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ANALYSIS OF AIR TOXICS EMISSIONS, EXPOSURES, CANCER RISKS AND CONTROLLABILITY IN FIVE URBAN AREAS

VOLUME II

Controllability Analysis And Results

U. S. ENVIRONMENTAL PROTECTION AGENCY

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EXECUTIVE SUMMARY

OVERVIEW

The Environmental Protection Agency (EPA), under its National Air Toxics Strategy (U.S. EPA, 1985a), has been encouraging State and local air pollution control agencies to assess and mitigate their urban air toxics problems. These problems are characterized by complex multi-source interactions and multi-pollutant exposures. Numerous studies, including Volume I of this report, suggest that area-wide lifetime excess cancer risks from urban air toxics may range from about one in 10,000 to one in 1,000, and that cancer incidence may range from 1 to 23 excess cases per year per million population (Lahre, 1988). In addition to the typical area source problems in urban areas, high risk point sources in the proximity of urban areas can pose problems for individuals in areas of maximum exposure to those sources.

Our understanding of the nature of the urban problem is evolving. The basic tools (e.g., emission factors, potency numbers) to estimate impacts for the direct emissions of certain compounds change over time. Also, more needs to be done to determine the consequences of secondary pollutant formation where the potency of certain compounds may increase dramatically.

The purpose of this study (Volume II) is to gain some initial insight into the controllability of the urban air toxics problem as it is now understood. In particular, the objective is to investigate the prospects for reductions in aggregate cancer risk that may result from current national and local regulatory activities and to estimate the potential for further reductions that certain additional measures might achieve.

NATURE OF URBAN PROBLEM

The most commonly used measure of cancer risk in urban assessments is "aggregate cancer incidence," which is a measure of the excess cancer cases over an entire area associated with multi-source, multi-pollutant exposures to air toxics. (This is also called "population risk.") Incidence is typically expressed as the number of excess cancer cases expected in a single year, but is estimated based on an assumed 70 year "lifetime" exposure. In this report, incidence is considered additive in that the individual incidence from all the pollutants under study are added together. Incidence is also population-normalized by adjusting to a per million persons rate. As such, the measure of cancer risk most commonly expressed herein is "excess aggregate additive incidence per year per million population." Normalization by population allows incidence from one urban area to be compared with another.

Volume I of this report explores the nature and magnitude of the urban air toxics problem and presents a base year analysis involving dispersion modeling of emissions data for five urban areas in the United States. In this analysis, the available emissions and source data were compiled and used as input to EPA's Human Exposure Model (HEM) (U.S. EPA, 1986) to estimate ambient air concentrations and population exposures to the following known or suspected air carcinogens:

- arsenic
- asbestos
- benzene
- benzo(a)pyrene, or B(a)P
- beryllium
- 1,3-butadiene
- cadmium
- carbon tetrachloride
- chloroform
- chromium (VI and total)
- diesel particulate
- ethylene dichloride
- ethylene oxide
- formaldehyde
- gasoline particulate
- gasoline vapors
- manganese
- mercury
- methylene chloride
- nickel
- perchloroethylene
- trichloroethylene
- vinyl chloride

These compounds are suspected contributors to aggregate cancer incidence in urban areas and are those for which cancer unit risk numbers have been established. From this modeling investigation, estimates were made of the sources and pollutants contributing to additive (i.e., multi-pollutant) cancer risk throughout each urban area. Emphasis was placed on estimating area-wide population risk, i.e., aggregate incidence, from multi-pollutant, multi-source exposures. The year 1980 was nominally defined as the base year in this analysis, although some later year data were selectively incorporated into the data base.

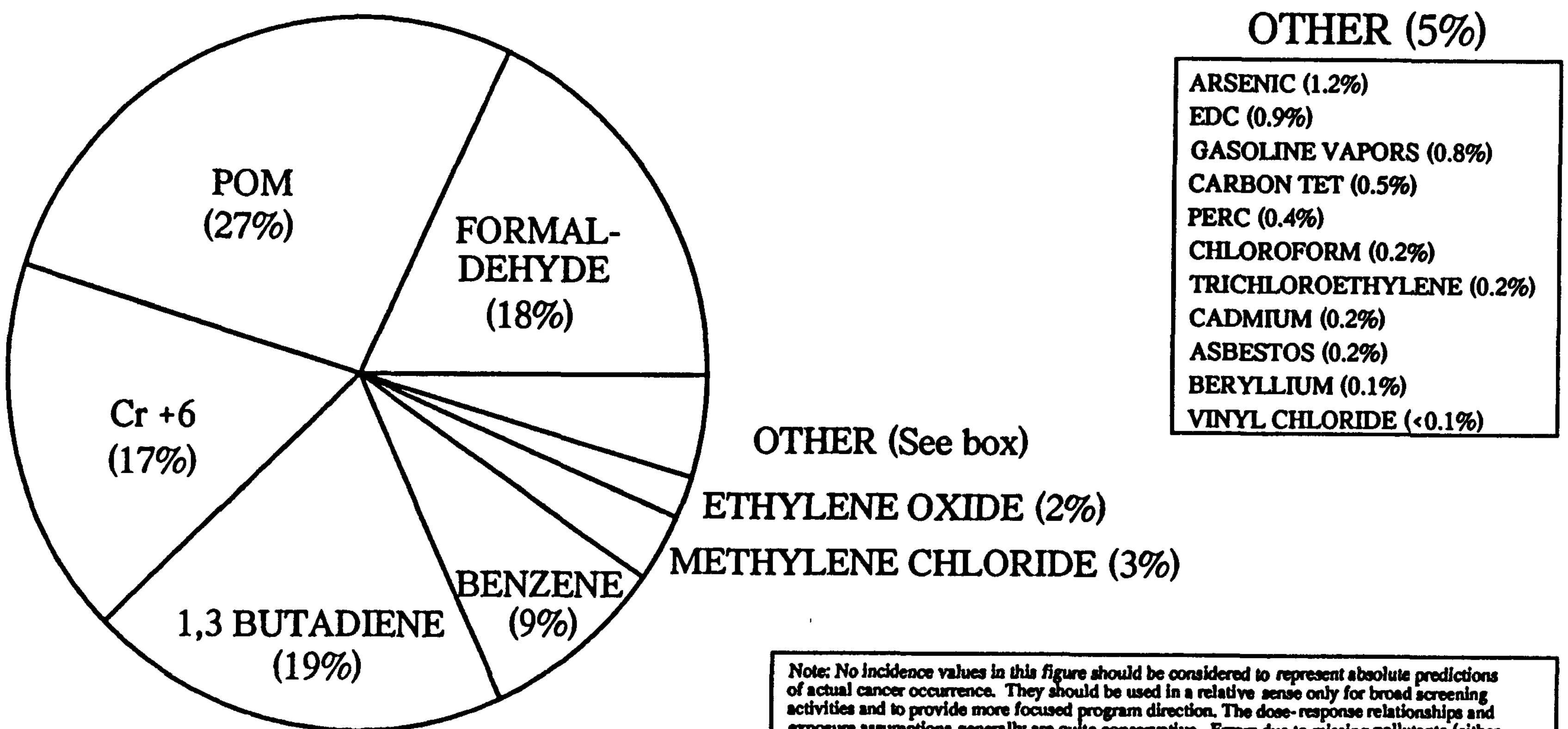
Figures 1 and 2 are based on average results from the five cities and indicate the pollutants and sources, respectively, that may be of the most concern in a typical urban area. Area-wide individual lifetime cancer risks averaged about 4×10^{-4}, ranging from 1.5×10^{-4} to 7×10^{-4}. Maximum individual risks can range higher and are generally associated with large point sources. The major contributing source categories tend to be motor vehicles and small point and area sources. The major contributing pollutants tend to be chromium, formaldehyde, products of incomplete combustion (including gas and diesel vehicle emissions), benzene, and 1,3-butadiene.

NATURE OF THIS STUDY

The object of Volume II is to analyze the base year emissions data base developed in Volume I (with minor adjustments) and determine (1) what urban risk reduction is likely to occur as a result of ongoing regulatory activities and (2) what further reductions might be possible with the application of additional measures. Current and expected programs which will address air toxics within the time frame of this study (i.e., 1995) include several Federal regulations for stationary and mobile sources, [e.g., National Emission Standards for Hazardous Air Pollutants (NESHAP), New Source Performance Standards (NSPS), and the Federal Motor Vehicle Control Program (FMVCP)], revisions to existing State implementation plan (SIP) requirements that will reduce both air toxics and criteria pollutant emissions, and specific air toxics rules established at the State and local level. A past study indicated that up to 50 percent of the overall air toxics problem may have been reduced by such measures (Haemisseger et al., 1985). In addition, there are potential risk reductions from other requirements which may be available for future consideration (e.g., adopting for all sources within a category the maximum control on any facility within that category). The three control scenarios which are the

FIGURE 1

POLLUTANTS CONTRIBUTING TO FIVE CITY AVERAGE EXCESS AGGREGATE CANCER INCIDENCE

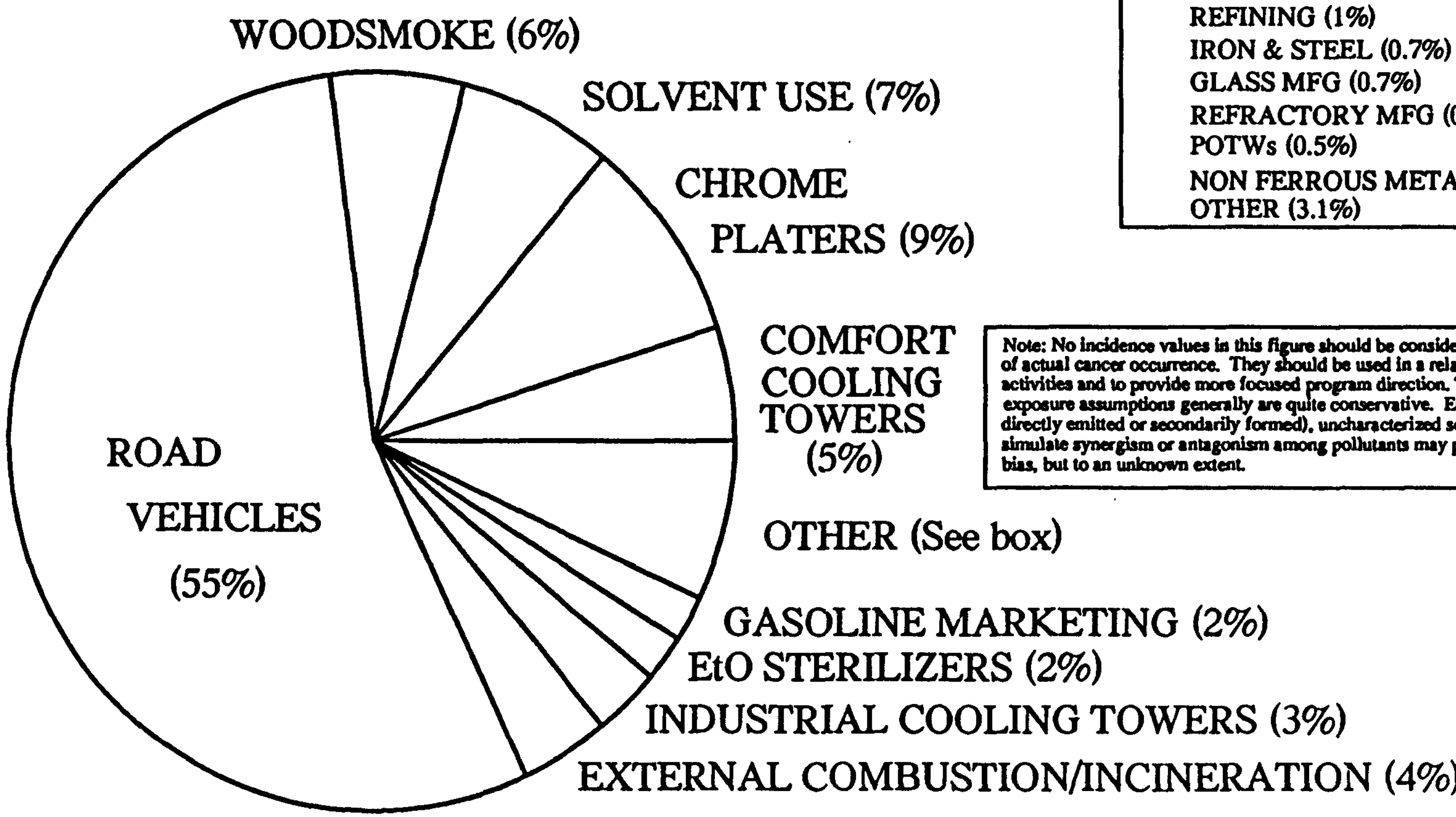


Note: No incidence values in this figure should be considered to represent absolute predictions of actual cancer occurrence. They should be used in a relative sense only for broad screening activities and to provide more focused program direction. The dose-response relationships and exposure assumptions generally are quite conservative. Errors due to missing pollutants (either directly emitted or secondarily formed), uncharacterized sources, and the lack of any mechanism to simulate synergism or antagonism among pollutants may potentially offset this conservative bias, but to an unknown extent.

AVERAGE 5 CITY INCIDENCE = 6 CASES/YEAR/MILLION POPULATION

FIGURE 2

SOURCES CONTRIBUTING TO FIVE CITY AVERAGE EXCESS AGGREGATE CANCER INCIDENCE



OTHER (8%)
CHEMICAL MFG (1.3%)
REFINING (1%)
IRON & STEEL (0.7%)
GLASS MFG (0.7%)
REFRACTORY MFG (0.5%)
POTWs (0.5%)
NON FERROUS METAL (0.2%)
OTHER (3.1%)

Note: No incidence values in this figure should be considered to represent absolute predictions of actual cancer occurrence. They should be used in a relative sense only for broad screening activities and to provide more focused program direction. The dose-response relationships and exposure assumptions generally are quite conservative. Errors due to missing pollutants (either directly emitted or secondarily formed), uncharacterized sources, and the lack of any mechanism to simulate synergism or antagonism among pollutants may potentially offset this conservative bias, but to an unknown extent.

AVERAGE 5 CITY INCIDENCE = 6 CASES/YEAR/MILLION POPULATION

focus of this Volume II study are labeled as (1) current rules, (2) expected controls, and (3) additional controls.

The current rules analysis reflects the effect of existing rules addressing volatile organic compounds (VOC) or particulate matter (PM) (or specific toxics) emissions, whether they are local, State, or Federal in nature. The expected controls analysis assumes that candidate Federal rules currently under consideration including NESHAP, NSPS, FMVCP, and Gasoline Reid Vapor Pressure (RVP) limits will be implemented in each area. The additional controls scenario added (1) control measures under consideration by EPA as part of the Federal Implementation Plan (FIP) for VOC, (2) the most stringent SIP level controls for particulate matter within the five study areas, and (3) the most stringent SIP control levels for a source category applied to all VOC stationary source emitters within the category. For particulate, if no category-specific regulations existed, a default control level of 98 percent was used for point sources. This 98 percent control level was selected by inspecting the requirements for point source PM control in the five study areas and choosing a control level representative of the maximum available. (There are source types achieving greater than 98 percent control of PM, but for categories with no specific regulations it seemed unrealistic to choose too high a value.) Area sources emitting PM were controlled further only if category specific information about controls was available. A vehicle miles traveled (VMT) reduction of 5 percent was also assumed in this scenario as a possible additional control measure.

MODELING ANALYSIS

All quantifiable control measures under the three scenarios were evaluated for VOC and PM emissions reductions by 1995 using the Regulatory Impact Model (RIM) developed by Radian Corporation. The RIM starts with a 1980 emissions data base and simulates how those emissions might be expected to change by source category in 1995. A more detailed description of how RIM simulates future emission changes and a summary of the three 1995 modeling scenarios included in this study are provided in Chapter III. Analyses were also performed to compare the effect of the control scenarios on the maximum individual risk from point sources.

RESULTS

Figure 3 displays the projected reduction in excess cancer cases per year per million population for the three control scenarios and the source categories contributing the greatest risk. Figure 4 contains the specific incidence reduction values by source category. The results in these figures assume 100 percent rule effectiveness (i.e., the applicable regulations are fully effective).

A review of Figures 3 and 4 indicates that a 27 percent reduction in excess cancer cases is estimated between the base year and 1995 under the current rules scenario. This reduction comes essentially from the FMVCP and is due to projected reductions in 1,3-butadiene, benzene, formaldehyde, and products of incomplete combustion. There is an estimated net increase in incidence from stationary source emissions even though emissions from some source categories are reduced (e.g., wood stoves, glass, and brick manufacturing). These emission decreases, however, are offset by growth in emissions and associated incidence from other source categories (e.g., cooling towers, use of miscellaneous solvent cleaners).

Under the expected controls scenario, an additional 20 percent reduction in incidence from the base year is projected resulting in an overall 47 percent reduction. This reduction results primarily from chromium source control of industrial and comfort cooling towers and chrome platers expected under the NESHAP program and the Toxics Substances Control Act.

The additional rules scenario projects another 13 percent incidence reduction from the base case to be possible if the most stringent regulations currently in effect for chromium sources and hospital sterilizers were applied in each urban area.

FIGURE 3

FIVE CITY CONTROLLABILITY OF AIR TOXICS IN 1995

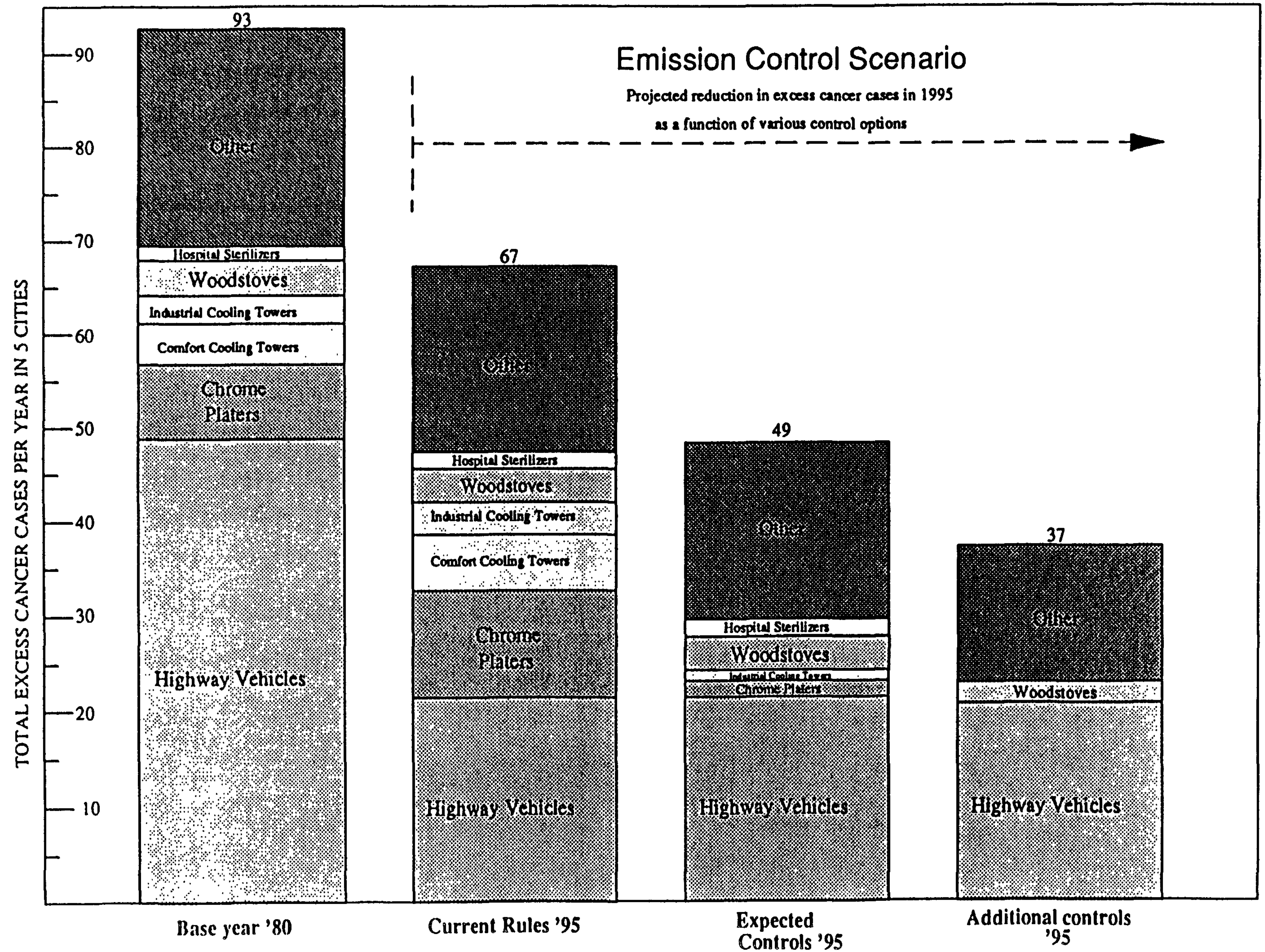


Figure 4

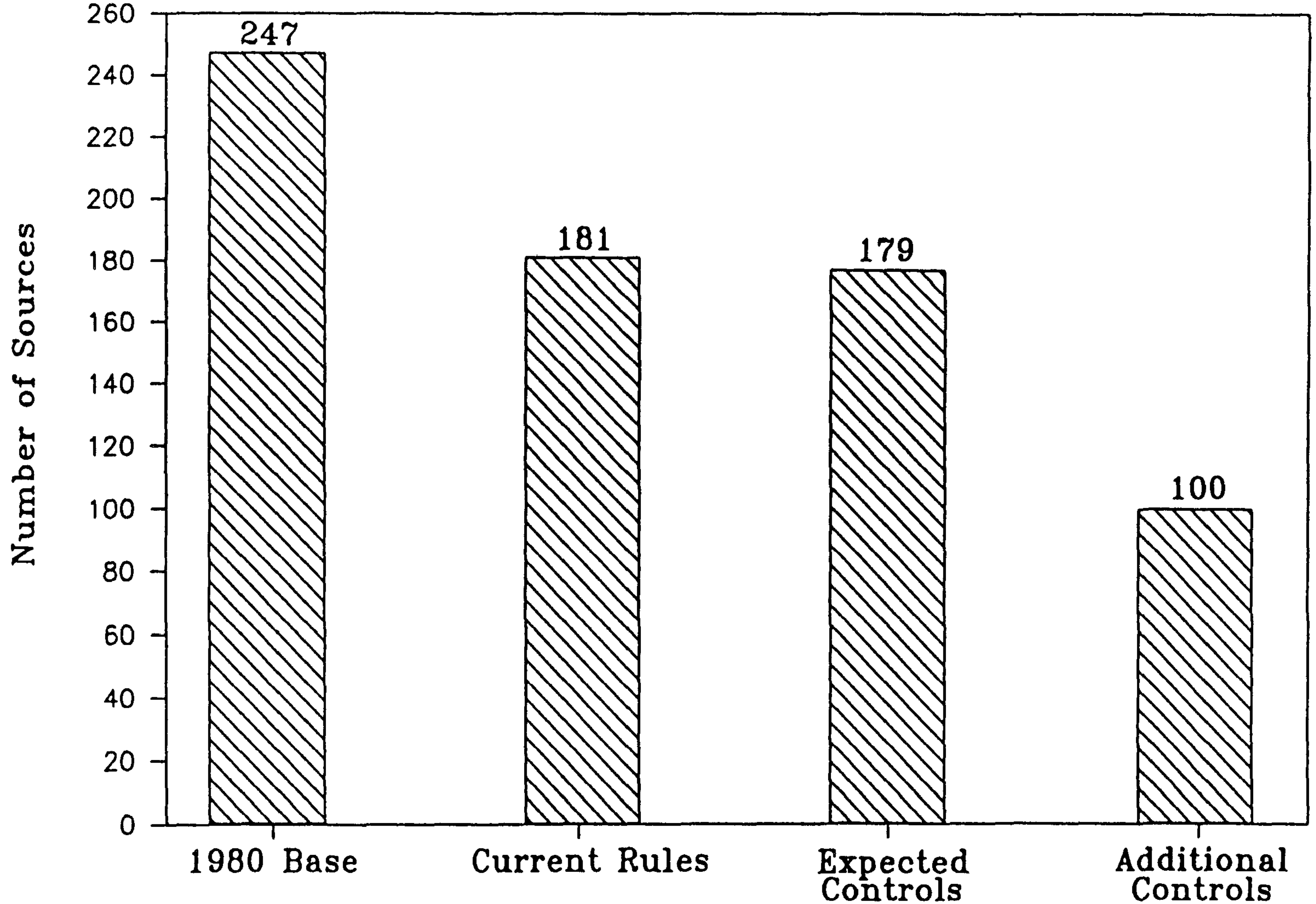
TOTAL FIVE CITY INCIDENCE CHANGES BY SCENARIO

(EXCESS ANNUAL CANCER CASES)

	BASE YEAR '80	CURRENT RULES '95	EXPECTED CONTROLS '95	ADDITIONAL CONTROLS '95
HIGHWAY VEHICLES	48.8	21.1	21.1	20.1
CHROME PLATING	8.0	11.2	1.8	0.1
COMFORT COOLING TOWERS	4.4	6.0	0	0
WOODSTOVES	3.8	3.5	3.5	2.2
INDUSTRIAL COOLING TOWER	3.0	3.5	1.1	0.5
MISC. SOLVENT	2.8	3.2	3.2	2.2
HOSPITAL STERILIZERS	1.5	1.8	1.8	0.02
FIREPLACES	1.4	1.6	1.6	1.6
MISC SURFACE COATING	1.2	1.4	1.4	1.4
COLD/DRY CLEANING	1.1	0.6	0.6	0.3
GLASS/BRICK MFG	1.1	0.2	0.2	0.2
POTWs	0.5	0.6	0.6	O.1
PETROL WASTEWATER TREAT	0.4	0.04	0.04	0.02
COKE OVENS	0.4	0.04	0.04	0.04
OTHER	14.3	12.4	11.8	8.6
TOTAL 5 CITY INCIDENCE (Percent reduction from base year)	92.7	67.0 (27%)	48.8 (47%)	37.3 (60%)

Figure 5

Number of Sources With Maximum Individual Risk Greater than One in a Million ($1x10^{-6}$)



Each source-pollutant combination contributing to one in a million MIR is counted every time it occurs.

