. Quarterly Mean	DOWN	2	0.06	0.04	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00
NO2	Arithmetic Mean	DOWN	4	0.023	0.022	0.023	0.022	0.022	0.019	0.021	0.021	0.020	0.021
OZONE	4th Max. 8-hr	NS	10	0.11	0.11	0.12	0.10	0.10	0.09	0.10	0.12	0.10	0.11
	2nd Daily Max. 1-hr	NS	10	0.18	0.18	0.19	0.17	0.16	0.16	0.15	0.17	0.16	0.17
PM_{10}	Weighted Annual Mean	DOWN	5	32	32	31	31	30	30	31	30	26	29
	99th Percentile	NS	5	69	69	71	96	94	82	69	82	53	93
SO_2	Arithmetic Mean	DOWN	7	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003
	2nd Max. 24-hr	DOWN	7	0.027	0.026	0.025	0.025	0.022	0.020	0.018	0.026	0.022	0.017
HUNTINGTON-ASHLAND, WV-KY-OH													
CO	2nd Max. 8-hr	DOWN	1	3.9	5.5	4.7	4.4	4.1	3.8	5.2	3.8	3.7	3.8
LEAD	Max. Quarterly Mean	DOWN	2	0.13	0.06	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.04

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	DOWN	3	0.11	0.09	0.09	0.10	0.08	0.09	0.09	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	3	0.13	0.12	0.11	0.13	0.10	0.11	0.13	0.12	0.10	0.11
PM_{10}	Weighted Annual Mean	DOWN	4	37	35	35	33	30	29	32	31	28	30
	99th Percentile	NS	4	91	89	99	63	68	63	68	76	66	73
SO_2	Arithmetic Mean	DOWN	7	0.016	0.014	0.013	0.012	0.010	0.011	0.010	0.009	0.008	0.008
	2nd Max. 24-hr	DOWN	7	0.091	0.080	0.075	0.051	0.044	0.053	0.048	0.036	0.029	0.033
HUNTSVILLE, AL													
CO	2nd Max. 8-hr	DOWN	1	5.0	5.2	4.2	4.1	4.2	4.0	3.5	3.6	3.0	3.1
OZONE	4th Max. 8-hr	NS	1	0.10	0.07	0.08	0.08	0.09	0.09	0.08	0.08	0.08	0.09
	2nd Daily Max. 1-hr	NS	1	0.13	0.09	0.09	0.11	0.11	0.11	0.11	0.10	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	31	31	30	28	30	23	21	22	21	21
	99th Percentile	DOWN	1	62	62	71	78	76	58	50	54	46	49
INDIANAPOLIS, IN													
CO	2nd Max. 8-hr	DOWN	2	4.0	4.0	4.0	5.2	3.5	4.0	3.5	3.9	2.8	3.2
LEAD	Max. Quarterly Mean	DOWN	4	0.68	0.53	0.68	0.30	0.26	0.11	0.20	0.06	0.03	0.04
OZONE	4th Max. 8-hr	NS	6	0.10	0.09	0.09	0.09	0.08	0.08	0.09	0.09	0.10	0.09
	2nd Daily Max. 1-hr	NS	6	0.12	0.11	0.10	0.10	0.09	0.10	0.11	0.11	0.12	0.10
PM_{10}	Weighted Annual Mean	DOWN	13	34	35	33	31	28	28	28	28	23	23
	99th Percentile	DOWN	13	82	82	89	76	65	68	68	67	54	53
SO_2	Arithmetic Mean	DOWN	10	0.011	0.011	0.009	0.009	0.008	0.009	0.007	0.005	0.006	0.006
	2nd Max. 24-hr	DOWN	10	0.046	0.040	0.036	0.030	0.030	0.038	0.039	0.025	0.027	0.026
JACKSON, MS													
OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.08	0.07	0.07	0.07	0.07	0.08	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.09	0.08	0.10	0.09	0.08	0.09	0.09	0.09	0.09	0.10
JACKSON, TN													
PM_{10}	Weighted Annual Mean	DOWN	2	32	31	28	27	27	23	23	25	22	23
	99th Percentile	DOWN	2	67	62	73	68	74	58	66	51	52	48
JACKSONVILLE, FL													
CO	2nd Max. 8-hr	DOWN	5	5.2	5.5	4.2	3.7	4.1	4.0	3.8	3.6	3.1	2.6
LEAD	Max. Quarterly Mean	DOWN	2	0.06	0.04	0.04	0.03	0.02	0.05	0.02	0.03	0.02	0.02
NO2	Arithmetic Mean	NS	1	0.019	0.015	0.015	0.014	0.014	0.015	0.014	0.016	0.015	0.014
OZONE	4th Max. 8-hr	NS	2	0.08	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.07	0.08
	2nd Daily Max. 1-hr	NS	2	0.11	0.11	0.11	0.09	0.10	0.11	0.10	0.11	0.09	0.10
PM_{10}	Weighted Annual Mean	DOWN	3	34	36	34	32	26	27	26	27	24	24
	99th Percentile	NS	3	72	63	62	64	69	66	51	63	57	55
SO_2	Arithmetic Mean	DOWN	5	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	2nd Max. 24-hr	DOWN	5	0.047	0.037	0.037	0.023	0.023	0.025	0.030	0.019	0.020	0.017
JAMESTOWN, NY													
SO_2	Arithmetic Mean	DOWN	1	0.014	0.014	0.012	0.013	0.011	0.011	0.010	0.009	0.008	0.008
	2nd Max. 24-hr	NS	1	0.054	0.072	0.065	0.048	0.050	0.049	0.072	0.056	0.039	0.039
JERSEY CITY, NJ													
CO	2nd Max. 8-hr	DOWN	1	7.8	7.3	7.2	7.5	6.0	5.6	5.9	6.2	4.9	4.3
LEAD	Max. Quarterly Mean	DOWN	2	0.11	0.07	0.05	0.06	0.04	0.04	0.03	0.04	0.04	0.04
NO2	Arithmetic Mean	DOWN	1	0.033	0.031	0.030	0.028	0.028	0.027	0.026	0.026	0.027	0.026
OZONE	4th Max. 8-hr	NS	1	0.14	0.10	0.11	0.12	0.09	0.10	0.10	0.10	0.09	0.11
	2nd Daily Max. 1-hr	DOWN	1	0.20	0.12	0.18	0.14	0.11	0.13	0.12	0.13	0.12	0.12
PM_{10}	Weighted Annual Mean	NS	3	31	33	31	32	26	27	32	25	27	26
	99th Percentile	DOWN	3	86	83	86	77	59	69	93	65	70	55
SO_2	Arithmetic Mean	DOWN	2	0.015	0.014	0.013	0.012	0.010	0.009	0.009	0.007	0.008	0.008
	2nd Max. 24-hr	DOWN	2	0.059	0.047	0.043	0.035	0.041	0.030	0.036	0.026	0.027	0.025
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA													
CO	2nd Max. 8-hr	NS	1	3.7	3.7	3.4	3.3	3.0	6.5	3.4	3.0	3.0	3.5
NO2	Arithmetic Mean	NS	1	0.019	0.019	0.019	0.019	0.018	0.017	0.017	0.018	0.018	0.018
OZONE	4th Max. 8-hr	NS	1	0.09	0.08	0.10	0.08	0.08	0.09	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	1	0.12	0.11	0.12	0.12	0.10	0.13	0.10	0.11	0.10	0.11
PM_{10}	Weighted Annual Mean	DOWN	3	31	31	32	32	29	29	28	27	26	25
	99th Percentile	NS	3	71	71	67	75	58	76	54	60	62	63
SO_2	Arithmetic Mean	NS	3	0.011	0.010	0.009	0.009	0.009	0.008	0.009	0.008	0.009	0.009
	2nd Max. 24-hr	NS	3	0.049	0.053	0.044	0.044	0.039	0.042	0.045	0.039	0.044	0.050
JOHNSTOWN, PA													
CO	2nd Max. 8-hr	NS	1	4.3	4.1	3.7	4.8	4.4	4.2	4.1	3.5	4.8	2.7
LEAD	Max. Quarterly Mean	DOWN	1	0.30	0.31	0.16	0.19	0.14	0.06	0.05	0.06	0.06	0.06
NO2	Arithmetic Mean	DOWN	1	0.019	0.019	0.018	0.019	0.018	0.017	0.018	0.015	0.018	0.016
OZONE	4th Max. 8-hr	NS	2	0.12	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.14	0.10	0.10	0.11	0.09	0.10	0.10	0.11	0.09	0.10
SO_2	Arithmetic Mean	DOWN	1	0.017	0.017	0.014	0.015	0.013	0.015	0.014	0.012	0.011	0.009
	2nd Max. 24-hr	DOWN	1	0.054	0.089	0.046	0.043	0.052	0.049	0.080	0.042	0.034	0.030
KALAMAZOO-BATTLE CREEK, MI													
PM_{10}	Weighted Annual Mean	DOWN	1	38	34	28	29	27	24	26	26	22	23
	99th Percentile	DOWN	1	103	79	94	94	66	66	74	63	79	49
KANSAS CITY, MO-KS													
CO	2nd Max. 8-hr	DOWN	4	4.7	5.1	4.7	4.1	3.8	4.3	4.5	3.5	3.4	3.4

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
LEAD	Max. Quarterly Mean	NS	5	0.17	0.06	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.10
NO2	Arithmetic Mean	NS	3	0.010	0.011	0.011	0.010	0.010	0.009	0.010	0.010	0.012	0.010
OZONE	4th Max. 8-hr	NS	6	0.09	0.07	0.07	0.08	0.08	0.07	0.08	0.09	0.08	0.09
	2nd Daily Max. 1-hr	NS	6	0.13	0.10	0.10	0.10	0.09	0.10	0.10	0.12	0.10	0.11
PM$_{10}$	Weighted Annual Mean	DOWN	7	33	34	31	32	30	30	30	24	33	26
	99th Percentile	NS	7	76	90	83	70	78	89	71	68	87	63
SO$_2$	Arithmetic Mean	NS	5	0.005	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004
	2nd Max. 24-hr	NS	5	0.022	0.016	0.022	0.017	0.016	0.020	0.025	0.018	0.024	0.013
KENOSHA,WI													
OZONE	4th Max. 8-hr	NS	2	0.14	0.10	0.08	0.11	0.08	0.09	0.09	0.10	0.08	0.09
	2nd Daily Max. 1-hr	NS	2	0.19	0.13	0.11	0.14	0.11	0.11	0.12	0.12	0.13	0.11
KNOXVILLE, TN													
CO	2nd Max. 8-hr	DOWN	1	6.1	6.7	5.1	4.5	4.5	4.6	4.3	4.1	3.3	4.8
OZONE	4th Max. 8-hr	NS	4	0.10	0.07	0.09	0.08	0.08	0.09	0.09	0.09	0.09	0.10
	2nd Daily Max. 1-hr	NS	4	0.12	0.09	0.11	0.10	0.10	0.11	0.11	0.12	0.11	0.12
PM$_{10}$	Weighted Annual Mean	DOWN	8	33	32	32	34	30	30	32	31	31	26
	99th Percentile	DOWN	8	72	66	76	68	63	68	61	61	68	58
SO$_2$	Arithmetic Mean	NS	2	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006
	2nd Max. 24-hr	UP	2	0.032	0.031	0.033	0.039	0.035	0.041	0.042	0.038	0.047	0.037
LAKE CHARLES, LA													
OZONE	4th Max. 8-hr	NS	1	0.10	0.09	0.09	0.09	0.07	0.08	0.08	0.08	0.08	0.09
	2nd Daily Max. 1-hr	DOWN	1	0.13	0.12	0.11	0.12	0.11	0.10	0.10	0.11	0.09	0.11
LAKELAND-WINTER HAVEN, FL													
SO$_2$	Arithmetic Mean	UP	1	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.006	0.007
	2nd Max. 24-hr	NS	1	0.016	0.016	0.022	0.016	0.018	0.019	0.016	0.014	0.021	0.017
LANCASTER, PA													
CO	2nd Max. 8-hr	NS	1	3.4	4.1	3.4	2.6	2.6	3.0	3.8	2.4	2.6	3.3
LEAD	Max. Quarterly Mean	DOWN	1	0.07	0.05	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04
NO2	Arithmetic Mean	NS	1	0.020	0.018	0.017	0.018	0.015	0.015	0.019	0.016	0.017	0.016
OZONE	4th Max. 8-hr	NS	1	0.11	0.09	0.09	0.10	0.09	0.10	0.09	0.10	0.09	0.10
	2nd Daily Max. 1-hr	NS	1	0.13	0.10	0.10	0.12	0.11	0.12	0.11	0.12	0.10	0.13
PM$_{10}$	Weighted Annual Mean	NS	1	31	31	31	30	27	31	38	33	31	34
	99th Percentile	UP	1	70	70	70	51	60	76	135	84	92	89
SO$_2$	Arithmetic Mean	NS	1	0.007	0.007	0.006	0.006	0.006	0.007	0.006	0.006	0.005	0.007
	2nd Max. 24-hr	NS	1	0.028	0.037	0.028	0.023	0.023	0.026	0.030	0.018	0.021	0.023
LANSING-EAST LANSING, MI													
OZONE	4th Max. 8-hr	NS	2	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	2nd Daily Max. 1-hr	DOWN	2	0.12	0.10	0.10	0.11	0.09	0.10	0.09	0.10	0.09	0.09
LAS CRUCES, NM													
CO	2nd Max. 8-hr	NS	2	5.0	4.5	4.6	5.0	3.8	6.0	4.1	3.7	3.7	3.9
LEAD	Max. Quarterly Mean	DOWN	2	0.18	0.16	0.17	0.15	0.13	0.12	0.05	0.09	0.07	0.07
OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06
	2nd Daily Max. 1-hr	NS	2	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08
PM$_{10}$	Weighted Annual Mean	NS	3	44	45	35	31	31	30	33	34	33	27
	99th Percentile	NS	3	136	120	92	84	87	80	91	111	102	93
SO$_2$	Arithmetic Mean	DOWN	2	0.010	0.010	0.011	0.010	0.009	0.006	0.004	0.004	0.004	0.003
	2nd Max. 24-hr	DOWN	2	0.068	0.061	0.056	0.055	0.052	0.055	0.023	0.021	0.030	0.014
LAS VEGAS, NV-AZ													
CO	2nd Max. 8-hr	DOWN	2	11.1	10.0	10.9	9.5	7.9	8.6	8.8	7.8	8.4	7.8
NO2	Arithmetic Mean	DOWN	1	0.031	0.034	0.037	0.030	0.028	0.029	0.027	0.027	0.027	0.027
OZONE	4th Max. 8-hr	NS	3	0.08	0.08	0.07	0.07	0.08	0.08	0.08	0.07	0.08	0.07
	2nd Daily Max. 1-hr	DOWN	3	0.11	0.10	0.10	0.09	0.09	0.10	0.09	0.09	0.09	0.09
PM$_{10}$	Weighted Annual Mean	NS	1	37	60	69	59	48	43	47	47	53	60
	99th Percentile	NS	1	84	187	362	110	103	117	117	126	113	121
LAWRENCE, MA-NH													
OZONE	4th Max. 8-hr	NS	1	0.11	0.08	0.07	0.09	0.07	0.08	0.08	0.07	0.08	0.08
	2nd Daily Max. 1-hr	NS	1	0.13	0.11	0.09	0.12	0.09	0.10	0.10	0.08	0.09	0.10
PM$_{10}$	Weighted Annual Mean	DOWN	1	21	21	21	18	19	18	16	13	14	15
	99th Percentile	NS	1	41	41	41	45	74	57	54	29	35	42
SO$_2$	Arithmetic Mean	DOWN	2	0.008	0.009	0.008	0.007	0.008	0.008	0.006	0.006	0.005	0.005
	2nd Max. 24-hr	DOWN	2	0.031	0.036	0.029	0.026	0.027	0.026	0.027	0.025	0.019	0.020
LAWTON, OK													
PM$_{10}$	Weighted Annual Mean	DOWN	1	32	32	30	27	26	27	28	25	28	26
	99th Percentile	NS	1	104	74	100	71	53	59	62	52	70	71
LEWISTON-AUBURN, ME													
PM$_{10}$	Weighted Annual Mean	DOWN	1	25	25	25	29	24	24	20	20	20	21
	99th Percentile	NS	1	59	59	59	66	81	70	56	58	52	54
SO$_2$	Arithmetic Mean	DOWN	1	0.007	0.008	0.007	0.006	0.005	0.007	0.006	0.004	0.004	0.004
	2nd Max. 24-hr	DOWN	1	0.044	0.035	0.027	0.023	0.020	0.025	0.025	0.020	0.018	0.017
LEXINGTON, KY													
CO	2nd Max. 8-hr	NS	1	5.4	5.6	3.7	4.9	3.8	6.5	4.2	3.0	3.1	5.2
NO2	Arithmetic Mean	DOWN	1	0.018	0.019	0.017	0.016	0.016	0.017	0.016	0.017	0.014	0.014

