APPENDIX A

EMISSIONS AND AIR QUALITY

APPENDIX A.1
ESTIMATION OF 1990 EMISSIONS BY MAJOR SECTOR

Industrial Point Sources

The National Particulates Inventory (NPI) defines industrial point sources as those non-utility sources (i.e., boilers and processes) that emit more than 100 tons per year of at least one criteria air pollutant or precursor of such pollutants. Base year emissions are derived from the 1985 National Acid Precipitation Assessment Program (NAPAP) (U.S. EPA, 1989) and projected to 1990 based on Bureau of Economic Analysis (BEA) growth in industrial sector earnings (BEA, 1990). Because PM_{10} and $PM_{2.5}$ emission estimates are not available from the NAPAP files, annual PM_{10} and $PM_{2.5}$ emissions in the NPI are calculated from Total Suspended Particulates (TSP) emissions by applying a Source Classification Code (SCC)-specific particle size distribution factor from the PM calculator program (U.S. EPA, 1994b). Industrial point source emissions for California and Oregon from the Grand CanyonVisibility Transport Commission (GCVTC) are incorporated in the NPI (Radian, 1995).

Utility Sources

Emissions from fossil-fuel fired steam electric generating boilers are developed from 1990 U.S. Department of Energy (DOE, 1991b) fuel use data and emission limits combined with EPA emission factors (U.S. EPA, 1995a). Gas turbine and internal combustion (IC) engine emissions are derived from the 1985 NAPAP inventory (U.S. EPA, 1989) and projected to 1990 using BEA earnings data by industry sector (BEA, 1990).

Non-Road Engines/Vehicles

The non-road engine/vehicle sector includes all transportation sources that are not counted as highway vehicles such as marine vessels, railroads, aircraft, and non-road internal

combustion engines and vehicles. EPA's Office of Mobile Sources (OMS) developed a non-road internal combustion engine and vehicle emissions inventory for 27 ozone nonattainment areas (U.S. EPA, 1991b). These area-specific estimates are extrapolated to develop national nonroad emission estimates based on population. For aircraft, railroads, and commercial marine vessels, the 1985 NAPAP inventory (U.S. EPA, 1989) is grown to 1990 using sector-specific BEA growth factors. PM_{10} and $PM_{2.5}$ emissions are estimated by applying particle size multipliers to TSP emissions using the PM calculator program (U.S. EPA, 1994b).

Motor vehicles

Base year motor vehicle emissions are developed by multiplying VMT by pollutant-specific emission factor estimates. The NPI VMT, by county/SCC (i.e., vehicle type/functional roadway class), are based on data from the Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS) (FHWA, 1992). The HPMS areawide data base contains State-level VMT estimates for rural and small urban areas, as well as separate VMT estimates for each large urban area within a State. VMT estimates for each of these categories are provided by functional roadway class and are converted to county-level estimates segregated by vehicle type and roadway class.

1990 control-specific emission factors for VOC and NOx are generated using the EPA's motor vehicle emission factor model MOBILE5a (U.S.EPA, 1993a). PM_{10}, $PM_{2.5}$, and SO_2 1990 control-specific emission factors are generated using another EPA motor vehicle emission factor model, PART5 (U.S. EPA, 1994c). The 1990 emissions factors are calculated based on historical temperatures, gasoline volatility (RVP) data, and inspection/maintenance (I/M) information. Emissions estimates are calculated at the county/vehicle-type/roadway-type level, accounting for county differences in I/M programs. Additionally, emissions are calculated by month and summed to develop annual emission estimates. Ozone season daily VOC and NOx are calculated based on temporally allocated VMT and maximum ozone season temperatures for nonattainment areas and July temperatures for rest-of-state areas.