Figure 5 shows the results of the analysis to determine what effect the control scenarios would have on maximum individual risk from point sources. The measure chosen for demonstration purposes was the number of point sources that would cause a maximum individual risk above one in a million. From the base case to the current rules scenario, there was a 27 percent reduction in the number of sources above this cutoff level. The expected controls and the additional controls scenarios resulted in additional 1 and 32 percent reductions, respectively, for a total reduction of 60 percent.

In summary, this study estimates that the area-wide cancer incidence may be reduced by approximately half from the base case as a result of currently planned controls. It is interesting to note that this reduction is almost equally divided between reductions in VOC and PM emissions and that approximately half of the incidence reduction is due to mobile source control and the other half to stationary source control. The study also indicates that the control scenarios studied may significantly reduce the maximum individual risk contributions from point sources.

DATA BASE LIMITATIONS

While this study provides an initial insight into the potential for mitigating urban problems, it is important to remember the limitations of the available data base in terms of both data accuracy and source category comprehensiveness. The methods, data, and assumptions reflected in any study such as this tend to change, sometimes rapidly, as one's understanding of the urban air toxics problem evolves and matures. For example, new sources and pollutants may be uncovered, and new assumptions may be adopted concerning how exposure and risk characterizations should be conducted. A fundamental problem with this type of analysis is the adequacy of emissions inventory data for air toxics. The past efforts in emissions inventory development work have focused more on criteria pollutants and less on air toxics, leaving a gap in the air toxics inventory. In addition, there are many pollutants and sources encompassed by air toxics, few are covered by emission factors, and the emission factors that are available may not be very accurate. The emissions inventory data utilized in this study probably did not allow for identification of all air toxics sources, particularly the smaller ones. The full extent of the air toxics problem, therefore, may not be reflected and the potential for control may well be over- or underestimated.

USE OF RESULTS

Not all of the data and procedures used in this analysis have been reviewed by the State and local air agencies whose jurisdictions encompass the study cities. In many cases, especially with small point and area sources, EPA and its support contractor made their own emission estimates based on national data and "top down" procedures. Due to these and other data limitations, these results should not be associated with any particular city. Moreover, because of the many assumptions and limitations inherent in this type of assessment, the composite results for all five cities probably provide a better representation of the urban air toxics problem and its overall controllability than the results for any single city or the relative results of a particular control measure.

The study, therefore, should be considered as an analysis whose results give an indication of the potential and direction for an urban air toxics mitigation strategy. A factor to bear in mind when reviewing this report is that some source categories (e.g., small stationary sources) may not show up as significant contributors to risk due to data base shortfalls. Nevertheless this study is useful in giving some indication of the potential for risk reduction in urban areas from anticipated programs.

I OVERVIEW OF STUDY

A. PURPOSE OF STUDY

This Volume II study was performed to explore the overall controllability of urban air toxics. It is hoped that this study will provide some indication of the impact of some mitigation measures that might be implemented by State or local agencies to address the cancer risk portion of the urban air toxics problem. Within current legislative authorities, ongoing EPA efforts will contribute toward further reductions in air toxics emissions and associated incidence. These efforts include New Source Performance Standards (NSPS) for wood stoves and several volatile organic compound (VOC) sources, the National Emission Standards for Hazardous Air Pollutants (NESHAP) program, continued progress under the Federal Motor Vehicle Control Program (FMVCP), Resource Conservation and Recovery Act (RCRA) air emission limits for Treatment, Storage and Disposal Facilities (TSDFs), development of the upcoming national ozone strategy for reducing VOC emissions, and promulgation of PM_{10} ambient air quality standards. In addition, continued implementation of existing State and local plus Federal requirements will reduce emissions which are likely to contribute to the current urban air toxics problem.

This study provides a quantitative assessment of how air toxics emissions and associated risk might change between the base year and 1995 under current rules for a sample of compounds. Analyses are also provided for possible additional measures beyond what are currently required. The study was designed to examine criteria pollutant and compound specific emission reductions and associate with them potential reductions in estimated cancer incidence and maximum individual risk.

This study, like most urban assessments to date, should be considered a screening (or scoping) analysis, performed to yield an order-of-magnitude estimate of the relative nature of the urban cancer problem rather than to provide an absolute prediction of incidence and individual risks. It is especially critical in this type of study to ensure that the scope and use of the conclusions be kept compatible with one's confidence in the underlying data base and analyses. Most studies to date of this type are acknowledged to be screening or scoping studies whose results should be used only in a relative sense for providing broad program direction to suggest where more detailed and focused follow-up work is needed.

Not all of the data and procedures used in this analysis have been reviewed and approved by the States or local air agencies whose jurisdictions encompass the study cities. In many cases, especially with small point and area sources, EPA and its support contractor made their own emission estimates based on national data and "top down" procedures. For these reasons, no results are associated with any particular city in this report. Because of the many assumptions and limitations inherent in this type of assessment, and because of different characteristics of each of the five cities, the composite results for all five cities may provide a better overall representation of the urban air toxics problem in the United States than the results for any single city.

B. NATURE OF URBAN AIR TOXICS PROBLEM

Volume I of this study showed that for the base year, aggregate cancer incidence across the five cities in this study averaged about 6 excess annual cases per million persons, ranging from about 2 to 10 in individual cities. Area-wide individual lifetime cancer risks averaged about 4×10^{-4}, ranging from about 1.5×10^{-4} to 7×10^{-4}. Note that these risks are not maximum individual risks, which can be as high as 10^{-3} or even 10^{-2} at specific receptor sites around some large point sources (Haemisegger et al., 1985). Instead, these are individual risks averaged over entire urban populations. Volume I of this study did not attempt to estimate maximum individual risks. Results of the limited maximum individual risk (MIR) modeling performed in this study are presented in Chapter III of this report.

Figures I.1 and I.2 show the major pollutants and sources contributing to urban cancer incidence from air toxics in the base year, based on average results from the five cities. Figure I.2 shows that the major contributors to total aggregate incidence tend to be small point and area sources and road vehicles, the latter figuring importantly in most urban studies. Not surprisingly, the pollutants of primary importance tend to be those associated with these same source contributors. Total cancer incidence associated with POM in Figure I.1 is largely due to diesel particulate (45 percent), gasoline particulate (32 percent), and wood smoke (17 percent), all of which are area sources. Total cancer incidence associated with chromium is predominantly due to hexavalent chromium (Cr^{+6}) emitted from industrial cooling towers (19 percent), comfort cooling towers (28 percent), and chrome platers (51 percent). Cancer incidence from benzene and 1,3-butadiene exposure is primarily due to road vehicles.

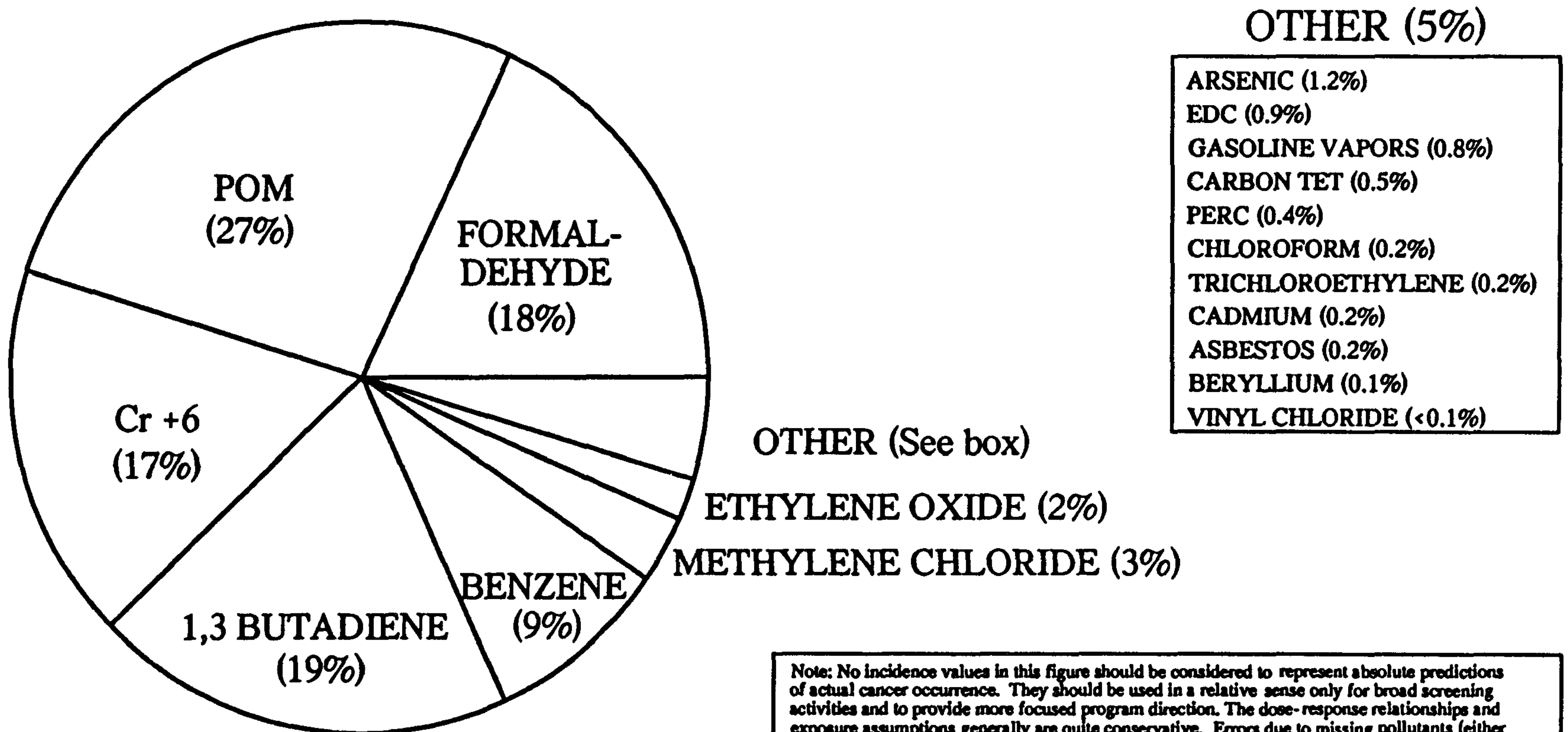
Risk from formaldehyde exposures is attributable both to secondary (or photochemically produced) formaldehyde and to primary (or directly emitted) formaldehyde. This study suggests that direct formaldehyde emissions account for about 40 percent of the total formaldehyde-related cancer risk whereas secondary formaldehyde accounts for about 60 percent. The primary VOC sources contributing to secondary formaldehyde production are road vehicles (35 percent), solvent use (29 percent), gasoline marketing (8 percent), and refining (6 percent).

C. STUDY FOCUS

1. Emphasis on Cancer

This study estimates cancer risks from long-term (i.e., annual average) exposures to multiple pollutants. This type of analysis has predominated urban air toxics assessments. To date, limited work has been done to quantify noncancer risks associated with short-term (i.e., acute and subchronic) exposures to air toxics.

FIGURE I.1
POLLUTANTS CONTRIBUTING TO FIVE CITY AVERAGE EXCESS AGGREGATE CANCER INCIDENCE

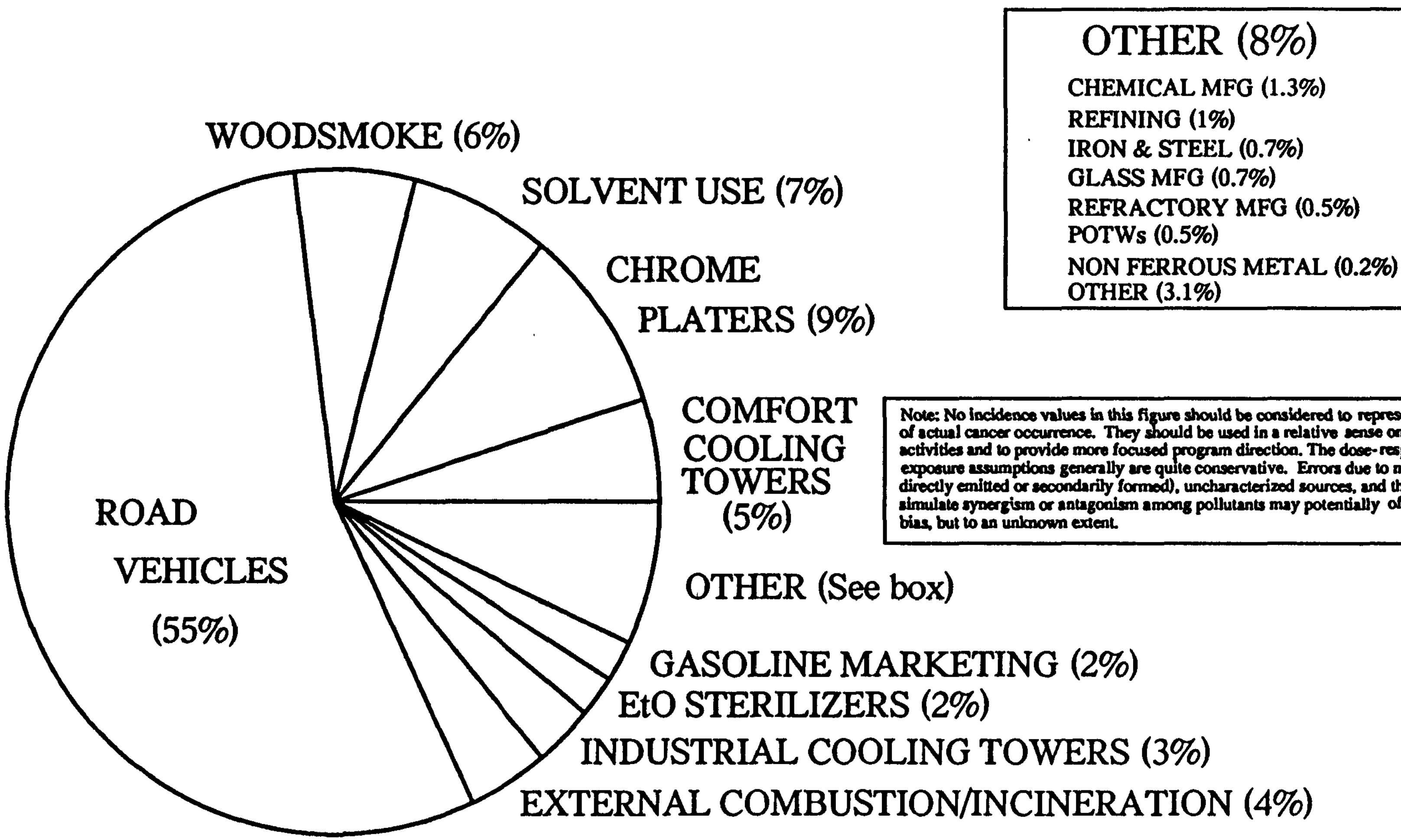


Note: No incidence values in this figure should be considered to represent absolute predictions of actual cancer occurrence. They should be used in a relative sense only for broad screening activities and to provide more focused program direction. The dose-response relationships and exposure assumptions generally are quite conservative. Errors due to missing pollutants (either directly emitted or secondarily formed), uncharacterized sources, and the lack of any mechanism to simulate synergism or antagonism among pollutants may potentially offset this conservative bias, but to an unknown extent.

AVERAGE 5 CITY INCIDENCE = 6 CASES/YEAR/MILLION POPULATION

FIGURE I.2

SOURCES CONTRIBUTING TO FIVE CITY AVERAGE EXCESS AGGREGATE CANCER INCIDENCE



Note: No incidence values in this figure should be considered to represent absolute predictions of actual cancer occurrence. They should be used in a relative sense only for broad screening activities and to provide more focused program direction. The dose-response relationships and exposure assumptions generally are quite conservative. Errors due to missing pollutants (either directly emitted or secondarily formed), uncharacterized sources, and the lack of any mechanism to simulate synergism or antagonism among pollutants may potentially offset this conservative bias, but to an unknown extent.

AVERAGE 5 CITY INCIDENCE = 6 CASES/YEAR/MILLION POPULATION

The most commonly used measure of cancer risk in urban assessments is "aggregate cancer incidence," which is a measure of the excess cancer cases over an entire urban area associated with multi-source, multi-pollutant exposures to air toxics. (This is also called "population risk.") Incidence is typically expressed as the number of excess cancer cases expected in a single year, but is estimated based on an assumed 70 year "lifetime" exposure. In this study, incidence is considered additive (covering multiple pollutants) and is population-normalized by adjusting per million persons. As such, the measure of cancer risk most commonly expressed herein is "excess aggregate additive incidence per year per million population." Normalization by population allows incidence from one urban area to be compared with another.

2. Modeling Scenarios

Three primary modeling scenarios, or groups of control measures, were developed for examination in this study. The three scenarios include a "current rules" analysis, "expected controls" analysis, and "additional controls" analysis. All quantifiable control measures under the three scenarios were evaluated for VOC and PM emissions reductions by 1995 using the Regulatory Impact Model (RIM) developed by Radian Corporation. The RIM starts with a 1980 emissions data base and simulates how those emissions might be expected to change by source category in 1995. A more detailed description of how the RIM simulates future emission changes is provided in Chapter II.

A summary of the three 1995 modeling scenarios included in this study is provided in Table I.1. The current rules analysis reflects the effect of existing rules affecting VOC or PM (or specific toxic) emissions, whether they are local, State, or Federal in nature. For stationary sources, current rules include SIP regulations, NSPS, and NESHAP. Mobile source controls include the effects of the FMVCP as well as existing inspection and maintenance programs.

The expected controls analysis adds additional emissions reductions to the current rules scenario. The additional

Table I.1
Summary of Scenarios (1995)

	Current Rules Analysis	Expected Controls	Additional Controls
Stationary Sources	Current SIP Regulations, NSPS and NESHAP	Candidate Federal rules	Add FIP measures for VOC and candidate CTGs Most stringent SIP level controls for PM Most stringent control levels available applied to all emitters For particulates, if no category-specific regulation information was available, a default control level of 98% was used for point sources.
Mobile Sources	FMVCP plus I/M programs in effect now	Add gasoline Reid Vapor Pressure limits (RVP)	Add 5% reduction in vehicle miles traveled (VMT)

reductions are attributable to candidate Federal rules currently in process. For mobile sources, the expected rules case includes gasoline Reid Vapor Pressure (RVP) limits.

The third, and most stringent, control scenario modeled is labeled the additional controls scenario and includes expected Federal Implementation Plan (FIP) control measures for VOC and the most stringent SIP level controls for particulates and control technique guidelines (CTGs) being considered as part of the EPA post-1987 ozone policy. As shown in Table I.1, this scenario applies the most stringent control levels available to all stationary source emitters. For particulates, if no category-specific regulation information was available, a default control level of 98 percent was used for point sources. This 98 percent control level was selected by inspecting the requirements for point source PM control in the five study areas and choosing a control level representative of the maximum available. (There are source types achieving greater than 98 percent control of PM, but for categories with no specific regulations it seemed unrealistic to choose too high a value.) PM emitting area sources were controlled further only if category specific information about controls was available. A vehicle miles traveled (VMT) reduction of 5 percent was added to the motor vehicle control measures modeled in the expected controls case to simulate the maximum expected for these sources.

3. Caveats

The reader is cautioned when drawing conclusions from the results of this report because they involve considerable uncertainty. Estimated incidence can change by a large magnitude and the ranking in importance of various sources and pollutants can change depending on the assumptions made in the analysis -- and these assumptions will continue to change as new information becomes available.

As an example, an initial modeling study conducted for the same five cities produced base year incidence estimates that were 800 percent higher than the current results. This dramatic decrease in incidence occurred despite adding a number of compounds to the study that were not analyzed previously and changing the approach for estimating formaldehyde-related incidence to account for secondary formation. Many of the unit risk values have changed as new information has become available. The other major change affecting analysis results has been the method for estimating polycyclic organic matter (POM) related incidence. The comparative potency approach used here produces much lower POM incidence estimates than the previous approach of using benzo(a)pyrene (B(a)P) as a surrogate for POM.

While this study provides an initial insight into the potential for mitigating urban problems, it is important to remember the limitations of the available data base in terms of both data accuracy and source category comprehensiveness. The methods, data, and assumptions reflected in any study such as this tend to change, sometimes rapidly, as one's understanding of the urban air toxics problem evolves and matures. For example, new sources and pollutants may be uncovered, and new assumptions may be adopted concerning how exposure and risk characterizations should be conducted. A fundamental problem with this type of analysis is the adequacy of emissions inventory data for air toxics. The past efforts in emissions inventory development work have focused more on criteria pollutants and less on air toxics, leaving a gap in the air toxics inventory. In addition, there are many pollutants and sources encompassed by air toxics, few are covered by emission factors, and the emission factors that are available may not be very accurate. The emissions inventory data utilized in this study probably did not allow for identification of all air toxics sources, particularly the smaller ones. The full extent of the air toxics problem, therefore, may not be reflected and the potential for control may well be over- or underestimated.

Other specific caveats and modeling assumptions are listed below.

(1) Personal exposure to air toxics was estimated using annual-average concentration estimates and it was assumed that exposures occur where people reside. In addition, only outdoor exposures were modeled. Thus, this methodology ignores people's movements throughout the urban area, travel

outside the urban area, and indoor exposures. Because exposures were simulated over a 70-year period, it is unclear how much this restricted modeling methodology affects the study results.

(2) The study relied solely on quantitative estimates of cancer risk associated with inhalation of ambient air. Acute and subchronic effects were not included, and cancer cases associated with exposure routes other than inhalation of ambient air were not quantified.

(3) Only a selected number of compounds were included in this study, although monitoring studies have shown that urban atmospheres typically contain many more pollutants. The compounds selected for study were chosen because they were estimated to be the most important contributors to excess cancer incidence.

(4) Annual-average emission estimates were used to estimate concentrations of air toxics. Thus, the study focused on routine, continuous emissions. Accidental releases were not modeled.

(5) Unit risk factors employed in this study represent the chance of contracting cancer from a lifetime (70 years) exposure to a given concentration of that pollutant. The carcinogenic potency estimates used in this study were developed by EPA's Carcinogen Assessment Group.

(6) Cancer incidence estimates are presented for existing conditions (1980) and a 1995 projection year. These incidence estimates are based on the assumption that emission levels for each scenario remain constant for a 70-year period. In reality, emissions will vary from year to year.

(7) In assessing cancer risk within an urban area, each of the compounds under study has been analyzed individually. Any possible synergistic or antagonistic health effects of these compounds have been ignored.

(8) Sources included in the exposure modeling data set for each study area were limited to those in the counties under study. Therefore, while contributions from these sources to areas outside the county boundaries were considered, contributions of sources located outside the county boundaries to air toxic concentrations within the study areas were not.

(9) Modeling results presented in this report for exposure to gasoline vapors do not include self-service exposures at service stations.

(10) Except for secondary formaldehyde formation, atmospheric transformation of toxic compounds has been ignored. Both secondary formation and scavenging may occur for the compounds included in this study. Thus, it is difficult to quantify how neglecting transformation might affect the final results.

(11) Incidence from secondary formaldehyde exposure was estimated using ambient monitoring data and assuming that everyone within an urban area is exposed to the same concentration. This is a relatively crude technique especially since it has been found that ambient ozone causes a negative interference with the dinitrophenylhydrazine (DNPH) method for measuring formaldehyde. Because so much of formaldehyde is formed secondarily, however, this procedure was judged to be preferable to modeling direct formaldehyde concentrations and ignoring secondary formation.