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	OZONE	4th Max. 8-hr	NS	2	0.11	0.09	0.08	0.08	0.06	0.08	0.09	0.08	0.08	0.08
		2nd Daily Max. 1-hr	NS	2	0.12	0.11	0.10	0.09	0.08	0.10	0.10	0.11	0.09	0.09
	PM_{10}	Weighted Annual Mean	DOWN	2	30	30	28	28	24	25	27	26	24	23
		99th Percentile	DOWN	2	82	82	67	61	62	58	83	63	58	56
	SO_2	Arithmetic Mean	NS	1	0.007	0.006	0.006	0.008	0.007	0.007	0.008	0.006	0.006	0.006
		2nd Max. 24-hr	NS	1	0.027	0.034	0.020	0.025	0.030	0.026	0.037	0.016	0.020	0.016
LIMA, OH														
	OZONE	4th Max. 8-hr	NS	1	0.09	0.09	0.08	0.09	0.08	0.09	0.09	0.09	0.09	0.08
		2nd Daily Max. 1-hr	NS	1	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.09
	SO_2	Arithmetic Mean	DOWN	1	0.006	0.006	0.005	0.006	0.004	0.005	0.004	0.003	0.003	0.003
		2nd Max. 24-hr	NS	1	0.024	0.033	0.026	0.021	0.020	0.023	0.036	0.015	0.015	0.016
LINCOLN, NE														
	CO	2nd Max. 8-hr	DOWN	2	6.4	6.1	6.2	7.4	4.5	4.3	4.0	4.9	3.4	5.0
	OZONE	4th Max. 8-hr	NS	1	0.07	0.06	0.06	0.06	0.07	0.05	0.06	0.06	0.05	0.05
		2nd Daily Max. 1-hr	NS	1	0.08	0.06	0.07	0.07	0.07	0.06	0.08	0.07	0.06	0.06
	PM_{10}	Weighted Annual Mean	DOWN	2	29	33	29	30	25	26	28	25	28	24
		99th Percentile	NS	2	63	65	62	100	51	54	49	67	80	55
LITTLE ROCK-NORTH LITTLE ROCK, AR														
	NO2	Arithmetic Mean	NS	1	0.010	0.009	0.009	0.009	0.012	0.009	0.011	0.011	0.011	0.010
	OZONE	4th Max. 8-hr	NS	2	0.09	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08
		2nd Daily Max. 1-hr	NS	2	0.11	0.09	0.10	0.10	0.09	0.10	0.09	0.11	0.10	0.10
	PM_{10}	Weighted Annual Mean	DOWN	4	30	29	29	25	28	27	27	29	26	25
		99th Percentile	NS	4	73	80	69	55	74	64	62	65	52	78
	SO_2	Arithmetic Mean	NS	1	0.002	0.002	0.003	0.003	0.005	0.006	0.003	0.002	0.002	0.002
		2nd Max. 24-hr	DOWN	1	0.016	0.010	0.014	0.012	0.012	0.017	0.009	0.008	0.009	0.006
LONGVIEW-MARSHALL, TX														
	OZONE	4th Max. 8-hr	NS	1	0.09	0.09	0.09	0.08	0.08	0.09	0.08	0.10	0.08	0.09
		2nd Daily Max. 1-hr	NS	1	0.12	0.10	0.13	0.11	0.10	0.11	0.10	0.15	0.11	0.12
LOS ANGELES-LONG BEACH, CA														
	CO	2nd Max. 8-hr	DOWN	13	10.1	9.6	9.0	8.8	7.8	6.8	8.0	7.5	6.8	6.6
	LEAD	Max. Quarterly Mean	DOWN	6	0.15	0.09	0.09	0.10	0.08	0.06	0.06	0.05	0.05	0.05
	NO2	Arithmetic Mean	DOWN	13	0.046	0.044	0.041	0.041	0.038	0.036	0.039	0.038	0.035	0.033
	OZONE	4th Max. 8-hr	DOWN	14	0.14	0.14	0.12	0.13	0.13	0.12	0.11	0.11	0.10	0.09
		2nd Daily Max. 1-hr	DOWN	14	0.23	0.22	0.19	0.19	0.20	0.17	0.17	0.15	0.14	0.12
	PM_{10}	Weighted Annual Mean	DOWN	9	57	57	49	53	41	40	39	39	38	39
		99th Percentile	DOWN	9	149	155	152	192	104	91	103	120	104	88
	SO_2	Arithmetic Mean	DOWN	4	0.005	0.004	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.003
		2nd Max. 24-hr	DOWN	4	0.019	0.015	0.012	0.013	0.015	0.011	0.008	0.008	0.008	0.007
LOUISVILLE, KY-IN														
	CO	2nd Max. 8-hr	DOWN	3	5.9	6.0	5.9	5.9	4.2	4.6	5.1	3.8	3.3	4.5
	LEAD	Max. Quarterly Mean	DOWN	2	0.07	0.05	0.04	0.05	0.05	0.05	0.02	0.05	0.02	0.02
	OZONE	4th Max. 8-hr	NS	4	0.11	0.08	0.08	0.09	0.07	0.09	0.09	0.09	0.09	0.09
		2nd Daily Max. 1-hr	NS	4	0.16	0.11	0.11	0.12	0.09	0.13	0.12	0.12	0.11	0.12
	PM_{10}	Weighted Annual Mean	DOWN	6	38	35	34	33	30	29	30	29	26	29
		99th Percentile	NS	6	90	77	74	67	62	70	104	68	72	78
	SO_2	Arithmetic Mean	DOWN	4	0.010	0.010	0.010	0.010	0.009	0.010	0.010	0.008	0.007	0.006
		2nd Max. 24-hr	DOWN	4	0.044	0.055	0.041	0.037	0.034	0.035	0.040	0.028	0.031	0.031
LOWELL, MA-NH														
	CO	2nd Max. 8-hr	NS	1	6.4	5.3	7.3	5.8	5.9	5.1	6.5	7.8	4.5	3.6
LUBBOCK, TX														
	PM_{10}	Weighted Annual Mean	DOWN	1	36	34	24	25	22	20	23	21	22	17
		99th Percentile	NS	1	100	94	61	66	58	56	81	64	85	38
LYNCHBURG, VA														
	PM_{10}	Weighted Annual Mean	DOWN	1	31	30	24	28	24	26	23	24	23	23
		99th Percentile	NS	1	80	58	53	89	50	68	51	55	46	55
MADISON, WI														
	PM_{10}	Weighted Annual Mean	DOWN	1	34	34	24	25	22	21	22	23	20	20
		99th Percentile	DOWN	1	90	90	54	61	42	85	61	64	52	37
MANSFIELD, OH														
	PM_{10}	Weighted Annual Mean	NS	1	27	27	27	27	26	28	29	25	24	23
		99th Percentile	NS	1	67	67	67	71	68	66	58	61	68	63
MEDFORD-ASHLAND, OR														
	CO	2nd Max. 8-hr	DOWN	1	11.3	11.0	8.2	8.1	6.4	6.9	6.2	5.3	6.4	5.7
	LEAD	Max. Quarterly Mean	DOWN	1	0.05	0.04	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
	PM_{10}	Weighted Annual Mean	DOWN	3	54	54	42	40	36	35	33	26	24	26
		99th Percentile	DOWN	3	171	179	117	144	102	88	78	59	66	74
MELBOURNE-TITUSVILLE-PALM BAY, FL														
	OZONE	4th Max. 8-hr	DOWN	2	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
		2nd Daily Max. 1-hr	NS	2	0.10	0.10	0.08	0.09	0.08	0.09	0.09	0.08	0.09	0.09
MEMPHIS, TN-AR-MS														
	CO	2nd Max. 8-hr	DOWN	5	6.4	8.2	7.5	6.1	7.7	7.6	7.3	6.0	5.3	5.0
	LEAD	Max. Quarterly Mean	DOWN	3	1.01	1.03	0.98	0.64	0.77	0.83	0.80	0.54	0.96	0.36

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
NO2	Arithmetic Mean	NS	1	0.032	0.026	0.023	0.024	0.026	0.026	0.027	0.027	0.024	0.028
OZONE	4th Max. 8-hr	NS	3	0.10	0.08	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	3	0.13	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.13	0.12
PM_{10}	Weighted Annual Mean	DOWN	2	31	31	31	27	28	29	27	27	27	26
	99th Percentile	NS	2	69	68	76	67	59	69	69	65	73	63
SO_2	Arithmetic Mean	DOWN	2	0.006	0.007	0.007	0.007	0.007	0.006	0.005	0.004	0.003	0.003
	2nd Max. 24-hr	DOWN	2	0.029	0.029	0.027	0.025	0.031	0.029	0.025	0.019	0.011	0.011
MERCED, CA													
PM_{10}	Weighted Annual Mean	DOWN	1	52	52	53	52	46	43	39	39	31	31
	99th Percentile	DOWN	1	114	148	211	145	98	121	131	100	61	61
MIAMI, FL													
CO	2nd Max. 8-hr	DOWN	2	4.8	7.3	6.0	7.2	6.2	5.3	4.4	4.9	4.5	3.8
LEAD	Max. Quarterly Mean	DOWN	2	0.05	0.05	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
NO2	Arithmetic Mean	NS	2	0.012	0.013	0.011	0.011	0.011	0.012	0.010	0.011	0.011	0.012
OZONE	4th Max. 8-hr	NS	4	0.08	0.08	0.07	0.06	0.07	0.08	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	NS	4	0.11	0.11	0.10	0.09	0.10	0.10	0.09	0.09	0.09	0.10
PM_{10}	Weighted Annual Mean	DOWN	3	28	27	28	26	27	27	26	24	25	23
	99th Percentile	UP	3	52	50	53	61	71	95	74	73	63	66
SO_2	Arithmetic Mean	UP	1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001
	2nd Max. 24-hr	UP	1	0.002	0.003	0.003	0.003	0.005	0.004	0.004	0.004	0.005	0.004
MIDDLESEX-SOMERSET-HUNTERDON, NJ													
CO	2nd Max. 8-hr	DOWN	1	5.3	5.4	5.4	4.2	3.9	3.7	4.3	5.3	3.3	3.8
LEAD	Max. Quarterly Mean	DOWN	1	0.38	0.38	0.30	1.15	1.22	0.33	0.12	0.07	0.06	0.08
OZONE	4th Max. 8-hr	NS	1	0.13	0.10	0.11	0.11	0.09	0.10	0.09	0.10	0.09	0.10
	2nd Daily Max. 1-hr	DOWN	1	0.16	0.13	0.14	0.12	0.12	0.12	0.11	0.12	0.11	0.12
PM_{10}	Weighted Annual Mean	DOWN	1	34	34	29	30	25	25	27	22	25	25
	99th Percentile	DOWN	1	67	67	60	72	55	62	68	59	46	46
SO_2	Arithmetic Mean	DOWN	1	0.012	0.010	0.007	0.007	0.006	0.005	0.005	0.004	0.005	0.005
	2nd Max. 24-hr	DOWN	1	0.043	0.037	0.032	0.025	0.026	0.018	0.028	0.018	0.024	0.019
MILWAUKEE-WAUKESHA, WI													
CO	2nd Max. 8-hr	DOWN	6	4.2	3.9	4.5	3.7	3.2	4.1	4.4	2.9	2.0	2.0
LEAD	Max. Quarterly Mean	DOWN	1	0.10	0.06	0.08	0.06	0.05	0.04	0.03	0.05	0.03	0.03
NO2	Arithmetic Mean	DOWN	2	0.023	0.024	0.022	0.021	0.021	0.020	0.021	0.021	0.020	0.020
OZONE	4th Max. 8-hr	NS	6	0.11	0.10	0.08	0.09	0.08	0.08	0.08	0.10	0.08	0.08
	2nd Daily Max. 1-hr	NS	6	0.15	0.13	0.11	0.14	0.10	0.10	0.12	0.12	0.11	0.12
PM_{10}	Weighted Annual Mean	DOWN	4	32	35	33	29	26	26	28	27	25	24
	99th Percentile	DOWN	4	94	86	80	83	57	77	81	68	57	54
SO_2	Arithmetic Mean	DOWN	2	0.006	0.006	0.006	0.006	0.005	0.003	0.004	0.003	0.004	0.004
	2nd Max. 24-hr	DOWN	2	0.035	0.030	0.039	0.034	0.026	0.024	0.027	0.023	0.025	0.025
MINNEAPOLIS-ST. PAUL, MN-WI													
CO	2nd Max. 8-hr	DOWN	3	7.7	9.0	6.5	7.2	5.9	5.2	6.4	6.0	5.1	4.5
LEAD	Max. Quarterly Mean	DOWN	3	0.55	0.38	0.77	0.31	0.25	0.12	0.07	0.23	0.12	0.09
NO2	Arithmetic Mean	NS	2	0.013	0.013	0.013	0.012	0.012	0.013	0.014	0.013	0.014	0.013
OZONE	4th Max. 8-hr	NS	4	0.08	0.07	0.07	0.07	0.08	0.06	0.07	0.08	0.07	0.07
	2nd Daily Max. 1-hr	NS	4	0.10	0.09	0.09	0.08	0.09	0.08	0.08	0.10	0.09	0.09
PM_{10}	Weighted Annual Mean	DOWN	9	31	30	28	26	22	22	23	23	23	22
	99th Percentile	DOWN	9	87	81	99	63	71	58	59	58	71	49
SO_2	Arithmetic Mean	DOWN	8	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.002
	2nd Max. 24-hr	DOWN	8	0.020	0.021	0.020	0.021	0.019	0.015	0.014	0.012	0.013	0.013
MOBILE, AL													
OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.08	0.05	0.07	0.07	0.07	0.08	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.10	0.09	0.10	0.07	0.10	0.09	0.09	0.11	0.10	0.11
PM_{10}	Weighted Annual Mean	DOWN	4	35	31	31	32	34	32	31	29	25	26
	99th Percentile	NS	4	80	76	61	70	93	77	61	57	53	62
SO_2	Arithmetic Mean	NS	1	0.008	0.008	0.008	0.009	0.010	0.010	0.011	0.009	0.009	0.008
	2nd Max. 24-hr	NS	1	0.054	0.064	0.038	0.050	0.054	0.066	0.052	0.053	0.070	0.049
MODESTO, CA													
CO	2nd Max. 8-hr	DOWN	1	9.7	11.8	10.5	9.4	5.9	6.6	6.3	5.4	5.6	4.2
LEAD	Max. Quarterly Mean	DOWN	1	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.01	0.01	0.01
NO2	Arithmetic Mean	DOWN	1	0.027	0.027	0.026	0.024	0.022	0.024	0.023	0.022	0.022	0.021
OZONE	4th Max. 8-hr	NS	1	0.09	0.09	0.10	0.09	0.08	0.09	0.09	0.10	0.09	0.08
	2nd Daily Max. 1-hr	NS	1	0.12	0.11	0.12	0.11	0.11	0.11	0.12	0.13	0.13	0.11
PM_{10}	Weighted Annual Mean	DOWN	2	46	46	44	48	39	40	37	34	28	31
	99th Percentile	DOWN	2	151	151	162	142	136	134	136	99	101	103
MONMOUTH-OCEAN, NJ													
CO	2nd Max. 8-hr	DOWN	2	6.6	6.1	5.7	5.5	4.7	5.3	4.9	3.8	4.4	3.7
OZONE	4th Max. 8-hr	NS	1	0.11	0.11	0.11	0.11	0.09	0.10	0.08	0.11	0.09	0.10
	2nd Daily Max. 1-hr	NS	1	0.14	0.14	0.14	0.15	0.14	0.13	0.11	0.15	0.12	0.13
MONTGOMERY, AL													
OZONE	4th Max. 8-hr	NS	1	0.08	0.08	0.08	0.07	0.08	0.09	0.08	0.09	0.08	0.07
	2nd Daily Max. 1-hr	NS	1	0.10	0.10	0.10	0.09	0.10	0.11	0.10	0.10	0.10	0.09

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
PM$_{10}$	Weighted Annual Mean	NS	1	23	23	27	26	24	23	25	26	23	24
	99th Percentile	NS	1	53	53	62	61	49	70	47	75	68	57
NASHUA, NH													
CO	2nd Max. 8-hr	NS	2	5.7	6.2	7.1	6.9	6.8	5.2	7.5	6.8	7.7	4.7
NO2	Arithmetic Mean	DOWN	1	0.024	0.022	0.019	0.016	0.015	0.016	0.015	0.014	0.019	0.016
OZONE	4th Max. 8-hr	NS	2	0.10	0.07	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.09
	2nd Daily Max. 1-hr	NS	2	0.14	0.09	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.11
PM$_{10}$	Weighted Annual Mean	DOWN	5	22	22	18	19	17	17	15	14	16	18
	99th Percentile	NS	5	65	53	50	53	80	43	43	46	43	53
SO$_2$	Arithmetic Mean	DOWN	3	0.008	0.008	0.007	0.005	0.006	0.006	0.006	0.005	0.005	0.006
	2nd Max. 24-hr	DOWN	3	0.044	0.040	0.036	0.024	0.025	0.022	0.028	0.023	0.021	0.025
NASHVILLE, TN													
CO	2nd Max. 8-hr	DOWN	3	6.5	7.4	5.9	5.0	5.5	6.4	5.4	4.8	3.9	4.7
LEAD	Max. Quarterly Mean	NS	4	1.29	0.66	1.45	1.21	1.05	0.91	0.98	1.93	0.62	0.65
NO2	Arithmetic Mean	NS	1	0.012	0.012	0.012	0.010	0.014	0.012	0.020	0.014	0.012	0.012
OZONE	4th Max. 8-hr	NS	7	0.10	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	7	0.12	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.11	0.11
PM$_{10}$	Weighted Annual Mean	DOWN	5	38	37	36	35	31	31	30	31	28	28
	99th Percentile	DOWN	5	80	79	78	75	62	81	71	67	64	61
SO$_2$	Arithmetic Mean	DOWN	4	0.008	0.008	0.009	0.009	0.006	0.007	0.006	0.004	0.005	0.005
	2nd Max. 24-hr	DOWN	5	0.047	0.053	0.050	0.056	0.025	0.043	0.038	0.024	0.033	0.037
NASSAU-SUFFOLK, NY													
CO	2nd Max. 8-hr	DOWN	1	9.1	6.5	7.2	6.6	5.6	5.6	5.4	5.0	4.9	4.7
NO2	Arithmetic Mean	DOWN	1	0.033	0.029	0.028	0.029	0.026	0.026	0.028	0.025	0.026	0.025
OZONE	4th Max. 8-hr	NS	1	0.12	0.11	0.11	0.11	0.09	0.10	0.09	0.11	0.09	0.11
	2nd Daily Max. 1-hr	NS	1	0.16	0.15	0.14	0.18	0.13	0.13	0.13	0.15	0.12	0.14
SO$_2$	Arithmetic Mean	DOWN	2	0.008	0.010	0.009	0.009	0.008	0.008	0.007	0.005	0.007	0.006
	2nd Max. 24-hr	DOWN	2	0.056	0.045	0.045	0.039	0.039	0.033	0.037	0.030	0.028	0.029
NEW BEDFORD, MA													
OZONE	4th Max. 8-hr	NS	1	0.13	0.09	0.10	0.10	0.09	0.07	0.08	0.11	0.09	0.09
	2nd Daily Max. 1-hr	NS	1	0.16	0.12	0.13	0.13	0.11	0.09	0.10	0.14	0.12	0.12
PM$_{10}$	Weighted Annual Mean	DOWN	1	23	23	23	20	17	17	19	14	16	18
	99th Percentile	UP	1	42	42	42	65	45	46	50	46	51	51
NEW HAVEN-MERIDEN, CT													
NO2	Arithmetic Mean	DOWN	1	0.029	0.028	0.027	0.028	0.025	0.027	0.030	0.025	0.026	0.024
OZONE	4th Max. 8-hr	NS	2	0.12	0.10	0.10	0.12	0.08	0.09	0.09	0.10	0.08	0.10
	2nd Daily Max. 1-hr	NS	2	0.17	0.15	0.13	0.16	0.12	0.14	0.14	0.14	0.11	0.14
PM$_{10}$	Weighted Annual Mean	DOWN	7	31	31	29	32	26	27	28	23	22	22
	99th Percentile	NS	7	71	69	86	87	69	72	81	71	63	57
SO$_2$	Arithmetic Mean	DOWN	2	0.015	0.012	0.010	0.010	0.009	0.008	0.008	0.006	0.006	0.005
	2nd Max. 24-hr	DOWN	2	0.071	0.071	0.045	0.055	0.042	0.038	0.049	0.031	0.027	0.028
NEW LONDON-NORWICH, CT-RI													
OZONE	4th Max. 8-hr	NS	1	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.10	0.10	0.11
	2nd Daily Max. 1-hr	NS	1	0.15	0.14	0.16	0.14	0.12	0.13	0.12	0.14	0.12	0.15
PM$_{10}$	Weighted Annual Mean	DOWN	2	23	23	21	24	20	18	22	17	19	18
	99th Percentile	NS	2	55	55	56	73	71	48	55	63	69	59
SO$_2$	Arithmetic Mean	DOWN	1	0.009	0.008	0.008	0.007	0.006	0.006	0.005	0.005	0.005	0.004
	2nd Max. 24-hr	DOWN	1	0.047	0.027	0.029	0.027	0.025	0.019	0.029	0.017	0.016	0.022
NEW ORLEANS, LA													
CO	2nd Max. 8-hr	DOWN	2	6.1	6.1	4.9	4.2	5.4	5.1	4.6	3.6	4.0	3.3
LEAD	Max. Quarterly Mean	DOWN	1	0.10	0.09	0.05	0.03	0.03	0.02	0.02	0.03	0.02	0.02
NO2	Arithmetic Mean	DOWN	2	0.019	0.017	0.016	0.015	0.017	0.016	0.015	0.016	0.015	0.014
OZONE	4th Max. 8-hr	NS	5	0.09	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.08	0.08
	2nd Daily Max. 1-hr	NS	5	0.11	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.10	0.10
PM$_{10}$	Weighted Annual Mean	DOWN	1	26	31	27	26	27	25	25	24	22	25
	99th Percentile	NS	1	57	68	75	59	72	85	53	55	58	100
SO$_2$	Arithmetic Mean	NS	2	0.004	0.003	0.003	0.004	0.005	0.005	0.005	0.005	0.005	0.004
	2nd Max. 24-hr	NS	2	0.017	0.017	0.013	0.023	0.018	0.019	0.021	0.019	0.025	0.016
NEW YORK, NY													
CO	2nd Max. 8-hr	DOWN	4	8.3	7.9	7.1	6.6	6.0	5.1	5.8	6.5	4.5	3.6
LEAD	Max. Quarterly Mean	NS	3	0.14	0.08	0.09	0.08	0.06	0.09	0.08	0.07	0.08	0.08
NO2	Arithmetic Mean	DOWN	1	0.049	0.049	0.046	0.047	0.036	0.043	0.046	0.042	0.042	0.040
OZONE	4th Max. 8-hr	NS	5	0.12	0.09	0.10	0.11	0.08	0.09	0.09	0.10	0.09	0.10
	2nd Daily Max. 1-hr	NS	5	0.17	0.12	0.13	0.14	0.12	0.12	0.12	0.12	0.12	0.13
PM$_{10}$	Weighted Annual Mean	DOWN	12	33	34	31	30	27	26	28	26	27	27
	99th Percentile	NS	12	74	78	77	78	62	62	79	73	69	77
SO$_2$	Arithmetic Mean	DOWN	7	0.015	0.015	0.014	0.014	0.013	0.012	0.013	0.010	0.010	0.009
	2nd Max. 24-hr	DOWN	7	0.060	0.060	0.054	0.048	0.051	0.039	0.054	0.038	0.040	0.033
NEWARK, NJ													
CO	2nd Max. 8-hr	DOWN	3	7.3	7.6	7.1	8.3	5.6	4.9	7.7	6.0	5.1	4.6
LEAD	Max. Quarterly Mean	DOWN	1	0.83	0.41	0.39	1.04	0.44	0.23	0.30	0.23	0.23	0.23
NO2	Arithmetic Mean	NS	4	0.033	0.030	0.029	0.028	0.030	0.028	0.030	0.028	0.029	0.028