Area Sources

Area sources include solvent use and small stationary sources (e.g., dry cleaners, gasoline marketing, and industrial fuel combustion) that emit less than 100 tons per year of at least one criteria air pollutant or preccursor pollutant. These sources are not included in the industrial point source data base. The 1985 NAPAP Inventory (U.S. EPA. 1989) is used as the basis for most area source categories. BEA historical earnings data (BEA, 1990), population, fuel use data from the State Energy Data System (SEDS) (DOE, 1991a), and other category-specific indicators are used to project the 1985 NAPAP to 1990. SEDS data serve as an indicator of emissions growth for the area source fuel combustion categories and for the gasoline marketing categories. Particle size multipliers are applied to estimate PM_{10} and $PM_{2.5}$ emissions from TSP estimates (U.S. EPA, 1994b).

Solvent emissions are estimated from a national solvent material balance model using solvent data from various marketing surveys (U.S. EPA, 1993b). Emissions are allocated to the county-level based on employment and population data (BOC, 1987; BOC, 1988a; BOC, 1988b).

Prescribed burning emission estimates are based on a 1989 USDA Forest Service Inventory of PM and air toxics (USDA, 1989). This inventory of prescribed burning contains State-level emissions, which are allocated to the county-level using the State-to-county distribution of emissions in the 1985 NAPAP Inventory.

PM_{10} emissions for fugitive dust sources for the NPI are taken from the 1990 National Emission Trends inventory for agricultural tilling, construction activity, paved and unpaved roads (U.S. EPA, 1996d). $PM_{2.5}$ emissions are estimated by applying particle size multipliers to the PM_{10} estimates (U.S. EPA, 1994b). Emissions for beef cattle feedlots are developed specifically for the NPI. Because construction activity emission estimates are provided at the EPA-region level, these estimates are disaggregated to the county-level based on Census of Agriculture data, land use, and construction earnings data (USDA, 1991; BOC, 1987). Paved

and unpaved road emissions are estimated using the EPA's OMS PART5 emission factor model (U.S. EPA, 1994c) combined with paved and unpaved road VMT estimates based on FHWA data (FHWA, 1992). PART5 reentrained road dust emission factors depend on the average weight, speed, and number of wheels of the vehicles traveling on paved and unpaved roadways, the silt content of roadway surface material, and precipitation data. The activity factor for calculating reentrained road dust emissions is VMT.

Residential wood combustion emissions estimated for the 1990 National Emission Trends inventory (U.S. EPA, 1993c) are used in Version 3 of the NPI. Residential wood combustion emissions include those from traditional masonry fireplaces, freestanding fireplaces, wood stoves, and furnaces.

Ammonia emissions from livestock feedlots and fertilizers are estimated based on county-level Census of Agriculture data for number of head of livestock raised and amount and type of fertilizer used (BOC, 1992). Emission factors are taken from a study of ammonia emissions conducted in the Netherlands (Asman, 1992; Battye et al., 1994)). Anthropogenic ammonia emissions are believed to be small relative to natural sources of ammonia.

For the States of California and Oregon, 1990 emissions from the GCVTC inventory are incorporated for all area source categories (Radian, 1995). The data for these two States are based on State-compiled inventories that are based on more recent and detailed data than the emissions in the NAPAP inventory.

Biogenics/Natural Sources

Biogenic VOC emissions are developed based on EPA’s Biogenic Emissions Inventory System (BEIS) (Pierce et al, 1990). State-level estimates are disaggregated to the county level based on urban and rural land use. EPA has since developed county-level biogenic emissions using version 2 of BEIS (BEIS2) (Geron, 1994), but these more recent estimates are not used in this analysis.

Emissions of primary PM come from natural sources such as wind erosion and wild fires. PM_{10} emissions from wind erosion are taken from the 1990 National Emission Trends inventory (U.S. EPA, 1996d). $PM_{2.5}$ emissions are estimated by applying particle size multipliers. Wild fire emissions are taken from estimates developed for the GCVTC for the 11 GCVTC States (Radian, 1995). The wildfire data in the GCVTC inventory represent a detailed survey of forest fires in the study area. For non-GCVTC States, emissions are based on the 1985 NAPAP inventory values (U.S.EPA, 1989). Wild fires also contribute to natural source VOC and NOx emissions and, to a much smaller extent, to SO_2 and SOA emissions.