(12) It has been suggested that background concentrations of some toxic compounds, notably carbon tetrachloride, may be contributing significantly to observed ambient readings. No attempt has been made in the dispersion modeling performed for this study to account for background concentration.

(13) While the comparative potency approach used to estimate POM risks is judged to be an improvement over previous particulate modeling techniques, which used B(a)P as a surrogate for POM, the particle unit-risk estimates are based on few measurements, especially for the important motor vehicle categories, and the uncertainty in these values should be recognized.

(14) Analyses of control measures for numerous VOC emitting source categories were limited by whether categories were covered in the emission inventories for the five cities included in the analysis. Thus, if no web-offset lithography sources appear in the emissions data base, then regulations to control this source type will show no benefit in the modeling analysis.

(15) Results of this study may be biased toward showing current regulations, particularly NESHAPs, to be more effective in reducing incidence than they may be in practice. This bias might occur because regulated sources are those for which the most information is available. If other sources turn out to be just as important as the well known ones, then these NESHAP regulations expected to be in place by 1995 will not achieve the percentage reductions in overall incidence that are estimated in this study. The percentages are affected because the problem is bigger than is estimated. The actual benefit is the same, but would show up as less of a percentage change if the total picture were known.

(16) The handling of some point sources as area sources for modeling purposes may introduce some upward bias in the resulting exposure/risk estimates since HEM distributes area source emissions by population and since area source emissions are released closer to ground level.

(17) Caution is urged when applying the study results to other cities since the sources and pollutants may not be representative of some other areas. For example, no study area includes the heavy concentration of wood stoves that characterize some northern cities; hence, the relative importance of wood smoke may be understated in this report.

(18) Hazardous waste treatment, storage, and disposal facilities (TSDF) emissions in the five areas selected for study here are lower on a per capita basis than the national average and, therefore, TSDF controls may be more effective in other areas where the share of TSDF emissions is larger.

(19) Any study such as this represents a "snapshot in time" of one's collective understanding of the urban air toxics problem. In fact, the emission estimates and dose-response relationships used in this study are subject to frequent revision as newer data become available. Hence, care should be taken when interpreting any results from this study or comparing these results to those from other studies where different data have been used.

4. Methodology

This section provides an overview of the study methods used in this analysis including the areas of data base development, modeling methodology, and constraint file development. Each of these areas is discussed in greater detail in Chapter II.

a. Data Base

The data base used in this study represents conditions generally existing between 1980 and 1985. The starting point of this inventory was the 1980 National Acid Precipitation Assessment Program (NAPAP) emission inventory and incorporated updated information from local and state agencies as well as EPA and other governmental studies. Several additional emission factor modifications were made to the base inventory developed for the Volume I study after examining a number of source categories and identifying several that were lacking emission factors in the Volume I inventory.

b. Modeling

Once the data base for the base year was established, inventories for 1995 for each of the three cases were developed. The future year emission projections were made using RIM. Source category growth rates and replacement rates were used as inputs to the model along with a constraint file that simulates how regulations will change new, replaced, and existing source emissions. The output of the RIM model, the percentage changes in VOC and PM emissions between 1980 and 1995 for each source, was input to the Human Exposure Model (HEM). Other inputs to HEM include unit risk factors for the pollutants of concern and population and meteorological data. The HEM model produces estimates of excess cancer incidences due to the toxic emissions calculated by RIM. More importantly, the output from HEM was used to show changes in incidence due to the three different control cases.

c. Constraint Files

The three different control cases modeled for this study are current rules case, expected controls, and additional controls. A separate constraint file was used to model the regulations in effect for each case. The constraint file for the current rules case included regulations in existence, being implemented, or under serious consideration for implementation as of 1985. The constraint file for the expected controls case includes the regulations included in the current rules case plus rules that are expected to be established or come into effect by 1995. The constraint file for the additional controls case includes the constraints from the expected controls case with the addition of constraints applying the most stringent control level available for all sources. These constraint files were applied in the RIM model to determine emissions in 1995 for each source category.

II STUDY METHODS

A. DATA BASE

A base year inventory was previously compiled for each of the five metropolitan study areas from a number of different sources of information. This effort mainly upgraded those areas of most importance reflecting newer source and emissions data. The base year nominally represents the year 1980 but, in fact, the data were not this well resolved temporally. Thus, the base year should really be considered to represent conditions generally existing between 1980 and 1985. Motor vehicle emissions were estimated using 1980 emission factors, but emission estimates for other categories were updated to current conditions when better information was available than existed in the 1980 emission inventory. These revisions included deleting plants from the data base which were known to have shut down after 1980. The first reliable[1] ambient formaldehyde data, used to estimate total formaldehyde-related risk, were not available until 1987.

The base year inventory was compiled from a number of sources. The starting point was the 1980 NAPAP emission inventory (Wagner et al., 1986). This inventory was improved by incorporation of the following:

- information from local surveys;
- comments from State and local air agencies;
- information and methodologies from EPA's Integrated Environmental Management Projects (IEMP) "geographic" studies;
- updated emission factors and emission estimates from EPA's NESHAP program;
- updated emission factors and emission estimates from EPA's Office of Mobile Sources (OMS);

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[1]The data are likely to have been underestimated due to ozone interference with the DNPH method.

- updated emission factors from EPA's emission factor documents; and

- special contractor studies of area source activity levels and emissions (hospital sterilizers, waste oil combustion, dry cleaning, residential wood combustion, and wastewater treatment).

Readers interested in a more detailed treatment of the emission inventory compilation are referred to Volume I of this report (Pechan, 1989). What follows is a discussion of how the toxics data base has been augmented since Volume I was completed.

Using the Crosswalk data retrieval system (U.S. EPA, 1987b) and the VOC Speciation Data System (Radian, 1989), each of the source categories currently being considered for control by Federal rule, CTG, or ACT was examined to determine whether any of the toxic species of interest to this study could be emitted by that category. This assessment led to three types of changes or additions being made to the inventory. The first involved adding toxic emission factors for point source SCCs for lithography and marine vessel loading. The second change consisted of adding a new area source SCC to the inventory to include VOC and toxic emissions from hazardous waste TSDFs. The final change consisted of adding five area sources (architectural surface coating, traffic paints, autobody refinishing, industrial maintenance coating, and miscellaneous industrial surface coating) whose VOC emissions were already included in SCC 99999971, Surface Coating. This SCC was eliminated after being broken down into five new area source SCCs to allow for different toxic emission factors and control efficiencies for each of the individual surface coating area sources. This breakdown is illustrated in Figure II.1. The total VOC emissions in each source category affected by these changes are shown in Table II.1 with the toxic pollutant emissions that were added to the inventory listed in Tables II.2 through Table II.5. A more detailed discussion of the changes made to the base case inventory is included in Appendix A.

Figure II.1
Allocation of Surface Coating Emissions to Different Uses

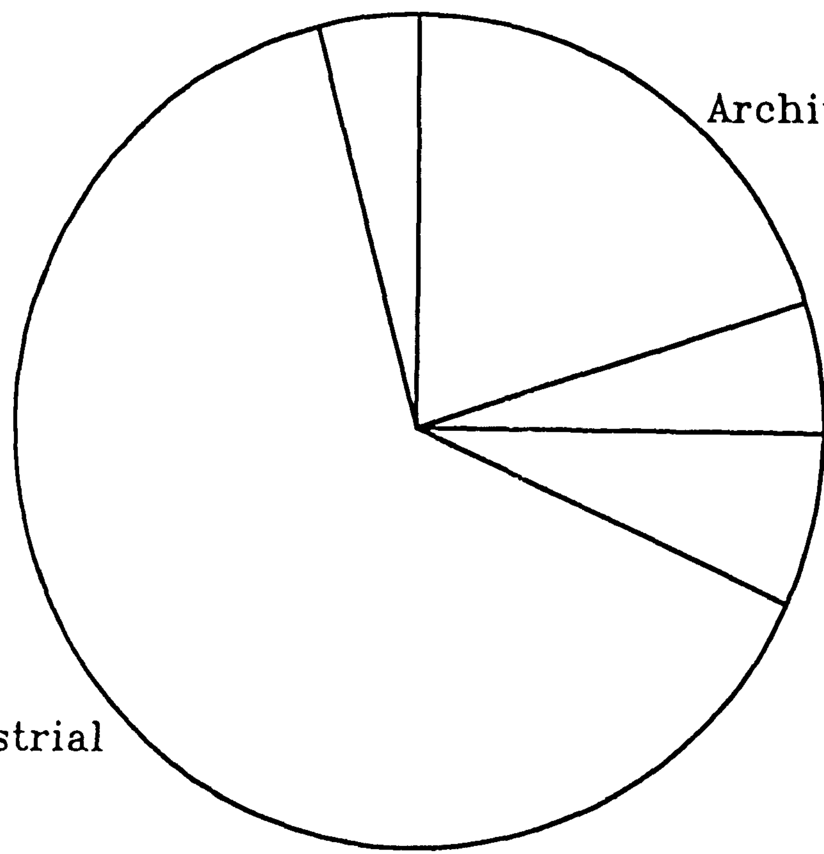


Table II.1

Total VOC Emissions in Each Source Category

City	Architectural Coating (tpy)	Traffic Paint (tpy)	Autobody Refinishing (tpy)	Misc. Surface Coating (tpy)	Industrial Maintenance Coating (tpy)	TSDF (tpy)	Web Offset Lithography (tpy)	Marine Vessel Loading (tpy)
A	2,093.5	533.9	701.3	6,709.8	429.2	90.5	NA	NA
B	13,702.2	3,494.1	4,590.2	43,915.6	2,809.0	7,541.7	3,958.0	458.0
C	502.5	128.1	168.3	1,610.4	103.0	693.3	NA	NA
D	937.6	239.1	314.1	3,005.0	192.2	673.4	17.0	NA
E	1,084.4	276.5	363.3	3,475.5	222.3	0.0	105.0	NA
Totals	18,320.2	4,671.7	6,137.3	58,716.3	3,755.6	8,998.9	4,080.0	458.0

Table II.2

Benzene Emissions Added by Source Category

City	Architectural Coating (tpy)	Traffic Paint (tpy)	Autobody Refinishing (tpy)	Industrial Maintenance Coating (tpy)	TSDF (tpy)	Marine Vessel Loading (tpy)
A	1.9	0.5	10.6	0.4	2.3	NA
B	12.3	3.1	69.3	2.5	193.8	10.8
C	0.5	0.1	2.5	0.1	17.8	NA
D	0.8	0.2	4.7	0.2	17.3	NA
E	1.0	0.2	5.5	0.2	0.0	NA
Totals	16.5	4.2	92.7	3.4	231.3	10.8

Table II.3

Methylene Chloride Emissions Added by Source Category

City	Architectural Coating (tpy)	Traffic Paint (tpy)	Industrial Maintenance Coating (tpy)	Web Offset Lithography (tpy)
A	31.6	8.1	6.5	NA
B	206.9	52.8	42.4	1,359.9
C	7.6	1.9	1.6	NA
D	14.2	3.6	2.9	NA
E	16.4	4.2	3.4	29.3
Totals	276.6	70.5	56.7	1,389.2

Table II.4

Perchloroethylene Emissions Added by Source Category

City	TSDF (tpy)
A	0.1
B	7.5
C	0.7
D	0.7
E	0.0
Totals	9.0

Table II.5

Formaldehyde Emissions Added by Source Category

City	Web Offset Lithography (tpy)
A	NA
B	12.6
C	NA
D	3.7
E	4.6
Totals	20.9

B. REGULATORY IMPACT MODEL

1. Model Overview

All measures analyzed in this study were evaluated for VOC and PM emissions reductions in 1995 using the RIM developed by Radian Corporation. The RIM starts with a 1980 emissions data base and simulates how those emissions are expected to change in 1995 by source category. Important variables in the projections include new source growth rates, replacement rates, and a constraint file which simulates how new, replaced, and existing source emissions are expected to be affected by regulations. The RIM also contains cost information for each control option, so that both projected emissions and control costs are an output of the model.

For estimating future year incidence, the RIM provides percentage changes in emissions between 1980 and 1995 for each source category for VOC and PM, and this information is used in the HEM to estimate incidence changes. As mentioned previously, in this study three scenarios were simulated using the RIM: a current rules case, an expected controls case, and an additional controls case. VOC and PM simulations were performed separately, with constraint files for each pollutant.

The overall study methodology is summarized in Figure II.2. This figure shows the relationship among the 1980 emissions data base, the projections to 1995, and the exposure models. Of most interest in this study is the application of the RIM, which is shown schematically in Figure II.3.

The RIM emission data bases (separate data bases are used for VOC and PM emissions) are organized by source category (SCC), with aggregations of controlled and uncontrolled emissions for each region or study area (these are also divided by large and small sized sources). Uncontrolled emissions are an important indicator of activity levels for a category since they eliminate source-by-source variations in control effectiveness. These uncontrolled emissions are calculated based on controlled emissions and control efficiency on a source-by-source basis and then are aggregated at the SCC level for input to RIM.

Figure II.2

AIR TOXICS CONTROLLABILITY STUDY METHODOLOGY

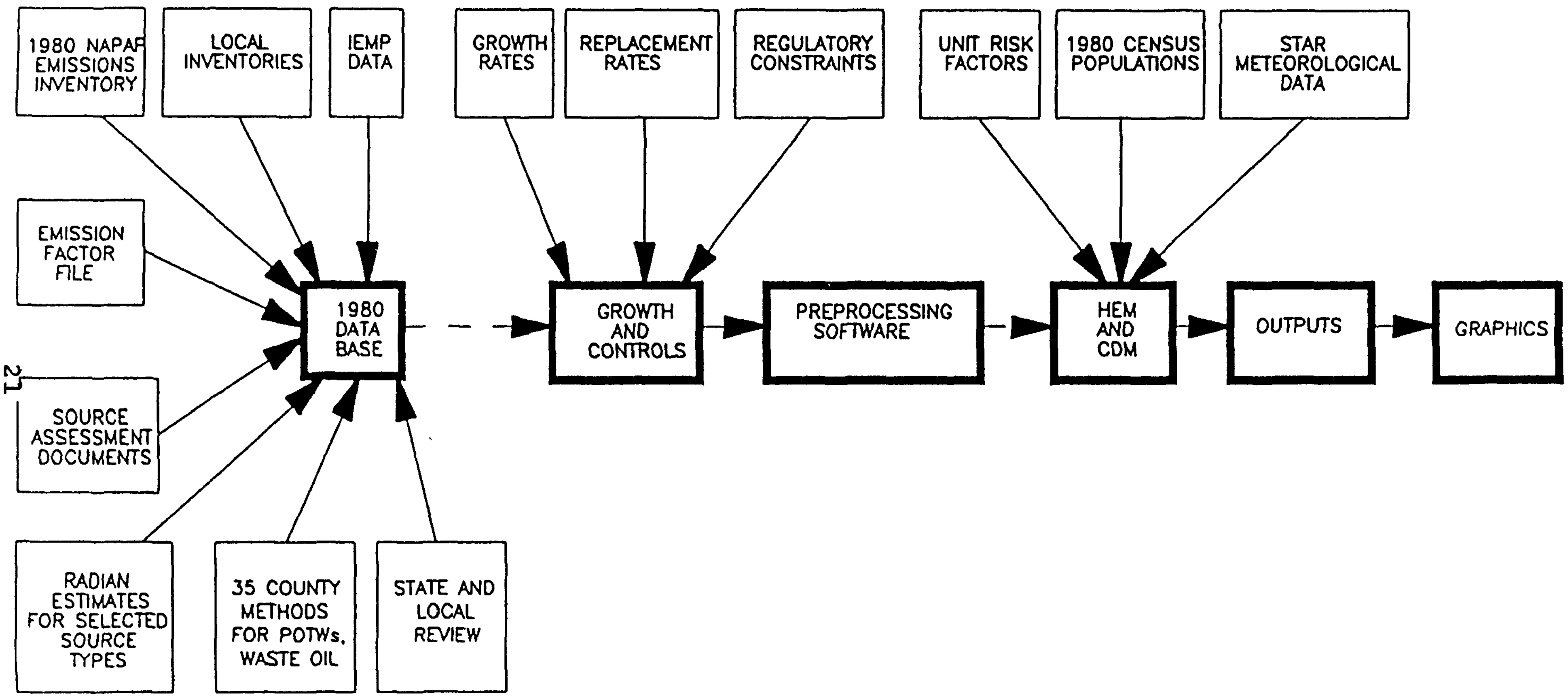
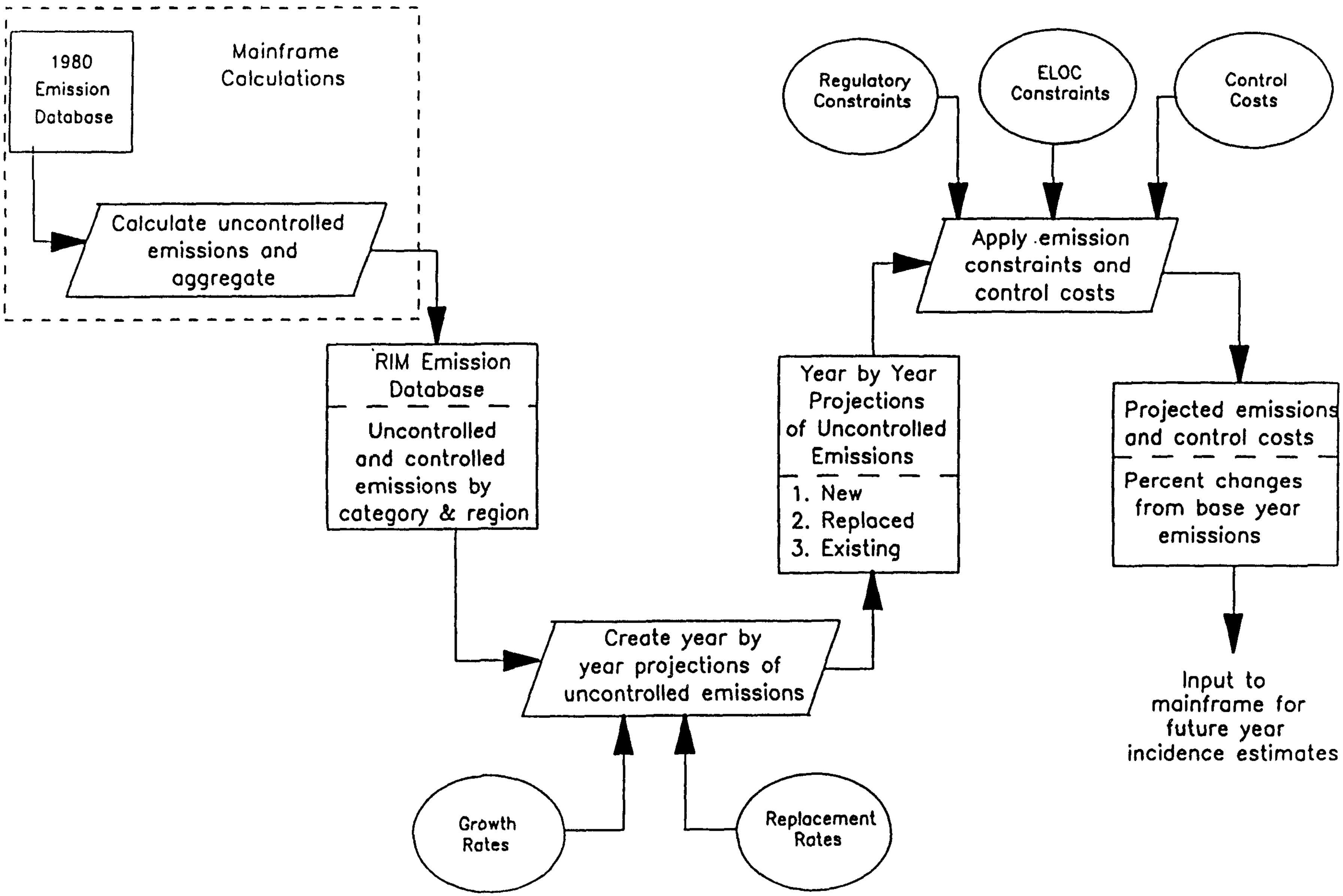


Figure II.3
Regulatory Impact Model



The RIM creates year by year projections of uncontrolled emissions based on growth and replacement rates. These emissions are separated into emissions from new, replaced, and existing sources. Constraints and control costs are specified for each of these three types of emissions. New source emissions added in a given year are estimated by applying annual growth rates to the total emissions in the previous year. Growth is compounded annually, increasing exponentially with time (or decreasing if the growth rate is negative indicating a decrease in activity for the source type). Replaced emissions in any year are calculated by multiplying the replacement rate by the base year (1980) uncontrolled emissions. Total replaced emissions from the base year exhibit a linear increase. As an example, a replacement rate of 3 percent per year results in 45 percent of the 1980 emissions being replaced by 1995. Since existing emissions are calculated by simply subtracting the replaced emissions, 55 percent of the base year emissions would be labeled as existing in the above example. Existing source emissions are those emissions remaining which were in place in the base year. The RIM keeps track of replaced emissions since they are often subject to more stringent regulations than are existing source emissions. New emissions coming on line after 1980 are not subject to replacement since equipment life generally exceeds the projection time period.

Uncontrolled emissions are projected on a year by year basis since regulatory constraints become effective in different years. For example, an NSPS starting in 1989 would not apply to new emissions prior to 1989. Along with applying the regulatory options found in the constraint files, the RIM also applies an implicit existing level of control (ELOC) constraint. This is applied to all future emissions since it is believed that within a given source category, all new and replaced emissions will be controlled at least to the level of existing sources. The ELOC is calculated by RIM based on the uncontrolled and controlled emissions. It is a measure of the average control level in place in the base year. The ELOC is specific to each source category and study area. Therefore, an ELOC constraint of 90 percent in Study Area B would not be applied to the same category in Study Area C.

Application of ELOC as a constraint is an important concept because of the potential effect overestimating base year control efficiencies can have on estimating future year emissions and incidence. First, it is necessary to understand the origin of the controlled and uncontrolled emission estimates. The controlled emissions in the National Emissions Data System (NEDS) may be either (1) estimated based on the operating rate, emission factor, and control efficiency, hereafter referred to as emission factor estimates, or (2) estimated based on stack tests, material balance measurements, or other methods, hereafter referred to as measured estimates.

Assuming that all other inputs are correct, the effect of overestimated control efficiencies varies depending on whether the emissions are measured or emission factor estimates. In the case of measured estimates, if controlled emissions are correct and the control efficiency is overestimated, then uncontrolled emissions will also be overestimated. With growth based on uncontrolled emissions, projections of new and replaced emissions will also be overestimated. With both the future year uncontrolled emissions and future year control level overestimated, the effect on controlled emissions, and thus incidence, is uncertain.

Overestimated control efficiencies for cases where emission factor estimates are used will have a different effect on future emissions. Uncontrolled emissions will, in effect, be based on the operating rate and emission factor and will not be affected by the control efficiency. The controlled emissions in the base year will be underestimated and ELOC will be overestimated. Projections of new and replaced uncontrolled emissions will be correct based on the uncontrolled emissions. Since ELOC is overestimated, future year control levels will be overestimated (given that ELOC is the effective constraint), reducing emissions and thus incidence. If constraints of a higher degree of control than ELOC are applicable to a category, ELOC will have no effect on the future year emissions and incidence for these cases.

After projections have been completed by the RIM, estimates of the percentage changes from base year controlled emissions by region and category are produced. These values are then used with the HEM results for the base year to project future year incidence.

2. Growth Rates

Growth in new source emissions was estimated for the 1980 to 1995 period using two-digit Standard Industrial Classification (SIC) level of detail for each industry. Population was used to estimate growth for some nonindustrial source types. Industry growth factors are from the Bureau of Economic Analysis (BEA) (U.S. Department of Commerce (DOC), 1981) and represent growth in industry earnings. Population projections are from the same source. Because Metropolitan Statistical Area (MSA) level industry earnings projections are only available at the one-digit SIC level, the method used to provide two-digit SIC growth rates was to allocate state level two-digit growth estimates to each MSA using that MSA's share of growth at the one-digit SIC level. This is believed to be a reasonable compromise between simply providing one-digit SIC growth rates for each MSA and assuming state-wide growth rates are representative of any area within that state. Table II.6 shows the growth factors by industry for each study area. Note that the services sector growth factors shown in Table II.6 are used to estimate growth in motor vehicle travel. Information on the motor vehicle emission factors used in estimating 1995 emissions is presented in Appendix B.

3. Sample Calculation

While Figure II.3 presented an overall picture of how the RIM operates, it is also useful to work through a sample calculation to show how a source category's emissions change under different scenarios. For this sample calculation, changes to Study Area B graphic arts VOC emissions (NEDS SCC = 40500599) are shown (1) for the 1995 base case scenario and (2) after expected controls are applied.

