EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

APPENDICES

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JUNE 2007

MARICOPA ASSOCIATION of GOVERNMENTS

EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

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EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

APPENDIX A

JUNE 2007

MARICOPA ASSOCIATION of GOVERNMENTS

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APPENDIX A

EXHIBIT 1

2002 PERIODIC EMISSIONS INVENTORY OF OZONE PRECURSORS FOR THE MARICOPA COUNTY, ARIZONA, NONATTAINMENT AREA

2002 Periodic Emissions Inventory for Ozone Precursors

for the

Maricopa County, Arizona, Nonattainment Area

June 2004

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1. Introduction

1.1 Overview

This 2002 periodic ozone emissions inventory was developed to meet requirements set forth in Title I of the Clean Air Act Amendments of 1990 (CAAA). The CAAA requires development of a baseline emission inventory and periodic revisions for areas that fail to meet the National Ambient Air Quality Standards (NAAQS). A portion of Maricopa County is classified as serious nonattainment for the one-hour ozone standard.

This inventory includes emission estimates for three ozone precursors: volatile organic compounds (VOCs), carbon monoxide (CO) and nitrogen oxides (NO_x). VOC is defined by Maricopa County's Rule 100 as "any organic compound, which participates in atmospheric photochemical reactions, except the non-precursor organic compounds". The inventory provides emission estimates from point, area, nonroad mobile, onroad mobile, and biogenic sources. Note that totals shown in tables may not equal the sum of individual values due to independent rounding.

1.2 Agencies responsible for the emissions inventory

Maricopa County Environmental Services Department (MCESD) has primary responsibility for preparing and submitting the 2002 Periodic Ozone Emissions Inventory. MCESD prepared emission estimates for point, area, and certain nonroad mobile sources (locomotives and aircraft). The remaining nonroad mobile emission estimates were developed by ENVIRON Corp. (Environ *et al.*, 2003), with additional work conducted by MCESD to develop estimates for the nonattainment area and a typical season day. The Maricopa Association of Governments (MAG) prepared the onroad mobile and biogenic emissions estimates. Table 1.2–1 lists those responsible for inventory preparation and quality assurance/quality control activities, which are described in the respective chapters.

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Point Sources	Bob Downing MCESD (602) 506-6790	Matt Poppen, Eric Raisanen and Dena Konopka MCESD (602) 506-6790 Ruey-in Chiou and Scott DiBiase MAG (602) 254-6300
Area Sources	Matt Poppen, Eric Raisanen and Dena Konopka MCESD (602) 506-6790	Bob Downing MCESD (602) 506-6790 Ruey-in Chiou and Scott DiBiase MAG (602) 254-6300
Nonroad Mobile Sources	Matt Poppen and Eric Raisanen MCESD (602) 506-6790	Bob Downing and Dena Konopka MCESD (602) 506-6790 Ruey-in Chiou and Scott DiBiase MAG (602) 254-6300
Onroad Mobile Sources	Roger Roy MAG (602) 254-6300	Ruey-in Chiou MAG (602) 254-6300 Bob Downing and Dena Konopka MCESD (602) 506-6790
Biogenic Sources	Steve Ochs MAG (602) 254-6300	Ruey-in Chiou MAG (602) 254-6300 Bob Downing and Dena Konopka MCESD (602) 506-6790