APPENDIX A.2

Base Year 1990 National Emissions Estimates by Source Category

Major Sector	VOC (1000 tpy)	NOx (1000 tpy)	SO_2 (1000 tpy)	PM_{10} (1000 tpy)	$PM_{2.5}$ (1000 tpy)	SOA (1000 tpy)
UTILITY						
Coal	27.1	6,689.5	15,221.9	268.4	99.2	0.5
Gas/Oil/Other	7.8	679.1	611.9	10.6	5.9	0.2
Internal Combustion	1.9	57.1	30.7	4.1	3.7	0.0
Total	**36.8**	**7,425.7**	**15,864.5**	**283.1**	**108.8**	**0.7**
INDUSTRIAL POINT						
Fuel Comb. Industrial	126.1	1,955.8	2,482.2	221.1	162.0	2.0
Fuel Comb. Other	10.3	103.9	202.4	16.6	8.2	0.1
Chemical & Allied Product Mfg.	1,066.2	275.4	440.1	62.5	42.7	5.0
Metals Processing	72.5	81.0	664.7	137.9	96.3	0.2
Petroleum & Related Industries	238.3	99.9	434.8	28.9	19.5	0.6
Other Industrial Processes	327.0	308.0	393.6	374.3	224.3	6.8
Solvent Utilization	1,126.2	2.5	0.8	2.1	1.8	16.1
Storage & Transport	490.1	2.4	4.6	64.4	26.5	4.1
Waste Disposal & Recycling	9.7	20.7	21.0	8.0	6.7	0.0
Miscellaneous	0.3	0.0	0.0	10.7	1.6	0.0
Total	**3,466.6**	**2,849.7**	**4,644.2**	**926.4**	**589.5**	**34.8**

Major Sector	VOC (1000 tpy)	NOx (1000 tpy)	SO_2 (1000 tpy)	PM_{10} (1000 tpy)	$PM_{2.5}$ (1000 tpy)	SOA (1000 tpy)
AREA						
Fuel Combustion Industrial	17.8	1,269.7	626.9	29.1	14.8	0.1
Fuel Combustion - Residential Wood	663.1	45.7	6.3	475.4	475.4	28.6
Fuel Combustion Other	22.8	565.5	384.3	35.3	20.4	0.4
Chemical & Allied Product MFG	449.2	0.0	0.0	0.0	1.6	0.9
Petroleum & Related Industries	450.2	19.4	1.4	1.6	22.6	1.1
Other Industrial Processes	84.4	4.3	1.7	34.6	0.0	0.2
Solvent Utilization	4,701.0	0.0	0.0	0.0	0.0	45.1
Storage & Transport	1,220.3	0.0	0.0	0.0	0.0	14.4
Waste Disposal & Recycling	2,154.6	60.0	14.8	218.2	190.7	1.3
Fugitive Dust - Natural Sources	13.8	0.0	0.0	5,184.8	777.7	0.0
Agricultural Production - Crops	78.9	10.4	0.2	7,004.5	1,467.7	0.1
Fugitive Dust - Paved Roads	0.0	0.0	0.0	5,960.7	1,490.2	0.0
Fugitive Dust - Unpaved Roads	0.0	0.0	0.0	12,362.0	1,854.3	0.0
Fugitive Dust - Construction	0.0	0.0	0.0	8,311.4	1,662.3	0.0
Agricultural Production - Livestock	76.1	0.0	0.0	401.7	60.3	0.0
Other Combustion - Wild Fires	234.2	89.1	1.3	243.6	217.0	0.2
Other Combustion - Prescribed Burning	179.5	124.6	4.7	447.1	377.1	0.1
Miscellaneous	0.0	0.0	0.0	8.5	1.9	0.0
Total	**10,345.9**	**2,188.8**	**1,041.5**	**40,718.5**	**8,634.1**	**92.4**