Table II.6

Population and Economic Growth Factors (1980-1995)
State Two-digit SIC Allocated to Selected Study Areas

SIC	Category	Study Area A	Study Area B	Study Area C	Study Area D	Study Area E
	Population	1.34	1.14	1.22	1.04	1.01
01-07	Agriculture	1.18	0.95	1.23	1.25	1.02
10	Metal Mining	1.17	NA	NA	NA	0.90
11-12	Coal Mining	NA	NA	2.84	1.55	1.69
13	Oil and Gas	NA	1.01	1.02	5.71	1.22
14	Nonmetal Mining	1.88	1.19	NA	0.91	1.03
15-17	Construction	1.54	1.35	1.35	1.31	1.36
20	Food	1.48	1.18	1.28	1.14	1.09
21	Tobacco	NA	0.97	0.48	NA	0.68
22	Textiles	1.07	1.75	NA	NA	0.84
23	Apparel	1.62	1.55	1.71	1.10	0.93
24	Lumber	1.72	1.21	1.33	NA	1.13
25	Furniture	1.94	1.39	1.13	NA	1.21
26	Paper	2.00	1.47	1.50	1.25	1.25
27	Printing	1.96	1.52	1.66	1.28	1.26
28	Chemicals	2.15	1.65	2.23	1.30	1.35
29	Petroleum Refining	1.92	1.18	1.60	1.27	1.06
30	Rubber and Plastics	2.50	1.70	NA	1.12	1.57
31	Leather	1.52	1.16	1.09	NA	0.73
32	Stone, Clay, and Glass	2.22	1.43	1.69	1.33	1.24
33	Primary Metals	1.62	1.32	2.90	1.19	1.15
34	Fabricated Metals	1.75	1.48	1.88	1.15	1.16
35	Non-electrical Machinery	1.95	1.74	2.66	1.35	1.20
36	Electrical Machinery	1.87	1.44	2.99	1.43	1.21
37	Transportation	1.50	1.07	1.90	1.14	1.44
38	Instruments	1.52	1.65	2.38	1.21	1.19
39	Misc. Manufacturing	1.46	1.36	1.52	0.94	1.04
72	Services	1.91	1.63	1.87	1.47	1.54

Source: U.S. DOC, 1981

The 1980 NAPAP Emissions Inventory point source file indicates that there are 1,585 tons of VOC emitted by sources with an SCC of 40500599 in Study Area B. These emissions and the VOC control efficiencies for each source with an SCC of 40500599 are used to calculate a weighted average ELOC for this SCC and region. For this particular example, uncontrolled VOC emissions were estimated to be 6,191 tons, which gives an existing level of control of 74.4 percent.

The growth rate for SIC 27, the printing industry, is used to estimate new source growth for graphic arts. The growth factor of 1.52 for Study Area B translates into an annual compounded rate of 2.83 percent. The estimated retirement rate for this industry is 4.6 percent.

The RIM constraint file shows two regulations which affect future year VOC emissions for graphic arts facilities in Study Area B. One is an NSPS that begins in 1986 and calls for 75 percent control of VOC emissions. A 100 percent penetration factor means that all new and replaced sources in the category are assumed to be affected by the NSPS. For this particular category, though, the SIP constraint is more stringent than the NSPS because it requires 85 percent control of existing, new, and replaced source emissions. Again, the penetration factor is 100 percent (applies to all sources regardless of size). A 1983 target year is listed for this regulation, but for a SIP regulation, the year of implementation is unimportant as long as it is prior to 1995, because all sources (existing and new) are affected.

As Table II.7 shows, for the 1995 base case scenario, controlled emission calculations are straightforward because all three categories of sources (existing, new, and replaced) have the same 85 percent control level. Calculation of 1995 uncontrolled VOC emissions is more complicated.

Shares of existing, new, and replaced emissions are estimated using the following three equations.

Table II.7
Stationary Source Sample Calculation
Regulatory Impact Model

	1980 Base Year			1995 Projection Year				
Source Type	Uncontrolled VOC	Controlled VOC	Control Level	Uncontrolled VOC	Current Rules Scenario	Current Rules Control Level	Expected Control Scenario	Expected Control Level
Existing	6,191	1,585	74.4%	1,919	288	85%	96	95%
New	--	--	--	3,218	483	85	161	95%
Replaced	--	--	--	4,272	641	85	214	95%
Total	6,191	1,585		9,409	1,412		471	

Note: VOC emissions are tons per year.

This sample calculation is for SCC = 40500599, Graphic Arts - Other emissions in Study Area B.

$$New_{1995} = Existing_{1980} * (1 + g)^n - Existing_{1980}$$

$$Replaced_{1995} = Existing_{1980} * (n * r)$$

$$Existing_{1995} = Existing_{1980} - Replaced_{1995}$$

Where: g = new source growth rate

r = retirement rate

n = number of years between the base year and the projection year

Applying these equations to the graphic arts SCC for Study Area B to estimate 1995 uncontrolled VOC emissions is shown below.

$$New_{1995} = 6{,}191 * (1.0283)^{15} - 6{,}191 = 3{,}218 \text{ tons}$$

$$Replaced_{1995} = 6{,}191 * (15 * 0.046) = 4{,}272 \text{ tons}$$

$$Existing_{1995} = 6{,}191 - 4{,}272 = 1{,}919 \text{ tons}$$

Controlled 1995 VOC emissions under the base case scenario are calculated as 1 minus the control efficiency (85 percent) times uncontrolled 1995 emissions. As shown in Table II.7, this total is 1,412 tons. This 1995 emission total for the base case scenario is then compared with the 1980 base year value for this SCC of 1,585 tons and the percentage change from 1980 to 1995 is estimated to be -10.9 percent. This percentage change is then used to estimate the change in emissions between 1980 and 1995 for all organic toxic compounds emitted by SCC 40500599 in Study Area B.

For the expected controls case, all the steps are the same with the exception that all new, replaced, and existing sources are assumed to be controlled by 95 percent instead of the 85 percent control assumed in the base case. This lowers the VOC emission estimate for the category to 471 tons and changes the percentage difference between 1980 and 1995 organic emissions to -70.3.

Note that while this sample calculation was performed for a relatively simple case, the calculations are more complex for some categories, e.g., where new and existing source regulations differ and where some sources are exempted from a regulation and these exemptions are simulated via penetration factors. Note also that for some source categories the existing level of control is higher than the highest level of control in the constraint file and thus will be binding on future year emissions rather than the constraint file controls.

C. CONSTRAINT FILES

1. Overview

This section provides an overview of the VOC and PM constraint files used to project future year emission changes. Separate constraint files are used for VOC and PM projections. The three scenarios examined include current rules, expected controls, and additional controls. Listings of the constraint files are in Appendix C.

a. Current Rules Case

The constraint file represents regulations in existence, being implemented, or under serious consideration for implementation as of 1985. Existing Federal and State requirements considered included SIPs, NESHAPs, NSPS, New Source Review (NSR), Best Available Control Technology (BACT), and Lowest Achievable Emission Rate (LAER). The principal information sources included the Federal Register, CTG documents, SIPs, and the Bureau of National Affairs Environmental Reporter. In addition, State officials within each study area and EPA staff having responsibility for pertinent criteria pollutant programs were contacted by Radian to identify control programs in the implementation process or under serious consideration for implementation. The SIP provisions for characteristics of specified sources to be controlled, NSR program policy, Prevention of Significant Deterioration (PSD) program policy, and local regulatory control plans were reviewed to identify any more stringent regulatory measures.

Review of earlier developed constraint files revealed that the expected reductions for gasoline marketing/vehicle refueling were likely overestimated. The expected level of control for

Study Area B was changed from 95 percent to 86 percent, which is the current EPA estimate of in-use efficiency of stage II controls with an annual enforcement program. The expected level of control for Study Areas A, D, and E was changed from 95 percent to 40 percent reflecting the likely effects of stage II controls with source size exemptions and minimal enforcement by 1995 for these regions.

In the current rules scenario, motor vehicle emissions were assumed to be controlled by both the FMVCP and inspection and maintenance (I/M) programs since all of the study areas currently have some form of I/M program in effect.

b. Expected Controls Scenario

The expected controls scenario represents new NESHAP and NSPS expected to be in effect by 1995 based on the EPA's expected schedule for currently considered air toxics regulations added to the current rule constraints. Table II.8 lists these NESHAP and NSPS constraints. All of the constraints for this scenario were given beginning and target years of 1992.

c. Additional Controls Scenario

The additional controls scenario is defined as the best control performance utilized for any source within the category and therefore includes the expected control scenario constraint file plus the most stringent control level available for all sources. Since no FIP study was available for PM emissions, reasonably achievable rules for PM were defined as the maximum constraint level for Study Area B from the current rules case. The constraint levels from Study Area B were applied to the same source types (new, replacement, or existing) as designated in the original constraint. Other measures for PM (listed in Table II.9) include residential oil combustion controls (correct tuning and operation of the furnace with repair or replacement of poor performers), fugitive dust controls, wood stove controls, and an incinerator NSPS. These controls were applied to new, replacement, and existing source emissions. Additional control levels were also taken from four sources for the PM constraint file: the current rule constraint file, the PM cost file, the

Table II.8

NESHAP and NSPS Constraints
Expected Controls Scenario

NESHAP		Reduction (%)	Start Date
VOC:	Hazardous Organic NESHAP Butadiene Production Ethylene Dichloride Production Chlorinated Hydrocarbon Production Neoprene Production Chlorinated HC Use in Chemical Production Pesticides Production Pharmaceutical Production	50	1993
	Coke Oven Emissions Charging and Topside Leaks	50	1992
	Coke Oven By-product Plants	63	1989
	Municipal Waste Combustion	80	1991
	Sewage Sludge Incineration	80	1991
PM:	Comfort Cooling Towers	100	1989
	Industrial Cooling Towers	67	1993
	Chrome Electroplating	95	1993
	Coke Oven Emissions	56	1992
	Municipal Waste Combustion	99	1991
	Sewage Sludge Incineration	99	1991
NSPS			
VOC:	Hospital Waste Incineration	80	1993
PM:	Hospital Waste Incineration	99	1993

Table II.9

Miscellaneous Measures Added to the Additional Controls Scenario

VOC:	Emission Reduction (%)
Wood Stoves	40
Perchloroethylene Dry Cleaning	95
Petroleum Solvent Dry Cleaning	72
PM:	
Wood Stoves	40
Incineration (NSPS)	99
Residential Oil Combustion	24
Fugitive Dust	50

SIP strategy measures, and potential air toxics regulations. The SIP strategy and air toxic measures were applied to all three source types, while BACT levels from the constraint and cost files were applied as specified in the files. The SIP strategy and air toxic measures included in the PM additional controls scenario are listed in Table II.10. For all sources, the maximum control level from any of the sources was chosen as BACT with the exception of SCCs using the default PM control values. Since these control levels were not derived from information specific to any of the sources, the lowest control level, 98 percent, was used for point source SCCs. Area source SCCs were controlled only if control information specific to that category was available. The beginning and target years for the constraints were specified as 1992.

For the VOC constraint file, reasonably achievable rule control levels were taken from a number of different sources. One source was EPA's FIP Study (U.S. EPA, 1987a). The control levels were applied to new, replacement, and existing source emissions in all study areas. The FIP study identified the expected SIP level of control for NEDS Source Classification Codes (SCCs) emitting over 1,000 tons of VOC per year nationally. Candidate Federal and CTG measures added for this scenario are listed in Table II.11. Miscellaneous measures for VOC based on guidance from EPA are listed in Table II.9. The additional control levels for VOC were also taken from the VOC current rules constraint file, the VOC control cost file, candidates for available control technologies (ACTs), SIP strategy measures, and additional air toxics regulations being considered. The BACT constraints taken from the current rule constraint file or the VOC control cost file were applied to the source types as designated. Candidates for ACTs and air toxics regulations added to the VOC additional controls scenario are listed in Table II.12. All VOC additional control constraints were designated with beginning and target years of 1992.

Table II.10

Measures Added to the PM Additional Controls Constraint File

SIP Strategy Measures	Reduction (%)
Ceramic Clay Manufacture	99
Feed and Grain Terminals and Country Elevators	95
Air Toxic Regulations	
Chromium Electroplating	99.8
Industrial Cooling Towers	85

Table II.11

Candidates for Federal Rules and CTGs
VOC Additional Controls Case

Measure	VOC Emission Reduction (%)
TSDF	93
Commercial and Consumer Solvents	20
Marine Vessel Loading	90
Architectural Coating	50
Industrial Maintenance Coating	65
Traffic Paint	80
SOCMI Distillation	85
POTW (Industrial Wastewater)	75
Autobody Refinishing	60
Petroleum Wastewater	50
Web Offset Lithography	80
SOCMI Reactor Processes	85

Table II.12

Candidates for ACT and Air Toxic Regulations
VOC Additional Controls Scenario

Available Control Technologies	Assumed Potential Reduction (%)
Cleanup Solvents	50
Adhesives	65
Ink Manufacture	35
Paint Manufacture	35
Pesticide Application	50
NESHAPs	
Hospital Sterilizers (Ethylene Oxide)	99
Pulp Manufacturing (Chloroform)	92
Ethylene Dichloride Production (more stringent control)	94

2. Quality Assurance

Quality assurance checks were carried out on both the emission inventory data taken from the NEDS file to prepare the base year emission inventory and on the assumptions used in the development of the modeling assumptions (i.e., the emission constraint file).

With only a limited number of areas included in this study (five cities), checks could be carried out on a source by source basis for a substantial number of sources. Thus, many sources were reviewed individually to determine the logical and engineering consistency of the data. The source records were reviewed to determine the following:

- If the record was internally consistent as to size, temperature, flow rate, etc. Engineering judgment was used to determine if the device/source combination was reasonable.

- If the control device listed was appropriate to the source and is able to control a given pollutant at the efficiency listed. It was not possible to determine the actual efficiencies of the control devices applied, but rather if the reductions were possible considering the application. For example, while a fabric filter is capable of achieving a 99.9 percent reduction in total particulates from a coal-fired boiler, it would be unlikely for a cyclone to reach that efficiency.

All controlled VOC point sources in Study Area C were reviewed individually, especially the VOC control efficiencies. While a number of problems were found with the VOC emission estimates and operating rates, because VOC control efficiencies were few in number and appeared to be reasonable, no changes were deemed to be warranted for this analysis. A similar analysis for PM emitters in Study Area C showed that source category/control equipment/control efficiency combinations were reasonable and did not need to be changed. The NEDS emission inventory also shows that the estimated total suspended particulates (TSP) emissions are almost always less than 100 tons per year at the source level, so changes to the control efficiencies for any individual source are unlikely to have a significant effect on toxic emissions for Study Area C.

3. Model Assumption Review

The key modeling assumptions that distinguish the different modeling cases relate to the degree of emission reduction required. For each strategy or scenario, all of the applicable regulations possible for each source category SCC were reviewed. An example is the 1995 current rules case where SIP regulations are applied to existing sources. For each SCC, all possible SIP regulations -- such as concentration limits, process weight limits, or opacity limits as well as source category specific regulations -- were reviewed to determine the most restrictive regulation. Average size sources in each SCC were used to determine the allowed emission rates under regulations which varied by size.

Applicable RACT, NSPS, BACT, and LAER regulations were handled in a slightly different manner. For these requirements, the average percentage reductions specified in EPA support documents were applied.

a. Particulates

Resulting changes to the PM constraint file included increasing the current rule control percentage for a number of industrial sources in Study Area B that are controlled by a process weight curve. The RIM constraint file had a number of PM emitters controlled to 80 percent in 1995, when higher control percentages are more reflective of current limits. Changes to the PM constraint file for Study Area D were largely to include constraints for source types known to exist in Study Area D that had no constraints listed previously.

Changes were also made to the PM constraint assumptions for cooling towers. Previously, comfort cooling towers and industrial cooling towers were combined in a single category. For this analysis, though, comfort and industrial cooling towers were separated in order to make control assignments more straightforward. For comfort cooling towers, a control percentage of 100 percent was assumed in the expected controls scenario reflecting the anticipated chromium ban enacted under the Toxic Substances Control Act (TSCA). For industrial cooling towers, a new NESHAP was assumed to reduce chromium emissions by 67 percent (expected rule). A higher control percentage of 85 percent was applied to industrial cooling towers in the additional controls case.

For chrome platers, an assumed zero control efficiency in the base year was changed to 70 percent to reflect the current mix of controlled and uncontrolled platers. An expected chrome plating NESHAP is assumed to raise the average control level on chrome plating shops to 97 percent from uncontrolled levels. Reductions up to a control level of 99.8 percent are assumed to be achievable in the additional controls case.

The EPA's promulgated wood stove NSPS will reduce particulate emissions from new wood stoves by about 75 percent from uncontrolled levels. An overall 40 percent reduction in particulate levels is assumed to be achievable in the expected controls case. This 40 percent reduction reflects a combination of measures such as burning bans, no burn days, and accelerated replacement programs.

b. Organics

In general, changes were made to the VOC constraint file to modify CTG/RACT requirements based on current information and to estimate the effect of general VOC control regulations. An example of a general VOC control regulation is the one applied to Study Area D. It applies to installations not affected by specific VOC control regulations. For instance, installations constructed before May 12, 1972, that emit more than 200 pounds per day of organics must reduce their emissions by 85 percent or more. Installations constructed on or after May 12, 1972, must reduce their VOC emissions by 85 percent or more if they emit more than 20 pounds per day. Changes were made to the RIM constraint file for VOC to reflect these general regulations.

While many of the changes to the current rule constraint file for PM were to increase the estimated future control levels, changes to the VOC constraint files were largely in the opposite direction (future control levels were adjusted downward). These changes to the VOC constraint file are summarized in Table II.13.

Table II.13

Changes to RIM VOC Constraint File

Source Category	Revised Constraint File Assumption	Rationale
Dry Cleaning-Perchloroethylene	RACT = 63% NSPS = 72% Expected = 95%	Rhode Island State regulations.
Hospital Sterilizers	Max Control = 99%	Ethylene oxide control (vent and drain sources).
Petroleum Refinery Wastewater	NSPS	Begins in 1989.
Surface Coating	SIP = 85%	From city-specific regulations and general regulations assumed to control coaters in other study areas.
Degreasing	RACT = 54% NSPS = 57%	NSPS for cold cleaners.
Graphic Arts	RACT = 70% (75% for rotogravure)	Added and used to replace previous SIP listings. NSPS dropped for lithographic.

III RESULTS

A. BASE YEAR SCENARIOS

Two base year scenarios were analyzed before projections to 1995 were made. These two base year scenarios included (1) base year emissions estimated using NEDS control efficiencies, and (2) base year emissions with SIP control levels substituted for control efficiencies reported in NEDS (in instances when SIP requirements were less stringent than NEDS control levels).

The second scenario was postulated because of concern that the VOC control efficiencies in the 1980 NAPAP Emissions Inventory overestimated the amount of control at VOC sources. This was of interest because it appeared that some controls in NEDS were at higher efficiencies than would be expected given the regulations in force in 1980.

When base year VOC and PM emissions were reestimated by substituting estimated SIP control levels for NEDS control efficiencies in instances when SIP control requirements were lower, there was little change in base year VOC emissions (1.2 percent). The average VOC control efficiency changes very little across the five study cities when SIP control levels are substituted, as illustrated in Table III.1. Changes in related annual incidence from one case to the next are negligible. Table III.2 shows the incidence estimates with formaldehyde included. Table III.2 estimated incidence is lower for area sources in the "with SIP control" level assumptions case because its percentage of total VOC emissions is lower, and this percentage is the basis for estimating contributions to formaldehyde-related incidence.

A 10 percent increase in particulate emissions was observed when PM sources were assumed to be controlled only to SIP levels. Problems with particulate control levels in NEDS seem less common than for VOC control levels, however, as PM sources are more well defined than VOC sources and less likely to be exceeding prescribed limits.

With the above analysis showing only a negligible change in VOC emissions with SIP control efficiencies substituted for NEDS

Table III.1
Comparison of All Study Area Base Year VOC Emissions and Related Incidence (Excluding Formaldehyde) under NEDS Control Efficiency vs. SIP Control Level Assumptions

	With NEDS Control Efficiencies			With SIP Control Levels		
	VOC Emissions (1000 tons)	Average Control Level	Related Annual Incidence	VOC Emissions (1000 tons)	Average Control Level	Related Annual Incidence
Stationary Sources*						
External Combustion	10.4	27%	0.00	10.4	27%	0.00
Internal Combustion	0.7	0	0.00	0.8	0	0.00
Industrial Process	205.9	29	1.05	210.9	28	1.07
Evaporation	179.6	74	0.93	188.5	72	1.68
Solid Waste Disposal	4.2	4	0.00	4.2	4	0.00
POTWs	1.6	0	0.46	1.6	0	0.46
Area Sources (including mobile)	735.8	0	31.44	747.9	0	31.44
	1138.4		33.88	1164.2		33.98

* Stationary source categories listed are the major source types in EPA's National Emissions Data System organization.

Table III.2

Comparison of All Study Area Base Year VOC Emissions and Related Incidence under NEDS Control Efficiency vs. SIP Control Level Assumptions

	With NEDS Control Efficiencies			With SIP Control Levels		
	VOC Emissions (1000 tons)	Average Control Level	Related Annual Incidence	VOC Emissions (1000 tons)	Average Control Level	Related Annual Incidence
Stationary Sources						
External Combustion	10.4	27%	0.13	10.4	22%	0.13
Internal Combustion	0.7	0	0.01	0.8	0	0.01
Industrial Process	205.9	29	2.61	210.9	23	2.74
Evaporation	179.6	74	4.31	188.5	59	4.45
Solid Waste Disposal	4.2	4	0.05	4.2	3	0.04
POTWs	1.6	0	0.48	1.6	0	0.48
Area Sources (including mobile)	735.8	0	43.02	747.9	0	42.85*
Total	1138.4		50.6	1164.2		50.7

* Estimated incidence is lower for area sources in the with SIP Controls case because its percentage of total VOC emissions is lower, and this percentage is the basis for estimating contributions to formaldehyde-related incidence.

control efficiencies, it was decided to continue to use NEDS control efficiencies as reflective of base year conditions for modeling all the future year scenarios.

B. FUTURE YEAR SCENARIOS

This section presents the results of three 1995 control scenarios: current rules, expected controls, and additional controls. The control measures included in each of these cases were described in Chapter II.

1. Excess Cancer Incidence

Figure III.1 summarizes total annual excess cancer incidence by scenario for the five study areas combined. As this figure shows, incidence would be expected to drop from 93 cases in the base year to 67 cases under the current rules case, a 28 percent decline. Reductions of up to 47 percent from the base case might be observed if all expected controls were adopted. With the maximum anticipated controls applied, incidence reductions of as much as 60 percent might be realized.

a. Base Case

Tables III.3 and III.4 show the source categories that contribute most to 1980 expected incidence for VOC and PM, respectively. The motor vehicle categories are prominent in both VOC and PM incidence contributions. With the exception of wood stoves, none of the nonmotor vehicle categories appear on both Tables III.3 and III.4.