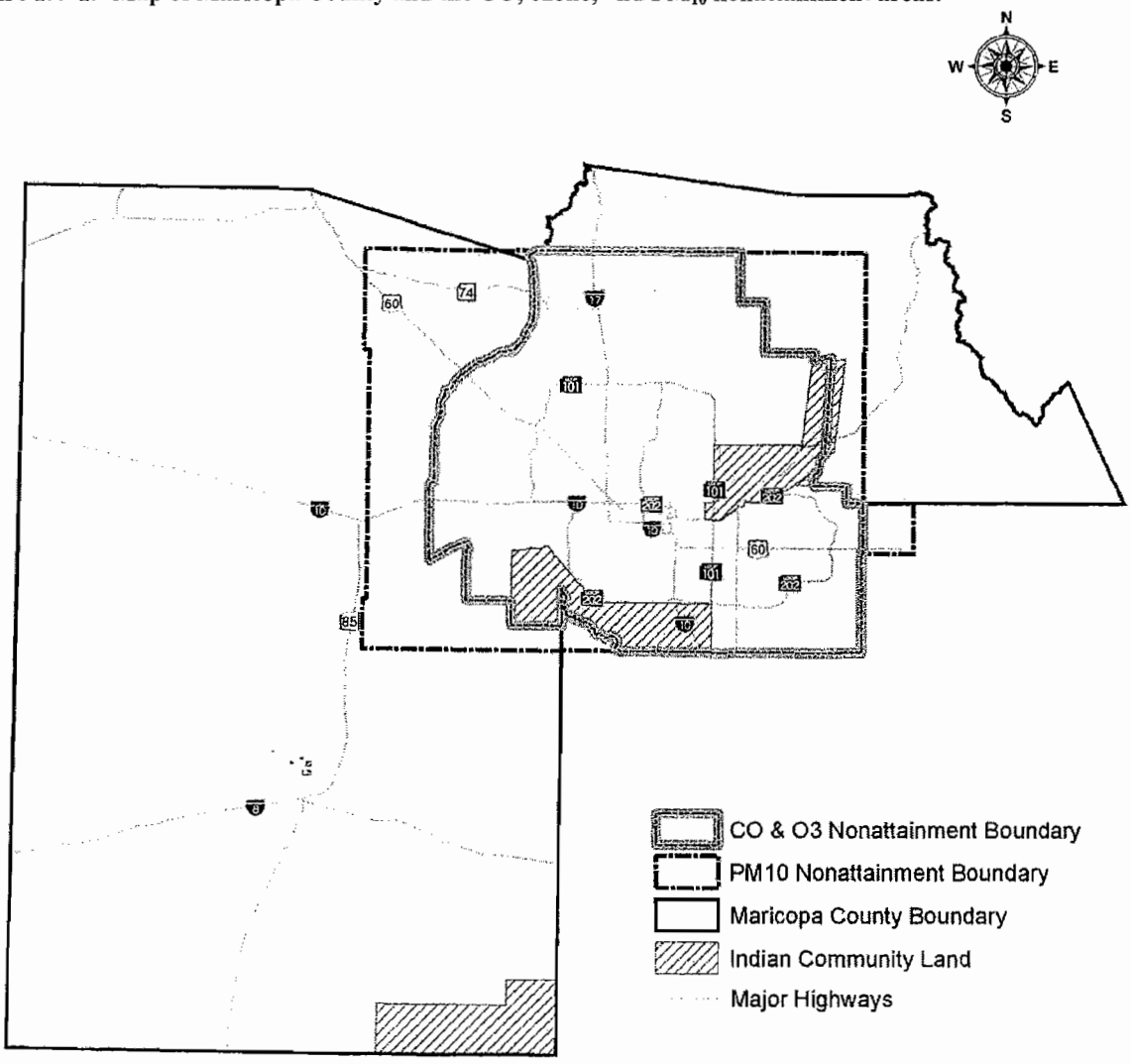
1.3 Temporal scope

Annual and ozone season-day emissions were estimated for the year 2002, for Maricopa County and the Maricopa County ozone nonattainment area (NAA). The three-month peak ozone season for the Maricopa County nonattainment area has been defined as July 1 through September 30 based on ozone exceedances that occurred from 1981 through 1991.

1.4 Geographic scope

This inventory includes emission estimates for Maricopa County and for the Maricopa County ozone nonattainment area. Maricopa County encompasses approximately 9,223 square miles of land area, while the Maricopa County ozone nonattainment area is approximately 1,946 square miles, or approximately 21 percent of the Maricopa County land area. A map of Maricopa County and the ozone nonattainment area is provided in Figure 1.4–1.

Figure 1.4–1. Map of Maricopa County and the CO, ozone, and PM_{10} nonattainment areas.



1.5 Overview of local demographic and land-use data

Many of the emissions estimates generated in this report were calculated using demographic and land-use data provided by the Maricopa Association of Governments (MAG). These data were used to apportion and/or scale Maricopa County emissions estimates to the nonattainment area and vice versa. (For example, county-level emissions from residential natural gas usage in Maricopa County was apportioned to the nonattainment area using the ratio of occupied households in each area). Detailed explanations of how emission estimates were apportioned or scaled are presented in each of the following chapters, along with the data sources used.

1.5.1 Demographic data

The demographic data provided by MAG included population, housing and employment data for calendar year 2002, for Maricopa County and the nonattainment area. Table 1.5-1 provides an overview of the demographic data used in this report.

Table 1.5–1. Demographic profile of Maricopa County and the ozone nonattainment area.

Demographic variable	Maricopa County	Within the ozone NAA	Percent within the ozone NAA
Total resident population	3,296,250	3,232,387	98.06%
Total non-resident population	253,443	249,420	98.41%
Total population:	**3,549,693**	**3,481,807**	**98.09%**
Occupied resident housing units	1,215,173	1,192,680	98.15%
Total non-resident households	146,664	144,419	98.47%
Total occupied households:	**1,361,837**	**1,337,099**	**98.18%**
Retail employment	438,674	431,973	98.47%
Office employment	392,383	390,375	99.49%
Industrial employment	383,938	376,610	98.09%
Public employment	221,676	213,061	96.11%
Other employment	232,614	227,953	98.00%
Total employment:	**1,669,285**	**1,639,972**	**98.24%**

1.5.2 Land-use data

The most recent land-use data available from MAG was for the year 2000. The 2000 land-use data was assumed to be representative of 2002. Table 1.5–2 presents a summary of the land-use categories and acreage used to develop emission estimates for this inventory. Note that the land-use data used to model emissions from biogenic sources is different from the land-use data discussed here. See Chapter 6 for a discussion of the biogenic land-use data.