Major Sector	VOC (1000 tpy)	NOx (1000 tpy)	SO_2 (1000 tpy)	PM_{10} (1000 tpy)	$PM_{2.5}$ (1000 tpy)	SOA (1000 tpy)
NONROAD						
Nonroad Gasoline	1,596.8	176.0	3.2	42.1	35.0	11.7
Nonroad Diesel	185.0	1,438.4	16.7	185.6	170.8	4.4
Aircraft	191.9	139.7	8.0	40.4	28.5	4.5
Marine Vessels	36.0	183.7	147.5	24.2	17.8	1.0
Railroads	44.2	898.0	66.6	44.0	40.5	1.0
Total	**2,053.9**	**2,835.8**	**242.0**	**336.3**	**292.6**	**22.7**
MOTOR VEHICLE						
LDGV	4,207.2	3,406.1	143.0	63.1	38.1	25.7
LDGT1	954.0	775.2	37.6	15.2	9.8	5.8
LDGT2	803.5	557.8	20.5	16.9	11.1	4.9
HDGV	466.9	333.1	10.8	10.6	7.0	3.4
LDDV	11.6	35.9	12.7	8.8	7.8	1.0
LDDT	2.8	7.4	2.8	1.7	1.5	0.0
HDDV	313.9	2,318.4	340.1	238.2	215.7	7.4
MC	50.5	11.6	0.3	0.4	0.2	0.3
Total	**6,810.5**	**7,445.6**	**567.70**	**354.70**	**291.2**	**47.6**

Note: Emission estimates may not sum due to rounding.
1990 fugitive dust emissions have not been adjusted here as described in Section 4.4.2.3.
Air quality impacts from major emitting sectors are not necessarily proportional to their contribution to national emissions estimates. See PM and ozone air quality modeling sections 4.4 and 4.5 and Chapters 6 and 7.

APPENDIX A.3
2010 CAA CONTROL ASSUMPTIONS BY MAJOR SECTOR

Industrial Point Sources

Point source control measures for VOC include RACT, new CTGs and Title III MACT controls (Pechan, 1997a). Title III MACT controls are generally as stringent, or more stringent, than RACT controls and are thus the dominant control option for many source categories. Major stationary source NOx emitters in marginal and above nonattainment areas and in the Northeast Ozone Transport Region (OTR) are required to install RACT-level controls. Given that NOx RACT controls are specified by each state, NOx RACT is modeled using representative RACT levels for each source category. OTAG Level 2 NOx controls and a 0.15 lb NOx/MMBtu cap on fuel combustors of >250 MW are also modeled for these sources in the 37 OTAG States. Rule effectiveness of 95% is assumed for all VOC and NOx control measures.

VOC and NOx emissions reductions in ozone nonattainment areas for the following CAA provisions are not accounted for: (1) offsets for major new source growth and major modifications; (2) Rate of Progress/Reasonable Further Progress (ROP/RFP) requirements; (3) additional VOC and/or NOx reductions needed in nonattainment areas for attainment of the current ozone standard by deadlines determined by nonattainment classification (e.g., serious, severe).

No new CAA-controls are assumed for point source SO_2 emitters, although individual states or nonattainment areas may require additional reductions. Because there are no PM_{10} control measures specifically prescribed by the CAA, PM controls for industrial point sources are assumed equivalent to 1990 levels. Although from a national perspective industrial point source PM_{10} emissions are a small component relative to area source PM_{10} emissions, this assumption could overestimate baseline PM_{10} emissions from individual point sources in some areas.