One observation that can be made from these tables and Figure III.1 is that VOC-related and PM-related incidence are about equal in importance, with organic compounds contributing slightly more than one-half (55 percent) of the base year incidence. Estimated incidence in the 1995 current rules scenario is split evenly between organics and particulates, as current rules prove to be more effective in reducing organic toxics than they are in reducing particulates. The converse is true in the expected controls scenario as particulate related incidence drops dramatically, while VOC related incidence changes little. Some further reductions in incidence are observed in the

Figure III.1
1995 Estimated Incidence by Scenario
Compared with 1980 Base Year

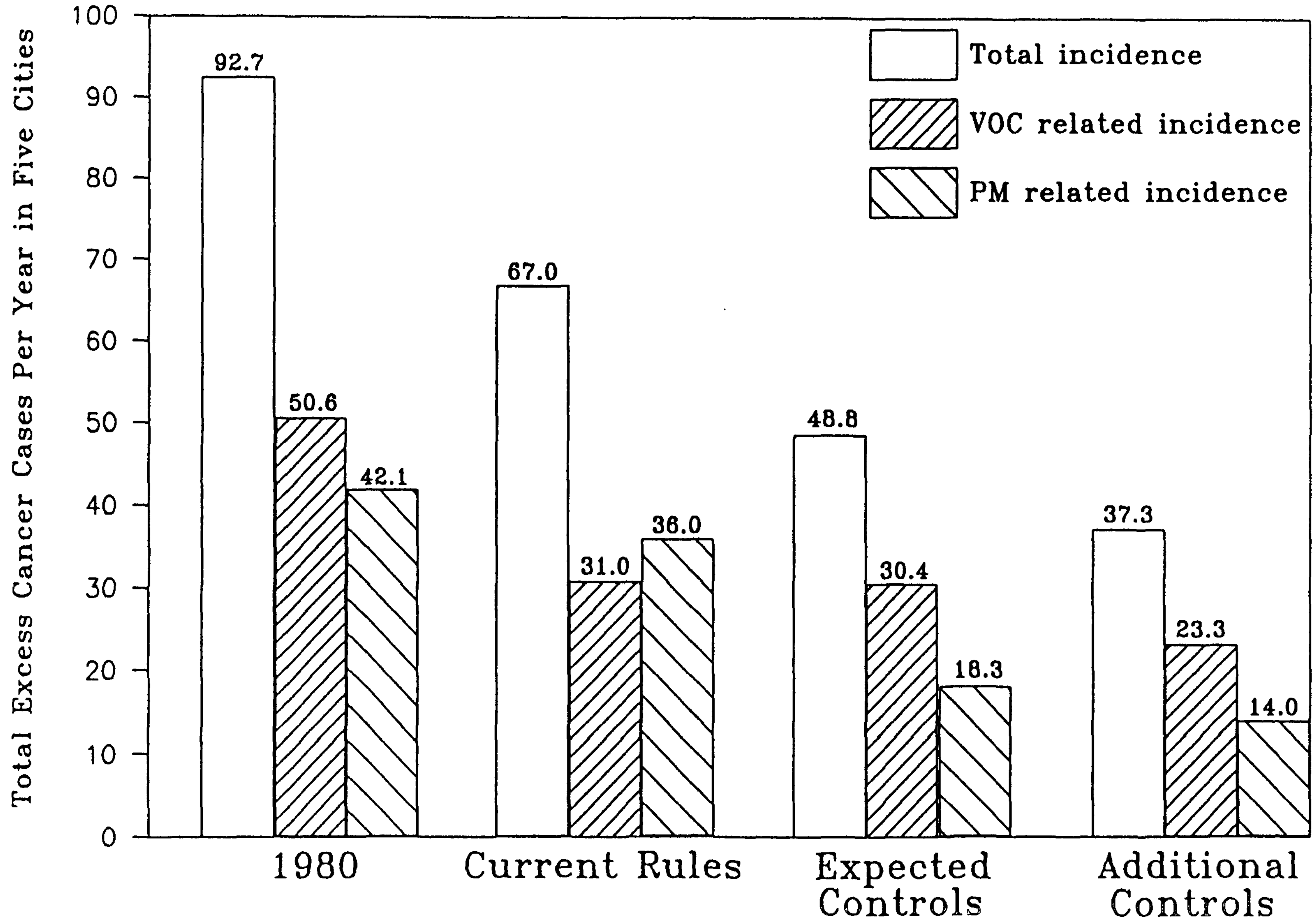


Table III.3
Annual VOC Related Incidence*

Source Categories	Base Case	Current Rules	Expected Controls	Additional Controls
	1980	1995	1995	1995
LD Gas Vehicles	19.99	7.76	7.76	7.35
LD Gas Trucks	6.40	2.64	2.64	2.50
Misc. Solvent Use	2.80	3.16	3.16	2.18
HD Gas Trucks	1.86	0.88	0.88	0.84
Hospital Sterilizers	1.54	1.79	1.79	0.02
Diesel Vehicles	1.25	0.72	0.72	0.68
Misc. Surface Coating	1.22	1.39	1.39	1.39
Wood Stoves	0.91	0.87	0.87	0.54
Residential Incineration	0.67	0.72	0.72	0.72
Dry Cleaning	0.54	0.19	0.19	0.17
Cold Cleaners	0.51	0.37	0.37	0.14
POTWs	0.48	0.55	0.55	0.14
Petroleum Waste Water Treatment	0.43	0.04	0.04	0.02
Misc. EDC	0.39	0.53	0.53	0.53
Off-Highway Vehicles	0.37	0.42	0.42	0.42
Other	11.26	8.98	8.39	5.67
Totals	50.62	31.00	30.42	23.32
Percentage	77.76	71.03	72.42	75.69

* VOC related incidence estimates include formaldehyde.

Table III.4
Annual PM Related Incidence

Source Categories	Base Case	Current Rules	Expected Controls	Additional Controls
	1980	1995	1995	1995
Diesel Vehicles	11.23	5.21	5.21	4.96
Chrome Plating	7.99	11.23	1.75	0.08
LD Gas Vehicles	6.17	3.41	3.41	3.24
Comfort Cooling Towers	4.37	5.97	0.00	0.00
Industrial Cooling Towers	2.99	3.47	1.14	0.52
Wood Stoves	2.88	2.66	2.66	1.66
LD Gas Trucks	1.43	0.11	0.11	0.10
Fireplaces	1.42	1.59	1.59	1.59
Glass Mfg.	0.66	0.15	0.15	0.15
Brick Mfg.	0.44	0.01	0.01	0.01
HD Gas Vehicles	0.44	0.41	0.41	0.39
Waste Oil Burning	0.35	0.41	0.41	0.41
Coke Ovens	0.35	0.04	0.04	0.04
Residential Dist. Oil	0.24	0.28	0.28	0.21
Utility Resid. Boilers	0.20	0.22	0.22	0.01
Totals	41.17	35.17	17.39	13.37
Totals - All Categories	42.06	36.03	18.25	14.00
Percentage of All Categories	97.88	97.61	95.29	95.50

additional controls scenario, but reductions here are not as significant as those in the other two cases.

Table III.3 shows that in the base case, 15 source categories contribute 78 percent of the VOC-related incidence in the five cities. The motor vehicle categories are prominent in VOC-related incidence in all cases modeled. Many of the nonmotor vehicle categories that appear in Table III.3 are there because they are large VOC emitters, and are assumed to contribute to formaldehyde formation, not because they are direct emitters of specific toxic compounds. An obvious exception to the above is hospital sterilizers, which are ethylene oxide emitters.

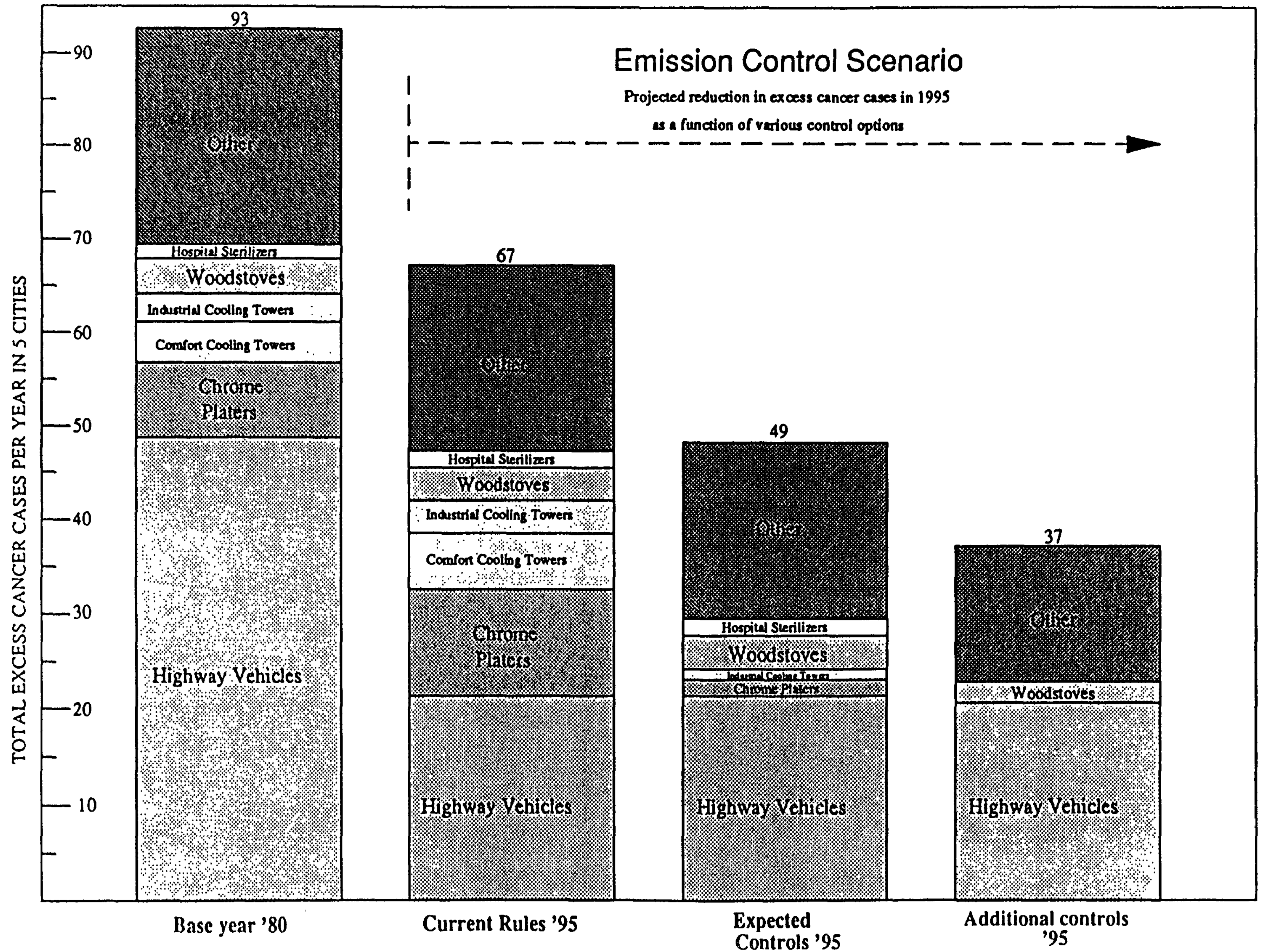
The combined PM and VOC incidence for the base case can be seen in Figure III.2. As the figure shows, highway vehicles account for over half of the total incidence in 1980. The incidence for the next three largest categories--chrome platers, comfort cooling towers, and industrial cooling towers--comes entirely from PM. Six categories account for 75 percent of the total annual incidence with the remaining incidence coming from numerous emitters of small amounts of toxic substances.

b. Current Rules Scenario

Reductions in VOC related incidence from the base year to 1995 under the current rules scenario comes mostly from motor vehicles and can be attributed to the current FMVCP with its associated emission standards and vehicle inspection and maintenance programs. Almost 90 percent of the incidence reduction in the current rules scenario is through these motor vehicle control programs. Other VOC-emitting categories where current rules are effective in reducing incidence include dry cleaners, cold cleaners, and petroleum refinery wastewater treatment.

For particulates, current rules are much less effective in reducing incidence. As with organics, motor vehicle emission controls provide most of the expected reductions in PM-related incidence. Some of the reduction observed from motor vehicle emission controls is offset by expected growth in emissions from

FIGURE III.2
FIVE CITY CONTROLLABILITY OF AIR TOXICS IN 1995



important contributors to incidence such as chrome platers, industrial cooling towers, and comfort cooling towers.

As Figure III.2 illustrated, the overall contribution of highway vehicles to the total incidence significantly declines from the base case to the current rules scenario. At the same time, the combined contribution of chrome platers, comfort cooling towers, industrial cooling towers, wood stoves, and hospital sterilizers increases from 22 percent in the base case to 39 percent in the current rules scenario. The only category in this group to show a decrease in incidence is wood stoves. The magnitude of the "other" category decreases by two cases of annual incidence in the current rules scenario.

c. Expected Controls Scenario

Motor vehicle-related incidence does not change in the expected controls scenario. Summertime gasoline RVP limits would not reduce the average VOC emissions from motor vehicles by 1995 for a number of reasons. There is a current RVP rule in California, so any Federal rule will not provide any benefits in that State. Second, summertime gasoline RVP in 1980, the base year for this study, was not as high as in-use RVP values in the mid-to-late 1980s. A MOBILE4 (U.S. EPA, 1989) sensitivity analysis performed using regional July RVP values for 1980 showed negligible differences in 1995 emissions with and without RVP control. Third, RVP limits are only expected to be in effect during the five warmest months of the year. Because annual average exposures are of interest for toxics, only 5/12 of the time do RVP limits reduce organic emissions.

Reductions in particulate-related toxics incidence in the expected controls scenario are significant and are largely attributable to probable NESHAP regulations. Three source categories are responsible for most of the incidence reduction in this scenario: chrome plating, comfort cooling towers, and industrial cooling towers. For chrome platers, reductions reflect going from a 70 percent average control level in the base year to a NESHAP that could result in a 95 percent level of control on all plating shops. Comfort cooling tower related incidence drops from 4.4 cases in the base year to none in the 1995 expected controls case. This reflects the anticipated chromium ban under the Toxic Substances Control Act which would affect all comfort cooling towers. Industrial cooling tower related incidence is also expected to drop substantially in the expected controls scenario with anticipated NESHAP controls. The NESHAP requirements are estimated to be achievable by use of a high efficiency drift eliminator.

The effect of these reductions on the overall incidence was previously illustrated in Figure III.2. While the incidence associated with highway vehicle emissions remains unchanged from the current rules case to the expected controls scenario, the combination of industrial cooling towers, comfort cooling towers, and chrome platers makes up only 6 percent of the total incidence in the expected controls scenario compared with 31 percent in the current rules case. The "other" category has decreased by about 0.6 cases per year, but the relative importance of this category has increased, now accounting for 24 percent of the total incidence.

d. Additional Controls Scenario

Applying the set of controls included in the additional controls scenario by 1995 provides some additional reductions in incidence when compared with the expected controls scenario. The additional reduction in incidence is about 11.5 cases per year. Seven of these cases are from organic toxic emission reductions and four are from particulate reductions. The largest reduction in VOC-related incidence in this case comes from controls being applied to hospital sterilizers, which emit ethylene oxide. Reductions shown in Table III.3 for miscellaneous solvent use result from an assumed 20 percent reduction in consumer solvent emissions. Motor vehicle emission reductions reflect an assumed 5 percent reduction in estimated 1995 vehicle miles traveled being achieved via transportation control measures.

Table III.5 itemizes the changes in annual incidence that might be expected from candidate Federal rules and CTGs being considered by EPA to reduce tropospheric ozone levels. Rules

Table III.5

Changes in Annual VOC Related Incidence Via Additional Controls

Source Categories	Change in Incidence: Expected to Additional Controls Scenario		
Candidates for Federal Rules	Before	After	Change
TSDF (Accelerated and Comprehensive)	0.27	0.02	0.25
Commercial/Consumer Solvents	2.02	1.62	0.40
Marine Vessel Loading	0.01	0.00	0.01
Architectural Coating	0.30	0.15	0.15
Industrial Coating	0.06	0.02	0.04
Traffic Paint	0.08	0.02	0.06
Total Federal Rules	2.74	1.83	0.91
Candidates for CTGs			
SOCMI Distillation	<0.01	<0.01	0.00
Indus. Wastewater (and POTW)	0.55	0.14	0.41
Autobody Refinishing	0.12	0.05	0.07
SOCMI Reactor and Batch Processes	0.02	<0.01	0.02
Petroleum Wastewater	0.04	0.04	0.00
Web Offset Lithography	0.05	0.05	0.00
Total CTGs	0.78	0.28	0.50
Candidates for Available Control Technologies (ACTs)			
Cleanup Solvents	1.14	0.56	0.58
Adhesives	0.004	0.003	0.001
Ink Manufacturing	0.001	0.000	0.001
Paint Manufacturing	0.005	0.000	0.005
Pesticide Application	0.17	0.09	0.08
Transportation Control Measures*	12.00	11.37	0.63
Total ACTs	13.32	12.02	1.30
Other Categories			
Other Federal Rules**	1.98	0.02	1.96
Other SIP Rules***	4.07	1.63	2.44
Total - All Categories	22.89	15.78	7.11

* e.g., measures such as trip reduction ordinances, employer based transportation management, improved public transit, and parking management.

** e.g., categories including hospital EtO sterilizers and pulp and paper production.

*** e.g., categories such as carbon black production, degreasing, by-product coke manufacture, pertroleum refinery fluid catalytic cracking units, service stations, and solvent use.

listed in this table are those with nonzero incidence estimated for the base case. The results for toxics are similar to the results for ozone control in that no single measure provides large reductions in VOC emissions or incidence. This results from the fact that there are many VOC-emitting source categories and targeting a few of them for control is not likely to be effective in reducing total VOC emissions or incidence. Reductions in wood stove-related incidence in the additional controls scenario reflect an assumption that SIP regulations could be enacted that could produce a 40 percent reduction in existing stove particulate emissions.

Table III.5 also itemizes the changes in VOC related incidence that might be achieved in the additional controls scenario from control measures considered as ACTs by the ozone program. Transportation control measures and reductions in cleanup solvent emissions are estimated to be the most effective of the ACTs in reducing incidence.

The most significant reduction in annual PM incidence in this scenario comes from applying chrome plating emission controls that have been proposed in California to all study areas. Motor vehicle incidence reductions shown in Table III.4 for particulates reflect the same 5 percent VMT reduction that was used to estimate organic emission changes.

Figure III.2 showed that the near elimination of emissions from hospital sterilizers, cooling towers, and chrome platers accounts for most of the overall reduction in incidence from the expected controls scenario to the additional controls scenario. Incidence from the "other" category decreased by about three cases per year and incidence from highway vehicles decreased by one case per year.

2. Maximum Individual Risk

While the results presented thus far in this chapter have focused on estimated annual incidence, maximum individual risk is another measure that can be used to characterize the hazards associated with ambient air toxics. The analyses presented here consist of determining the number of sources with MIR contributions above one in a million (1×10^{-6}) for individual compounds, and how that number changes under the different control scenarios.

Estimates of MIR (ground-level concentration times unit risk factor) were made using the HEM. Risks from industrial cooling tower chromium emissions were estimated from a separate analysis using the Climatological Dispersion Model (CDM) (Irwin et al., 1985). Industrial cooling towers were not modeled as point sources using HEM because they were included in the point source emission inventory after the HEM runs were completed. CDM does not estimate concentrations and risk at as many receptors as HEM, but would be expected to capture most, if not all, of the peak values when modeling elevated sources.

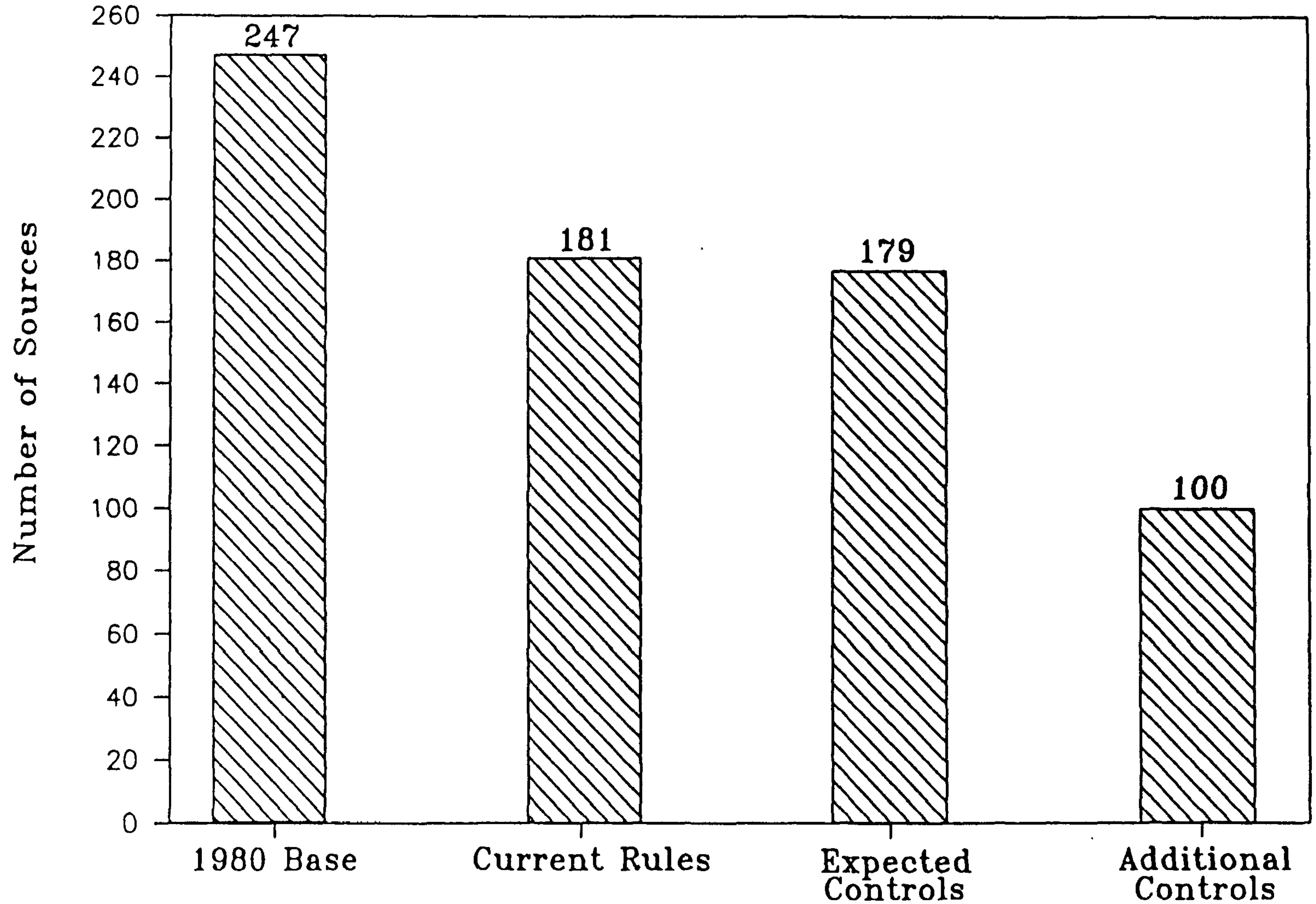
The source categories with greater than one in a million MIR total over the five-city study area in the base year are listed below.

Chemical Manufacturing
Iron/Steel Manufacturing
POTWs
Gasoline Marketing
Nonferrous Metals Production
Glass Manufacturing
Industrial Boilers - Oil
Dry Cleaning
Hospital Sterilizers
Solvent Evaporation
Petroleum Refining
Stage II - Vehicle Refueling
Utility Boilers - Oil
Utility Boilers - Coal
Surface Coating
Printing
Pulp & Paper Manufacturing

Figure III.3 presents the results of the MIR analysis. Note that each source-pollutant combination contributing to one in a million MIR is counted every time it occurs. Thus, if the MIR for a source is above the 1×10^{-6} threshold for both benzene and methylene chloride, it is counted as two occurrences. This accounting procedure does not make a big difference in reporting the results, however, as 215 of the 247 occurrences reported for 1980 are unique sources.

Figure III.3

Number of Sources With Maximum Individual Risk Greater than One in a Million ($1x10^{-6}$)



Each source-pollutant combination contributing to one in a million MIR is counted every time it occurs.

When the base year results are compared with the 1995 current rules scenario, there is a 27 percent reduction in 1 X 10^{-6} MIR occurrences. Only a 1 percent reduction in these occurrences is estimated with expected controls applied. The difference between the additional controls scenario and the expected controls scenario greater than 1 X 10^{-6} MIR estimates is 44 percent.

Contrasting the results in Figure III.3 for MIR with those from Figure III.1 for incidence shows that the percentage reductions in both MIR and incidence from the base year to the 1995 current rules case are nearly equal. The percentage decrease in incidence from the current to the expected rules case is larger than the associated decrease in MIR threshold exceedances. This difference occurs because most of the incidence reduction in the expected rules case is attributable to particulate control measures, and although area sources are important contributors to PM related toxics incidence, the MIR for area sources cannot be estimated. Conversely, the maximum control case shows a much higher reduction in MIR threshold exceedances than it does in incidence reduction potential.

C. DISCUSSION

The modeling results presented in the first two sections of this chapter show that the most effective rules for reducing future year expected incidence and MIR are motor vehicle emission controls and NESHAPs. Both particulate and VOC related toxics are reduced via motor vehicle controls. NESHAPs are expected to be especially effective in reducing particulate toxics.

The motor vehicle emission controls that are shown to be particularly effective in reducing expected incidence in future years include both the Federal Motor Vehicle Emission Control Program and inspection and maintenance programs.

The NESHAP that the modeling shows to be particularly effective in reducing PM-related incidence are modeled in this analysis as "expected controls." Thus, they have not yet been proposed. This analysis shows the importance of proceeding with the potential NESHAPs for chrome platers and industrial cooling towers from an incidence reduction standpoint. The anticipated chromium ban under the Toxic Substances Control Act would affect all comfort cooling towers and would also provide significant reductions in incidence if enacted.

Many VOC regulations are targeted as ozone reduction methods and so some of the measures included here are geared more toward reducing total VOC emissions rather than the specific toxic compounds that are responsible for the associated incidence. The PM regulations, on the other hand, are often targeted to reduce a specific toxic compound, and are therefore more effective in reducing stationary source-related incidence. As an example, sources like chrome platers and cooling towers are not normally considered to be contributors to ambient particulate problems, but future regulations for these source types are likely to be effective in reducing particulate related cancer incidence.

Figure III.4 provides a summary of the emission sources with the 15 highest related incidences. As this figure shows, current rules are expected to get as much as an additional 27 percent reduction in excess cancer incidence in the five study areas. Adding rules that could be expected to be achieved by 1995 would almost double the anticipated reduction in cancer incidence expected via the current rules. Up to 60 percent of the base case incidence could be reduced by applying additional or best available controls.