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	NS	2	0.13	0.09	0.10	0.10	0.09	0.09	0.09	0.10	0.09	0.10
	2nd Daily Max. 1-hr	DOWN	2	0.18	0.12	0.13	0.12	0.10	0.12	0.11	0.12	0.11	0.11
PM_{10}	Weighted Annual Mean	NS	3	35	35	31	30	29	30	35	28	31	31
	99th Percentile	NS	3	84	80	73	72	60	77	103	72	76	87
SO_2	Arithmetic Mean	DOWN	4	0.012	0.012	0.010	0.010	0.009	0.007	0.008	0.006	0.006	0.006
	2nd Max. 24-hr	DOWN	4	0.050	0.047	0.040	0.035	0.040	0.025	0.033	0.025	0.027	0.023
NEWBURGH, NY-PA													
LEAD	Max. Quarterly Mean	DOWN	2	1.33	1.42	1.01	0.66	0.58	0.34	0.08	0.08	0.06	0.20
NORFOLK-VA BEACH-NEWPORT NEWS,VA-N													
CO	2nd Max. 8-hr	DOWN	3	5.5	5.2	4.5	5.1	4.3	5.0	5.4	4.3	4.3	4.0
LEAD	Max. Quarterly Mean	DOWN	1	0.10	0.12	0.18	0.03	0.03	0.03	0.02	0.03	0.03	0.03
NO2	Arithmetic Mean	NS	1	0.020	0.020	0.019	0.020	0.020	0.021	0.019	0.018	0.018	0.019
OZONE	4th Max. 8-hr	NS	2	0.11	0.08	0.09	0.08	0.09	0.10	0.08	0.08	0.08	0.09
	2nd Daily Max. 1-hr	NS	2	0.13	0.10	0.11	0.10	0.13	0.13	0.10	0.10	0.10	0.11
PM_{10}	Weighted Annual Mean	DOWN	4	28	27	26	26	23	23	20	21	22	22
	99th Percentile	DOWN	4	61	64	70	58	52	59	49	44	49	53
SO_2	Arithmetic Mean	DOWN	2	0.008	0.007	0.007	0.007	0.006	0.007	0.007	0.006	0.006	0.006
	2nd Max. 24-hr	NS	2	0.032	0.033	0.025	0.022	0.024	0.026	0.024	0.022	0.022	0.025
OAKLAND, CA													
CO	2nd Max. 8-hr	DOWN	6	4.9	4.9	4.8	4.8	4.0	3.4	3.6	2.7	2.9	2.9
LEAD	Max. Quarterly Mean	DOWN	4	0.15	0.13	0.08	0.10	0.02	0.02	0.02	0.02	0.01	0.01
NO2	Arithmetic Mean	DOWN	2	0.023	0.022	0.021	0.022	0.020	0.020	0.020	0.019	0.018	0.017
OZONE	4th Max. 8-hr	NS	7	0.08	0.07	0.06	0.06	0.06	0.07	0.07	0.08	0.07	0.06
	2nd Daily Max. 1-hr	NS	7	0.11	0.10	0.09	0.09	0.09	0.10	0.10	0.13	0.10	0.09
PM_{10}	Weighted Annual Mean	DOWN	3	30	31	30	33	27	25	25	22	22	23
	99th Percentile	DOWN	3	87	100	127	115	82	79	87	53	58	56
SO_2	Arithmetic Mean	NS	3	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	2nd Max. 24-hr	DOWN	3	0.010	0.013	0.011	0.010	0.009	0.010	0.007	0.007	0.007	0.008
OKLAHOMA CITY, OK													
CO	2nd Max. 8-hr	NS	3	5.2	6.4	5.4	4.7	4.8	6.1	5.2	5.0	5.1	5.1
LEAD	Max. Quarterly Mean	DOWN	2	0.07	0.05	0.02	0.03	0.02	0.02	0.01	0.01	0.00	0.00
NO2	Arithmetic Mean	NS	3	0.018	0.013	0.012	0.011	0.011	0.011	0.012	0.012	0.012	0.013
OZONE	4th Max. 8-hr	NS	4	0.08	0.08	0.08	0.08	0.07	0.07	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	4	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.11	0.09	0.10
PM_{10}	Weighted Annual Mean	NS	4	24	23	22	22	22	21	21	21	24	22
	99th Percentile	NS	4	59	59	55	53	65	49	49	57	64	55
SO_2	Arithmetic Mean	NS	1	0.010	0.007	0.004	0.002	0.002	0.003	0.004	0.002	0.002	0.002
	2nd Max. 24-hr	DOWN	1	0.041	0.015	0.019	0.005	0.009	0.008	0.007	0.006	0.006	0.006
OLYMPIA, WA													
PM_{10}	Weighted Annual Mean	DOWN	1	35	28	24	25	24	24	17	17	16	16
	99th Percentile	DOWN	1	169	118	86	99	78	78	63	65	53	58
OMAHA, NE-IA													
CO	2nd Max. 8-hr	NS	2	5.5	4.8	5.2	5.8	5.9	5.3	4.0	5.5	4.9	4.2
LEAD	Max. Quarterly Mean	DOWN	5	0.79	0.67	0.54	0.44	0.69	0.55	0.73	0.49	0.38	0.21
OZONE	4th Max. 8-hr	DOWN	3	0.08	0.07	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06
	2nd Daily Max. 1-hr	DOWN	3	0.09	0.08	0.07	0.08	0.08	0.06	0.07	0.08	0.07	0.07
PM_{10}	Weighted Annual Mean	DOWN	7	42	42	37	36	36	31	33	30	33	33
	99th Percentile	DOWN	7	112	110	113	86	107	88	90	91	85	90
ORANGE COUNTY, CA													
CO	2nd Max. 8-hr	DOWN	4	8.8	9.0	8.3	7.0	7.5	5.8	7.3	5.7	5.8	4.8
LEAD	Max. Quarterly Mean	DOWN	1	0.09	0.08	0.06	0.06	0.03	0.05	0.04	0.04	0.04	0.04
NO2	Arithmetic Mean	DOWN	3	0.038	0.038	0.039	0.038	0.034	0.032	0.034	0.033	0.029	0.028
OZONE	4th Max. 8-hr	DOWN	3	0.12	0.13	0.11	0.10	0.11	0.10	0.11	0.09	0.09	0.08
	2nd Daily Max. 1-hr	DOWN	3	0.22	0.23	0.19	0.19	0.18	0.16	0.17	0.13	0.13	0.11
PM_{10}	Weighted Annual Mean	DOWN	2	45	45	45	41	37	36	36	41	33	37
	99th Percentile	NS	2	123	123	123	120	86	104	99	147	90	89
SO_2	Arithmetic Mean	NS	2	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002
	2nd Max. 24-hr	DOWN	2	0.011	0.009	0.007	0.010	0.008	0.007	0.006	0.005	0.004	0.005
ORLANDO, FL													
CO	2nd Max. 8-hr	DOWN	2	4.5	4.3	4.5	3.6	3.9	3.8	3.6	3.3	3.3	3.6
LEAD	Max. Quarterly Mean	DOWN	2	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO2	Arithmetic Mean	NS	1	0.013	0.013	0.012	0.012	0.011	0.012	0.011	0.010	0.013	0.013
OZONE	4th Max. 8-hr	NS	3	0.08	0.09	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.08
	2nd Daily Max. 1-hr	NS	3	0.10	0.11	0.11	0.09	0.10	0.10	0.10	0.10	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	3	28	27	27	27	24	24	23	22	23	23
	99th Percentile	NS	3	56	53	48	54	57	99	91	38	77	47
SO_2	Arithmetic Mean	NS	1	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	2nd Max. 24-hr	NS	1	0.010	0.006	0.011	0.007	0.007	0.011	0.012	0.006	0.008	0.006
OWENSBORO, KY													
CO	2nd Max. 8-hr	NS	1	6.4	5.9	5.4	3.8	4.5	5.5	3.9	4.2	4.2	4.2
NO2	Arithmetic Mean	NS	1	0.015	0.014	0.011	0.011	0.012	0.012	0.012	0.013	0.011	0.012

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	NS	1	0.11	0.08	0.09	0.08	0.08	0.08	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	1	0.14	0.10	0.11	0.09	0.09	0.11	0.11	0.11	0.11	0.11
PM$_{10}$	Weighted Annual Mean	DOWN	1	33	33	29	29	27	25	30	29	24	26
	99th Percentile	NS	1	82	82	71	62	52	61	106	77	61	56
SO$_2$	Arithmetic Mean	DOWN	1	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.007	0.007	0.007
	2nd Max. 24-hr	DOWN	1	0.040	0.053	0.038	0.044	0.053	0.050	0.035	0.028	0.020	0.027
PARKERSBURG-MARIETTA,WV-OH													
LEAD	Max. Quarterly Mean	NS	1	0.04	0.04	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02
OZONE	4th Max. 8-hr	NS	1	0.12	0.09	0.08	0.10	0.07	0.08	0.09	0.10	0.09	0.09
	2nd Daily Max. 1-hr	NS	1	0.15	0.12	0.11	0.12	0.10	0.10	0.11	0.12	0.11	0.11
SO$_2$	Arithmetic Mean	NS	1	0.015	0.016	0.014	0.014	0.014	0.014	0.017	0.010	0.010	0.010
	2nd Max. 24-hr	NS	1	0.076	0.076	0.064	0.060	0.059	0.065	0.084	0.041	0.046	0.052
PENSACOLA, FL													
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.08	0.08	0.09
	2nd Daily Max. 1-hr	NS	2	0.10	0.09	0.11	0.10	0.10	0.10	0.11	0.12	0.10	0.11
SO$_2$	Arithmetic Mean	DOWN	1	0.007	0.007	0.008	0.006	0.007	0.005	0.004	0.003	0.003	0.004
	2nd Max. 24-hr	DOWN	1	0.057	0.057	0.078	0.056	0.057	0.032	0.039	0.019	0.015	0.028
PEORIA-PEKIN, IL													
CO	2nd Max. 8-hr	DOWN	1	7.9	7.7	7.4	6.3	7.2	7.3	5.7	5.6	4.6	4.7
LEAD	Max. Quarterly Mean	DOWN	1	0.04	0.04	0.04	0.02	0.02	0.03	0.02	0.03	0.02	0.02
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.07	0.08	0.07	0.06	0.08	0.08	0.08	0.07
	2nd Daily Max. 1-hr	NS	2	0.11	0.10	0.08	0.10	0.09	0.08	0.09	0.09	0.09	0.09
PM$_{10}$	Weighted Annual Mean	NS	1	23	28	27	24	25	20	21	20	21	26
	99th Percentile	NS	1	72	71	72	58	65	42	54	50	52	76
SO$_2$	Arithmetic Mean	NS	2	0.009	0.007	0.007	0.008	0.007	0.007	0.007	0.007	0.007	0.007
	2nd Max. 24-hr	NS	2	0.062	0.046	0.055	0.065	0.043	0.039	0.049	0.084	0.045	0.042
PHILADELPHIA, PA-NJ													
CO	2nd Max. 8-hr	DOWN	9	5.4	7.1	4.9	4.6	4.7	4.7	5.2	4.1	4.2	3.3
LEAD	Max. Quarterly Mean	UP	10	0.50	0.38	0.54	0.35	0.56	0.86	0.54	0.69	0.92	0.77
NO2	Arithmetic Mean	DOWN	5	0.031	0.030	0.028	0.028	0.028	0.026	0.028	0.027	0.028	0.027
OZONE	4th Max. 8-hr	NS	8	0.13	0.10	0.10	0.11	0.09	0.10	0.09	0.11	0.09	0.10
	2nd Daily Max. 1-hr	NS	8	0.17	0.13	0.13	0.14	0.11	0.13	0.12	0.13	0.12	0.13
PM$_{10}$	Weighted Annual Mean	DOWN	6	36	35	32	35	29	30	33	30	30	30
	99th Percentile	NS	6	83	85	75	87	84	81	81	78	71	99
SO$_2$	Arithmetic Mean	DOWN	11	0.012	0.011	0.010	0.010	0.008	0.008	0.009	0.007	0.007	0.007
	2nd Max. 24-hr	DOWN	11	0.050	0.045	0.040	0.034	0.034	0.031	0.040	0.027	0.026	0.027
PHOENIX-MESA, AZ													
CO	2nd Max. 8-hr	DOWN	8	8.0	7.8	6.7	6.2	6.5	6.0	6.3	6.2	5.7	5.1
LEAD	Max. Quarterly Mean	DOWN	2	0.16	0.09	0.09	0.11	0.06	0.05	0.05	0.06	0.04	0.03
OZONE	4th Max. 8-hr	UP	8	0.08	0.07	0.08	0.07	0.08	0.08	0.08	0.09	0.09	0.08
	2nd Daily Max. 1-hr	NS	8	0.11	0.10	0.11	0.10	0.11	0.11	0.11	0.12	0.11	0.10
PM$_{10}$	Weighted Annual Mean	DOWN	6	48	51	43	44	43	43	42	43	44	43
	99th Percentile	NS	6	108	133	95	99	133	92	94	110	98	91
SO$_2$	Arithmetic Mean	NS	1	0.001	0.002	0.003	0.005	0.004	0.003	0.003	0.002	0.003	0.004
	2nd Max. 24-hr	NS	1	0.001	0.006	0.011	0.013	0.010	0.009	0.009	0.008	0.017	0.010
PINE BLUFF, AR													
PM$_{10}$	Weighted Annual Mean	NS	1	27	27	21	19	22	23	25	26	23	25
	99th Percentile	NS	1	77	77	55	46	66	57	63	73	52	78
PITTSBURGH, PA													
CO	2nd Max. 8-hr	DOWN	5	5.1	5.3	5.6	4.3	4.8	3.8	4.3	3.8	3.3	2.5
LEAD	Max. Quarterly Mean	DOWN	4	0.13	0.12	0.09	0.09	0.07	0.07	0.08	0.06	0.04	0.05
NO2	Arithmetic Mean	DOWN	5	0.023	0.023	0.023	0.023	0.022	0.022	0.023	0.021	0.021	0.020
OZONE	4th Max. 8-hr	NS	8	0.10	0.09	0.08	0.09	0.07	0.09	0.09	0.10	0.09	0.09
	2nd Daily Max. 1-hr	NS	8	0.13	0.11	0.10	0.11	0.09	0.11	0.11	0.12	0.11	0.12
PM$_{10}$	Weighted Annual Mean	DOWN	12	35	34	33	33	30	29	33	29	28	29
	99th Percentile	DOWN	12	106	97	90	84	81	85	92	85	79	70
SO$_2$	Arithmetic Mean	DOWN	13	0.017	0.017	0.016	0.015	0.014	0.014	0.015	0.011	0.010	0.011
	2nd Max. 24-hr	DOWN	13	0.075	0.072	0.070	0.055	0.068	0.060	0.071	0.045	0.042	0.045
PITTSFIELD, MA													
OZONE	4th Max. 8-hr	NS	1	0.08	0.08	0.09	0.09	0.09	0.08	0.07	0.07	0.08	0.08
	2nd Daily Max. 1-hr	NS	1	0.09	0.09	0.11	0.10	0.11	0.11	0.09	0.09	0.11	0.09
PONCE, PR													
PM$_{10}$	Weighted Annual Mean	DOWN	1	46	46	38	30	29	30	27	24	24	29
	99th Percentile	NS	1	119	119	91	63	79	78	89	64	55	91
PORTLAND-VANCOUVER, OR-WA													
CO	2nd Max. 8-hr	DOWN	2	8.9	8.2	8.5	9.1	7.0	6.3	7.0	5.7	6.1	5.4
LEAD	Max. Quarterly Mean	DOWN	2	0.12	0.07	0.06	0.06	0.05	0.06	0.04	0.03	0.02	0.04
OZONE	4th Max. 8-hr	NS	4	0.07	0.06	0.08	0.06	0.07	0.06	0.06	0.07	0.09	0.06
	2nd Daily Max. 1-hr	NS	4	0.11	0.09	0.12	0.09	0.10	0.09	0.09	0.10	0.12	0.08
PM$_{10}$	Weighted Annual Mean	DOWN	6	28	25	25	26	23	25	23	20	20	21
	99th Percentile	DOWN	6	76	76	77	133	63	73	56	48	54	46

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area			Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
PORTLAND, ME														
	OZONE	4th Max. 8-hr	NS	1	0.12	0.10	0.09	0.11	0.10	0.09	0.09	0.10	0.08	0.10
		2nd Daily Max. 1-hr	DOWN	1	0.17	0.13	0.13	0.14	0.12	0.11	0.12	0.12	0.10	0.13
	PM$_{10}$	Weighted Annual Mean	DOWN	1	24	26	23	25	23	21	21	21	20	23
		99th Percentile	NS	1	64	57	49	54	60	64	59	69	42	60
	SO$_2$	Arithmetic Mean	DOWN	1	0.010	0.010	0.010	0.009	0.008	0.009	0.008	0.006	0.005	0.005
		2nd Max. 24-hr	DOWN	1	0.044	0.039	0.034	0.032	0.029	0.032	0.043	0.022	0.021	0.023
PORTSMOUTH-ROCHESTER, NH-ME														
	OZONE	4th Max. 8-hr	NS	2	0.11	0.09	0.08	0.10	0.09	0.09	0.09	0.09	0.08	0.10
		2nd Daily Max. 1-hr	NS	2	0.17	0.12	0.11	0.14	0.11	0.11	0.11	0.12	0.10	0.13
	PM$_{10}$	Weighted Annual Mean	DOWN	2	21	21	20	19	19	18	14	15	16	17
		99th Percentile	NS	2	57	66	46	56	90	56	48	51	45	48
	SO$_2$	Arithmetic Mean	DOWN	1	0.006	0.008	0.007	0.007	0.006	0.006	0.006	0.004	0.004	0.004
		2nd Max. 24-hr	DOWN	1	0.034	0.029	0.025	0.021	0.027	0.019	0.022	0.017	0.015	0.018
PROVIDENCE-FALL RIVER-WARWICK, RI-MA														
	CO	2nd Max. 8-hr	NS	1	7.3	6.2	7.3	7.4	6.3	5.4	6.7	7.0	4.4	5.6
	NO2	Arithmetic Mean	NS	1	0.024	0.024	0.024	0.025	0.023	0.022	0.022	0.022	0.025	0.025
	OZONE	4th Max. 8-hr	NS	2	0.12	0.09	0.09	0.10	0.08	0.09	0.09	0.10	0.07	0.09
		2nd Daily Max. 1-hr	DOWN	2	0.15	0.12	0.13	0.14	0.11	0.11	0.12	0.13	0.10	0.11
	PM$_{10}$	Weighted Annual Mean	DOWN	3	31	31	29	30	24	26	29	24	27	25
		99th Percentile	NS	3	71	65	82	81	72	67	65	72	71	61
	SO$_2$	Arithmetic Mean	DOWN	5	0.011	0.010	0.009	0.008	0.009	0.008	0.007	0.005	0.006	0.006
		2nd Max. 24-hr	DOWN	5	0.050	0.043	0.039	0.039	0.044	0.036	0.035	0.022	0.030	0.030
PROVO-OREM, UT														
	CO	2nd Max. 8-hr	DOWN	1	11.0	15.8	16.2	11.6	10.0	9.6	9.3	7.1	7.1	7.1
	NO2	Arithmetic Mean	NS	1	0.028	0.028	0.025	0.022	0.019	0.026	0.024	0.023	0.024	0.023
	OZONE	4th Max. 8-hr	NS	1	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07
		2nd Daily Max. 1-hr	DOWN	1	0.11	0.11	0.09	0.08	0.09	0.08	0.08	0.08	0.10	0.08
	PM$_{10}$	Weighted Annual Mean	DOWN	3	50	49	32	42	37	38	34	29	34	30
		99th Percentile	DOWN	3	212	194	104	196	169	161	96	86	116	92
PUEBLO, CO														
	PM$_{10}$	Weighted Annual Mean	DOWN	1	35	33	26	30	26	26	30	26	26	27
		99th Percentile	NS	1	71	84	75	63	61	52	63	100	59	88
RACINE, WI														
	CO	2nd Max. 8-hr	DOWN	1	7.4	6.4	5.5	5.7	4.9	4.1	4.3	4.3	3.0	3.1
	OZONE	4th Max. 8-hr	NS	1	0.14	0.11	0.09	0.10	0.08	0.08	0.09	0.10	0.08	0.10
		2nd Daily Max. 1-hr	NS	1	0.18	0.14	0.11	0.14	0.10	0.10	0.11	0.11	0.13	0.12
RALEIGH-DURHAM-CHAPEL HILL, NC														
	CO	2nd Max. 8-hr	DOWN	1	10.9	10.9	8.7	8.8	7.3	7.2	6.9	6.6	5.6	6.6
	OZONE	4th Max. 8-hr	NS	1	0.09	0.09	0.09	0.09	0.08	0.10	0.08	0.08	0.08	0.10
		2nd Daily Max. 1-hr	NS	1	0.11	0.11	0.12	0.11	0.10	0.11	0.11	0.10	0.09	0.11
	PM$_{10}$	Weighted Annual Mean	DOWN	2	34	29	29	26	24	25	22	23	25	25
		99th Percentile	NS	2	79	60	60	52	53	52	48	51	59	64
RAPID CITY, SD														
	PM$_{10}$	Weighted Annual Mean	NS	2	29	26	27	28	25	23	29	24	23	25
		99th Percentile	DOWN	2	96	83	100	111	62	87	74	78	69	58
READING, PA														
	CO	2nd Max. 8-hr	DOWN	1	5.2	5.0	6.4	4.6	4.6	3.8	5.4	3.9	3.4	3.0
	LEAD	Max. Quarterly Mean	DOWN	11	0.58	0.68	0.61	0.66	0.57	0.48	0.50	0.34	0.33	0.38
	NO2	Arithmetic Mean	DOWN	1	0.024	0.023	0.022	0.022	0.020	0.021	0.023	0.021	0.022	0.021
	OZONE	4th Max. 8-hr	NS	2	0.12	0.09	0.09	0.10	0.09	0.09	0.08	0.09	0.09	0.09
		2nd Daily Max. 1-hr	NS	2	0.15	0.11	0.11	0.12	0.10	0.11	0.10	0.11	0.11	0.11
	SO$_2$	Arithmetic Mean	DOWN	2	0.013	0.012	0.010	0.010	0.009	0.009	0.011	0.009	0.009	0.009
		2nd Max. 24-hr	DOWN	2	0.053	0.048	0.038	0.034	0.033	0.033	0.040	0.033	0.036	0.030
REDDING, CA														
	OZONE	4th Max. 8-hr	NS	1	0.07	0.07	0.08	0.07	0.07	0.06	0.08	0.07	0.07	0.07
		2nd Daily Max. 1-hr	NS	1	0.08	0.09	0.09	0.08	0.08	0.07	0.09	0.09	0.08	0.08
	PM$_{10}$	Weighted Annual Mean	DOWN	1	26	26	25	29	25	20	24	20	19	17
		99th Percentile	DOWN	1	67	67	61	83	60	61	58	49	35	44
RENO, NV														
	CO	2nd Max. 8-hr	DOWN	5	7.1	7.3	7.0	7.5	5.9	5.0	6.0	4.4	5.2	5.0
	OZONE	4th Max. 8-hr	NS	4	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.06
		2nd Daily Max. 1-hr	DOWN	4	0.10	0.10	0.11	0.09	0.08	0.09	0.09	0.08	0.09	0.08
	PM$_{10}$	Weighted Annual Mean	DOWN	6	44	42	44	36	36	40	36	32	29	32
		99th Percentile	DOWN	6	135	137	140	125	100	116	94	72	93	82
RICHMOND-PETERSBURG, VA														
	CO	2nd Max. 8-hr	DOWN	2	4.1	4.0	4.4	3.7	2.5	3.9	3.4	2.6	2.9	3.2
	NO2	Arithmetic Mean	DOWN	1	0.026	0.025	0.023	0.024	0.023	0.024	0.024	0.022	0.022	0.021
	OZONE	4th Max. 8-hr	NS	4	0.12	0.08	0.08	0.09	0.09	0.10	0.09	0.09	0.08	0.10
		2nd Daily Max. 1-hr	NS	4	0.14	0.11	0.11	0.11	0.12	0.12	0.11	0.11	0.10	0.12
	PM$_{10}$	Weighted Annual Mean	DOWN	3	28	28	25	26	22	23	21	23	24	22
		99th Percentile	NS	3	68	71	72	61	49	64	39	58	67	68