Utility

The 2010 CAA-control emissions for the utility sector are modeled using the Integrated Planning Model (IPM). Control measure assumptions include Title I and IV requirements. Existing fossil fuel burning units >25 MW and all new fossil fuel units (regardless of size) must comply with the Title IV Acid Rain SO_2 Allowance Trading Program. All new units are modeled as meeting SO_2 New Source Performance Standards (NSPS) for coal-fired units. However, it is assumed that every utility will operate new and existing units to obtain the largest amount of SO_2 reduction possible (i.e., 95%) to minimize allowances that any utility would have to purchase under the Title IV program. NOx RACT requirements are applied for existing sources in the OTR and nonattainment areas, where States have not applied for NOx waivers. Title IV Phase I and II emission limits are modeled as appropriate. Additionally, an OTAG-wide 0.15 lb/MMBtu summertime NOx cap with trading and banking implemented in 2005 is modeled (U.S.EPA, 1997a).

No CAA-mandated controls are assumed for emissions of VOC, PM_{10}, and $PM_{2.5}$ from utilities. However, emissions of these three pollutants are affected by the SO_2 and NOx controls modeled. VOC, PM_{10}, and $PM_{2.5}$ are calculated using boiler-specific heat input and emissions factors. Ammonia slippage is estimated for units where Selective Catalytic Reduction (SCR) is chosen as the control measure in IPM (Pechan, 1997a).

Nonroad Engines/Vehicles

The final rule for heavy duty diesel engines and the proposed Phase I rule for gasoline engines are incorporated in the 2010 CAA emissions scenario. Although Phase II emissions standards for small gasoline engines have not been proposed, emission reduction estimates are used from the California Federal Implementation Plan (FIP). Proposed emissions standards for gasoline and diesel marine engines and locomotives are applied in the 2010 CAA control emissions scenario. There are no CAA-mandated controls modeled for commercial aircraft for the 2010 baseline. Finally, a reformulated gasoline benefit of 3.3 percent is applied to all

gasoline-powered engines in estimating 2010 emissions in areas that participate in the Federal reformulated gasoline program (Pechan, 1997a).

Motor Vehicles

The 2010 CAA control emissions also incorporate effects of mobile source controls (Pechan, 1997a). The nationwide emissions impacts from Federal tailpipe and evaporative emissions standards, Phase II Reid Vapor Pressure (RVP) limits for fuel volatility, the Federal Motor Vehicle Control Program (FMVCP) and heavy-duty NOx standard are estimated. The Federal reformulated gasoline program is applied to nine areas required to adopt this program under the CAA plus those areas that have opted into the program. The effects of the Oxygenated Fuel program for all carbon monoxide nonattainment areas are incorporated in the 2010 emissions. Basic I/M, low-enhanced I/M or high-enhanced I/M are applied to nonattainment areas according to requirements laid out in the CAA. National LEV is estimated nationally, with the exception of California where California LEV is applied.

Area Sources

Area source control measures incorporated in the 2010 CAA emissions include direct PM emissions controls in PM nonattainment areas, area source industrial fuel combustion NOx RACT, and VOC controls for: (1) Title I RACT and new CTGs in ozone nonattainment areas; (2) Title I national Stage II vapor recovery, final rules for Treatment, Storage and Disposal Facilities (TSDFs) and Municipal Solid Waste Landfills, and proposed Federal consumer solvent and AIM coatings rules; (3) Title III national MACT standards; and (4) onboard vapor recovery systems in the OTR and ozone nonattainment areas classified as serious and above (Pechan, 1997a). There are no controls for ammonia in the 2010 emissions baseline.