Figure III.4

TOTAL FIVE CITY INCIDENCE CHANGES BY SCENARIO

(EXCESS ANNUAL CANCER CASES)

	BASE YEAR '80	CURRENT RULES '95	EXPECTED CONTROLS '95	ADDITIONAL CONTROLS '95
HIGHWAY VEHICLES	48.8	21.1	21.1	20.1
CHROME PLATING	8.0	11.2	1.8	0.1
COMFORT COOLING TOWERS	4.4	6.0	0	0
WOODSTOVES	3.8	3.5	3.5	2.2
INDUSTRIAL COOLING TOWER	3.0	3.5	1.1	0.5
MISC. SOLVENT	2.8	3.2	3.2	2.2
HOSPITAL STERILIZERS	1.5	1.8	1.8	0.02
FIREPLACES	1.4	1.6	1.6	1.6
MISC SURFACE COATING	1.2	1.4	1.4	1.4
COLD/DRY CLEANING	1.1	0.6	0.6	0.3
GLASS/BRICK MFG	1.1	0.2	0.2	0.2
POTWs	0.5	0.6	0.6	O.1
PETROL WASTEWATER TREAT	0.4	0.04	0.04	0.02
COKE OVENS	0.4	0.04	0.04	0.04
OTHER	14.3	12.4	11.8	8.6
TOTAL 5 CITY INCIDENCE (Percent reduction from base year)	92.7	67.0 (27%)	48.8 (47%)	37.3 (60%)

ABBREVIATIONS AND ACRONYMS

ACT	available control technology
B(a)P	benzo(a)pyrene
BACT	Best Available Control Technology
BEA	Bureau of Economic Analysis
CDM	Climatological Dispersion Model
CTG	control technique guideline
DNPH	dinitrophenylhydrazine
DOC	Department of Commerce
ELOC	existing level of control
EPA	Environmental Protection Agency
FIP	Federal Implementation Plan
FMVCP	Federal Motor Vehicle Control Program
GC/MS	gas chromatograph/mass spectrometer
HC	hydrocarbon
HDDV	heavy-duty diesel vehicle
HEM	Human Exposure Model
IEMP	Integrated Environmental Management Projects
I/M	inspection and maintenance
LAER	Lowest Achievable Emission Rate
MRI	maximum individual risk
MSA	Metropolitan Statistical Area
NAPAP	National Acid Precipitation Assessment Program
NEDS	National Emissions Data System
NESHAP	National Emission Standards for Hazardous Air Pollutants
NSPS	New Source Performance Standards
NSR	New Source Review
OMS	Office of Mobile Sources
PM	particulate matter
POM	polycyclic organic matter
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RIM	Regulatory Impact Model
RTI	Research Triangle Institute

RVP	Reid Vapor Pressure
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	State Implementation Plan
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage and Disposal Facility
TSP	total suspended particulates
VMT	vehicle miles traveled
VOC	volatile organic compounds

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APPENDIX A

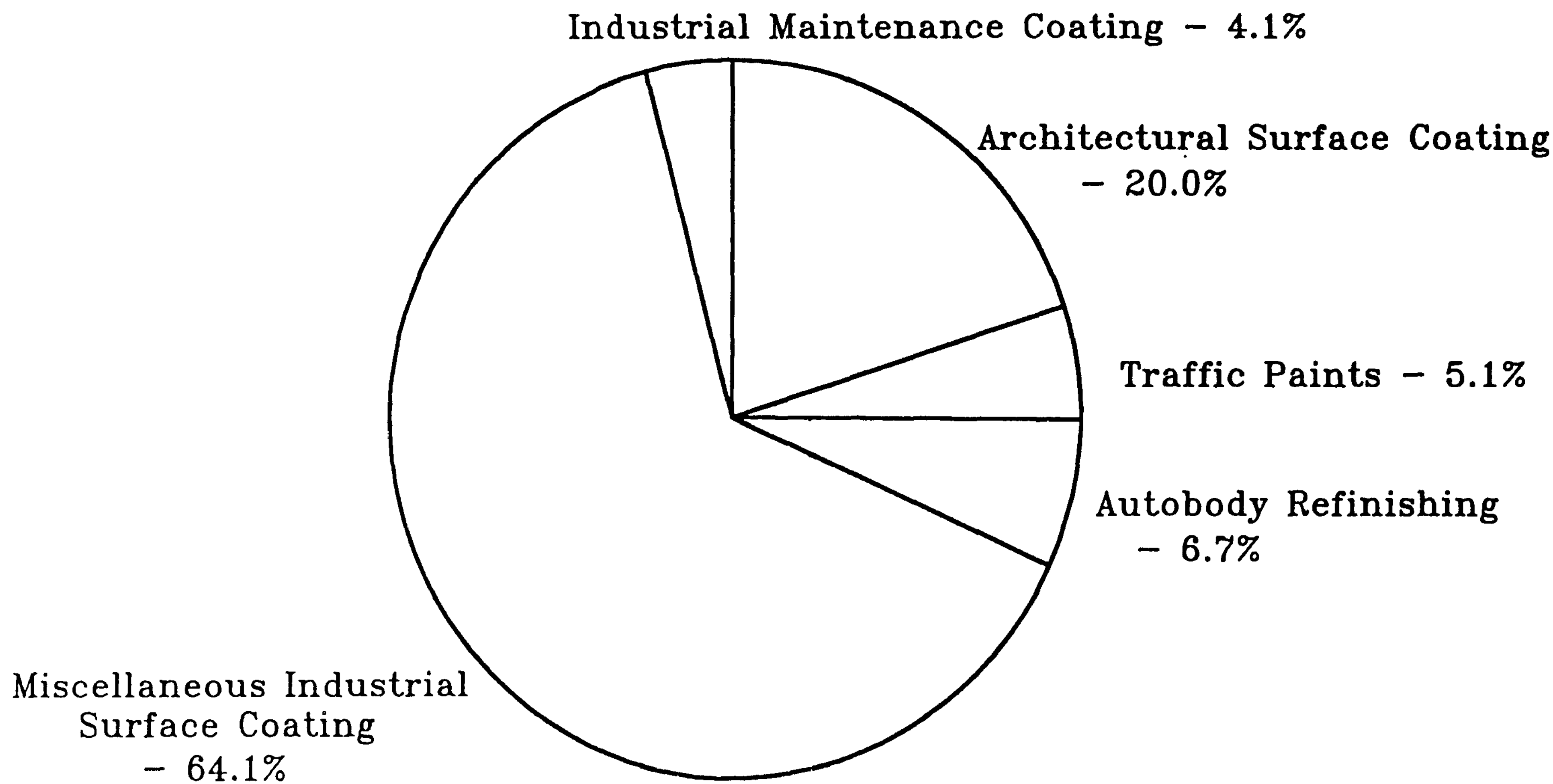
CHANGES TO BASE CASE INVENTORY

There are several differences between the inventory used to perform the analyses in this report and the inventory used to perform the base year analysis documented in the Volume I companion report (Pechan, 1989). These changes were made to better and more fully assess the impact of regulating emission sources that are candidates for Federal rules, Control Technique Guidelines (CTG), or Achievable Control Technologies (ACT) rules. The methodology used to determine what changes and additions to make to the inventory is discussed below.

Using the Crosswalk data retrieval system (U.S. EPA, 1987b) and the VOC Speciation Data System (Radian, 1989), each of the source categories currently being considered for control by Federal rule, CTG, or ACT was examined to determine whether any of the toxic species of interest to this study could be emitted from each category. This assessment led to three types of changes or additions being made to the inventory. The first involved adding toxic emission factors for point source SCCs for lithography and marine vessel loading. The second type of change consisted of adding a new area source SCC to the inventory to include VOC and toxic emissions from treatment, storage, and disposal facilities (TSDFs). The final change consisted of adding five area sources (architectural surface coating, traffic paints, autobody refinishing, industrial maintenance coating, and miscellaneous industrial surface coating) whose VOC emissions were already included in SCC 99999971, Surface Coating. This SCC was eliminated after being broken down into the five new area source SCCs to allow for different toxic emission factors and control efficiencies for each of the individual surface coating area sources. This breakdown is illustrated in Figure A.1.

In the first grouping of changes, several point source SCCs were identified as being toxic emitters which previously had no toxics listed. The categories of web-offset lithography and marine vessel loading were found to be lacking toxic emissions in

Figure A.1
Allocation of Surface Coating Emissions to Different Uses



the previous version of the inventory. Toxics for both of these categories were identified using the VOC Data Speciation System (Radian, 1989). The profile used for SCC 40500101, Lithography - Inking and Drying - Direct Fired Dryer, is based on composite survey data of the industry and a gas chromatograph/mass spectrometer (GC/MS) analysis of a sampling train catch. This profile lists methylene chloride as making up approximately 35 percent of the VOC emissions from this source. The other lithography source for which a toxic emission factor was added is SCC 40500401. The profile for this source, Printing Press - Lithography Inking and Drying, is also based on composite survey data and a GC/MS analysis. About 22 percent of the VOC emissions from this source are formaldehyde emissions. The toxic emissions added for each city in this category can be seen in Tables A.1 and A.2.

Benzene emission factors were added to four SCCs in the marine vessel loading category. These emission factors were determined through the VOC Speciation Data System (Radian, 1989). The VOC emissions for SCCs 40600243, 40600248, and 40600251 contain 2.4 percent benzene according to the profile Fixed Roof Tank - Crude Oil Refinery. The speciation for this profile is based on an engineering evaluation of test and literature data. The profile for SCC 40600245, Gasoline - Summer Blend, shows 0.77 percent benzene in its speciation. This profile information was based on vapor samples composed of four product types combined in proportion to 1979 sales figures for California. The vapor samples were analyzed using a dual detection FID/PID GC. The benzene emissions added for this category are listed in Table B.3.

A new area source SCC (99999814) was added to the inventory to include emissions from hazardous waste TSDFs. The VOC emissions for each county from this source were obtained from a TSDF data base developed by Research Triangle Institute (RTI). The toxic emissions from TSDFs were determined using the VOC Speciation Data System (Radian, 1989) and are shown in Tables A.3 and A.4. The applicable profile, Solid Waste Disposal - Average,

Table A.1

Methylene Chloride Emissions Added by Source Category

City	Architectural Coating (tpy)	Traffic Paint (tpy)	Industrial Maintenance Coating (tpy)	Web Offset Lithography (tpy)
A	31.6	8.1	6.5	NA
B	206.9	52.8	42.4	1,359.9
C	7.6	1.9	1.6	NA
D	14.2	3.6	2.9	NA
E	16.4	4.2	3.4	29.3
Totals	276.6	70.5	56.7	1,389.2

Table A.2

Formaldehyde Emissions Added by Source Category

City	Web Offset Lithography (tpy)
A	NA
B	12.6
C	NA
D	3.7
E	4.6
Totals	20.9

Table A.3

Benzene Emissions Added by Source Category

City	Architectural Coating (tpy)	Traffic Paint (tpy)	Autobody Refinishing (tpy)	Industrial Maintenance Coating (tpy)	TSDF (tpy)
A	1.9	0.5	10.6	0.4	2.3
B	12.3	3.1	69.3	2.5	193.8
C	0.5	0.1	2.5	0.1	17.8
D	0.8	0.2	4.7	0.2	17.3
E	1.0	0.2	5.5	0.2	0.0
Totals	16.5	4.2	92.7	3.4	231.3

Table A.4

Perchloroethylene Emissions Added by Source Category

City	TSDF (tpy)
A	0.1
B	7.5
C	0.7
D	0.7
E	0.0
Totals	9.0

shows 0.10 percent perchloroethylene and 2.57 percent benzene. This profile was developed as an average of the original profiles representing the source category 5XXXXXXX (solid waste disposal).

The final group of changes to the inventory involved the breakdown of an existing area source and the addition of toxic emission factors to the newly created SCCs. These changes affected SCC 99999971, Surface Coating, which has now been eliminated from the inventory. The new split of this area source is illustrated in Figure A.1. The allocation of emissions from the surface coating category was based on data showing the total 1979 national solvent use in paints and coatings by type of application (Rogozen et al., 1985). Thinner usage was apportioned to each category in direct proportion to the percentage of paints and coatings in each category. The toxic emissions from these surface coating categories are listed by city in Tables A.1 and A.3.

The profile for architectural coatings was based on the composite of three profiles: solvent based coatings (composite of profiles for lacquer, primer, and enamel in proportion to usage in Southern California), thinning and cleanup solvents (composite based on sales volume from nine solvents used with architectural coatings), and water based coating (composite of seven coatings in proportion to 1980 sales figures). These three profiles were found in the VOC Speciation Data System (Radian, 1989) and were combined in proportion to the percentage of VOC emissions from each of these categories from a 1984 survey of the New York major metropolitan area and the entire State of New Jersey (Scheff et al., 1989). This composite included methylene chloride as 1.51 percent of VOC emissions and benzene as 0.09 percent of VOC emissions. Traffic paints and maintenance coatings were assumed to have the same profile as architectural coatings.

The profile used for autobody refinishing, Autobody Repairs, was based on a GC/MS analysis of the semivolatile compounds of 12 automotive aftermarket paint and thinner samples of acrylic lacquer and alkyd enamel from three paint manufacturers (Radian, 1989). The samples were combined using market statistics. This profile identified benzene as making up 1.51 percent of VOC emissions. The profiles for miscellaneous industrial surface coating did not include any of the toxics being studied in this report.

APPENDIX B
MOTOR VEHICLE EMISSION PROJECTIONS

Motor vehicles are an important contributor to estimated base year incidence, so care was taken to ensure that the most recent information available was used to estimate future year changes in motor vehicle emissions. Motor vehicle emission factors for 1980 and 1995 are shown in Table B.1. The vehicle categories used match those in the EPA National Emissions Data System (NEDS). There is only one diesel-powered vehicle category in NEDS (heavy-duty diesels), but the emission factors for heavy-duty diesel vehicles (HDDVs) listed in Table B.1 represent a weighted average factor for all diesels including light-duty diesel vehicle and light-duty diesel truck travel.

Organic toxic emissions were estimated as a percentage of total hydrocarbons using MOBILE3 (Federal Test Procedure conditions) and toxic fractions (Carey, 1988). Particulate emission estimates were made using the current schedule of motor vehicle particulate standards and registration and travel fractions from MOBILE3 (U.S. EPA, 1985b).

Because formaldehyde incidence is estimated based on total VOC emissions, there was no need to apply the Table B.1 formaldehyde emission factors for this study. In addition, because the difference between 1980 and 1995 emission factors for total hydrocarbon (HC), benzene, and 1,3-butadiene emissions was approximately the same, total HC was used as a surrogate for estimating 1995 emission levels for all organic toxics. This allowed area specific I/M program effectiveness values for VOC to be taken into account in the Regulatory Impact Model (RIM).

Table B.1

Motor Vehicle Air Toxic Emission Factors
(mg/mile)

Pollutant	Vehicle Type	1980	1995 No I/M	1995 With I/M
Formaldehyde	LDGV	61.7	11.6	7.9
	LDGT	76.2	27.4	17.2
	HDGV	290.8	78.7	78.7
	HDDV	152.5	80.6	80.6
Benzene	LDGV	168.6	52.8	36.9
	LDGT	229.4	90.1	60.0
	HDGV	412.4	115.9	115.9
	HDDV	51.3	28.3	28.3
1,3-Butadiene	LDGV	12.7	4.1	2.8
	LDGT	20.5	8.7	5.5
	HDGV	32.8	8.9	8.9
	HDDV	15.9	8.6	8.6
Particulates	LDGV	14.9	6.0	5.1
	LDGT	18.2	6.9	5.1
	HDGV	31.3	19.2	18.0
	HDDV	1,973.0	566.5	566.5

LDGV = light-duty gasoline-powered vehicle
LDGT = light-duty gasoline-powered truck
HDGV = heavy-duty gasoline-powered vehicle
HDDV = heavy-duty diesel-powered vehicle

APPENDIX C

CONSTRAINT FILES

Presented in this appendix are listings of the VOC and PM constraint files for the current rules and additional controls scenarios. Table II.8 in the main body of the report lists the constraints that were added to the current rules constraint file to simulate the expected controls scenario. The information presented below can be used as a guide in interpreting the information in the Appendix C tables:

No - constraint number

Name - constraint name (first 19 characters)

Region IDs - regional (city) applicability of constraint

Ind Cat IDs - applicable industrial categories (SCCs)
(? = wildcard)

N - applies to new sources?
R - applies to replaced sources?
E - applies to existing sources?
A - applies in attainment areas?
N - applies in nonattainment areas?

Beg - constraint beginning year
Targ - constraint target year for full implementation (The beginning and target year do not affect the results for constraints applicable to existing sources)

R Ctr - relative control; based on process rate (not applicable to this study)

A Ctr - absolute control; reduction from uncontrolled emissions

Pentr - constraint penetration; fraction of emissions affected

Table C.1
VOC Current Rule Constraint File

No	Name	Region IDs	Ind Cat IDs	N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
1	LAER - PET LIQUID S	ALL	4040010?? 40400110? 40400111?	T	T	F	F	T	1980	1980	MISS	0.960	1.000
2	LAER - PETROLEUM LI	ALL	40300211? 40300212? 4030100?? 40301013? 40301015? 40301109? 40301111?	T	T	F	F	T	1980	1980	MISS	0.960	1.000
3	LAER- GASOLINE BULK	ALL	40600101? 40600131? 40600136? 40600141? 99999804? 40400199?	T	T	F	F	T	1980	1980	MISS	0.970	1.000
4	LAER- PETROLEUM REF	ALL	3060080??	T	T	F	F	T	1980	1980	MISS	0.900	1.000
5	LAER- PETROLEUM REF	ALL	30600501? 30600503?	T	T	F	F	T	1980	1980	MISS	0.900	1.000
6	LAER-PETROLEUM LIQU	ALL	40300101? 40300102? 40300103? 40300104? 40300105? 40300150? 40300201? 40300203? 40300205? 40300208?	T	T	F	F	T	1980	1980	MISS	0.960	1.000
7	NESHAP - BENZENE FU	ALL	30600801? 30600802? 30600803? 30600804? 30600805?	T	T	T	T	T	1981	1981	MISS	0.900	0.050
8	NESHAP - SOCMI BENZ	ALL	30180001?	T	T	T	T	T	1981	1981	MISS	0.900	0.050
9	NESHAP - VINYL CHLO	ALL	30101801? 30112540?	T	T	T	T	T	1980	1980	MISS	0.940	0.990
10	NSPS - DRYCLEANING	ALL	401001??? 99999973? 99999981?	T	T	F	T	T	1984	1985	MISS	0.720	1.000
11	NSPS - GRAPHIC ARTS	ALL	40500101? 40500201? 405003??? 405005???	T	T	F	T	T	1986	1986	MISS	0.750	1.000
12	NSPS - PETROLEUM RE	ALL	30600801? 30600802? 30600803? 30600804? 30600805?	T	T	F	T	T	1983	1983	MISS	0.830	1.000
13	NSPS - PETROLEUM RE	ALL	30600503?	T	T	F	T	T	1989	1989	MISS	0.900	1.000
14	NSPS - POLYMER & RE	ALL	30101802?	T	T	F	T	T	1984	1984	MISS	0.980	1.000
15	NSPS - SOCMI : FUGI	ALL	30180001? 99999990?	T	T	F	T	T	1981	1981	MISS	0.870	0.990
16	NSPS - SOCMI DISTIL	ALL	30101904?	T	T	F	T	T	1983	1983	MISS	0.930	1.000
17	NSPS - SOCMI VOL ST	ALL	30102427L	T	T	F	T	T	1984	1984	MISS	0.960	0.800
18	NSPS - WOODSTOVE	ALL	99999985?	T	T	F	T	T	1991	1991	MISS	0.750	1.000
19	NSPS- RUBBER TIRE	ALL	30800101? 30800102? 30800103? 30800104? 30800105? 30800199?	T	T	F	T	T	1983	1983	MISS	0.750	1.000
20	NSPS- SOLVENT METAL	ALL	4010020?? 40100299? 99999801? 99999802? 99999803? 40100302? 40100305?	T	T	F	T	T	1985	1985	MISS	0.570	1.000
21	NSPS- SYNTHETIC FIB	ALL	30102402?	T	T	F	T	T	1982	1982	MISS	0.800	0.990
22	RACT - ASPHALT BLOW	ALL	30500199? 30500102? 30500104? 30500201? 30500299? 30500202? 30601101?	T	T	T	F	T	1980	1980	MISS	0.850	1.000
23	RACT	ALL	405003???	T	T	T	T	T	1980	1980	MISS	0.700	1.000
24	RACT - AREA SOURCE	ALL	99999972?	T	T	T	F	T	1980	1980	MISS	0.350	1.000
25	RACT - DRYCLEANING	ALL	401001??? 99999973? 99999981?	T	T	T	T	T	1980	1980	MISS	0.630	1.000
26	RACT - GRAPHIC ARTS	ALL	405005???	T	T	T	T	T	1980	1980	MISS	0.750	1.000
27	RACT - HI DENSITY R	ALL	30101802?	T	T	T	F	T	1986	1990	MISS	0.980	1.000
28	RACT - MISC. REFINE	ALL	30600503?	T	T	T	F	T	1980	1987	MISS	0.950	1.000
29	RACT - PET REF FUGS	ALL	30600801? 30600802? 30600803? 30600804? 30600805?	T	T	T	T	T	1980	1980	MISS	0.630	1.000
30	RACT - SOCMI FUGITI	ALL	30180001?	T	T	T	F	T	1986	1990	MISS	0.670	0.900
31	RACT - SOCMI VOL. S	ALL	30102427L	T	T	T	F	T	1986	1990	MISS	0.950	0.800
32	RACT - STYRENE/BUTA	ALL	30102601?	T	T	T	F	T	1990	1995	MISS	0.500	1.000
33	RACT - VOL STORAGE	ALL	4030100?? 40301013? 40301015? 4040010??	T	T	T	F	T	1986	1990	MISS	0.950	1.000

Table C.1
VOC Current Rule Constraint File

No	Name	Region IDs	Ind Cat IDs	N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
34	RACT- MISC REFINERY	ALL	30600602?	T	T	T	F	T	1980	1987	MISS	0.950	1.000
35	RACT- VOL STORAGE:	ALL	40300201? 40300203? 40300205? 40300208? 40400110? 40400111? 40300212? 40300101? 40300102? 40300103? 40300104? 40300105? 40301109? 40301111? 40300150?	T	T	T	F	T	1986	1990	MISS	0.950	1.000
36	RACT-SOLVENT METAL	ALL	401002??? 401003??? 99999801? 99999802? 99999803?	T	T	T	F	T	1980	1980	MISS	0.540	1.000
37	SIP	02	3010180??	T	T	T	T	T	1983	1985	MISS	0.950	1.000
38	SIP	05	30102601??	T	T	T	T	T	1980	1980	MISS	0.850	1.000
39	SIP	ALL	40300201? 40300203? 40300205? 40300208? 40300212? 40301109? 40301111?	T	T	T	T	T	1980	1980	MISS	0.950	1.000
40	SIP	ALL	40300211?	T	T	T	T	T	1980	1980	MISS	0.950	1.000
41	`SIP	ALL	40400110? 40400111?	T	T	T	T	T	1980	1980	MISS	0.950	1.000
42	SIP	ALL	4040019?? 40600101? 40600136? 40600141? 99999804?	T	T	T	T	T	1980	1980	MISS	0.950	1.000
43	SIP	ALL	40600130? 40600134? 40600142? 40600143? 40600146? 40600148? 40600197? 40600198? 40600199?	T	T	T	T	T	1980	1980	MISS	0.950	1.000
44	SIP	ALL	406003???	T	T	T	T	T	1984	1984	MISS	0.900	1.000
45	SIP - GRAPHIC ARTS	02	40500101?	T	T	T	T	T	1983	1983	MISS	0.900	1.000
46	SIP - GRAPHIC ARTS	02	40500401L	T	T	T	T	T	1983	1983	MISS	0.850	1.000
47	SIP - GRAPHIC ARTS	04	405004???	T	T	T	T	T	1980	1980	MISS	0.850	1.000
48	SIP - GRAPHIC ARTS	05	40500101L 40500201? 40500401L 40500499L	T	T	T	T	T	1980	1987	MISS	0.800	1.000
49	SIP - INDUSTRIAL SU	ALL	40200101? 40200301? 40200401? 40200501? 40200601? 40200701? 40200801? 40200802? 40200803? 40200899? 402009??? 40201001? 40200406? 40200899? 40299999?	T	T	T	T	T	1980	1980	MISS	0.850	1.000
50	SIP - PETROLEUM LIQ	02	40300107? 40300152? 40300198? 40300199? 40301198? 40399999? 40300207? 40301099? 40301113? 40301197?	T	T	T	T	T	1980	1980	MISS	0.950	1.000
51	SIP - SCAQMD RULE 4	02	30300305?	T	T	T	T	T	1977	1981	MISS	0.500	0.900
52	SIP ASPHALT BLOWING	02	30500102? 30500104? 30500201? 30500202? 30601101? 30500199? 30500299?	T	T	T	T	T	1980	1980	MISS	0.930	1.000
53	SIP COATINGS AND IN	02	301014??? 301015??? 301020???	T	T	T	T	T	1983	1985	MISS	0.800	1.000
54	SIP MISC CHEM MFG	04	30199999L	T	T	T	T	T	1980	1986	MISS	0.850	1.000
55	SIP MISC WASTE GAS	03	30190099L	T	T	T	T	T	1980	1982	MISS	0.800	1.000
56	SIP MISC WASTE GAS	04	30190099L	T	T	T	T	T	1980	1987	MISS	0.850	1.000
57	SIP PLASTICS PROD.	03	30102699L	T	T	T	T	T	1980	1986	MISS	0.800	1.000
58	SIP RACT - BULK TER	03 04	40600101? 40600126? 40600131L 40600136? 40600141L 40600144L 99999804?	T	T	T	T	T	1980	1980	MISS	0.530	1.000
59	SIP RACT - GAS BULK	04	99999806?	T	T	T	F	T	1980	1980	MISS	0.770	0.500
60	SIP RACT - GAS BULK	03	99999806?	T	T	T	F	T	1980	1982	MISS	0.770	0.500
61	SIP RACT - GAS BULK	05	99999806?	T	T	T	F	T	1980	1987	MISS	0.770	0.500