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SO_2	Arithmetic Mean	DOWN	1	0.009	0.009	0.006	0.006	0.005	0.007	0.006	0.005	0.005	0.005
	2nd Max. 24-hr	DOWN	1	0.042	0.032	0.034	0.027	0.024	0.023	0.022	0.016	0.027	0.024
RIVERSIDE-SAN BERNARDINO, CA													
CO	2nd Max. 8-hr	DOWN	7	4.7	5.1	4.4	5.1	3.6	3.5	3.5	3.4	2.9	3.1
LEAD	Max. Quarterly Mean	NS	4	0.08	0.06	0.05	0.06	0.03	0.04	0.04	0.04	0.04	0.04
NO2	Arithmetic Mean	DOWN	7	0.030	0.030	0.029	0.029	0.027	0.028	0.028	0.029	0.027	0.024
OZONE	4th Max. 8-hr	DOWN	16	0.16	0.16	0.14	0.15	0.14	0.13	0.13	0.13	0.12	0.11
	2nd Daily Max. 1-hr	DOWN	16	0.22	0.22	0.21	0.21	0.19	0.18	0.19	0.18	0.16	0.15
PM_{10}	Weighted Annual Mean	DOWN	10	66	69	62	58	50	49	47	47	45	44
	99th Percentile	DOWN	10	173	266	261	177	170	127	123	139	120	114
SO_2	Arithmetic Mean	DOWN	4	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001
	2nd Max. 24-hr	DOWN	4	0.012	0.013	0.006	0.008	0.009	0.006	0.004	0.005	0.004	0.004
ROANOKE, VA													
NO2	Arithmetic Mean	DOWN	1	0.016	0.014	0.013	0.014	0.013	0.014	0.013	0.013	0.013	0.013
OZONE	4th Max. 8-hr	NS	1	0.10	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.07	0.08
	2nd Daily Max. 1-hr	NS	1	0.13	0.10	0.09	0.10	0.09	0.10	0.10	0.09	0.08	0.10
PM_{10}	Weighted Annual Mean	DOWN	2	37	35	36	33	32	35	36	34	33	30
	99th Percentile	NS	2	82	71	72	75	68	79	72	81	84	84
SO_2	Arithmetic Mean	DOWN	1	0.004	0.005	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003
	2nd Max. 24-hr	DOWN	1	0.018	0.022	0.018	0.019	0.016	0.018	0.011	0.010	0.014	0.013
ROCHESTER, MN													
CO	2nd Max. 8-hr	DOWN	1	7.1	6.3	6.1	6.3	5.1	4.9	5.0	4.0	4.0	4.0
PM_{10}	Weighted Annual Mean	DOWN	1	29	30	28	23	21	20	21	20	19	20
	99th Percentile	NS	1	64	70	102	43	44	45	53	50	59	39
ROCHESTER, NY													
CO	2nd Max. 8-hr	NS	2	4.0	3.6	3.5	3.3	3.5	3.2	4.5	3.2	3.7	1.9
LEAD	Max. Quarterly Mean	NS	1	0.09	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
OZONE	4th Max. 8-hr	NS	2	0.11	0.09	0.09	0.10	0.08	0.08	0.08	0.09	0.07	0.09
	2nd Daily Max. 1-hr	NS	2	0.13	0.10	0.11	0.11	0.09	0.09	0.09	0.11	0.08	0.10
PM_{10}	Weighted Annual Mean	DOWN	2	30	24	21	26	22	23	20	21	21	20
	99th Percentile	NS	2	99	65	59	72	60	76	48	49	65	53
SO_2	Arithmetic Mean	DOWN	2	0.012	0.013	0.012	0.011	0.011	0.010	0.011	0.010	0.009	0.008
	2nd Max. 24-hr	NS	2	0.038	0.054	0.040	0.043	0.039	0.041	0.043	0.038	0.033	0.038
ROCKFORD, IL													
CO	2nd Max. 8-hr	DOWN	1	8.1	6.6	6.5	5.1	4.6	4.3	4.0	4.5	3.2	3.7
LEAD	Max. Quarterly Mean	DOWN	1	0.13	0.07	0.09	0.04	0.06	0.03	0.04	0.03	0.05	0.03
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.07	0.08	0.08	0.07	0.08	0.09	0.08	0.07
	2nd Daily Max. 1-hr	NS	2	0.11	0.09	0.09	0.09	0.09	0.08	0.10	0.10	0.09	0.08
PM_{10}	Weighted Annual Mean	NS	1	17	25	25	22	21	16	19	19	18	26
	99th Percentile	NS	1	39	62	78	57	49	47	46	59	45	73
SACRAMENTO, CA													
CO	2nd Max. 8-hr	DOWN	6	9.5	9.0	8.9	8.2	6.2	6.4	6.2	5.2	4.9	4.5
LEAD	Max. Quarterly Mean	DOWN	2	0.08	0.07	0.10	0.04	0.02	0.05	0.02	0.02	0.01	0.01
NO2	Arithmetic Mean	DOWN	5	0.018	0.018	0.018	0.016	0.016	0.017	0.014	0.015	0.015	0.013
OZONE	4th Max. 8-hr	NS	6	0.10	0.08	0.09	0.10	0.09	0.09	0.09	0.10	0.09	0.08
	2nd Daily Max. 1-hr	NS	6	0.14	0.11	0.13	0.14	0.12	0.12	0.11	0.13	0.12	0.10
SO_2	Arithmetic Mean	DOWN	1	0.010	0.006	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.001
	2nd Max. 24-hr	DOWN	1	0.020	0.020	0.010	0.010	0.010	0.003	0.004	0.004	0.003	0.003
SALINAS, CA													
CO	2nd Max. 8-hr	NS	1	2.3	2.3	2.5	2.1	2.3	2.1	2.0	1.7	2.4	1.7
NO2	Arithmetic Mean	DOWN	1	0.014	0.014	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.010
OZONE	4th Max. 8-hr	DOWN	2	0.06	0.07	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.05
	2nd Daily Max. 1-hr	DOWN	2	0.08	0.10	0.08	0.08	0.07	0.08	0.08	0.07	0.08	0.07
PM_{10}	Weighted Annual Mean	DOWN	1	25	25	23	23	23	22	20	21	20	21
	99th Percentile	NS	1	54	54	56	46	66	86	50	50	50	59
SALT LAKE CITY-OGDEN, UT													
CO	2nd Max. 8-hr	DOWN	1	7.8	7.7	6.8	7.5	6.5	6.4	5.9	4.5	6.2	5.4
LEAD	Max. Quarterly Mean	DOWN	2	0.16	0.12	0.08	0.08	0.05	0.07	0.05	0.05	0.03	0.07
NO2	Arithmetic Mean	NS	1	0.026	0.027	0.019	0.020	0.022	0.025	0.026	0.024	0.026	0.024
OZONE	4th Max. 8-hr	NS	2	0.09	0.09	0.08	0.08	0.07	0.08	0.08	0.08	0.09	0.08
	2nd Daily Max. 1-hr	NS	2	0.14	0.14	0.11	0.11	0.10	0.10	0.11	0.12	0.11	0.10
PM_{10}	Weighted Annual Mean	DOWN	6	43	45	33	41	36	37	32	29	33	29
	99th Percentile	DOWN	6	132	129	99	152	131	115	105	79	119	85
SO_2	Arithmetic Mean	DOWN	3	0.011	0.011	0.009	0.010	0.009	0.007	0.004	0.003	0.003	0.003
	2nd Max. 24-hr	DOWN	3	0.054	0.081	0.039	0.051	0.046	0.043	0.013	0.013	0.014	0.008
SAN ANTONIO, TX													
CO	2nd Max. 8-hr	NS	2	5.7	6.3	5.4	4.6	4.7	5.1	3.5	3.8	4.8	4.7
LEAD	Max. Quarterly Mean	DOWN	1	0.06	0.04	0.07	0.03	0.03	0.03	0.03	0.03	0.02	0.02
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.08	0.08	0.07	0.08	0.09	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.12	0.11	0.10	0.11	0.10	0.11	0.11	0.12	0.12	0.10
PM_{10}	Weighted Annual Mean	DOWN	3	28	28	25	25	25	23	23	21	19	19
	99th Percentile	DOWN	3	76	80	53	81	68	57	51	75	39	46

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area			Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SAN DIEGO, CA														
	CO	2nd Max. 8-hr	DOWN	7	6.1	6.6	5.8	5.4	5.0	4.5	4.8	4.2	4.2	3.8
	LEAD	Max. Quarterly Mean	DOWN	3	0.10	0.08	0.09	0.04	0.03	0.03	0.02	0.03	0.02	0.02
	NO2	Arithmetic Mean	DOWN	7	0.028	0.027	0.025	0.025	0.024	0.020	0.021	0.021	0.019	0.019
	OZONE	4th Max. 8-hr	DOWN	8	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.08
		2nd Daily Max. 1-hr	DOWN	8	0.17	0.16	0.16	0.15	0.14	0.13	0.11	0.12	0.10	0.11
	PM_{10}	Weighted Annual Mean	DOWN	3	36	39	34	37	32	30	31	32	28	27
		99th Percentile	NS	3	71	83	85	76	56	68	70	88	64	61
	SO_2	Arithmetic Mean	DOWN	2	0.005	0.005	0.004	0.003	0.004	0.003	0.003	0.003	0.004	0.003
		2nd Max. 24-hr	NS	2	0.014	0.016	0.015	0.018	0.019	0.010	0.014	0.012	0.014	0.013
SAN FRANCISCO, CA														
	CO	2nd Max. 8-hr	DOWN	4	6.3	5.9	5.7	6.2	4.8	4.6	4.3	3.7	3.9	3.4
	LEAD	Max. Quarterly Mean	DOWN	1	0.10	0.08	0.04	0.04	0.02	0.03	0.02	0.03	0.01	0.02
	NO2	Arithmetic Mean	DOWN	1	0.026	0.026	0.021	0.024	0.022	0.024	0.022	0.021	0.022	0.020
	OZONE	4th Max. 8-hr	NS	3	0.06	0.06	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.05
		2nd Daily Max. 1-hr	NS	3	0.09	0.08	0.06	0.06	0.06	0.08	0.07	0.09	0.08	0.07
	PM_{10}	Weighted Annual Mean	DOWN	1	33	33	28	32	29	27	25	21	21	24
		99th Percentile	DOWN	1	90	90	137	90	80	76	76	48	48	70
	SO_2	Arithmetic Mean	DOWN	1	0.002	0.003	0.002	0.002	0.003	0.002	0.001	0.002	0.002	0.002
		2nd Max. 24-hr	DOWN	1	0.012	0.015	0.010	0.013	0.012	0.010	0.005	0.005	0.007	0.006
SAN JOSE, CA														
	CO	2nd Max. 8-hr	DOWN	2	10.4	11.9	10.8	10.2	7.3	6.4	7.4	5.6	5.7	5.4
	LEAD	Max. Quarterly Mean	DOWN	2	0.12	0.12	0.08	0.04	0.03	0.02	0.02	0.02	0.01	0.01
	OZONE	4th Max. 8-hr	NS	4	0.09	0.08	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.06
		2nd Daily Max. 1-hr	NS	4	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.12	0.11	0.08
	PM_{10}	Weighted Annual Mean	DOWN	4	38	39	36	34	30	26	26	22	21	22
		99th Percentile	DOWN	4	129	140	147	115	102	83	82	54	64	76
SAN JUAN-BAYAMON, PR														
	CO	2nd Max. 8-hr	DOWN	2	5.4	5.5	5.3	5.3	5.3	4.5	4.8	4.9	4.0	3.9
	PM_{10}	Weighted Annual Mean	DOWN	6	33	34	35	30	28	32	30	26	27	32
		99th Percentile	NS	6	87	87	84	77	72	81	77	63	64	94
	SO_2	Arithmetic Mean	NS	2	0.007	0.007	0.007	0.010	0.009	0.008	0.008	0.006	0.005	0.004
		2nd Max. 24-hr	DOWN	2	0.055	0.051	0.056	0.062	0.068	0.038	0.048	0.039	0.021	0.017
SAN LUIS OBISPO-ATASCADERO-PASO ROBLES,C														
	CO	2nd Max. 8-hr	DOWN	1	4.0	4.7	3.9	3.3	3.0	3.1	3.1	2.4	2.3	2.3
	NO2	Arithmetic Mean	DOWN	2	0.012	0.013	0.012	0.012	0.011	0.011	0.011	0.010	0.010	0.010
	OZONE	4th Max. 8-hr	DOWN	5	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.06
		2nd Daily Max. 1-hr	DOWN	5	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	PM_{10}	Weighted Annual Mean	DOWN	2	27	27	24	26	22	23	21	21	18	20
		99th Percentile	NS	2	59	59	61	57	40	68	61	52	42	63
	SO_2	Arithmetic Mean	NS	3	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001
		2nd Max. 24-hr	DOWN	3	0.006	0.006	0.005	0.006	0.005	0.003	0.005	0.004	0.004	0.004
SANTA BARBARA-SANTA MARIA-LOMPOC, CA														
	CO	2nd Max. 8-hr	DOWN	4	2.6	2.8	2.4	2.3	2.3	2.2	2.5	2.1	1.9	1.6
	LEAD	Max. Quarterly Mean	DOWN	1	0.05	0.05	0.03	0.03	0.01	0.02	0.01	0.01	0.01	0.01
	NO2	Arithmetic Mean	DOWN	19	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006
	OZONE	4th Max. 8-hr	DOWN	20	0.08	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.08	0.07
		2nd Daily Max. 1-hr	DOWN	20	0.11	0.15	0.10	0.10	0.10	0.10	0.09	0.10	0.10	0.09
	PM_{10}	Weighted Annual Mean	NS	14	26	25	23	22	22	24	23	23	22	23
		99th Percentile	NS	14	63	65	57	53	52	59	68	56	52	49
	SO_2	Arithmetic Mean	NS	12	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
		2nd Max. 24-hr	NS	12	0.004	0.003	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.002
SANTA CRUZ-WATSONVILLE, CA														
	CO	2nd Max. 8-hr	NS	1	1.0	1.1	1.0	1.0	1.0	1.0	1.2	0.8	0.7	0.7
	NO2	Arithmetic Mean	DOWN	1	0.008	0.009	0.008	0.010	0.007	0.006	0.006	0.005	0.005	0.004
	OZONE	4th Max. 8-hr	NS	2	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.06	0.06
		2nd Daily Max. 1-hr	NS	2	0.08	0.08	0.08	0.09	0.07	0.08	0.07	0.07	0.08	0.07
	PM_{10}	Weighted Annual Mean	DOWN	1	30	31	24	24	23	22	22	19	19	19
		99th Percentile	NS	1	65	51	49	49	55	61	45	36	55	55
	SO_2	Arithmetic Mean	NS	1	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.001
		2nd Max. 24-hr	NS	1	0.007	0.004	0.003	0.002	0.006	0.006	0.006	0.008	0.003	0.002
SANTA FE, NM														
	CO	2nd Max. 8-hr	DOWN	1	3.8	3.5	3.5	3.9	3.7	3.4	2.7	2.3	2.2	2.1
	PM_{10}	Weighted Annual Mean	DOWN	2	17	16	17	14	16	15	14	13	14	14
		99th Percentile	DOWN	2	58	45	48	32	37	35	30	33	32	31
SANTA ROSA, CA														
	CO	2nd Max. 8-hr	DOWN	1	4.9	5.0	4.3	3.8	3.5	3.8	3.2	2.4	3.0	3.1
	NO2	Arithmetic Mean	DOWN	1	0.016	0.015	0.015	0.015	0.016	0.016	0.015	0.015	0.014	0.013
	OZONE	4th Max. 8-hr	NS	2	0.07	0.06	0.06	0.07	0.06	0.06	0.06	0.05	0.06	0.06
		2nd Daily Max. 1-hr	NS	2	0.10	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.08
	PM_{10}	Weighted Annual Mean	DOWN	3	23	23	20	23	18	19	18	16	16	15
		99th Percentile	DOWN	3	58	58	58	74	51	48	45	40	36	53