APPENDIX A.4

2010 National Post-CAA Control Emissions Estimates by Source Category

Major Sector	VOC (1000 tpy)	NOx (1000 tpy)	SO_2 (1000 tpy)	PM_{10} (1000 tpy)	$PM_{2.5}$ (1000 tpy)	SOA (1000 tpy)
UTILITY						
Coal	24.7	3,598.8	9,661.4	249.0	83.8	0.5
Gas/Oil/Other	1.7	72.6	84.2	1.6	1.6	0.0
Internal Combustion	23.5	83.7	0.0	26.0	25.9	0.0
Total	**49.9**	**3,755.1**	**9,745.6**	**276.6**	**111.3**	**0.5**
INDUSTRIAL POINT						
Fuel Comb. Industrial	134.0	1,149.0	3,262.0	275.8	200.0	2.6
Fuel Comb. Other	14.9	76.9	282.9	23.0	11.1	0.1
Chemical & Allied Product Mfg.	542.7	211.1	546.4	74.2	52.0	1.8
Metals Processing	67.0	104.0	857.1	175.1	121.4	0.2
Petroleum & Related Industries	103.4	109.0	489.3	36.0	24.1	0.3
Other Industrial Processes	230.9	284.2	522.6	480.9	293.0	6.4
Solvent Utilization	809.5	3.1	1.0	3.0	2.5	12.0
Storage & Transport	252.7	3.0	6.4	75.9	30.8	1.8
Waste Disposal & Recycling	8.8	17.3	22.0	9.0	7.5	0.0
Miscellaneous	0.6	0.0	0.0	16.9	2.6	0.0
Total	**2,164.5**	**1,957.6**	**5,989.8**	**1,169.9**	**745.1**	**25.2**

Major Sector	VOC (1000 tpy)	NOx (1000 tpy)	SO_2 (1000 tpy)	PM_{10} (1000 tpy)	$PM_{2.5}$ (1000 tpy)	SOA (1000 tpy)
AREA						
Fuel Combustion Industrial	26.6	1,896.8	948.4	43.8	22.2	0.2
Fuel Combustion - Residential Wood	489.2	55.4	9.2	350.9	350.9	21.1
Fuel Combustion Other	29.0	742.3	532.3	47.4	27.3	0.5
Chemical & Allied Product MFG	270.4	0.0	0.0	0.0	0.0	0.5
Petroleum & Related Industries	202.8	15.0	1.1	1.2	1.2	0.4
Other Industrial Processes	108.0	6.0	2.5	44.2	29.3	0.3
Solvent Utilization	4,701.4	0.0	0.0	0.0	0.0	43.5
Storage & Transport	769.6	0.0	0.0	0.0	0.0	5.4
Waste Disposal & Recycling	513.5	74.5	19.6	261.6	228.1	0.5
Fugitive Dust - Natural Sources	13.8	0.0	0.0	5,184.8	777.7	0.0
Agricultural Production - Crops	127.8	17.0	0.4	10,004.5	2,102.1	0.1
Fugitive Dust - Paved Roads	0.0	0.0	0.0	7,489.0	1,872.3	0.0
Fugitive Dust - Unpaved Roads	0.0	0.0	0.0	12,300.2	1,846.0	0.0
Fugitive Dust - Construction	0.0	0.0	0.0	9,389.7	1,973.3	0.0
Agricultural Production - Livestock	115.3	0.0	0.0	658.4	99.1	0.0
Other Combustion - Wild Fires	234.2	89.1	1.3	243.6	217.0	0.2
Other Combustion - Prescribed Burning	179.5	124.6	4.7	445.0	377.1	0.1
Miscellaneous	0.0	0.0	0.0	16.1	2.6	0.0
Total	**7,781.1**	**3,020.7**	**1,519.5**	**46,480.4**	**9,926.2**	**72.8**