Table C.1
VOC Current Rule Constraint File

No	Name	Region IDs			Ind Cat IDs			N R E A N	Beg	Targ	R Ctr	A Ctr	Pentr
62	SIP RACT - PHARMACE	05			30106001?			T T T F T	1981	1987	MISS	0.850	0.970
63	SIP RACT - PNEUMATI	05			30800199?			T T T F T	1981	1987	MISS	0.800	0.970
64	SIP RACT - SERVICE	04	05		40600401?	40600402?	40600403?	T T T F T	1985	1987	MISS	0.400	1.000
					40600499?	99999808?							
65	SIP RACT - SERVICE	02			40600401?	40600402?	40600403?	T T T F T	1980	1982	MISS	0.860	1.000
					40600499?	99999808?	99999954?						
66	SIP RACT - SERVICE	02			40600302?	40600307?		T T F F T	1981	1981	MISS	0.950	0.990
67	SIP RACT - SYNTHESI	03			30106001?			T T T F T	1981	1985	MISS	0.900	0.970
68	SIP RACT - SYTHESIZ	04			30106001?			T T T F T	1981	1987	MISS	0.900	1.000
69	SIP RACT - VOL STOR	02	05		40100199?	40600136?	40600101?	T T T T T	1980	1987	MISS	0.550	1.000
					40600141L	40600126?	40600131L						
70	SIP RACT- GASOLINE	02			99999806?			T T T F T	1980	1987	MISS	0.540	0.500
71	SIP RACT- MISC REFI	02	05		30600401?			T T T F T	1980	1987	MISS	0.950	1.000
72	SIP RACT- MISC REFI	03			30600401?			T T T F T	1980	1982	MISS	0.950	0.970
73	SIP SOCMI /TRANSFER	02			4909?????			T T T T T	1980	1987	MISS	0.900	1.000
74	SIP STAGE 2 CONTROL	01	04	05	99999808?			T T T F T	1989	1989	MISS	0.400	1.000
75	SIP VARNISH MFG	05			30101501L			T T T T T	1980	1987	MISS	0.850	1.000
76	SIP-AGRIG CHEM MANF	02			30113004L			T T T T T	1980	1980	MISS	0.850	1.000
77	SIP-CHEM MANF:NON-C	02			30199999L			T T T T T	1980	1980	MISS	0.850	1.000
78	SIP-CHEMICAL MANF:W	02			30190099?			T T T T T	1980	1980	MISS	0.850	1.000
79	SIP-METAL CAN MAKIN	02			30902099L			T T T T T	1980	1980	MISS	0.850	1.000
80	SIP-PETROLEUM IND:R	02			30601201L			T T T T T	1980	1980	MISS	0.850	1.000
81	SIP-PETROLEUM INDUS	02			30699998L			T T T T T	1980	1980	MISS	0.850	1.000
82	SIP-PETROLEUM INDUS	02			30600201L	30600301L		T T T T T	1980	1980	MISS	0.850	1.000
83	SIP-PETROLEUM MARKE	02			406002???			T T F T T	1980	1980	MISS	0.999	1.000
84	SIP-PETROLEUM MARKE	02			406002??L			F F T T T	1980	1987	MISS	1.000	0.100
85	SIP-SYNTHETIC RUBBE	02			30102699L			T T T T T	1980	1980	MISS	0.850	1.000

Table C.2
VOC Additional Controls Constraint File

No	Name	Region IDs	Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
1	LAER - PET LIQUID S	ALL	4040010??	40400110?	40400111?	T	T	F	F	T	1980	1980	MISS	0.960	1.000
2	LAER - PETROLEUM LI	ALL	40300211?	40300212?	4030100??	T	T	F	F	T	1980	1980	MISS	0.960	1.000
			40301013?	40301015?	40301109?										
			40301111?												
3	LAER- GASOLINE BULK	ALL	40600101?	40600131?	40600136?	T	T	F	F	T	1980	1980	MISS	0.970	1.000
			40600141?	99999804?	40400199?										
4	LAER- PETROLEUM REF	ALL	3060080??			T	T	F	F	T	1980	1980	MISS	0.900	1.000
5	LAER- PETROLEUM REF	ALL	30600501?	30600503?		T	T	F	F	T	1980	1980	MISS	0.900	1.000
6	LAER-PETROLEUM LIQU	ALL	40300101?	40300102?	40300103?	T	T	F	F	T	1980	1980	MISS	0.960	1.000
			40300104?	40300105?	40300150?										
			40300201?	40300203?	40300205?										
			40300208?												
7	NESHAP BENZENE FUGI	ALL	30600801?	30600802?	30600803?	T	T	T	T	T	1981	1981	MISS	0.900	0.050
			30600804?	30600805?											
8	NESHAP SOCMI BENZEN	ALL	30180001?			T	T	T	T	T	1981	1981	MISS	0.900	0.050
9	NESHAP - VINYL CHLO	ALL	30101801?	30112540?		T	T	T	T	T	1980	1980	MISS	0.940	0.990
10	NSPS - DRYCLEANING	ALL	401001???	99999973?	99999981?	T	T	F	T	T	1984	1985	MISS	0.720	1.000
11	NSPS - GRAPHIC ARTS	ALL	40500101?	40500201?	405003???	T	T	F	T	T	1986	1986	MISS	0.750	1.000
			405005???												
12	NSPS - PETROLEUM RE	ALL	30600801?	30600802?	30600803?	T	T	F	T	T	1983	1983	MISS	0.830	1.000
			30600804?	30600805?											
13	NSPS - PETROLEUM RE	ALL	30600503?			T	T	F	T	T	1989	1989	MISS	0.900	1.000
14	NSPS - POLYMER & RE	ALL	30101802?			T	T	F	T	T	1984	1984	MISS	0.980	1.000
15	NSPS - SOCMI : FUGI	ALL	30180001?	99999990?		T	T	F	T	T	1981	1981	MISS	0.870	0.990
16	NSPS - SOCMI DISTIL	ALL	30101904?			T	T	F	T	T	1983	1983	MISS	0.930	1.000
17	SIP-SYNTHETIC RUBBE	02	30102699L			T	T	T	T	T	1980	1980	MISS	0.850	1.000
18	NSPS WOODSTOVE	ALL	99999985?			T	T	F	F	T	1991	1991	MISS	0.750	1.000
19	NSPS- RUBBER TIRE	ALL	30800101?	30800102?	30800103?	T	T	F	T	T	1983	1983	MISS	0.750	1.000
			30800104?	30800105?	30800199?										
20	NSPS- SOLVENT METAL	ALL	4010020??	40100299?	99999801?	T	T	F	T	T	1985	1985	MISS	0.570	1.000
			99999802?	99999803?	40100302?										
			40100305?												
21	NSPS SYNTHETIC FIBE	ALL	30102402?			T	T	F	T	T	1982	1982	MISS	0.800	0.990
22	RACT - ASPHALT BLOW	ALL	30500199?	30500102?	30500104?	T	T	T	F	T	1980	1980	MISS	0.850	1.000
			30500201?	30500299?	30500202?										
			30601101?												
23	RACT	ALL	405003???			T	T	T	T	T	1980	1980	MISS	0.700	1.000
24	RACT - AREA SOURCE	ALL	99999972?			T	T	T	F	T	1980	1980	MISS	0.350	1.000
25	RACT - DRYCLEANING	ALL	401001???	99999973?	99999981?	T	T	T	T	T	1980	1980	MISS	0.630	1.000
26	RACT - GRAPHIC ARTS	ALL	405005???			T	T	T	T	T	1980	1980	MISS	0.750	1.000
27	RACT - HI DENSITY R	ALL	30101802?			T	T	T	F	T	1986	1990	MISS	0.980	1.000
28	RACT - MISC. REFINE	ALL	30600503?			T	T	T	F	T	1980	1987	MISS	0.950	1.000
29	RACT - PET REF FUGS	ALL	30600801?	30600802?	30600803?	T	T	T	T	T	1980	1980	MISS	0.630	1.000
			30600804?	30600805?											
30	RACT - SOCMI FUGITI	ALL	30180001?			T	T	T	F	T	1986	1990	MISS	0.670	0.900
31	RACT - SOCMI VOL. S	ALL	30102427L			T	T	T	F	T	1986	1990	MISS	0.950	0.800
32	RACT - STYRENE/BUTA	ALL	30102601?			T	T	T	F	T	1990	1995	MISS	0.500	1.000
33	RACT VOL STORAGE	ALL	4030100??	40301013?	40301015?	T	T	T	F	T	1986	1990	MISS	0.950	1.000
			4040010??												
34	RACT MISC REFINERY	ALL	30600602?			T	T	T	F	T	1980	1987	MISS	0.950	1.000

Table C.2
VOC Additional Controls Constraint File

No	Name	Region IDs	Ind Cat IDs			N R E A N	Beg	Targ	R Ctr	A Ctr	Pentr
35	RACT- VOL STORAGE:	ALL	40300201?	40300203?	40300205?	T T T F T	1986	1990	MISS	0.950	1.000
			40300208?	40400110?	40400111?						
			40300212?	40300101?	40300102?						
			40300103?	40300104?	40300105?						
			40301109?	40301111?	40300150?						
36	RACT-SOLVENT METAL	ALL	401002???	401003???	99999801?	T T T F T	1980	1980	MISS	0.540	1.000
			99999802?	99999803?							
37	SIP	02	3010180??			T T T T T	1983	1985	MISS	0.950	1.000
38	SIP	05	30102601??			T T T T T	1980	1980	MISS	0.850	1.000
39	SIP	ALL	40300201?	40300203?	40300205?	T T T T T	1980	1980	MISS	0.950	1.000
			40300208?	40300212?	40301109?						
			40301111?								
40	SIP	ALL	40300211?			T T T T T	1980	1980	MISS	0.950	1.000
41	SIP	ALL	40400110?	40400111?		T T T T T	1980	1980	MISS	0.950	1.000
42	SIP	ALL	4040019??	40600101?	40600136?	T T T T T	1980	1980	MISS	0.950	1.000
			40600141?	99999804?							
43	SIP	ALL	40600130?	40600134?	40600142?	T T T T T	1980	1980	MISS	0.950	1.000
			40600143?	40600146?	40600148?						
			40600197?	40600198?	40600199?						
44	SIP	ALL	406003???			T T T T T	1984	1984	MISS	0.900	1.000
45	SIP - GRAPHIC ARTS	02	40500101?			T T T T T	1983	1983	MISS	0.900	1.000
46	SIP - GRAPHIC ARTS	02	40500401L			T T T T T	1983	1983	MISS	0.850	1.000
47	SIP - GRAPHIC ARTS	04	405004???			T T T T T	1980	1980	MISS	0.850	1.000
48	SIP - GRAPHIC ARTS	05	40500101L	40500201?	40500401L	T T T T T	1980	1987	MISS	0.800	1.000
			40500499L								
49	SIP - INDUSTRIAL SU	ALL	40200101?	40200301?	40200401?	T T T T T	1980	1980	MISS	0.850	1.000
			40200501?	40200601?	40200701?						
			40200801?	40200802?	40200803?						
			40200899?	402009???	40201001?						
			40200406?	40200899?	40299999?						
50	SIP - PETROLEUM LIQ	02 ,	40300107?	40300152?	40300198?	T T T T T	1980	1980	MISS	0.950	1.000
			40300199?	40301198?	40399999?						
			40300207?	40301099?	40301113?						
			40301197?								
51	SIP - SCAQMD RULE 4	02	30300305?			T T T T T	1977	1981	MISS	0.500	0.900
52	SIP ASPHALT BLOWING	2	30500102?	30500104?	30500201?	T T T T T	1980	1980	MISS	0.930	1.000
			30500202?	30601101?	30500199?						
			30500299?								
53	SIP COATINGS AND IN	02	301014???	301015???	301020???	T T T T T	1983	1985	MISS	0.800	1.000
54	SIP MISC CHEM MFG	04	30199999L			T T T T T	1980	1986	MISS	0.850	1.000
55	SIP MISC WASTE GAS	03	30190099L			T T T T T	1980	1982	MISS	0.800	1.000
56	SIP MISC WASTE GAS	04	30190099L			T T T T T	1980	1987	MISS	0.850	1.000
57	SIP PLASTICS PROD.	03	30102699L			T T T T T	1980	1986	MISS	0.800	1.000
58	SIP RACT - BULK TER	03 04	40600101?	40600126?	40600131L	T T T T T	1980	1980	MISS	0.530	1.000
			40600136?	40600141L	40600144L						
			99999804?								
59	SIP RACT - GAS BULK	04	99999806?			T T T F T	1980	1980	MISS	0.770	0.500
60	SIP RACT - GAS BULK	03	99999806?			T T T F T	1980	1982	MISS	0.770	0.500
61	SIP RACT - GAS BULK	05	99999806?			T T T F T	1980	1987	MISS	0.770	0.500
62	SIP RACT - PHARMACE	05	30106001?			T T T F T	1981	1987	MISS	0.850	0.970

Table C.2
VOC Additional Controls Constraint File

No	Name	Region IDs			Ind Cat IDs			N R E A N	Beg	Targ	R Ctr	A Ctr	Pentr
63	SIP RACT - PNEUMATI	05			30800199?			T T T F T	1981	1987	MISS	0.800	0.970
64	SIP RACT - SERVICE	04	05		40600401?	40600402?	40600403?	T T T F T	1985	1987	MISS	0.400	1.000
					40600499?	99999808?							
65	SIP SERVICE STATION	02			40600401?	40600402?	40600403?	T T T F T	1980	1982	MISS	0.860	1.000
					40600499?	99999808?							
66	SIP SERVICE STATION	02			40600302?	40300307?		T T F F T	1981	1981	MISS	0.950	0.990
67	SIP RACT - SYNTHESI	03			30106001?			T T T F T	1981	1985	MISS	0.900	0.970
68	SIP RACT - SYTHESIZ	04			30106001?			T T T F T	1981	1987	MISS	0.900	1.000
69	SIP RACT - VOL STOR	02	05		40100199?	40600136?	40600101?	T T T T T	1980	1987	MISS	0.550	1.000
					40600141L	40600126?	40600131L						
70	SIP RACT - GASOLINE	2			99999806?			T T T F T	1980	1987	MISS	0.540	0.500
71	SIP RACT- MISC REFI	02	05		30600401?			T T T F T	1980	1987	MISS	0.950	1.000
72	SIP RACT- MISC REFI	03			30600401?			T T T F T	1980	1982	MISS	0.950	0.970
73	SIP SOCMI /TRANSFER	02			4909?????			T T T T T	1980	1987	MISS	0.900	1.000
74	SIP STAGE 2 CONTROL	01	04	05	99999808?			T T T F T	1989	1989	MISS	0.400	1.000
75	SIP VARNISH MFG	05			30101501L			T T T T T	1980	1987	MISS	0.850	1.000
76	SIP-AGRIG CHEM MANF	02			30113004L			T T T T T	1980	1980	MISS	0.850	1.000
77	SIP-CHEM MANF:NON-C	02			30199999L			T T T T T	1980	1980	MISS	0.850	1.000
78	SIP-CHEMICAL MANF:W	02			30190099?			T T T T T	1980	1980	MISS	0.850	1.000
79	SIP-METAL CAN MAKIN	02			30902099L			T T T T T	1980	1980	MISS	0.850	1.000
80	SIP-PETROLEUM IND:R	02			30601201L			T T T T T	1980	1980	MISS	0.850	1.000
81	SIP-PETROLEUM INDUS	02			30699998L			T T T T T	1980	1980	MISS	0.850	1.000
82	SIP-PETROLEUM INDUS	02			30600201L	30600301L		T T T T T	1980	1980	MISS	0.850	1.000
83	SIP-PETROLEUM MARKE	02			406002???			T T F T T	1980	1980	MISS	0.999	1.000
84	SIP-PETROLEUM MARKE	02			406002??L			F F T T T	1980	1987	MISS	1.000	0.100
85	SIP-SYNTHETIC RUBBE	02			30102699L			T T T T T	1980	1980	MISS	0.850	1.000
86	X - FIP STUDY	ALL			30101401?	30600801?	30600802?	T T T T T	1992	1992	MISS	0.900	1.000
					30600803?	30600804?	30600805?						
					40100102?	40100104?							
87	X - FIP STUDY	ALL			40300198?	40300199?	40300202?	T T T T T	1992	1992	MISS	0.950	1.000
					40301097?	40301099?	40301198?						
					40400199?	40500301?	40500305?						
					40500501?	40500599?	40600126?						
					40600131?	40600401?							
88	X - FIP STUDY	ALL			30600602?			T T T T T	1992	1992	MISS	0.980	1.000
89	X - FED/CTG TSDF	ALL			99999814?			T T T T T	1992	1992	MISS	0.930	1.000
90	X - FED/CTG CONSUME	ALL			99999975?			T T T T T	1992	1992	MISS	0.200	1.000
91	X - FED/CTG MARINE	ALL			40600236?	40600243?	40600244?	T T T T T	1992	1992	MISS	0.900	1.000
					40600245?	40600248?	40600251?						
92	X - FED/CTG ARCHITE	ALL			99999815?			T T T T T	1992	1992	MISS	0.500	1.000
93	X - FED/CTG IND MAI	ALL			99999819?			T T T T T	1992	1992	MISS	0.650	1.000
94	X - FED/CTG TRAFFIC	ALL			99999816?			T T T T T	1992	1992	MISS	0.800	1.000
95	X - FED/CTG SOCMI D	ALL			30101904?			T T T T T	1992	1992	MISS	0.850	1.000
96	X - FED/CTG POTW	ALL			70000001			T T T T T	1992	1992	MISS	0.750	1.000
97	X - FED/CTG AUTOBOD	ALL			99999817?			T T T T T	1992	1992	MISS	0.600	1.000
98	X - FED/CTG PETROLE	ALL			30600503?			T T T T T	1992	1992	MISS	0.500	1.000
99	X - FED/CTG WEB OFF	ALL			40500101?	40500401?		T T T T T	1992	1992	MISS	0.800	1.000
100	X - FED/CTG SOCMI R	ALL			30110099?	30112501?	30112502?	T T T T T	1992	1992	MISS	0.850	1.000
					30112540?	30125801?							
101	X - WOODSTOVES	ALL			99999985?			T T T T T	1992	1992	MISS	0.400	1.000

Table C.2
VOC Additional Controls Constraint File

No	Name	Region IDs	Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
102	X - PERC DRYCLEANIN	ALL	40100101?	40100103?		T	T	T	T	T	1992	1992	MISS	0.950	1.000
103	X - DRYCLEANING	ALL	99999973?	401001???		T	T	T	T	T	1992	1992	MISS	0.720	1.000
104	X - NESHAP HAZARDOU	ALL	30115301?	30112501?	30112502?	T	T	T	T	T	1993	1993	MISS	0.500	1.000
			30112540?	30102601?	30102608?										
			30102699?	30101801?	30103301?										
			30103399?	30106001?											
105	X - NESHAP COKE OVE	ALL	30300302?			T	T	T	T	T	1992	1992	MISS	0.560	1.000
106	X - NESHAP BENZENE	ALL	30300315?			T	T	T	T	T	1989	1989	MISS	0.630	1.000
107	X - NESHAP MUNICIPA	ALL	50100101?	50100506?		T	T	T	T	T	1991	1991	MISS	0.800	1.000
108	X - NSPS HOSPITAL I	ALL	50200505?			T	T	F	T	T	1993	1993	MISS	0.800	1.000
109	ZZ - CLEANUP SOLVEN	ALL	99999975?			T	T	T	T	T	1992	1992	MISS	0.500	0.360
110	ZZ - ADHESIVES	ALL	40200701?			T	T	T	T	T	1992	1992	MISS	0.650	1.000
111	ZZ - INK & PAINT MF	ALL	30102099?	30101401?	30101499?	T	T	T	T	T	1992	1992	MISS	0.350	1.000
			30101501?	30101599?											
112	ZZ - PESTICIDE MFG	ALL	99999987?			T	T	T	T	T	1992	1992	MISS	0.500	1.000
113	ZZ - HOSPITAL STERI	ALL	31502001?	99999982?		T	T	T	T	T	1992	1992	MISS	0.990	1.000
114	ZZ - PULP MFG CHLOR	ALL	30700108?			T	T	T	T	T	1992	1992	MISS	0.920	1.000
115	ZZ - EDC PROD (LAST	ALL	30112501?	30112502?		T	T	T	T	T	1992	1992	MISS	0.940	0.990
116	ZZ - BACT	ALL	30100308?	30100309?	30102499?	T	T	T	T	T	1992	1992	MISS	0.410	1.000
117	ZZ - BACT	ALL	30100999?	30101401?	30103399?	T	T	T	T	T	1992	1992	MISS	0.990	1.000
			30400401?	30400403?	30400499?										
			30499999?	30500201?	30601101?										
			301015???	30101904?	40300106?										
			40300107?	40300116?	40300152?										
			40300161?	40300198?	40300199?										
			40301021?	40300201L	30100503?										
118	ZZ - BACT	ALL	30101801?	301100???	301125???	T	T	T	T	T	1992	1992	MISS	0.980	1.000
			301258???	30300302?	40301202?										
			40301204?												
119	ZZ - BACT	ALL	301018???	306004???	306006???	T	T	T	T	T	1992	1992	MISS	0.950	1.000
			306005???	40301113?	40301197?										
			40301198?	40399999?	40500401?										
			406003???	99999974?											
120	ZZ - BACT	ALL	301020???	405002???		T	T	T	T	T	1992	1992	MISS	0.800	1.000
121	ZZ - BACT	ALL	30102399L	30600503?	30600504?	T	T	T	T	T	1992	1992	MISS	0.970	1.000
122	ZZ - BACT	ALL	30113004?	40500304?	40500305?	T	T	T	T	T	1992	1992	MISS	0.850	1.000
			40500306?	40500503L	40500510?										
			40500599?												
123	ZZ - BACT	ALL	30600101?	30600102?	30600103?	T	T	T	T	T	1992	1992	MISS	0.999	1.000
			30600104?	30600201?	30600301?										
			30699998?	30699999?	30600602L										
			30600802?	30600804?	30600805?										
			30601201?												
124	ZZ - BACT	ALL	30600801?	30600803?	99999990?	T	T	T	T	T	1992	1992	MISS	0.910	1.000
125	ZZ - BACT	ALL	30999999?			T	T	T	T	T	1992	1992	MISS	0.460	1.000
126	ZZ - BACT	ALL	30999999?			T	T	F	T	T	1992	1992	MISS	0.990	1.000

Table C.2
VOC Additional Controls Constraint File

No	Name	Region IDs	Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
127	ZZ - BACT	ALL	40200101?	40200301?	40200401?	T	T	T	T	T	1992	1992	MISS	0.900	1.000
			40200501?	40200601?	40200701?										
			40200801?	40200802?	40200803?										
			40200899?	402009???	99999807?										
			99999903?	99999904?											
128	ZZ - BACT	ALL	40300101?	40300102?	40300103?	T	T	T	T	T	1992	1992	MISS	0.996	1.000
			40100101L												
129	ZZ - BACT	ALL	40300201S			T	T	T	T	T	1992	1992	MISS	0.973	1.000
130	ZZ - BACT	ALL	40300302?			T	T	T	T	T	1992	1992	MISS	0.570	1.000
131	ZZ - BACT	ALL	40400199L	40600101L	40600126L	T	T	F	T	T	1992	1992	MISS	0.977	1.000
			40600130L	40600131L	40600134L										
			40600138L	40600139L	40600140L										
			40600143L	40600146L	40600148L										
			40600197L	40600198L	40600199L										
132	ZZ - BACT	ALL	40400199S	40600101S	40600126S	T	T	F	T	T	1992	1992	MISS	0.920	1.000
			40600130S	40600139S	40600140S										
			40600141S	40600146S	40600197S										
			40600198S	40600199S											
133	ZZ - BACT	ALL	40500301?			T	T	T	T	T	1992	1992	MISS	0.750	1.000
134	ZZ - BACT	ALL	40600101?	40600126?	40600130?	T	T	T	T	T	1992	1992	MISS	0.550	1.000
			40600147L	40600144L	40600162L										
			40600163L												
135	ZZ - BACT	ALL	406004???	99999954?	99999808?	T	T	T	T	T	1992	1992	MISS	0.860	1.000
136	ZZ - BACT	ALL	49099999?			T	T	T	T	T	1992	1992	MISS	0.920	1.000
137	ZZ - BACT	ALL	99999801?			T	T	T	T	T	1992	1992	MISS	0.830	1.000
138	ZZ - BACT	ALL	99999804?			T	T	T	T	T	1992	1992	MISS	0.977	1.000
139	ZZ - BACT	ALL	99999805?	99999806?		T	T	T	T	T	1992	1992	MISS	0.973	1.000
140	ZZ - BACT	ALL	99999971?			T	T	T	T	T	1992	1992	MISS	0.900	1.000