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SARASOTA-BRADENTON, FL													
CO	2nd Max. 8-hr	DOWN	1	6.3	6.3	6.2	6.9	5.6	6.5	5.3	5.9	5.1	5.3
OZONE	4th Max. 8-hr	NS	3	0.07	0.07	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.08
	2nd Daily Max. 1-hr	DOWN	3	0.10	0.10	0.10	0.10	0.10	0.09	0.10	0.10	0.09	0.10
PM_{10}	Weighted Annual Mean	NS	2	24	24	24	24	26	25	22	20	19	21
	99th Percentile	NS	2	48	48	48	69	103	104	87	51	75	50
SO_2	Arithmetic Mean	NS	1	0.002	0.003	0.002	0.003	0.003	0.003	0.003	0.002	0.002	0.002
	2nd Max. 24-hr	NS	1	0.012	0.017	0.016	0.035	0.021	0.018	0.017	0.010	0.018	0.009
SAVANNAH, GA													
SO_2	Arithmetic Mean	NS	1	0.007	0.003	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.003
	2nd Max. 24-hr	NS	1	0.046	0.013	0.008	0.009	0.008	0.011	0.015	0.013	0.019	0.013
SCRANTON—WILKES-BARRE—HAZLETON, PA													
CO	2nd Max. 8-hr	DOWN	2	4.8	4.1	4.5	4.2	3.8	2.9	3.6	2.8	3.8	3.1
NO2	Arithmetic Mean	DOWN	2	0.018	0.019	0.018	0.017	0.016	0.018	0.018	0.016	0.018	0.016
OZONE	4th Max. 8-hr	NS	3	0.11	0.08	0.09	0.10	0.08	0.09	0.08	0.09	0.08	0.09
	2nd Daily Max. 1-hr	NS	3	0.13	0.10	0.10	0.12	0.10	0.11	0.10	0.10	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	3	29	29	25	29	25	26	28	25	24	26
	99th Percentile	NS	3	75	75	65	73	49	73	64	69	57	79
SO_2	Arithmetic Mean	DOWN	2	0.010	0.009	0.010	0.009	0.008	0.007	0.007	0.005	0.006	0.007
	2nd Max. 24-hr	DOWN	2	0.051	0.047	0.049	0.039	0.033	0.026	0.035	0.036	0.028	0.029
SEATTLE-BELLEVUE-EVERETT, WA													
CO	2nd Max. 8-hr	DOWN	5	9.1	8.5	7.3	7.4	7.5	5.6	5.4	5.4	5.0	5.4
LEAD	Max. Quarterly Mean	NS	1	0.84	0.31	0.64	0.56	0.40	0.37	0.61	0.51	0.66	0.87
OZONE	4th Max. 8-hr	NS	2	0.08	0.08	0.09	0.07	0.08	0.07	0.06	0.07	0.08	0.07
	2nd Daily Max. 1-hr	DOWN	2	0.12	0.11	0.13	0.10	0.10	0.10	0.12	0.09	0.11	0.08
PM_{10}	Weighted Annual Mean	DOWN	7	31	32	29	30	29	28	23	22	20	22
	99th Percentile	DOWN	7	93	96	87	94	75	79	59	65	61	76
SO_2	Arithmetic Mean	DOWN	2	0.007	0.007	0.008	0.008	0.008	0.008	0.006	0.005	0.004	0.004
	2nd Max. 24-hr	DOWN	2	0.024	0.021	0.023	0.023	0.020	0.020	0.022	0.017	0.017	0.011
SHARON, PA													
OZONE	4th Max. 8-hr	DOWN	2	0.12	0.09	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	2	0.14	0.10	0.10	0.11	0.10	0.11	0.11	0.11	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	37	35	30	36	27	28	30	28	29	28
	99th Percentile	NS	1	84	88	85	76	61	66	82	74	101	60
SO_2	Arithmetic Mean	DOWN	1	0.011	0.011	0.010	0.009	0.008	0.008	0.008	0.008	0.007	0.007
	2nd Max. 24-hr	DOWN	1	0.054	0.043	0.036	0.032	0.030	0.029	0.047	0.032	0.029	0.032
SHREVEPORT-BOSSIER CITY, LA													
OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.09	0.08	0.08	0.09	0.08	0.08	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.11	0.12	0.11	0.10	0.10	0.11	0.09	0.10	0.10	0.10
PM_{10}	Weighted Annual Mean	NS	1	23	23	23	28	24	22	24	24	22	23
	99th Percentile	NS	1	47	47	47	130	106	68	51	56	46	99
SO_2	Arithmetic Mean	NS	1	0.003	0.004	0.002	0.002	0.004	0.004	0.002	0.001	0.002	0.002
	2nd Max. 24-hr	NS	1	0.009	0.023	0.006	0.009	0.013	0.011	0.008	0.004	0.004	0.007
SIOUX CITY, IA-NE													
PM_{10}	Weighted Annual Mean	NS	1	31	28	28	28	25	23	23	26	33	28
	99th Percentile	NS	1	98	83	74	70	93	58	71	73	107	102
SIOUX FALLS, SD													
PM_{10}	Weighted Annual Mean	NS	1	22	22	20	19	19	15	22	20	19	19
	99th Percentile	NS	1	52	114	87	52	45	48	47	51	70	50
SOUTH BEND, IN													
OZONE	4th Max. 8-hr	NS	2	0.10	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09
	2nd Daily Max. 1-hr	NS	2	0.12	0.08	0.09	0.10	0.10	0.09	0.10	0.11	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	2	29	30	31	30	23	24	27	22	20	17
	99th Percentile	DOWN	2	79	72	90	68	70	65	95	55	55	45
SPOKANE, WA													
CO	2nd Max. 8-hr	DOWN	3	9.9	9.4	9.1	9.3	8.1	8.0	6.4	6.9	6.8	5.1
OZONE	4th Max. 8-hr	UP	1	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07
	2nd Daily Max. 1-hr	NS	1	0.07	0.07	0.07	0.08	0.08	0.07	0.09	0.08	0.08	0.08
PM_{10}	Weighted Annual Mean	DOWN	4	50	46	45	40	40	40	37	31	32	28
	99th Percentile	DOWN	4	263	332	202	102	142	131	88	86	94	62
SPRINGFIELD, IL													
CO	2nd Max. 8-hr	DOWN	1	4.8	4.4	4.4	4.3	4.5	3.9	3.1	3.2	3.0	2.1
OZONE	4th Max. 8-hr	DOWN	1	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07
	2nd Daily Max. 1-hr	DOWN	1	0.11	0.11	0.10	0.10	0.09	0.11	0.10	0.10	0.10	0.09
SO_2	Arithmetic Mean	DOWN	1	0.007	0.007	0.007	0.008	0.006	0.006	0.006	0.006	0.006	0.006
	2nd Max. 24-hr	NS	1	0.074	0.047	0.054	0.048	0.043	0.040	0.050	0.062	0.061	0.043
SPRINGFIELD, MA													
CO	2nd Max. 8-hr	NS	2	7.3	7.3	6.7	6.3	7.1	6.1	7.5	7.9	7.1	5.1
NO2	Arithmetic Mean	DOWN	2	0.019	0.018	0.018	0.017	0.016	0.016	0.019	0.015	0.016	0.015
OZONE	4th Max. 8-hr	NS	4	0.13	0.09	0.09	0.10	0.09	0.10	0.09	0.09	0.08	0.09
	2nd Daily Max. 1-hr	NS	4	0.16	0.12	0.12	0.13	0.12	0.13	0.12	0.12	0.10	0.12

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
PM_{10}	Weighted Annual Mean	DOWN	4	27	25	22	22	20	20	23	19	20	20
	99th Percentile	NS	4	64	59	65	67	59	54	75	49	58	52
SO_2	Arithmetic Mean	DOWN	3	0.010	0.009	0.008	0.008	0.007	0.006	0.006	0.005	0.005	0.005
	2nd Max. 24-hr	DOWN	3	0.049	0.040	0.033	0.031	0.034	0.023	0.048	0.023	0.024	0.021
SPRINGFIELD, MO													
CO	2nd Max. 8-hr	DOWN	1	6.9	6.7	7.2	6.9	6.2	5.3	5.9	4.1	3.3	4.6
NO2	Arithmetic Mean	UP	1	0.010	0.010	0.008	0.008	0.010	0.011	0.013	0.012	0.011	0.011
OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.06	0.06	0.06	0.07	0.07	0.08	0.07	0.07
	2nd Daily Max. 1-hr	NS	2	0.09	0.07	0.08	0.07	0.08	0.08	0.09	0.10	0.09	0.08
PM_{10}	Weighted Annual Mean	DOWN	3	22	22	22	18	19	17	17	17	18	16
	99th Percentile	NS	3	55	50	52	35	53	40	55	45	61	51
SO_2	Arithmetic Mean	NS	2	0.006	0.006	0.006	0.003	0.004	0.006	0.008	0.003	0.005	0.002
	2nd Max. 24-hr	NS	2	0.057	0.052	0.057	0.033	0.034	0.040	0.067	0.021	0.043	0.022
ST. JOSEPH, MO													
PM_{10}	Weighted Annual Mean	DOWN	1	46	45	40	44	39	32	34	33	32	31
	99th Percentile	NS	1	112	98	95	103	88	100	77	101	96	88
ST. LOUIS, MO-IL													
CO	2nd Max. 8-hr	DOWN	7	4.6	4.8	4.0	4.1	3.3	3.3	3.5	3.3	3.3	3.2
LEAD	Max. Quarterly Mean	DOWN	12	1.99	0.81	0.71	0.62	0.64	0.50	0.56	0.57	0.61	0.46
NO2	Arithmetic Mean	NS	8	0.020	0.019	0.018	0.018	0.019	0.018	0.019	0.019	0.018	0.018
OZONE	4th Max. 8-hr	NS	17	0.10	0.08	0.08	0.09	0.08	0.07	0.09	0.09	0.09	0.08
	2nd Daily Max. 1-hr	NS	17	0.13	0.11	0.11	0.11	0.10	0.11	0.12	0.12	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	14	37	37	34	32	33	29	31	31	28	28
	99th Percentile	DOWN	14	89	89	85	75	79	70	87	72	68	67
SO_2	Arithmetic Mean	DOWN	15	0.012	0.012	0.011	0.010	0.009	0.009	0.009	0.008	0.008	0.007
	2nd Max. 24-hr	DOWN	15	0.054	0.056	0.042	0.042	0.039	0.041	0.041	0.037	0.039	0.034
STAMFORD-NORWALK, CT													
CO	2nd Max. 8-hr	DOWN	1	6.9	6.0	6.3	6.0	5.5	5.2	6.2	5.4	4.1	5.1
OZONE	4th Max. 8-hr	DOWN	1	0.14	0.11	0.11	0.11	0.08	0.10	0.11	0.10	0.09	0.10
	2nd Daily Max. 1-hr	DOWN	1	0.22	0.16	0.14	0.15	0.11	0.15	0.16	0.14	0.12	0.14
PM_{10}	Weighted Annual Mean	NS	3	31	29	30	32	24	23	28	25	25	26
	99th Percentile	NS	3	68	66	75	73	61	61	73	76	62	73
SO_2	Arithmetic Mean	DOWN	1	0.006	0.006	0.005	0.006	0.005	0.005	0.006	0.004	0.005	0.004
	2nd Max. 24-hr	NS	1	0.031	0.029	0.024	0.025	0.022	0.020	0.028	0.023	0.019	0.025
STATE COLLEGE, PA													
OZONE	4th Max. 8-hr	NS	1	0.12	0.08	0.10	0.10	0.09	0.10	0.09	0.10	0.08	0.08
	2nd Daily Max. 1-hr	DOWN	1	0.14	0.10	0.11	0.12	0.10	0.12	0.10	0.11	0.09	0.09
STEUBENVILLE-WEIRTON, OH-WV													
CO	2nd Max. 8-hr	DOWN	1	19.6	13.3	20.5	13.9	6.9	6.6	8.2	5.7	5.3	2.2
LEAD	Max. Quarterly Mean	NS	1	0.05	0.09	0.08	0.07	0.14	0.07	0.07	0.06	0.04	0.04
NO2	Arithmetic Mean	DOWN	1	0.021	0.023	0.020	0.021	0.019	0.017	0.020	0.020	0.020	0.017
OZONE	4th Max. 8-hr	NS	2	0.10	0.08	0.07	0.09	0.08	0.08	0.08	0.09	0.08	0.08
	2nd Daily Max. 1-hr	NS	2	0.12	0.10	0.09	0.11	0.09	0.10	0.10	0.11	0.10	0.09
PM_{10}	Weighted Annual Mean	DOWN	6	41	42	37	40	36	34	35	34	32	27
	99th Percentile	DOWN	6	110	126	94	108	100	97	98	97	98	67
SO_2	Arithmetic Mean	DOWN	6	0.026	0.026	0.025	0.024	0.019	0.019	0.018	0.011	0.011	0.011
	2nd Max. 24-hr	DOWN	6	0.091	0.094	0.089	0.083	0.079	0.086	0.092	0.050	0.050	0.051
STOCKTON-LODI, CA													
CO	2nd Max. 8-hr	DOWN	2	9.4	9.0	10.9	9.7	5.9	5.8	7.0	4.8	6.0	3.7
LEAD	Max. Quarterly Mean	DOWN	1	0.07	0.05	0.04	0.04	0.02	0.03	0.02	0.02	0.02	0.01
NO2	Arithmetic Mean	DOWN	1	0.026	0.026	0.026	0.025	0.024	0.024	0.024	0.022	0.023	0.022
OZONE	4th Max. 8-hr	NS	2	0.10	0.08	0.09	0.09	0.09	0.08	0.09	0.09	0.08	0.07
	2nd Daily Max. 1-hr	NS	2	0.12	0.11	0.12	0.11	0.11	0.11	0.12	0.13	0.10	0.09
PM_{10}	Weighted Annual Mean	DOWN	2	42	46	45	49	39	36	35	31	26	29
	99th Percentile	NS	2	109	124	181	133	110	101	105	108	113	95
SYRACUSE, NY													
CO	2nd Max. 8-hr	DOWN	1	7.8	9.7	6.8	8.4	7.5	5.6	6.5	3.3	3.9	4.0
PM_{10}	Weighted Annual Mean	DOWN	3	32	32	27	29	27	24	24	23	23	23
	99th Percentile	DOWN	3	77	77	69	82	64	75	69	55	61	55
TACOMA, WA													
CO	2nd Max. 8-hr	NS	1	11.6	10.3	8.0	8.7	8.9	5.9	6.0	6.3	6.3	6.8
OZONE	4th Max. 8-hr	NS	1	0.08	0.07	0.09	0.08	0.08	0.07	0.07	0.07	0.08	0.07
	2nd Daily Max. 1-hr	NS	1	0.11	0.09	0.13	0.09	0.10	0.10	0.11	0.09	0.10	0.08
PM_{10}	Weighted Annual Mean	DOWN	3	34	36	31	32	34	29	24	24	22	24
	99th Percentile	DOWN	3	119	109	84	89	97	80	74	66	60	78
SO_2	Arithmetic Mean	NS	2	0.007	0.007	0.008	0.008	0.009	0.009	0.007	0.006	0.006	0.006
	2nd Max. 24-hr	DOWN	2	0.029	0.027	0.026	0.023	0.030	0.025	0.021	0.020	0.024	0.023
TAMPA-ST. PETERSBURG-CLEARWATER, FL													
CO	2nd Max. 8-hr	DOWN	6	4.4	3.7	3.8	2.9	2.9	2.6	2.2	2.8	2.5	2.4
LEAD	Max. Quarterly Mean	DOWN	2	0.03	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO2	Arithmetic Mean	DOWN	2	0.013	0.013	0.013	0.012	0.011	0.011	0.010	0.011	0.011	0.011

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
OZONE	4th Max. 8-hr	NS	6	0.08	0.08	0.08	0.07	0.07	0.07	0.08	0.07	0.07	0.08
	2nd Daily Max. 1-hr	NS	6	0.11	0.10	0.11	0.10	0.10	0.09	0.10	0.10	0.10	0.10
PM_{10}	Weighted Annual Mean	DOWN	3	29	29	28	29	26	27	26	25	25	25
	99th Percentile	NS	3	61	60	52	54	62	105	93	56	79	65
SO_2	Arithmetic Mean	DOWN	7	0.006	0.007	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.005
	2nd Max. 24-hr	DOWN	7	0.027	0.028	0.027	0.025	0.024	0.024	0.027	0.022	0.022	0.023
TERRE HAUTE, IN													
OZONE	4th Max. 8-hr	NS	1	0.07	0.09	0.09	0.09	0.07	0.07	0.09	0.09	0.10	0.08
	2nd Daily Max. 1-hr	NS	1	0.08	0.11	0.11	0.10	0.08	0.09	0.11	0.10	0.11	0.10
PM_{10}	Weighted Annual Mean	DOWN	5	34	33	33	30	26	25	25	27	22	23
	99th Percentile	DOWN	5	108	92	98	77	66	67	67	67	51	57
SO_2	Arithmetic Mean	NS	2	0.008	0.009	0.011	0.011	0.007	0.009	0.010	0.007	0.009	0.006
	2nd Max. 24-hr	NS	2	0.035	0.043	0.038	0.037	0.033	0.039	0.039	0.029	0.033	0.023
TEXARKANA, TX-TEXARKANA, AR													
PM_{10}	Weighted Annual Mean	NS	1	26	26	24	22	23	22	23	26	23	22
	99th Percentile	NS	1	55	55	49	48	84	63	54	57	51	78
TOLEDO, OH													
LEAD	Max. Quarterly Mean	NS	1	0.54	0.48	0.79	0.48	0.57	0.63	0.70	0.43	0.44	0.42
OZONE	4th Max. 8-hr	NS	2	0.11	0.08	0.08	0.09	0.08	0.08	0.09	0.09	0.09	0.08
	2nd Daily Max. 1-hr	NS	2	0.13	0.10	0.10	0.11	0.09	0.11	0.11	0.11	0.11	0.10
PM_{10}	Weighted Annual Mean	DOWN	1	36	36	26	29	28	25	26	25	22	22
	99th Percentile	DOWN	1	64	64	66	76	62	74	60	58	43	43
SO_2	Arithmetic Mean	DOWN	2	0.009	0.007	0.006	0.006	0.006	0.007	0.007	0.004	0.004	0.004
	2nd Max. 24-hr	NS	2	0.041	0.040	0.033	0.022	0.029	0.028	0.047	0.025	0.031	0.020
TOPEKA, KS													
LEAD	Max. Quarterly Mean	DOWN	4	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PM_{10}	Weighted Annual Mean	NS	1	40	40	33	26	28	27	29	34	27	28
	99th Percentile	NS	1	70	70	80	62	61	54	50	83	86	60
TRENTON, NJ													
OZONE	4th Max. 8-hr	DOWN	2	0.12	0.10	0.11	0.12	0.11	0.10	0.10	0.11	0.09	0.10
	2nd Daily Max. 1-hr	DOWN	2	0.17	0.14	0.14	0.15	0.14	0.13	0.14	0.13	0.12	0.12
PM_{10}	Weighted Annual Mean	DOWN	1	32	30	29	31	26	27	29	24	27	27
	99th Percentile	NS	1	87	69	77	68	56	72	65	58	79	87
TULSA, OK													
CO	2nd Max. 8-hr	NS	2	4.2	5.6	4.7	4.6	5.1	3.9	3.9	3.4	5.3	5.7
LEAD	Max. Quarterly Mean	DOWN	1	0.13	0.20	0.11	0.21	0.10	0.20	0.10	0.09	0.11	0.02
NO2	Arithmetic Mean	NS	2	0.013	0.014	0.011	0.013	0.013	0.013	0.013	0.010	0.012	0.012
OZONE	4th Max. 8-hr	NS	3	0.09	0.08	0.09	0.09	0.08	0.08	0.09	0.10	0.09	0.08
	2nd Daily Max. 1-hr	NS	3	0.12	0.11	0.12	0.11	0.10	0.11	0.11	0.12	0.11	0.11
PM_{10}	Weighted Annual Mean	NS	5	28	28	24	25	24	26	26	26	26	24
	99th Percentile	NS	5	73	82	67	61	61	67	56	66	66	73
SO_2	Arithmetic Mean	NS	2	0.009	0.006	0.009	0.009	0.009	0.006	0.005	0.007	0.008	0.007
	2nd Max. 24-hr	NS	2	0.045	0.035	0.046	0.052	0.048	0.035	0.031	0.031	0.036	0.029
TUSCALOOSA, AL													
PM_{10}	Weighted Annual Mean	DOWN	1	29	29	32	28	26	26	26	27	26	25
	99th Percentile	NS	1	60	60	85	111	45	67	53	67	67	70
TUSCON, AZ													
CO	2nd Max. 8-hr	DOWN	4	6.7	5.9	4.6	4.5	4.7	4.6	4.6	4.4	4.1	3.7
NO2	Arithmetic Mean	DOWN	2	0.021	0.021	0.020	0.021	0.020	0.020	0.020	0.020	0.018	0.018
OZONE	4th Max. 8-hr	NS	7	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07	0.07
	2nd Daily Max. 1-hr	NS	7	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	0.09
PM_{10}	Weighted Annual Mean	DOWN	9	38	40	33	26	24	22	22	26	25	26
	99th Percentile	NS	9	92	100	99	62	58	53	46	71	61	69
SO_2	Arithmetic Mean	DOWN	1	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.002
	2nd Max. 24-hr	DOWN	1	0.007	0.007	0.007	0.007	0.006	0.005	0.004	0.004	0.004	0.004
UTICA-ROME, NY													
OZONE	4th Max. 8-hr	DOWN	1	0.10	0.08	0.09	0.09	0.08	0.07	0.07	0.08	0.06	0.07
	2nd Daily Max. 1-hr	DOWN	1	0.12	0.09	0.10	0.10	0.09	0.09	0.09	0.10	0.08	0.09
VALLEJO-FAIRFIELD-NAPA, CA													
CO	2nd Max. 8-hr	DOWN	2	7.3	7.4	6.9	6.6	5.6	5.6	5.2	4.2	4.2	4.4
OZONE	4th Max. 8-hr	NS	3	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07	0.06
	2nd Daily Max. 1-hr	NS	3	0.10	0.10	0.09	0.10	0.09	0.10	0.10	0.11	0.10	0.08
PM_{10}	Weighted Annual Mean	DOWN	1	27	27	27	41	24	23	21	19	17	16
	99th Percentile	DOWN	1	96	96	96	98	70	47	76	62	45	74
VENTURA, CA													
CO	2nd Max. 8-hr	NS	2	3.3	3.0	3.3	3.1	2.3	2.5	2.8	3.2	2.4	2.4
LEAD	Max. Quarterly Mean	DOWN	1	0.04	0.04	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.01
NO2	Arithmetic Mean	DOWN	4	0.016	0.017	0.016	0.015	0.014	0.014	0.014	0.014	0.013	0.012
OZONE	4th Max. 8-hr	DOWN	6	0.11	0.11	0.10	0.11	0.10	0.09	0.10	0.10	0.09	0.08
	2nd Daily Max. 1-hr	DOWN	6	0.14	0.15	0.13	0.14	0.13	0.12	0.13	0.13	0.13	0.11
PM_{10}	Weighted Annual Mean	DOWN	6	38	38	34	35	30	27	29	27	26	28
	99th Percentile	NS	6	92	80	94	73	71	57	64	71	64	107