Major Sector	VOC (1000 tpy)	NOx (1000 tpy)	SO_2 (1000 tpy)	PM_{10} (1000 tpy)	$PM_{2.5}$ (1000 tpy)	SOA (1000 tpy)
NONROAD						
Nonroad Gasoline	1,255.9	276.3	4.1	51.6	42.9	9.2
Nonroad Diesel	261.6	935.8	22.4	187.1	172.1	6.2
Aircraft	300.3	249.2	13.8	41.3	29.1	7.1
Marine Vessels	34.4	158.5	142.3	23.3	17.0	1.0
Railroads	35.5	442.8	53.8	33.1	30.4	0.8
Total	**1,887.7**	**2,062.6**	**236.4**	**336.4**	**291.5**	**24.3**
MOTOR VEHICLE						
LDGV	2,263.6	2,402.1	178.0	74.0	42.2	13.8
LDGT1	760.6	783.8	64.0	22.7	13.4	4.6
LDGT2	583.0	631.6	32.6	11.4	6.8	3.6
HDGV	142.2	296.3	14.1	6.6	4.3	1.0
LDDV	0.0	0.0	0.0	0.0	0.0	0.0
LDDT	0.4	1.0	0.1	0.1	0.1	0.0
HDDV	151.8	1,443.0	120.1	88.4	73.9	3.6
MC	44.3	16.5	0.5	0.5	0.3	0.3
Total	**3,945.9**	**5,574.3**	**409.2**	**203.7**	**141.0**	**26.9**

Note: Emission estimates may not sum due to rounding.
1990 fugitive dust emissions have not been adjusted here as described in Section 4.4.2.3.
Air quality impacts from major emitting sectors are not necessarily proportional to their contribution to national emissions estimates. See PM and ozone air quality modeling sections 4.4 and 4.5 and Chapters 6 and 7.

APPENDIX A.5

OZONE REGRESSION EQUATION USED IN ROM EXTRAPOLATION METHODOLOGY

The equations used to predict average expected changes in ozone concentrations between 1990 and 2007 were generated through Ordinary Least Squares (OLS) regression of 1990 ROM basecase ozone concentration predictions and a number of explanatory variables against 2007 ROM predictions for the two emissions scenarios: CAA control and regional control strategy scenarios (MathTech, 1997). ROM results are available for the Eastern U.S. However, air quality concentrations are needed for the entire country to assess national benefits and costs. Through the inclusion of other explanatory variables, the regression equations control for factors that may differ between the east and west and could therefore explain variations in concentration values between 1990 and 2007.

The coefficient for ROM90, the modeled ozone concentration value in 1990, is positive and statistically different from zero in both regression equations. The results for the CAA-control scenario indicate that, all else equal, 2007 hourly ozone concentrations can be expected to decrease percent relative to 1990 hourly ozone concentrations (ROM90 coefficient = 0.90). The results for the regional control strategy scenario suggest that, all else equal, 2007 hourly ozone concentrations can be expected to decrease relative to 1990 hourly ozone concentrations (ROM90 = 0.79).

- Functional form: linear
- Sample selection: A random sample of ROM hourly predicted grid cell ozone concentrations for both 1990 and 2007 were selected using a random number generator
- Model specification: Five additional descriptive variables were included in the regression:
  - MFGPC:growth rate in manufacturing earnings per capita between 1990 and 2007 per county (BEA, 1990)
  - POP07: county population growth rate between 1990 and 2007 (BOC, 1992)

- County ozone nonattainment classification as expressed by 1 of 3 binary variables:
  - SEVR: severe
  - SERS7: serious
  - MAMD: moderate or marginal

Table 1. ROM Extrapolation Methodology: Regression Equation Statistics (Ordinary Least Squares)

INDEPENDENT VARIABLES	DEPENDENT VARIABLES			
	REGIONAL CONTROL STRATEGY (7,484 Observations)		CAA-CONTROL SCENARIO (1,093 Observations)	
	COEFFICIENT	T-STATISTIC	COEFFICIENT	T-STATISTIC
Constant	9.4709	6.362	-1.09765	-0.403
ROM90	0.78766	292.809	0.904335	193.696 *
MFGPC	0.37046	0.506	1.66716	1.306 **
POP07	-2.3576	-2.487	2.47670	1.404 **
SEVR	0.88009	2.941	0.601086	1.255
SERS7	0.39421	1.247	-0.789582	-1.580 **
MAMD	1.3104	7.088	0.258379	0.748
Adjusted R^2		**.92**		**.973**

* Statistically significant at the one percent level
** Statistically significant at the twenty percent level