Table C.3
PM Current Rules Constraint File

No	Name	Region IDs			Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
1	Aluminum Smelting P	01			304001???			T	T	T	T	T	1984	1984	MISS	1.000	1.000
2	BACT	01	03	05	101002???			T	T	F	T	T	1984	1984	MISS	1.000	1.000
3	BACT : SEC ZINC/GAL	ALL			30400805?			T	T	F	T	T	1980	1980	MISS	0.985	1.000
4	BACT SEC. LEAD/KETT	05			30400401?			T	T	F	T	T	1980	1980	MISS	0.995	1.000
5	BACT/LAER	ALL			101002???			T	T	F	T	T	1980	1980	MISS	0.999	0.900
6	BACT/LAER	ALL			30400204?	30400209?	30400215?	T	T	F	T	T	1980	1987	MISS	0.995	1.000
7	BACT/LAER (Secondar	ALL			304004???			T	T	F	T	T	1980	1987	MISS	0.995	1.000
8	LAER	02	04		101002???			T	T	F	T	T	1984	1984	MISS	1.000	1.000
9	LAER for Secondary	ALL			30400103?	30400104?	30400199?	T	T	F	T	T	1980	1980	MISS	0.999	1.000
10	LAER/Primary Lead S	ALL			30301002?			T	T	F	T	T	1980	1980	MISS	0.995	1.000
11	NSPS	01	02	04	10100401?			T	T	F	T	T	1978	1978	MISS	0.916	1.000
		05															
12	NSPS	04			10100203L			T	T	T	T	T	1978	1978	MISS	0.995	1.000
13	NSPS	ALL			101002???			T	T	F	T	T	1980	1980	MISS	0.995	0.990
14	NSPS	ALL			1010050??			T	T	F	T	T	1980	1978	MISS	0.930	1.000
15	NSPS	ALL			1010060??			T	T	F	T	T	1978	1978	MISS	MISS	1.000
16	NSPS	ALL			305020???			T	T	T	T	T	1980	1980	MISS	0.950	1.000
17	NSPS	ALL			99999917?			T	T	F	T	T	1986	1986	MISS	0.780	1.000
18	NSPS - SECONDARY LE	ALL			30400401?	30400402?	30400403?	T	T	F	T	T	1973	1972	MISS	0.997	1.000
					304004004?	304004005?											
19	NSPS - WOODSTOVE	ALL			99999985?			T	T	F	T	T	1991	1991	MISS	0.750	1.000
20	NSPS /NON METALLIC	ALL			30500502?	30500302?		T	T	F	T	T	1983	1984	MISS	0.998	0.980
21	NSPS ALUMINUM REDUC	ALL			303001???			T	T	F	T	T	1974	1974	MISS	0.960	1.000
22	NSPS BRASS/BRONZE	ALL			30400215?	30400217?	30400219?	T	T	F	T	T	1973	1973	MISS	0.962	1.000
23	NSPS SEC. LEAD REVE	ALL			30400402?			T	T	F	T	T	1973	1973	MISS	0.992	1.000
24	NSPS- REVISED	02			10200403?			T	T	F	T	T	1986	1986	MISS	0.550	1.000
25	NSPS- REVISED	ALL			102004???			T	T	F	T	T	1986	1986	MISS	0.780	1.000
26	NSPS- REVISION	ALL			101002???			T	T	F	T	T	1986	1986	MISS	1.000	1.000
27	SIP	01			101002???			T	T	T	T	T	1980	1984	MISS	0.999	1.000
28	SIP	01			10100401L			T	T	T	T	T	1980	1980	MISS	0.560	1.000
29	SIP	01			10100401S			T	T	T	T	T	1980	1980	MISS	0.380	1.000
30	SIP	01			10100501L			T	T	T	T	T	1980	1980	MISS	0.630	1.000
31	SIP	01			10100501S			T	T	T	T	T	1980	1980	MISS	0.465	1.000
32	SIP	02			101002???			T	T	T	T	T	1980	1980	MISS	0.999	1.000
33	SIP	02			10200401L			T	T	T	T	T	1976	1980	MISS	0.775	1.000
34	SIP	02			10200401S			T	T	T	T	T	1976	1980	MISS	0.550	1.000
35	SIP	02			10200402L			T	T	T	T	T	1976	1980	MISS	0.416	1.000
36	SIP	02			306002???	306003???		T	T	T	T	T	1980	1987	MISS	0.980	1.000
37	SIP	02			306012???			T	T	T	T	T	1980	1987	MISS	0.950	1.000
38	SIP	02	04		30400101?			T	T	T	T	T	1980	1987	MISS	0.930	1.000
39	SIP	02	04		3050?????	3069999??	3070?????	T	T	T	T	T	1980	1980	MISS	0.800	1.000
					3080?????												
40	SIP	04			10100203L			T	T	T	T	T	1975	1980	MISS	0.990	1.000
41	SIP	04			10100401?			T	T	T	T	T	1975	1980	MISS	0.940	1.000
42	SIP	04			10200401?	10200402?		T	T	T	T	T	1980	1980	MISS	0.830	1.000
43	SIP	05			10100401L			T	T	T	T	T	1980	1980	MISS	0.750	1.000
44	SIP	05			10100401S			T	T	T	T	T	1980	1980	MISS	0.580	1.000
45	SIP	05			10100501L			T	T	T	T	T	1980	1980	MISS	0.790	1.000
46	SIP	05			10100501S			T	T	T	T	T	1980	1980	MISS	0.645	1.000
47	SIP	05			10200402L			T	T	T	T	T	1980	1980	MISS	0.232	1.000

Table C.3
PM Current Rules Constraint File

No	Name	Region IDs		Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
48	SIP COMAR 10.18.10	04		30300999?	30300922?	30300808?	T	T	T	T	T	1980	1981	MISS	0.700	0.850
49	SIP LA / SEC. LEAD	03		30400402?			T	T	T	T	T	1980	1987	MISS	0.670	1.000
50	SIP LA AIR POLLUTIO	03		30500303?			T	T	T	T	T	1977	1977	MISS	0.100	0.300
51	SIP LA AIR POLLUTIO	03		30500302?			T	T	T	T	T	1977	1977	MISS	0.980	0.900
52	SIP PA TITLE 25 PAR	05		30500399?			T	T	T	T	T	1971	1971	MISS	0.990	0.900
53	SIP PA TITLE 5 PART	05		30500502?			T	T	T	T	T	1971	1971	MISS	0.990	0.900
54	SIP PHILADELPHIA LO	05		304002???			T	T	T	T	T	1980	1980	MISS	0.985	0.900
55	SIP PHILADELPHIA LO	05		30400401?			T	T	T	T	T	1980	1980	MISS	0.900	1.000
56	SIP PHILADELPHIA, L	05		30400805?			T	T	T	T	T	1980	1980	MISS	0.910	1.000
57	SIP PROCESS CURVE	02		30100503?			T	T	T	T	T	1980	1980	MISS	0.995	1.000
58	SIP PROCESS CURVE	02		30100599?			T	T	T	T	T	1980	1980	MISS	0.940	1.000
59	SIP PROCESS CURVE	02		30100901?	30100910?	30100999?	T	T	T	T	T	1980	1980	MISS	0.880	1.000
60	SIP PROCESS CURVE	02		30300399?	303008???	303009???	T	T	T	T	T	1980	1980	MISS	0.950	1.000
61	SIP PROCESS CURVE	02		30300931L			T	T	T	T	T	1980	1980	MISS	0.987	1.000
62	SIP PROCESS CURVE	02	04	3010?????	3020?????		T	T	T	T	T	1980	1980	MISS	0.850	1.000
63	SIP PROCESS CURVE	02	04	303009???			T	T	T	T	T	1980	1980	MISS	0.950	1.000
64	SIP PROCESS CURVE	02	04	3030?????			T	T	T	T	T	1980	1980	MISS	0.900	1.000
65	SIP PROCESS CURVE	02	04	30400402?	30400403?	30400701L	T	T	T	T	T	1980	1980	MISS	0.960	1.000
				30400702L	30400704?	30700799L										
66	SIP PROCESS CURVE	02	04	3040?????	303010???	303030???	T	T	T	T	T	1980	1980	MISS	0.930	1.000
67	SIP PROCESS CURVE	02	04	305006???	305007???	305008???	T	T	T	T	T	1980	1980	MISS	0.950	1.000
				305009???												
68	SIP PROCESS CURVE	02	04	306010???	306011???	306012???	T	T	T	T	T	1980	1980	MISS	0.900	1.000
69	SIP SCAQMD - RULE 4	02		30300304?			T	T	T	T	T	1976	1976	MISS	0.960	0.250
70	SIP SCAQMD: Rule 4	02		30301002?			T	T	T	T	T	1980	1980	MISS	0.961	1.000
71	SIP STATE AIR REG C	04		30500501?			T	T	T	T	T	1980	1980	MISS	0.996	0.900
72	SIP STATE AIR REG C	04		30500502?			T	T	T	T	T	1980	1980	MISS	0.909	0.900
73	SIP STATE AIR REG C	04		30500503?			T	T	T	T	T	1980	1980	MISS	0.998	0.900
74	SIP TITLE 25 PART 1	05		30300804?			T	T	T	T	T	1971	1971	MISS	0.200	0.500
75	SIP TITLE 25 Part 1	05		30300804?			T	T	T	T	T	1971	1971	MISS	0.500	0.800

Table C.4
PM Additional Controls Constraint File

No	Name	Region IDs			Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
1	Aluminum Smelting P	01			304001???			T	T	T	T	T	1984	1984	MISS	1.000	1.000
2	BACT	01	03	05	101002???			T	T	F	T	T	1984	1984	MISS	1.000	1.000
3	BACT : SEC ZINC/GAL	ALL			30400805?			T	T	F	T	T	1980	1980	MISS	0.985	1.000
4	BACT SEC. LEAD/KETT	05			30400401?			T	T	F	T	T	1980	1980	MISS	0.995	1.000
5	BACT/LAER	ALL			101002???			T	T	F	T	T	1980	1980	MISS	0.999	0.900
6	BACT/LAER	ALL			30400204?	30400209?	30400215?	T	T	F	T	T	1980	1987	MISS	0.995	1.000
7	BACT/LAER (Secondar	ALL			304004???			T	T	F	T	T	1980	1987	MISS	0.995	1.000
8	LAER	02	04		101002???			T	T	F	T	T	1984	1984	MISS	1.000	1.000
9	LAER for Secondary	ALL			30400103?	30400104?	30400199?	T	T	F	T	T	1980	1980	MISS	0.999	1.000
10	LAER/Primary Lead S	ALL			30301002?			T	T	F	T	T	1980	1980	MISS	0.995	1.000
11	NSPS	01	02	04	10100401?			T	T	F	T	T	1978	1978	MISS	0.916	1.000
		05															
12	NSPS	04			10100203L			T	T	T	T	T	1978	1978	MISS	0.995	1.000
13	NSPS	ALL			101002???			T	T	F	T	T	1980	1980	MISS	0.995	0.990
14	NSPS	ALL			1010050??			T	T	F	T	T	1980	1978	MISS	0.930	1.000
15	NSPS	ALL			1010060??			T	T	F	T	T	1978	1978	MISS	MISS	1.000
16	NSPS	ALL			305020???			T	T	T	T	T	1980	1980	MISS	0.950	1.000
17	NSPS	ALL			99999917?			T	T	F	T	T	1986	1986	MISS	0.780	1.000
18	NSPS - SECONDARY LE	ALL			30400401?	30400402?	30400403?	T	T	F	T	T	1973	1972	MISS	0.997	1.000
					304004004?	304004005?											
19	NSPS - WOODSTOVE	ALL			99999985?			T	T	F	T	T	1991	1991	MISS	0.750	1.000
20	NSPS /NON METALLIC	ALL			30500502?	30500302?		T	T	F	T	T	1983	1984	MISS	0.998	0.980
21	NSPS ALUMINUM REDUC	ALL			303001???			T	T	F	T	T	1974	1974	MISS	0.960	1.000
22	NSPS BRASS/BRONZE	ALL			30400215?	30400217?	30400219?	T	T	F	T	T	1973	1973	MISS	0.962	1.000
23	NSPS SEC. LEAD REVE	ALL			30400402?			T	T	F	T	T	1973	1973	MISS	0.992	1.000
24	NSPS- REVISED	02			10200403?			T	T	F	T	T	1986	1986	MISS	0.550	1.000
25	NSPS- REVISED	ALL			102004???			T	T	F	T	T	1986	1986	MISS	0.780	1.000
26	NSPS- REVISION	ALL			101002???			T	T	F	T	T	1986	1986	MISS	1.000	1.000
27	SIP	ALL			101002???			T	T	T	T	T	1980	1984	MISS	0.999	1.000
28	SIP	ALL			10100401L			T	T	T	T	T	1980	1980	MISS	0.560	1.000
29	SIP	ALL			10100401S			T	T	T	T	T	1980	1980	MISS	0.380	1.000
30	SIP	ALL			10100501L			T	T	T	T	T	1980	1980	MISS	0.630	1.000
31	SIP	ALL			10100501S			T	T	T	T	T	1980	1980	MISS	0.465	1.000
32	SIP	ALL			101002???			T	T	T	T	T	1980	1980	MISS	0.999	1.000
33	SIP	ALL			10200401L			T	T	T	T	T	1976	1980	MISS	0.775	1.000
34	SIP	ALL			10200401S			T	T	T	T	T	1976	1980	MISS	0.550	1.000
35	SIP	ALL			10200402L			T	T	T	T	T	1976	1980	MISS	0.416	1.000
36	SIP	ALL			306002???	306003???		T	T	T	T	T	1980	1987	MISS	0.980	1.000
37	SIP	ALL			306012???			T	T	T	T	T	1980	1987	MISS	0.950	1.000
38	SIP	ALL			30400101?			T	T	T	T	T	1980	1987	MISS	0.930	1.000
39	SIP	ALL			3050?????	3069999??	3070?????	T	T	T	T	T	1980	1980	MISS	0.800	1.000
					3080?????												
40	SIP	ALL			10100203L			T	T	T	T	T	1975	1980	MISS	0.990	1.000
41	SIP	ALL			10100401?			T	T	T	T	T	1975	1980	MISS	0.940	1.000
42	SIP	ALL			10200401?	10200402?		T	T	T	T	T	1980	1980	MISS	0.830	1.000
43	SIP	ALL			10100401L			T	T	T	T	T	1980	1980	MISS	0.750	1.000
44	SIP	ALL			10100401S			T	T	T	T	T	1980	1980	MISS	0.580	1.000
45	SIP	ALL			10100501L			T	T	T	T	T	1980	1980	MISS	0.790	1.000
46	SIP	ALL			10100501S			T	T	T	T	T	1980	1980	MISS	0.645	1.000
47	SIP	ALL			10200402L			T	T	T	T	T	1980	1980	MISS	0.232	1.000

Table C.4
PM Additional Controls Constraint File

No	Name	Region IDs	Ind Cat IDs	N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
48	SIP COMAR 10.18.10	ALL	30300999? 30300922? 30300808?	T	T	T	T	T	1980	1981	MISS	0.700	0.850
49	SIP LA / SEC. LEAD	ALL	30400402?	T	T	T	T	T	1980	1987	MISS	0.670	1.000
50	SIP LA AIR POLLUTIO	ALL	30500303?	T	T	T	T	T	1977	1977	MISS	0.100	0.300
51	SIP LA AIR POLLUTIO	ALL	30500302?	T	T	T	T	T	1977	1977	MISS	0.980	0.900
52	SIP PA TITLE 25 PAR	ALL	30500399?	T	T	T	T	T	1971	1971	MISS	0.990	0.900
53	SIP PA TITLE 5 PART	ALL	30500502?	T	T	T	T	T	1971	1971	MISS	0.990	0.900
54	SIP PHILADELPHIA LO	ALL	304002???	T	T	T	T	T	1980	1980	MISS	0.985	0.900
55	SIP PHILADELPHIA LO	ALL	30400401?	T	T	T	T	T	1980	1980	MISS	0.900	1.000
56	SIP PHILADELPHIA, L	ALL	30400805?	T	T	T	T	T	1980	1980	MISS	0.910	1.000
57	SIP PROCESS CURVE	ALL	30100503?	T	T	T	T	T	1980	1980	MISS	0.995	1.000
58	SIP PROCESS CURVE	ALL	30100599?	T	T	T	T	T	1980	1980	MISS	0.940	1.000
59	SIP PROCESS CURVE	ALL	30100901? 30100910? 30100999?	T	T	T	T	T	1980	1980	MISS	0.880	1.000
60	SIP PROCESS CURVE	ALL	30300399? 303008??? 303009???	T	T	T	T	T	1980	1980	MISS	0.950	1.000
61	SIP PROCESS CURVE	ALL	30300931L	T	T	T	T	T	1980	1980	MISS	0.987	1.000
62	SIP PROCESS CURVE	ALL	3010????? 3020?????	T	T	T	T	T	1980	1980	MISS	0.850	1.000
63	SIP PROCESS CURVE	ALL	303009???	T	T	T	T	T	1980	1980	MISS	0.950	1.000
64	SIP PROCESS CURVE	ALL	3030?????	T	T	T	T	T	1980	1980	MISS	0.900	1.000
65	SIP PROCESS CURVE	ALL	30400402? 30400403? 30400701L 30400702L 30400704? 30700799L	T	T	T	T	T	1980	1980	MISS	0.960	1.000
66	SIP PROCESS CURVE	ALL	3040????? 303010??? 303030???	T	T	T	T	T	1980	1980	MISS	0.930	1.000
67	SIP PROCESS CURVE	ALL	305006??? 305007??? 305008??? 305009???	T	T	T	T	T	1980	1980	MISS	0.950	1.000
68	SIP PROCESS CURVE	ALL	306010??? 306011??? 306012???	T	T	T	T	T	1980	1980	MISS	0.900	1.000
69	SIP SCAQMD RULE 4	ALL	30300304?	T	T	T	T	T	1976	1976	MISS	0.960	0.250
70	SIP SCAQMD: Rule 4	ALL	30301002?	T	T	T	T	T	1980	1980	MISS	0.961	1.000
71	SIP STATE AIR REG C	ALL	30500501?	T	T	T	T	T	1980	1980	MISS	0.996	0.900
72	SIP STATE AIR REG C	ALL	30500502?	T	T	T	T	T	1980	1980	MISS	0.909	0.900
73	SIP STATE AIR REG C	ALL	30500503?	T	T	T	T	T	1980	1980	MISS	0.998	0.900
74	SIP TITLE 25 PART 1	ALL	30300804?	T	T	T	T	T	1971	1971	MISS	0.200	0.500
75	SIP TITLE 25 Part 1	ALL	30300804?	T	T	T	T	T	1971	1971	MISS	0.500	0.800
76	X - WOODSTOVES	ALL	99999985?	T	T	T	T	T	1992	1992	MISS	0.400	1.000
77	X - INCINERATION NS	ALL	501001??? 502001??? 503001???	T	T	F	T	T	1990	1990	MISS	0.990	1.000
78	X - SIP RESIDENTIAL	ALL	99999903? 99999904?	T	T	T	T	T	1990	1990	MISS	0.240	1.000
79	X - SIP FUGITIVE DU	ALL	99999955? 99999957? 99999958?	T	T	T	T	T	1990	1990	MISS	0.500	1.000
80	X - NESHAP COMFORT	ALL	99999998?	T	T	T	T	T	1989	1989	MISS	1.000	1.000
81	X - NESHAP CHROME P	ALL	309010??? 99999811?	T	T	T	T	T	1993	1993	MISS	0.950	1.000
82	X - HESHAP BY-PRODU	ALL	30300302? 30300304? 30300399?	T	T	T	T	T	1992	1992	MISS	0.560	1.000
83	X - NESHAP INDUSTRI	ALL	38888888?	T	T	T	T	T	1993	1993	MISS	0.670	1.000
84	X - NESHAP MUNICIPA	ALL	50100101? 50100506? 50200503? 50300506?	T	T	T	T	T	1991	1991	MISS	0.990	1.000
85	X - NSPS HOSPITAL I	ALL	50100505? 50200505?	T	T	T	T	T	1993	1993	MISS	0.990	1.000
86	ZZ - BACT	ALL	99999811? 309010???	T	T	T	T	T	1992	1992	MISS	0.998	1.000
87	ZZ - BACT	ALL	38888888?	T	T	T	T	T	1992	1992	MISS	0.850	1.000
88	ZZ - BACT	ALL	305008???	T	T	T	T	T	1992	1992	MISS	0.990	1.000
89	ZZ - BACT	ALL	302005??? 302006???	T	T	T	T	T	1992	1992	MISS	0.950	1.000
90	ZZ - BACT	ALL	10100401? 10100501? 10100505? 101006??? 30500302? 30500502? 30500505?	T	T	T	T	T	1992	1992	MISS	0.995	1.000

Table C.4
PM Additional Controls Constraint File

No	Name	Region IDs	Ind Cat IDs			N	R	E	A	N	Beg	Targ	R Ctr	A Ctr	Pentr
91	ZZ - BACT	ALL	10200501?	10200502?	10200503?	T	T	T	T	T	1992	1992	MISS	0.980	1.000
			10200601?	10200602?	10200603?										
			10200701?	10200708?	10200904?										
			10201101?	10201201?	103??????										
			105??????	2????????	309??????										
			32???????	33???????	39???????										
			4????????	5????????	10300401?										
			10300404?	10300501?	40200101?										
92	ZZ - BACT	ALL	30199999?			T	T	T	T	T	1992	1992	MISS	0.980	1.000
93	ZZ - BACT	ALL	30200501?	30200502?	30200503?	T	T	T	T	T	1992	1992	MISS	0.950	1.000
			302006???	30600103?											
94	ZZ - BACT	ALL	30300904?			T	T	T	T	T	1992	1992	MISS	0.975	1.000
95	ZZ - BACT	ALL	30400212?	30400217?	30400219?	T	T	F	T	T	1992	1992	MISS	0.990	1.000
			30400299?	30500104?	30500199?										
96	ZZ - BACT	ALL	304002???			T	T	T	T	T	1992	1992	MISS	0.985	1.000
97	ZZ - BACT	ALL	30400301?	30500301?	30500303?	T	T	F	T	T	1992	1992	MISS	0.996	1.000
			30500501?	30500502?											
98	ZZ - BACT	ALL	30400303?			T	T	F	T	T	1992	1992	MISS	0.975	1.000
99	ZZ - BACT	ALL	30500301?			T	T	T	T	T	1992	1992	MISS	0.920	1.000
100	ZZ - BACT	ALL	305008???			T	T	T	T	T	1992	1992	MISS	0.990	1.000
101	ZZ - BACT	ALL	306001???			T	T	T	T	T	1992	1992	MISS	0.800	1.000

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report (Volume II) is the second phase of a study to define the urban air toxics problem and to discern what combination of control measures can best be employed to mitigate the problem. Volume I of this study documented the base year analysis (nominally the year 1980), involving dispersion modeling of emissions data for 25 carcinogenic air toxics in five U.S. urban areas and a subsequent assessment of estimated aggregate cancer incidence. This Volume II report applies various control strategies and analyzes the resulting reduction in aggregate cancer incidence that would occur between 1980 and 1995.

Control scenarios consisted of (1) efforts that were currently underway to reduce air toxics emissions at the time of this study, (2) efforts that were expected to occur by 1995, mainly national standards that were under development, and (3) a series of selected more rigorous controls. Current rules would reduce cancer incidence by 27 percent, expected rules would gain another 20 percent, and selected additional controls would add another 13 percent reduction. Reduction would be almost equally divided between volatile organic compound and particulate emissions and approximately half of the incidence reduction would come from mobile source control.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Toxics Cancer incidence, air toxics Controllability, air toxics Hazardous air pollutants Mitigation, air toxics Risk assessment, air toxics Urban air toxics (urban soup)		

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