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (contined)

Metropolitan Statistical Area		Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
VINELAND-MILLVILLE-BRIDGETON, NJ													
OZONE	4th Max. 8-hr	DOWN	1	0.13	0.11	0.11	0.11	0.09	0.10	0.09	0.09	0.09	0.10
	2nd Daily Max. 1-hr	DOWN	1	0.15	0.13	0.13	0.12	0.10	0.12	0.10	0.13	0.11	0.12
SO_2	Arithmetic Mean	DOWN	1	0.009	0.008	0.007	0.007	0.006	0.006	0.005	0.004	0.005	0.004
	2nd Max. 24-hr	DOWN	1	0.034	0.049	0.024	0.023	0.021	0.019	0.032	0.016	0.016	0.018
VISALIA-TULARE-PORTERVILLE, CA													
CO	2nd Max. 8-hr	DOWN	1	5.6	5.9	5.0	5.3	4.3	3.5	4.0	4.2	3.9	3.5
NO2	Arithmetic Mean	NS	1	0.023	0.021	0.021	0.022	0.020	0.023	0.023	0.023	0.018	0.019
OZONE	4th Max. 8-hr	NS	3	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.10	0.10	0.10
	2nd Daily Max. 1-hr	NS	3	0.12	0.13	0.12	0.12	0.12	0.13	0.13	0.12	0.13	0.12
PM_{10}	Weighted Annual Mean	DOWN	2	60	61	69	61	51	49	42	47	40	40
	99th Percentile	DOWN	2	125	196	225	149	110	100	101	121	96	94
WASHINGTON, DC-MD-VA-WV													
CO	2nd Max. 8-hr	DOWN	8	6.4	6.2	5.2	5.0	4.4	5.0	4.5	4.4	3.9	4.0
LEAD	Max. Quarterly Mean	DOWN	5	0.04	0.05	0.05	0.03	0.02	0.02	0.02	0.02	0.01	0.01
NO2	Arithmetic Mean	NS	7	0.025	0.025	0.027	0.026	0.026	0.026	0.026	0.023	0.023	0.023
OZONE	4th Max. 8-hr	NS	12	0.12	0.09	0.09	0.10	0.09	0.10	0.09	0.10	0.08	0.09
	2nd Daily Max. 1-hr	NS	12	0.16	0.11	0.12	0.13	0.11	0.12	0.12	0.12	0.11	0.12
PM_{10}	Weighted Annual Mean	DOWN	8	29	31	26	26	22	22	21	22	20	20
	99th Percentile	DOWN	8	80	84	73	61	45	63	51	51	51	54
SO_2	Arithmetic Mean	DOWN	4	0.009	0.010	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007
	2nd Max. 24-hr	DOWN	4	0.030	0.038	0.030	0.029	0.033	0.027	0.031	0.020	0.028	0.022
WATERBURY, CT													
PM_{10}	Weighted Annual Mean	NS	2	31	32	34	30	23	24	26	24	26	24
	99th Percentile	DOWN	2	90	71	86	69	63	65	57	73	68	47
SO_2	Arithmetic Mean	DOWN	1	0.010	0.010	0.010	0.009	0.007	0.006	0.007	0.005	0.005	0.005
	2nd Max. 24-hr	DOWN	1	0.055	0.048	0.042	0.038	0.029	0.021	0.030	0.019	0.022	0.020
WEST PALM BEACH-BOCA RATON, FL													
CO	2nd Max. 8-hr	NS	1	4.0	3.7	2.7	3.1	3.7	3.1	2.8	2.8	2.5	3.6
NO2	Arithmetic Mean	NS	1	0.013	0.013	0.014	0.012	0.011	0.013	0.012	0.012	0.012	0.012
OZONE	4th Max. 8-hr	NS	2	0.06	0.06	0.07	0.06	0.05	0.08	0.07	0.06	0.06	0.06
	2nd Daily Max. 1-hr	NS	2	0.10	0.10	0.09	0.08	0.07	0.12	0.08	0.08	0.09	0.08
PM_{10}	Weighted Annual Mean	NS	2	19	19	19	18	20	19	18	18	18	20
	99th Percentile	UP	2	39	39	39	41	63	70	63	45	63	65
SO_2	Arithmetic Mean	NS	1	0.001	0.003	0.002	0.002	0.003	0.004	0.003	0.002	0.002	0.002
	2nd Max. 24-hr	UP	1	0.004	0.009	0.007	0.012	0.010	0.028	0.016	0.019	0.014	0.013
WHEELING, WV-OH													
CO	2nd Max. 8-hr	NS	1	4.0	5.2	7.1	5.6	5.6	4.1	4.6	5.0	3.5	3.1
OZONE	4th Max. 8-hr	NS	1	0.10	0.08	0.08	0.09	0.08	0.08	0.08	0.09	0.09	0.08
	2nd Daily Max. 1-hr	NS	1	0.12	0.11	0.11	0.11	0.10	0.11	0.10	0.10	0.11	0.11
PM_{10}	Weighted Annual Mean	DOWN	2	34	34	30	31	30	29	28	28	28	24
	99th Percentile	DOWN	2	88	81	85	68	75	80	75	67	82	49
SO_2	Arithmetic Mean	DOWN	3	0.021	0.021	0.020	0.020	0.018	0.018	0.015	0.010	0.011	0.010
	2nd Max. 24-hr	NS	3	0.072	0.065	0.064	0.074	0.077	0.075	0.065	0.055	0.058	0.043
WICHITA, KS													
CO	2nd Max. 8-hr	DOWN	3	7.0	7.9	5.9	5.9	5.6	5.0	4.9	5.2	5.8	4.8
LEAD	Max. Quarterly Mean	DOWN	5	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
OZONE	4th Max. 8-hr	NS	2	0.08	0.07	0.08	0.08	0.07	0.06	0.07	0.07	0.07	0.08
	2nd Daily Max. 1-hr	NS	2	0.10	0.07	0.10	0.09	0.08	0.08	0.09	0.10	0.09	0.09
PM_{10}	Weighted Annual Mean	DOWN	4	31	30	28	31	32	31	26	27	25	22
	99th Percentile	NS	4	71	72	69	86	84	91	71	92	100	66
WILLIAMSPORT, PA													
OZONE	4th Max. 8-hr	NS	1	0.10	0.07	0.07	0.08	0.07	0.08	0.07	0.07	0.07	0.08
	2nd Daily Max. 1-hr	NS	1	0.12	0.08	0.09	0.10	0.09	0.09	0.08	0.09	0.08	0.09
PM_{10}	Weighted Annual Mean	NS	1	29	29	26	31	24	24	28	28	25	26
	99th Percentile	NS	1	72	72	64	74	45	63	64	60	64	57
SO_2	Arithmetic Mean	NS	1	0.009	0.007	0.006	0.007	0.007	0.006	0.006	0.006	0.006	0.008
	2nd Max. 24-hr	NS	1	0.035	0.042	0.025	0.025	0.029	0.025	0.042	0.027	0.028	0.028
WILMINGTON-NEWARK, DE-MD													
CO	2nd Max. 8-hr	NS	1	5.3	4.5	5.4	4.0	4.1	3.8	4.3	4.6	3.6	4.5
OZONE	4th Max. 8-hr	DOWN	1	0.13	0.10	0.10	0.11	0.09	0.09	0.09	0.12	0.08	0.09
	2nd Daily Max. 1-hr	NS	1	0.19	0.12	0.14	0.14	0.12	0.14	0.12	0.14	0.11	0.12
PM_{10}	Weighted Annual Mean	NS	1	32	42	37	33	28	29	38	37	32	32
	99th Percentile	NS	1	61	87	107	67	72	71	85	77	71	92
SO_2	Arithmetic Mean	DOWN	2	0.016	0.016	0.013	0.012	0.013	0.013	0.012	0.010	0.009	0.008
	2nd Max. 24-hr	DOWN	2	0.054	0.048	0.043	0.033	0.046	0.041	0.044	0.036	0.035	0.034
WORCESTER, MA-CT													
CO	2nd Max. 8-hr	DOWN	1	5.6	7.9	6.0	7.2	8.0	6.1	5.9	4.2	5.3	3.4
NO2	Arithmetic Mean	DOWN	1	0.029	0.026	0.022	0.023	0.024	0.028	0.025	0.021	0.019	0.019
PM_{10}	Weighted Annual Mean	DOWN	2	27	26	23	21	20	20	20	19	20	20
	99th Percentile	NS	2	65	58	60	50	44	46	46	53	54	52

Table A-14. Metropolitan Statistical Area Air Quality Trends, 1988–1997 (continued)

Metropolitan Statistical Area			Trend	#Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	SO_2	Arithmetic Mean	DOWN	1	0.009	0.011	0.008	0.009	0.007	0.007	0.008	0.006	0.005	0.004
		2nd Max. 24-hr	DOWN	1	0.042	0.040	0.034	0.029	0.033	0.025	0.024	0.023	0.021	0.021
YAKIMA,WA														
	CO	2nd Max. 8-hr	DOWN	1	8.9	8.7	7.4	9.0	8.8	7.9	8.0	7.1	7.4	7.4
	PM_{10}	Weighted Annual Mean	NS	1	34	34	34	44	32	38	31	24	35	35
		99th Percentile	NS	1	112	112	112	255	89	97	89	55	119	110
YORK, PA														
	CO	2nd Max. 8-hr	DOWN	1	4.2	4.6	4.4	3.7	3.6	3.3	3.9	2.7	2.8	3.4
	NO2	Arithmetic Mean	DOWN	1	0.023	0.022	0.022	0.021	0.020	0.022	0.024	0.021	0.021	0.019
	OZONE	4th Max. 8-hr	NS	1	0.12	0.09	0.10	0.10	0.08	0.09	0.08	0.09	0.08	0.09
		2nd Daily Max. 1-hr	NS	1	0.14	0.10	0.12	0.11	0.10	0.11	0.12	0.10	0.10	0.11
	PM_{10}	Weighted Annual Mean	NS	1	33	31	30	32	27	31	32	30	28	31
		99th Percentile	NS	1	88	79	91	76	51	95	82	68	63	82
	SO_2	Arithmetic Mean	NS	1	0.007	0.008	0.007	0.008	0.007	0.008	0.009	0.006	0.007	0.009
		2nd Max. 24-hr	NS	1	0.029	0.035	0.023	0.020	0.034	0.032	0.041	0.020	0.022	0.026
YOUNGSTOWN-WARREN, OH														
	OZONE	4th Max. 8-hr	NS	1	0.11	0.09	0.08	0.10	0.09	0.08	0.08	0.10	0.09	0.08
		2nd Daily Max. 1-hr	DOWN	1	0.12	0.11	0.10	0.12	0.10	0.10	0.10	0.11	0.10	0.10
	PM_{10}	Weighted Annual Mean	DOWN	6	37	36	31	34	31	30	31	30	28	26
		99th Percentile	DOWN	6	105	98	81	82	90	77	91	86	80	58
	SO_2	Arithmetic Mean	DOWN	2	0.014	0.016	0.016	0.016	0.013	0.011	0.011	0.010	0.009	0.008
		2nd Max. 24-hr	NS	2	0.077	0.043	0.053	0.048	0.056	0.063	0.051	0.038	0.044	0.037
YUBA CITY, CA														
	OZONE	4th Max. 8-hr	NS	2	0.09	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.09	0.07
		2nd Daily Max. 1-hr	NS	2	0.11	0.09	0.10	0.10	0.11	0.11	0.10	0.11	0.11	0.09
	PM_{10}	Weighted Annual Mean	DOWN	1	39	39	39	39	34	30	34	33	29	29
		99th Percentile	NS	1	96	96	96	108	79	78	154	128	82	98

CO = Highest second maximum non-overlapping 8-hour concentration *(Applicable NAAQS is 9 ppm)*
Pb = Highest quarterly maximum concentration *(Applicable NAAQS is 1.5 ug/m^3)*
NO_2 = Highest arithmetic mean concentration *(Applicable NAAQS is 0.053 ppm)*
O_3 = Highest second daily maximum 1-hour concentration *(Applicable NAAQS is 0.12 ppm)*
= Highest fourth daily maximum 8-hour concentration *(Applicable NAAQS is 0.08 ppm)*
PM_{10} = Highest weighted annual mean concentration *(Applicable NAAQS is 50 ug/m^3)*
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 150 ug/m^3)*
= Highest 99th percentile 24-hour concentration *(Applicable NAAQS is 150 ug/m^3)*
Data from exceptional events not included.
SO_2 = Highest annual mean concentration *(Applicable NAAQS is 0.03 ppm)*
= Highest second maximum 24-hour concentration *(Applicable NAAQS is 0.14 ppm)*

Table A-15. Number of Days with PSI Values Greater Than 100 at Trend Sites, 1988–1997, and All Sites in 1997

Metropolitan Statistical Area	# of Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total # of Sites	PSI > 100 1997
AKRON, OH	5	46	15	9	30	8	10	8	12	11	6	7	6
ALBANY-SCHENECTADY-TROY, NY	7	23	4	4	9	5	5	6	3	4	3	13	3
ALBUQUERQUE, NM	21	9	9	8	5	0	0	1	1	0	0	26	0
ALLENTOWN-BETHLEHEM-EASTON, PA	7	35	11	10	14	3	6	10	17	6	13	9	13
ATLANTA, GA	9	44	17	52	24	19	42	13	43	22	26	17	36
AUSTIN-SAN MARCOS, TX	5	7	4	4	3	1	2	4	12	0	0	5	6
BAKERSFIELD, CA	7	126	114	97	109	100	97	97	104	109	55	18	58
BALTIMORE, MD	16	60	28	29	50	23	48	41	36	28	30	23	30
BATON ROUGE, LA	6	17	11	28	11	5	5	7	15	7	8	12	16
BERGEN-PASSAIC, NJ	8	27	12	9	11	2	3	5	10	3	5	9	5
BIRMINGHAM, AL	17	33	5	28	5	12	10	6	32	15	8	17	8
BOSTON, MA-NH	24	28	12	7	13	9	6	10	8	2	8	27	10
BUFFALO-NIAGARA FALLS, NY	21	31	4	8	9	3	1	4	6	3	1	21	1
CHARLESTON-NORTH CHARLESTON, SC	8	11	5	1	2	0	2	2	1	3	3	9	3
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	10	43	13	31	12	11	23	9	13	18	26	31	31
CHICAGO, IL	42	40	16	5	21	4	3	8	21	6	9	64	10
CINCINNATI, OH-KY-IN	21	57	19	19	22	3	13	19	22	11	11	25	14
CLEVELAND-LORAIN-ELYRIA, OH	24	45	19	10	23	11	13	23	24	17	12	43	16
COLUMBUS, OH	9	24	7	4	9	1	6	7	7	11	5	14	14
DALLAS, TX	8	37	18	24	2	11	11	15	36	12	15	22	32
DAYTON-SPRINGFIELD, OH	10	37	10	13	12	2	11	14	11	18	9	13	13
DENVER, CO	20	35	16	11	7	8	3	2	2	0	0	32	0
DETROIT, MI	30	35	18	11	28	8	5	13	14	13	12	35	12
EL PASO, TX	17	15	26	22	7	11	9	8	5	7	3	22	4
FORT LAUDERDALE, FL	7	3	6	1	0	2	4	1	1	1	0	19	0
FORT WORTH-ARLINGTON, TX	8	27	17	16	20	7	9	31	28	14	14	8	14
FRESNO, CA	9	110	91	62	83	61	59	55	60	65	50	16	75
GARY, IN	19	37	16	14	12	5	1	6	17	11	12	22	12
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	7	36	16	10	20	4	2	6	11	6	6	10	10
GREENSBORO-WINSTON-SALEM-HIGH PT, NC	8	46	8	12	5	2	21	9	8	6	13	22	17
GREENVILLE-SPARTANBURG-ANDERSON, SC	4	35	3	2	3	4	7	4	5	7	9	8	10
HARRISBURG-LEBANON-CARLISLE, PA	7	39	10	10	21	1	15	12	13	3	9	7	9
HARTFORD, CT	14	39	19	13	23	15	14	18	15	5	16	15	16
HONOLULU, HI	4	0	0	0	0	0	0	0	0	0	0	12	0
HOUSTON, TX	26	72	43	54	37	32	28	45	65	28	47	29	47
INDIANAPOLIS, IN	31	39	15	9	12	7	9	22	19	13	12	31	12
JACKSONVILLE, FL	15	4	4	3	0	2	3	2	1	1	4	17	4
JERSEY CITY, NJ	7	30	14	15	25	9	19	11	14	5	9	8	9
KANSAS CITY, MO-KS	22	23	5	2	11	1	3	10	22	10	18	25	18
KNOXVILLE, TN	13	33	2	23	10	7	20	13	20	19	36	21	38
LAS VEGAS, NV-AZ	6	30	45	22	10	6	9	14	4	5	0	19	6
LITTLE ROCK-NORTH LITTLE ROCK, AR	7	9	1	1	3	0	2	2	7	1	1	8	1
LOS ANGELES-LONG BEACH, CA	36	239	222	174	174	178	137	144	109	94	63	38	66
LOUISVILLE, KY-IN	17	49	15	10	15	2	19	27	21	10	13	26	18
MEMPHIS, TN-AR-MS	12	44	8	24	9	14	16	11	18	17	14	15	17
MIAMI, FL	10	8	6	1	1	3	6	1	2	1	3	12	3
MIDDLESEX-SOMERSET-HUNTERDON, NJ	4	35	19	22	24	8	11	9	15	8	18	4	19
MILWAUKEE-WAUKESHA, WI	18	40	17	8	24	3	4	8	13	5	4	22	5
MINNEAPOLIS-ST. PAUL, MN-WI	24	11	8	4	2	3	0	2	7	2	0	41	0

Table A-15. Number of Days with PSI Values Greater Than 100 at Trend Sites, 1988–1997, and All Sites in 1997 (continued)

Metropolitan Statistical Area	# of Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total # of Sites	PSI > 100 1997
MONMOUTH-OCEAN, NJ	3	0	14	21	20	6	11	3	6	12	12	4	21
NASHVILLE, TN	19	55	11	31	13	6	18	21	27	23	20	19	24
NASSAU-SUFFOLK, NY	4	22	14	20	25	5	15	10	9	6	8	8	12
NEW HAVEN-MERIDEN, CT	10	26	11	15	30	10	12	13	14	8	19	10	19
NEW ORLEANS, LA	10	24	4	6	2	5	6	8	18	8	6	13	7
NEW YORK, NY	28	57	30	37	50	11	19	21	19	15	23	40	24
NEWARK, NJ	12	41	21	23	33	10	12	14	20	12	13	15	13
NORFOLK-VA BEACH-NEWPORT NEWS,VA-NC	11	23	4	8	6	7	12	4	3	4	15	12	17
OAKLAND, CA	19	8	6	4	4	3	4	3	12	11	0	33	0
OKLAHOMA CITY, OK	12	8	6	4	4	2	2	7	13	3	4	12	4
OMAHA, NE-IA	9	7	1	1	0	0	0	0	1	1	0	13	0
ORANGE COUNTY, CA	12	56	58	46	35	38	25	15	9	9	3	12	3
ORLANDO, FL	9	2	9	4	1	4	4	3	1	1	4	14	5
PHILADELPHIA, PA-NJ	34	53	44	39	48	24	50	26	30	22	32	49	39
PHOENIX-MESA, AZ	23	29	34	13	11	15	17	11	25	17	15	52	44
PITTSBURGH, PA	38	43	21	19	22	9	13	19	25	11	20	56	21
PONCE, PR	1	0	0	0	0	0	.	.	0	0	1	1	1
PORTLAND-VANCOUVER, OR-WA	12	9	5	12	10	6	0	3	2	6	0	17	0
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	11	18	9	13	18	5	7	7	11	4	10	21	11
RALEIGH-DURHAM-CHAPEL HILL, NC	4	4	14	15	6	1	11	2	1	1	13	18	24
RICHMOND-PETERSBURG, VA	10	37	11	6	18	8	30	13	19	5	21	11	21
RIVERSIDE-SAN BERNARDINO, CA	36	185	190	158	159	175	167	148	125	118	106	56	123
ROCHESTER, NY	8	24	5	5	16	2	0	1	6	0	6	8	6
SACRAMENTO, CA	13	88	71	66	69	48	22	37	34	33	2	35	19
ST. LOUIS, MO-IL	53	44	29	24	33	16	9	32	35	20	15	60	15
SALT LAKE CITY-OGDEN, UT	12	16	22	5	20	9	2	4	4	9	1	26	2
SAN ANTONIO, TX	7	7	3	4	3	1	3	4	18	3	3	7	3
SAN DIEGO, CA	20	123	128	97	67	66	57	45	47	31	14	28	16
SAN FRANCISCO, CA	9	1	0	0	0	0	0	0	2	0	0	11	0
SAN JOSE, CA	8	24	21	10	13	3	4	2	9	7	0	11	0
SAN JUAN-BAYAMON, PR	10	0	0	0	0	0	0	0	0	1	2	27	2
SCRANTON–WILKES-BARRE–HAZLETON, PA	10	30	6	9	15	3	8	6	10	4	9	11	11
SEATTLE-BELLEVUE-EVERETT, WA	16	20	7	10	5	3	0	3	0	6	1	23	1
SPRINGFIELD, MA	13	29	10	13	15	12	13	12	10	5	10	13	10
SYRACUSE, NY	4	1	2	1	2	0	0	0	0	0	0	8	2
TACOMA, WA	7	10	4	5	1	3	0	2	0	1	0	9	0
TAMPA-ST. PETERSBURG-CLEARWATER, FL	22	9	4	6	1	1	1	3	2	3	4	32	4
TOLEDO, OH	5	29	8	3	6	1	4	9	7	10	3	8	5
TUSCON, AZ	21	6	2	1	0	1	1	1	3	0	1	27	1
TULSA, OK	12	23	5	16	12	2	4	12	21	14	7	13	7
VENTURA, CA	13	108	93	70	89	55	44	64	66	62	44	15	48
WASHINGTON, DC-MD-VA-WV	32	56	27	26	49	15	47	21	30	18	28	47	31
WEST PALM BEACH-BOCA RATON, FL	6	0	1	0	0	0	3	0	0	0	0	10	0
WILMINGTON-NEWARK, DE-MD	5	28	12	9	12	7	10	5	12	3	6	12	21
YOUNGSTOWN-WARREN, OH	9	25	8	3	14	5	2	0	11	5	3	14	10

Table A-16. (Ozone only) Number of Days with PSI Values Greater Than 100 at Trend Sites, 1988–1997, and All Sites in 1997

Metropolitan Statistical Area	# of Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total # of Sites	PSI > 100 1997
AKRON, OH	2	46	15	9	30	8	10	8	12	11	6	2	6
ALBANY-SCHENECTADY-TROY, NY	3	23	4	4	9	5	5	6	3	4	3	3	3
ALBUQUERQUE, NM	7	1	0	2	0	0	0	1	0	0	0	9	0
ALLENTOWN-BETHLEHEM-EASTON, PA	3	34	11	10	14	3	6	9	17	6	13	3	13
ATLANTA, GA	4	44	17	52	24	19	42	13	43	22	26	7	36
AUSTIN-SAN MARCOS, TX	2	7	4	4	3	1	2	4	12	0	0	2	6
BAKERSFIELD, CA	5	123	111	95	107	100	97	97	104	109	55	8	58
BALTIMORE, MD	7	57	28	28	50	23	48	40	36	28	30	9	30
BATON ROUGE, LA	3	17	11	28	11	5	5	7	15	7	8	7	16
BERGEN-PASSAIC, NJ	1	26	10	8	11	2	3	5	10	3	5	1	5
BIRMINGHAM, AL	6	32	5	28	5	12	10	6	32	15	8	6	8
BOSTON, MA-NH	4	28	12	7	13	9	6	10	8	2	8	6	10
BUFFALO-NIAGARA FALLS, NY	2	31	4	7	9	3	1	4	6	3	1	2	1
CHARLESTON-NORTH CHARLESTON, SC	3	11	5	1	1	0	2	2	1	3	3	3	3
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC	3	43	12	29	12	11	23	9	13	18	26	7	31
CHICAGO, IL	16	40	15	3	21	4	3	7	21	6	9	22	10
CINCINNATI, OH-KY-IN	7	57	19	19	22	3	13	19	22	11	11	8	14
CLEVELAND-LORAIN-ELYRIA, OH	6	45	17	10	23	10	12	22	21	17	11	9	15
COLUMBUS, OH	2	24	7	4	9	0	6	7	7	11	5	5	14
DALLAS, TX	2	37	18	24	2	11	11	15	36	12	15	7	32
DAYTON-SPRINGFIELD, OH	3	37	10	13	12	2	11	14	11	18	9	5	13
DENVER, CO	5	20	5	4	0	1	0	0	0	0	0	9	0
DETROIT, MI	8	34	18	11	28	7	5	11	12	12	12	8	12
EL PASO, TX	3	5	5	6	1	3	3	6	5	2	1	4	1
FORT LAUDERDALE, FL	3	3	6	1	0	2	4	1	1	1	0	3	0
FORT WORTH-ARLINGTON, TX	2	27	17	16	20	7	9	31	28	14	14	2	14
FRESNO, CA	4	109	89	54	81	61	59	55	60	65	50	7	75
GARY, IN	4	37	15	14	12	5	1	6	17	11	11	4	11
GRAND RAPIDS-MUSKEGON-HOLLAND, MI	3	36	16	10	20	4	2	6	11	6	6	5	10
GREENSBORO–WINSTON-SALEM–HIGH PT, NC	3	41	4	12	5	2	21	9	8	6	13	6	17
GREENVILLE-SPARTANBURG-ANDERSON, SC	3	35	3	2	3	4	7	4	5	7	9	4	10
HARRISBURG-LEBANON-CARLISLE, PA	3	39	10	10	21	1	15	12	13	3	9	3	9
HARTFORD, CT	3	36	18	13	21	14	14	18	13	5	16	3	16
HONOLULU, HI	1	0	0	0	0	0	0	0	0	0	0	1	0
HOUSTON, TX	10	72	43	54	37	32	28	45	65	28	47	12	47
INDIANAPOLIS, IN	6	39	15	9	11	6	9	22	19	13	12	9	12
JACKSONVILLE, FL	2	4	4	3	0	2	3	2	1	1	4	3	4
JERSEY CITY, NJ	1	30	14	15	25	9	19	11	14	5	9	1	9
KANSAS CITY, MO-KS	6	23	4	2	11	1	3	10	22	9	18	7	18
KNOXVILLE, TN	4	33	2	23	10	7	20	13	20	19	36	7	37
LAS VEGAS, NV-AZ	3	2	2	2	0	1	2	2	0	2	0	4	0
LITTLE ROCK-NORTH LITTLE ROCK, AR	2	9	1	1	3	0	2	2	7	1	1	2	1
LOS ANGELES-LONG BEACH, CA	13	180	149	128	124	139	108	117	92	68	42	14	45
LOUISVILLE, KY-IN	4	49	13	10	15	2	19	27	21	10	13	7	18
MEMPHIS, TN-AR-MS	3	43	5	22	8	12	13	10	18	16	14	4	17
MIAMI, FL	4	8	5	1	1	3	6	1	2	1	3	4	3
MIDDLESEX-SOMERSET-HUNTERDON, NJ	1	35	19	22	24	8	11	9	15	8	18	2	19
MILWAUKEE-WAUKESHA, WI	6	40	17	8	24	3	4	8	13	5	4	9	5

Table A-16. (Ozone only) Number of Days with PSI Values Greater Than 100 at Trend Sites, 1988–1997, and All Sites in 1997 (continued)

Metropolitan Statistical Area	# of Trend Sites	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total # of Sites	PSI > 100 1997
MINNEAPOLIS-ST. PAUL, MN-WI	4	9	1	1	0	2	0	0	4	1	0	5	0
MONMOUTH-OCEAN, NJ	1	0	14	21	20	6	11	3	6	12	12	2	21
NASHVILLE, TN	7	55	9	31	13	6	18	21	27	23	20	7	24
NASSAU-SUFFOLK, NY	1	20	14	20	25	5	15	10	9	6	8	2	12
NEW HAVEN-MERIDEN, CT	2	26	11	13	28	10	12	13	14	8	19	2	19
NEW ORLEANS, LA	5	24	4	6	2	5	6	8	18	8	6	6	7
NEW YORK, NY	5	46	24	33	47	10	19	21	18	15	23	9	24
NEWARK, NJ	2	39	20	22	30	10	12	12	20	12	13	3	13
NORFOLK-VA BEACH-NEWPORT NEWS,VA-NC	2	22	4	8	6	7	12	4	3	4	15	3	17
OAKLAND, CA	7	8	6	4	3	3	4	3	12	11	0	10	0
OKLAHOMA CITY, OK	4	8	4	4	4	2	2	5	13	2	4	4	4
OMAHA, NE-IA	3	6	0	1	0	0	0	0	0	0	0	3	0
ORANGE COUNTY, CA	4	47	43	38	35	35	25	15	8	9	3	4	3
ORLANDO, FL	3	2	9	4	1	4	4	3	1	1	4	4	5
PHILADELPHIA, PA-NJ	8	53	42	39	48	24	50	25	30	22	32	10	32
PHOENIX-MESA, AZ	8	9	4	7	7	11	16	7	19	17	10	20	14
PITTSBURGH, PA	8	39	14	11	20	8	13	19	24	11	20	12	20
PONCE, PR	0	0	0	0	0	0	.	.	0	0	0	0	0
PORTLAND-VANCOUVER, OR-WA	4	3	0	8	3	6	0	1	2	6	0	4	0
PROVIDENCE-FALL RIVER-WARWICK, RI-MA	2	18	9	13	18	5	7	7	11	4	10	4	11
RALEIGH-DURHAM-CHAPEL HILL, NC	1	0	10	15	5	0	11	2	1	1	13	8	24
RICHMOND-PETERSBURG, VA	4	37	11	6	18	8	30	13	19	5	21	4	21
RIVERSIDE-SAN BERNARDINO, CA	16	183	182	153	157	173	167	148	120	115	102	21	117
ROCHESTER, NY	2	24	5	5	16	2	0	1	6	0	6	2	6
SACRAMENTO, CA	6	66	35	42	55	47	20	37	34	33	2	14	19
ST. LOUIS, MO-IL	17	44	25	24	33	16	9	32	35	20	14	17	14
SALT LAKE CITY-OGDEN, UT	2	13	14	5	3	0	2	4	4	6	1	7	2
SAN ANTONIO, TX	2	7	3	4	3	1	3	4	18	3	3	2	3
SAN DIEGO, CA	8	119	122	96	67	66	57	45	47	31	14	10	16
SAN FRANCISCO, CA	3	0	0	0	0	0	0	0	2	0	0	3	0
SAN JOSE, CA	4	19	7	4	5	3	4	2	9	7	0	6	0
SAN JUAN-BAYAMON, PR	0	0	0	0	0	0	0	0	0	0	0	1	0
SCRANTON–WILKES-BARRE–HAZLETON, PA	3	30	6	9	15	3	8	6	10	4	9	4	11
SEATTLE-BELLEVUE-EVERETT, WA	2	1	0	7	3	3	0	3	0	6	1	5	1
SPRINGFIELD, MA	4	29	10	13	15	12	13	12	9	4	10	4	10
SYRACUSE, NY	0	0	0	0	0	0	0	0	0	0	0	2	2
TACOMA, WA	1	2	0	4	0	2	0	2	0	1	0	2	0
TAMPA-ST. PETERSBURG-CLEARWATER, FL	6	8	4	6	1	1	1	3	2	3	4	7	4
TOLEDO, OH	2	29	8	3	6	1	4	9	7	10	3	5	5
TUSCON, AZ	7	0	0	1	0	1	1	1	3	0	1	7	1
TULSA, OK	3	23	5	16	12	1	4	12	21	14	7	3	7
VENTURA, CA	6	108	93	70	89	55	44	64	66	62	42	7	46
WASHINGTON, DC-MD-VA-WV	12	55	24	26	49	15	47	21	30	18	28	17	31
WEST PALM BEACH-BOCA RATON, FL	2	0	1	0	0	0	3	0	0	0	0	2	0
WILMINGTON-NEWARK, DE-MD	1	28	12	9	12	7	10	5	12	3	6	4	21
YOUNGSTOWN-WARREN, OH	1	25	8	3	14	5	2	0	11	5	3	3	10

Table A-17. Condensed Nonattainment Areas List(a)

			Pollutant(c)						Population(d)					
	State	**Area Name(b)**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**NO_2**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**All**
1	AK	Anchorage	.	1	.	1	.	.		222	.	170	.	222
2	AK	Fairbanks	.	1	.	.	.	.	.	30	.	.	.	30
3	AK	Juneau	.	.	.	1	.	.	.	.	.	12	.	12
4	AL	Birmingham	1	.	.	.	.	.	751	.	.	.	.	751
5	AZ	Ajo	.	.	1	1	.	.	.	.	6	6	.	6
6	AZ	Bullhead City	.	.	.	1	.	.	.	.	.	5	.	5
7	AZ	Douglas	.	.	1	1	.	.	.	.	13	13	.	13
8	AZ	Miami-Hayden	.	.	2	1	.	.	.	.	3	3	.	3
9	AZ	Morenci	.	.	1	.	.	.	.	.	8	.	.	8
10	AZ	Nogales	.	.	.	1	.	.	.	.	.	19	.	19
11	AZ	Paul Spur	.	.	.	1	.	.	.	.	.	1	.	1
12	AZ	Payson	.	.	.	1	.	.	.	.	.	8	.	8
13	AZ	Phoenix	1	1	.	1	.	.	2,092	2,006	.	2,122	.	2,122
14	AZ	Rillito	.	.	.	1	.	.	.	.	.	0	.	0
15	AZ	San Manuel	.	.	1	.	.	.	.	.	5	.	.	5
16	AZ	Yuma	.	.	.	1	.	.	.	.	.	54	.	54
17	CA	Imperial Valley	.	.	.	1	.	.	.	.	.	92	.	92
18	CA	Los Angeles-South Coast Air Basin	1	1	.	1	.	.	13,000	13,000	.	13,000	.	13,000
19	CA	Mono Basin (in Mono Co.)	.	.	.	1	.	.	.	.	.	0	.	0
20	CA	Owens Valley	.	.	.	1	.	.	.	.	.	18	.	18
21	CA	Sacramento Metro	1	.	.	1	.	.	1,639	.	.	1,041	.	1,639
22	CA	San Diego	1	.	.	.	.	.	2,498	.	.	.	.	2,498
23	CA	San Francisco-Oakland-San Jose	1	.	.	.	.	.	5,815	.	.	.	.	5,815
24	CA	San Joaquin Valley	1	.	.	1	.	.	2,742	.	.	2,742	.	2,742
25	CA	Santa Barbara-Santa Maria-Lompoc	1	.	.	.	.	.	370	.	.	.	.	370
26	CA	Searles Valley	.	.	.	1	.	.	.	.	.	30	.	30
27	CA	Southeast Desert Modified AQMA	1	.	.	2	.	.	384	.	.	349	.	384
28	CA	Ventura Co.	1	.	.	.	.	.	669	.	.	.	.	669
29	CO	Aspen	.	.	.	1	.	.	.	.	.	5	.	5
30	CO	Canon City	.	.	.	1	.	.	.	.	.	12	.	12
31	CO	Colorado Springs	.	1	.	.	.	.	.	353	.	.	.	353
32	CO	Denver-Boulder	.	1	.	1	.	.	.	1,800	.	1,836	.	1,836
33	CO	Fort Collins	.	1	.	.	.	.	.	106	.	.	.	106
34	CO	Lamar	.	.	.	1	.	.	.	.	.	8	.	8
35	CO	Longmont	.	1	.	.	.	.	.	52	.	.	.	52
36	CO	Pagosa Springs	.	.	.	1	.	.	.	.	.	1	.	1
37	CO	Steamboat Springs	.	.	.	1	.	.	.	.	.	6	.	6
38	CO	Telluride	.		.	1	.	.	.	.	.	1	.	1
39	CT	Greater Connecticut	1	.	.	1	.	.	2,470		.	126	.	2,470
40	DC-MD-VA	Washington	1	.	.	.	.	.	3,923	.	.	.	.	3,923
41	GA	Atlanta	1	.	.	.	.	.	2,653	.	.	.	.	2,653
42	GA	Muscogee Co. (Columbus)	.	.	.	.	1	.	.	.	.	.	179	179
43	GU	Piti Power Plant	.	.	1	.	.	.	.	.	0	.	.	0
44	GU	Tanguisson Power Plant	.	.	1	.	.	.	.	.	0	.	.	0
45	ID	Boise	.	.	.	1	.	.	.	.	.	125	.	125
46	ID	Bonner Co.(Sandpoint)	.	.	.	1	.	.	.	.	.	26	.	26
47	ID	Pocatello	.	.	.	1	.	.	.	.	.	46	.	46
48	ID	Shoshone Co.	.	.	.	2	.	.	.	.	.	13	.	13
49	IL-IN	Chicago-Gary-Lake County	1	.	1	3	.	.	7,887	.	475	625	.	7,887
50	IN	Marion Co. (Indianapolis)	.	.	.	.	1(e)	.	.	.	.	.	16	16
51	KY	Boyd Co. (Ashland)		.	1(f)	.	.	.	.	.	51	.	.	51

Table A-17. Condensed Nonattainment Areas List(a) (continued)

			Pollutant(c)						Population(d)					
	State	**Area Name(b)**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**NO_2**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**All**
52	KY	Muhlenberg Co.	.	.	1	.	.	.	.	.	31	.	.	31
53	KY-IN	Louisville	1	.	.	.	.	.	834	.	.	.	.	834
54	LA	Baton Rouge	1	.	.	.	.	.	559	.	.	.	.	559
55	MA	Springfield (W. Mass)	1	.	.	.	.	.	812	.	.	.	.	812
56	MA-NH	Boston-Lawrence-Worcester	1	.	.	.	.	.	5,507	.	.	.	.	5,507
57	MD	Baltimore	1	.	.	.	.	.	2,348	.	.	.	.	2,348
58	MD	Kent and Queen Anne Cos.	1	.	.	.	.	.	52	.	.	.	.	52
59	ME	Portland	1	.	.	.	.	.	441	.	.	.	.	441
60	MI	Muskegon	1	.	.	.	.	.	159	.	.	.	.	159
61	MN	Minneapolis-St. Paul	.	1	.	1	.	.	.	2,310	.	272	.	2,310
62	MN	Olmsted Co. (Rochester)	.	.	1	.	.	.	.	.	71	.	.	71
63	MO	Dent	.	.	.	.	1	.	.	.	.	.	2	2
64	MO	Liberty-Arcadia	.	.	.	.	1	.	.	.	.	.	2	2
65	MO-IL	St. Louis	1	.	.	.	1(g)	.	2,390	.	.		2	2,390
66	MT	Butte	.	.	.	1	.	.	.	.	.	33	.	33
67	MT	Columbia Falls	.	.	.	1	.	.	.	.	.	2	.	2
68	MT	Kalispell	.	.	.	1	.	.	.	.	.	11	.	11
69	MT	Lame Deer	.	.	.	1	.	.	.	.	.	0	.	0
70	MT	Lewis & Clark (E. Helena)	.	.	1	.	1(h)	.	.	.	2	.	2	2
71	MT	Libby	.	.	.	1	.	.	.	.	.	2	.	2
72	MT	Missoula	.	1	.	1	.	.	.	43	.	43	.	43
73	MT	Polson	.	.	.	1	.	.	.	.	.	3	.	3
74	MT	Ronan	.	.	.	1	.	.	.	.	.	1	.	1
75	MT	Thompson Falls	.	.	.	1	.	.	.	.	.	1	.	1
76	MT	Whitefish	.	.	.	1	.	.	.	.	.	3	.	3
77	MT	Yellowstone Co. (Laurel)	.	.	1	.	.	.	.	.	5	.	.	5
78	NE	Douglas Co. (Omaha)	.	.	.	.	1	.	.	.	.	.	1	1
79	NH	Portsmouth-Dover-Rochester	1	.	.	.	.	.	183	.	.	.	.	183
80	NM	Anthony	.	.	.	1	.	.	.	.	.	1	.	1
81	NM	Grant Co.	.	.	1	.	.	.	.	.	27	.	.	27
82	NM	Sunland Park	1(i)	.	.	.	.	.	8	.	.	.	.	8
83	NV	Central Steptoe Valley	.	.	1	.	.	.	.	.	2	.	.	2
84	NV	Las Vegas	.	1	.	1	.	.	.	258	.	741	.	741
85	NV	Reno	.	1	.	1	.	.	.	134	.	254	.	254
86	NY-NJ-CT	New York-N. New Jersey-Long Island	1	1	.	1	.	.	17,943	13,155	.	1,487	.	17,943
87	OH	Cleveland-Akron-Lorain	.	.	3	1	.	.	.	.	1,898	1,412	.	1,898
88	OH	Coshocton Co.	.	.	1	.	.	.	.	.	35	.	.	35
89	OH	Gallia Co.	.	.	1	.	.	.	.	.	30	.	.	30
90	OH	Jefferson Co. (Steubenville)	.	.	1	1	.	.	.	.	80	4	.	80
91	OH	Lucas Co. (Toledo)	.	.	1	.	.	.	.	.	462	.	.	462
92	OH-KY	Cincinnati-Hamilton	1	.	.	.	.	.	1,705	.	.	.	.	1,705
93	OR	Grants Pass	.	1	.	1	.	.	.	17	.	17	.	17
94	OR	Klamath Falls	.	1	.	1	.	.	.	18	.	17	.	18
95	OR	LaGrande	.	.	.	1	.	.	.	.	.	11	.	11
96	OR	Lakeview	.	.	.	1	.	.	.	.	.	2	.	2
97	OR	Medford	.	1	.	1	.	.	.	62	.	63	.	63
98	OR	Oakridge	.	.	.	1	.	.	.	.	.	3	.	3
99	OR	Springfield-Eugene	.	.	.	1	.	.	.	.	.	157	.	157
100	PA	Lancaster	1	.	.	.	.	.	423	.	.	.	.	423
101	PA	Pittsburgh-Beaver Valley	1	.	2	1	.	.	2,468	.	446	75	.	2,468
102	PA	Warren Co	.	.	2	.	.	.	.	.	22	.	.	22

Table A-17. Condensed Nonattainment Areas List(a)

			Pollutant(c)						Population(d)					
	State	**Area Name(b)**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**NO_2**	**O_3**	**CO**	**SO_2**	**PM_{10}**	**Pb**	**All**
103	PA-DE-NJ-MD	Philadelphia-Wilmington-Trenton	1	.		.	.	.	.	6,010	.	.	.	6,010
104	PA-NJ	Allentown-Bethlehem		.	1				.	.	91	.	.	.
105	PR	Guaynabo Co.	.	.	.	1	.	.	.	.	.	85	.	85
106	RI	Providence (all of RI)	1	.	.	.	.	.	1,003	.	.	.	.	1,003
107	TN	Shelby Co. (Memphis)	.	.	.	.	1(j)	.	.	.	.	.	826	826
108	TN	Nashville	.	.	.	.	1(k)	.	.	.	.	.	81	81
109	TX	Beaumont-Port Arthur	1	.	.	.	.	.	361	.	.	.	.	361
110	TX	Dallas-Fort Worth	1	.	.	.	1(l)	.	3,561	.	.	.	264	3,561
111	TX	El Paso	1	1	.	1	.	.	592	54	.	515	.	592
112	TX	Houston-Galveston-Brazoria	1	.	.	.	.	.	3,731	.	.	.	.	3,731
113	UT	Ogden	.	1	.	1	.	.	.	63	.	63	.	63
114	UT	Salt Lake City	.	.	1	1	.	.	.	.	725	725	.	725
115	UT	Tooele Co.	.	.	1	.	.	.	.	.	26	.	.	26
116	UT	Utah Co. (Provo)	.	1	.	1	.	.	.	85	.	263	.	263
117	WA	Olympia-Tumwater-Lacey	.	.	.	1	.	.	.	.	.	63	.	63
118	WA	Seattle-Tacoma	.	.	.	3	.	.	.	.	.	730	.	730
119	WA	Spokane	.	1	.	1	.	.	.	279	.	177	.	279
120	WA	Wallula	.	.	.	1	.	.	.	.	.	47	.	47
121	WA	Yakima	.	.	.	1	.	.	.	.	.	54	.	54
122	WI	Door Co.	1	.	.	.	.	.	26	.	.	.	.	26
123	WI	Manitowoc Co.	1	.	.	.	.	.	80	.	.	.	.	80
124	WI	Marathon Co. (Wausau)	.	.	1	.	.	.	.	.	115	.	.	115
125	WI	Milwaukee-Racine	1	.	.	.	.	.	1,735	.	.	.	.	1,735
126	WI	Oneida Co. (Rhinelander)	.	.	1	.	.	.	.	.	31	.	.	31
127	WV	Follansbee	.	.	.	1	.	.	.	.	.	3	.	3
128	WV	New Manchester Gr. (in Hancock Co)	.	.	1	.	.	.	.	.	10	.	.	10
129	WV	Wier.-Butler-Clay (in Hancock Co)	.	.	1	1	.	.	.	.	25	22	.	25
130	WY	Sheridan	.	.	.	1	.	.	.	.	.	13	.	13
		Total	38	20	34	77	10	0	99,824	34,047	4,695	29,890	1,375	113,001

Notes:

(a) This is a simplified listing of Classified Nonattainment areas. Unclassified and Section 185a nonattainment areas are not included. In certain cases, footnotes are used to clarify the areas involved. For example, the lead nonattainment area listed within the Dallas-Fort Worth ozone nonattainment area is in Frisco, Texas, which is not in Dallas county, but is within the designated boundaries of the ozone nonattainment area. Readers interested in more detailed information should use the official Federal Register citation (40 CFR 81).

(b) Names of nonattainment areas are listed alphabetically within each state. The largest city determines which state is listed first in the case of multiple-city nonattainment areas. When a larger nonattainment area, such as ozone, contains one or more smaller nonattainment areas, such as PM_{10} or lead, the common name for the larger nonattainment area is used. Note that several smaller nonattainment areas may be inside one larger nonattainment area, as is the case in Figure A-1. For the purpose of this table, these are considered one nonattainment area and are listed on one line. Occasionally, two nonattainment areas may only partially overlap, as in Figure A-2. These are counted as two distinct nonattainment areas and are listed on separate lines.

(c) The number of nonattainment areas for each of the criteria pollutants is listed.

(d) Population figures were obtained from 1990 census data. For nonattainment areas defined as only partial counties, population figures for just the nonattainment area were used when these were available. Otherwise, whole county population figures were used. When a larger nonattainment area encompasses a smaller one, double-counting the population in the “All” column is avoided by only counting the population of the larger nonattainment area.

(e) Lead nonattainment area is a portion of Franklin township, Marion county, Indiana.

(f) Sulfur dioxide nonattainment area is a portion of Boyd county.

Table A-17. Condensed Nonattainment Areas List(a) (continued)

(g) Lead nonattainment area is Herculaneum, Missouri in Jefferson county.

(h) Lead nonattainment area is a portion of Lewis and Clark county, Montana.

(i) Ozone nonattainment area is a portion of Dona Ana county, New Mexico.

(j) Lead nonattainment area is a portion of Shelby county, Tennessee.

(k) Lead nonattainment area is a portion of Williamson county, Tennessee.

(l) Lead nonattainment area is Frisco, Texas, in Collin county.

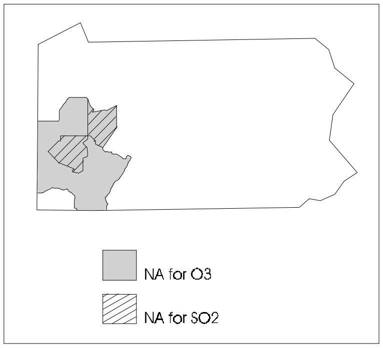

Figure A-1. (Multiple NA areas within a larger NA area) Two SO_2 areas inside the Pittsburgh–Beaver Valley ozone NA. Counted as one NA area.

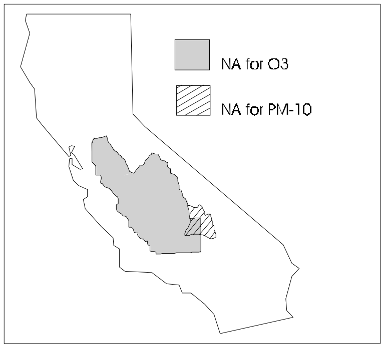

Figure A-2. (Overlapping NA areas) Searles Valley PM_{10} NA partially overlaps the San Joaquin Valley ozone NA. Counted as two NA areas.

APPENDIX B

Methodology

AIR QUALITY DATA BASE

The ambient air quality data presented in Chapter 2 of this report are based on data retrieved from AIRS on June 30, 1998. These are direct measurements of pollutant concentrations at monitoring stations operated by state and local governments throughout the nation. The monitoring stations are generally located in larger urban areas. EPA and other federal agencies also operate some air quality monitoring sites on a temporary basis as a part of air pollution research studies. The national monitoring network conforms to uniform criteria for monitor siting, instrumentation, and quality assurance.[1,2]

In 1997, 4,738 monitoring sites reported air quality data for one or more of the six NAAQS pollutants to AIRS, as seen in Table B-1. The geographic locations of these monitoring sites are displayed in Figures B-1 to B-6. The sites are identified as National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations (SLAMS), or "other." NAMS were established to ensure a long-term national network for urban area-oriented ambient monitoring and to provide a systematic, consistent data base for air quality comparisons and trends analysis. SLAMS allow state or local governments to develop networks tailored for their immediate monitoring needs. "Other" monitors may be Special Purpose Monitors, industrial monitors, tribal monitors, etc.

Table B-1. Number of Ambient Monitors Reporting Data to AIRS

Pollutant	# of Sites Reporting Data to AIRS in 1997	# of Trend Sites 1988–1997
CO	538	368
Pb	381	195
NO_2	409	224
O_3	1,019	660
PM_{10}	1,733	845
SO2	658	486
Total	**4,738**	**2,778**

Air quality monitoring sites are selected as national trends sites if they have complete data for at least eight of the 10 years between 1988 and 1997. The annual data completeness criteria are specific to each pollutant and measurement methodology. Table B-1 displays the number of sites meeting the 10-year trend completeness criteria. Because of the annual turnover of monitoring sites, the use of a moving 10-year window maximizes the number of sites available for trends and yields a data base that is consistent with the current monitoring network.

The air quality data are divided into two major groupings: daily (24-hour) measurements and continuous (1-hour) measurements. The daily measurements are obtained from monitoring instruments that produce one measurement per 24-hour period and typically operate on a systematic sampling schedule of once every six days, or 61 samples per year. Such instruments are used to measure PM_{10} and lead. More frequent sampling of PM_{10} (every other day or every day) is also common. Only PM_{10} weighted (for each quarter to account for seasonality) annual arithmetic means that meet the AIRS annual summary criteria are selected as valid means for trends purposes.[3] Only lead sites with at least six samples per quarter in three of the four calendar quarters qualify as trends sites. Monthly composite lead data are used if at least two monthly samples are available for at least three of the four calendar quarters.

Monitoring instruments that operate continuously produce a measurement every hour for a possible total of 8,760 hourly measurements in a year. For hourly data, only annual averages based on at least 4,380 hourly observations are considered as trends statistics. The SO_2 standard-related daily statistics require at least 183 daily values to be included in the analysis. Ozone sites meet the annual trends

Figure B-1. Carbon monoxide monitoring network, 1997.

Figure B-2. Lead monitoring network, 1997.

Figure B-3. Nitrogen dioxide, 1997.

Figure B-4. Ozone monitoring network, 1997.

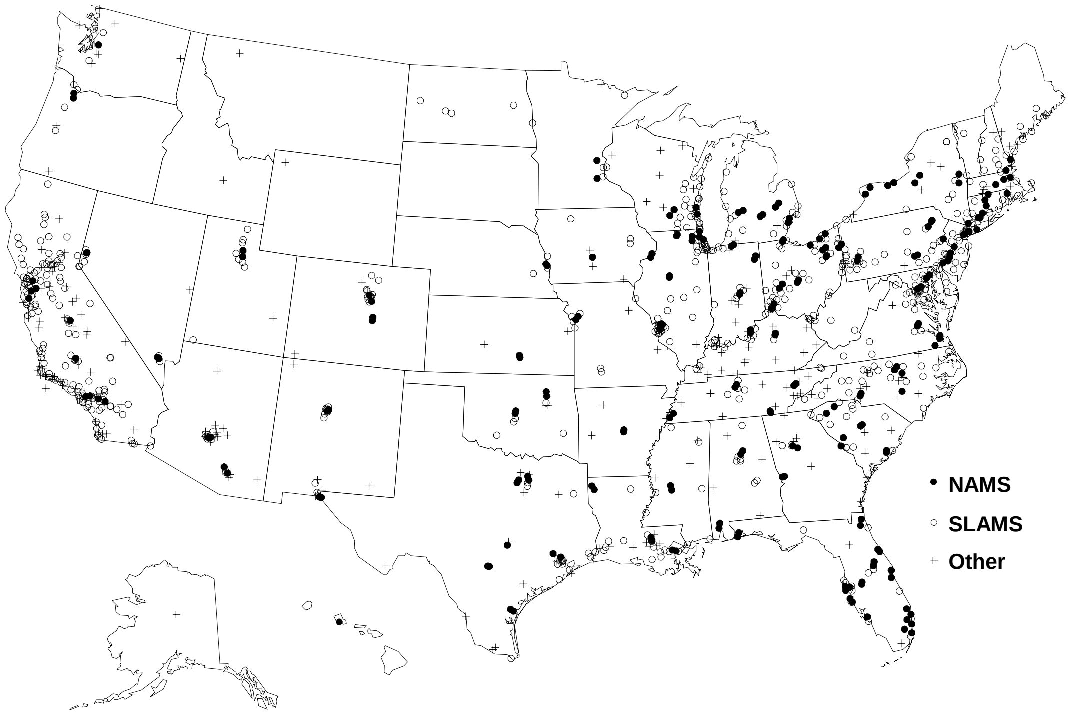

Figure B-5. PM_{10} monitoring network, 1997.

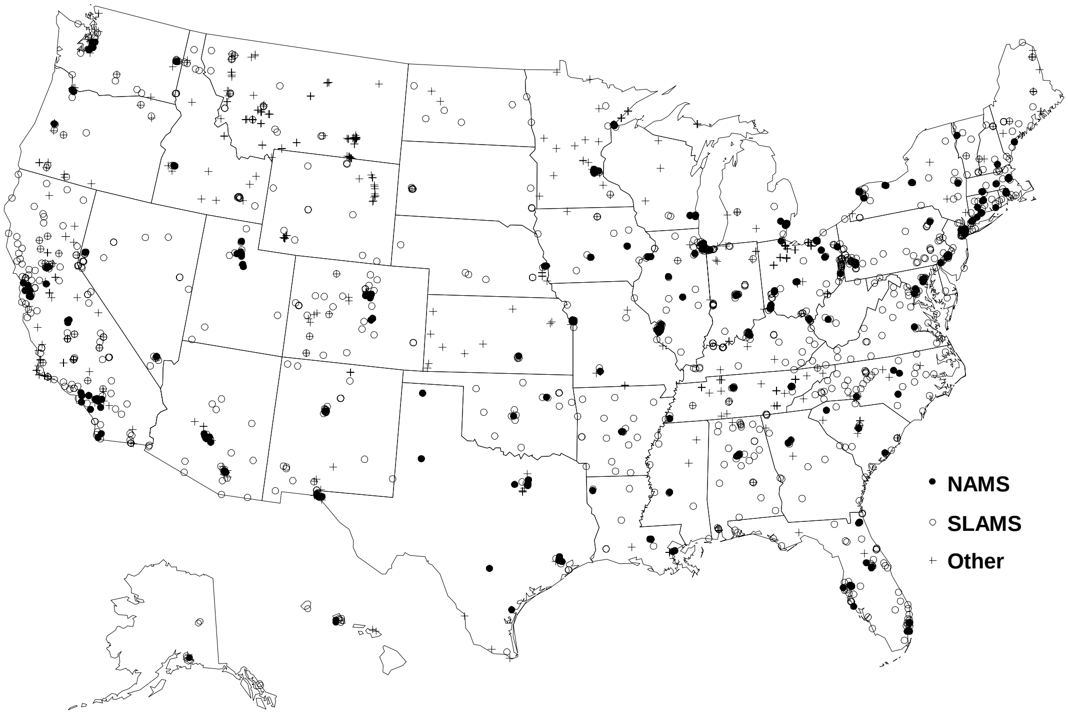

Figure B-6. Sulfur dioxide monitoring network, 1997.

data completeness requirement if they have at least 50 percent of the daily data available for the ozone season, which varies by state, but typically runs from May through September.[4]

AIR QUALITY TREND STATISTICS

The air quality statistics presented in this report relate to the pollutant-specific NAAQS and comply with the recommendations of the Intra-Agency Task Force on Air Quality Indicators.[5] A composite average of each trend statistic is used in the graphical presentations throughout this report. All sites were weighted equally in calculating the composite average trend statistic. Missing annual summary statistics for the second through ninth years for a site are estimated by linear interpolation from the surrounding years. Missing end points are replaced with the nearest valid year of data. The resulting data sets are statistically balanced, allowing simple statistical procedures and graphics to be easily applied. This procedure is conservative since endpoint rates of change are dampened by the interpolated estimates.

EMISSIONS ESTIMATES METHODOLOGY

Trends are presented for annual nationwide emissions of CO, lead, NO_x, VOCs, PM_{10}, and SO_2. These trends are estimates of the amount and kinds of pollution being emitted by automobiles, factories, and other sources based upon best available engineering calculations. Because of recent changes in the methodology used to obtain these emissions estimates, the estimates have been recomputed for each year. Thus, comparisons of the estimates for a given year in this report to the same year in previous reports may not be appropriate.

The emissions estimates presented in this report reflect several major changes in methodologies that were instituted mainly in 1997. First, state-derived emissions estimates were included primarily for nonutility point and area sources. Also, 1985–1994 NO_x emission rates derived from test data from the Acid Rain Division, U.S. EPA, were utilized. The MOBILE5b model was run instead of MOBILE5a for 1996 and 1997. The Office of Mobile Sources, U.S. EPA, provided new estimates from the beta version of the non-road model for most non-road diesel equipment categories. Finally, additional improvements were made to the particulate matter fugitive dust categories.

In addition to the changes in methodology affecting most source categories and pollutants, other changes were made to the emissions for specific pollutants, source categories, and/or individual sources. Activity data and correction parameters for agricultural crops, construction, and paved roads were included. State-supplied MOBILE model inputs for 1990, 1995, and 1996 were used, as well as state-supplied VMT data for 1990. Rule effectiveness from pre-1990 chemical and allied product emissions was removed. Lead content of unleaded and leaded gasoline for the on-road and non-road engine lead emission estimates was revised, and Alaska and Hawaii nonutility point and area source emissions from several sources were added. Also, this report incorporates data from CEMs collected between 1994 and 1997 for NO_x and SO_2 emissions at major electric utilities.

All of these changes are part of a broad effort to update and improve emissions estimates. Additional emissions estimates and a more detailed description of the estimation methodology are available in two companion reports, the *National Air Pollutant Emission Trends, 1900–1996* and the *National Air Pollutant Emission Trends Procedures Document, 1900–1996*.[6,7] The Emission Trends report will not be published this year. However, updated emissions estimates can be found at **http://www.epa.gov/oar/emtrnd**.

REFERENCES

1. Clean Air Act Amendments of 1990, U.S. Code, volume 42, section 7403 (c)(2), 1990.
2. Ambient Air Quality Surveillance, 44 CFR 27558, May 10, 1979.
3. *Aerometric Information Retrieval System (AIRS)*, Volume 2, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, October, 1993.
4. Ambient Air Quality Surveillance, 51 FR 9597, March 19, 1986.
5. U.S. Environmental Protection Agency Intra-Agency Task Force Report on Air Quality Indicators, EPA-450/4-81-015, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, February 1981.
6. *National Air Pollutant Emission Trends, 1900–1996*, EPA-454/R-97-011, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, December 1997.
7. *National Air Pollutant Emission Trends Procedures Document*, 1900-1996, EPA-454/R-98-008, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 1998.