Table 1.5–2. Land-use categories used to apportion emissions.

Description	Acreage in Maricopa County	Acreage within the ozone NAA	Percent within the ozone NAA
Active open space (e.g., parks)	127,792	90,038	70.46%
Passive open space (e.g., mountain preserves)	2,057,048	40,846	1.99%
General open space (not elsewhere classified)	849	782	92.16%
Golf courses	22,922	22,231	96.98%
Water	110,940	38,057	34.30%
Agriculture	415,473	185,029	44.53%
Vacant (e.g., developable land)	2,653,351	414,465	15.62%

1.6 Emissions overview by source category

1.6.1 Point sources

The point source category includes those stationary sources that emit a significant amount of pollution into the air such as power plants, petroleum product storage and transfer facilities, and large industrial facilities. As Maricopa County has an established annual reporting program for sources with air quality permits, the thresholds for defining a point source are lower than the minimums required by the US EPA. For the purposes of this inventory, a point source is a stationary operation within Maricopa County or within 25 miles of the ozone nonattainment area, which in 2002 emitted:

- 25 English (short) tons or more of carbon monoxide (CO); or
- 10 tons or more of volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or
- 5 tons or more of particulate matter less than 10 microns (PM_{10}) or ammonia compounds (NH_x).

Table 1.6–1 summarizes annual and season-day emissions of the chief point source categories. A detailed breakdown of emissions calculations for all point sources is contained in Chapter 2.

Table 1.6–1. Summary of annual and season-day emissions from point sources in Maricopa County.

	Annual emissions (tons/yr)			Ozone season-day emissions (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Electricity generation	69.07	2,783.19	1,058.25	495.6	20,778.6	7,231.3
Commercial/institutional fuel combustion	6.99	103.90	45.63	62.0	877.3	273.9
Industrial fuel combustion	43.99	481.08	426.44	335.3	3,322.8	2,773.6
Food/agriculture	98.76			674.7		
Industrial processes	35.21	60.74	82.07	211.3	342.0	565.5
Manufacturing processes	1,013.62	65.13	146.12	7,225.9	464.8	928.3
Petroleum product storage	19.74			126.4		
Petroleum product transportation/marketing	550.34			2,948.7		
Waste disposal	40.79	27.51	64.40	236.4	152.8	357.8
Health services	17.94			98.6		
Solvent use	367.47			2,541.0		
Surface coating	1,831.86			15,771.8		
All point sources:	**4,095.77**	**3,521.55**	**1,822.90**	**30,727.8**	**25,938.4**	**12,130.3**

Table 1.6–2. Summary of annual and season-day emissions from point sources in the ozone NAA.

	Annual emissions (tons/yr)			Ozone season-day emissions (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Electricity generation	53.50	2,560.30	894.61	412.9	19,595.3	6,379.1
Commercial/institutional fuel combustion	6.99	103.90	45.63	62.0	877.3	273.9
Industrial fuel combustion	39.05	387.15	401.93	304.7	2,770.6	2,630.9
Food/agriculture	98.76			674.7		
Industrial processes	22.82	60.74	82.07	146.7	342.0	565.5
Manufacturing processes	925.90	52.24	135.99	6,551.1	365.6	850.4
Petroleum product storage	13.21			86.5		
Petroleum product transportation/marketing	550.34			2,948.7		
Waste disposal	27.64	26.24	56.41	164.1	145.8	313.9
Health services	17.94			98.6		
Solvent use	361.14			2,504.9		
Surface coating	1,752.52			15,171.1		
All point sources:	**3,869.81**	**3,190.56**	**1,616.64**	**29,126.1**	**24,096.6**	**11,013.6**

1.6.2 Area sources

Area sources are facilities or activities whose individual emissions do not qualify them as point sources. Area sources represent numerous facilities or activities that individually release small amounts of a given pollutant, but collectively they can release significant amounts of a pollutant. Stationary sources with annual emissions lower than the point source thresholds described in Section 1.6.1 were included in the area source inventory. Examples of area source categories include residential wood burning, commercial cooking, waste incineration and wildfires.

Tables 1.6–3 and 1.6–4 summarize annual and season-day emissions of the chief area source categories, for Maricopa County and the ozone nonattainment area, respectively. A detailed breakdown of emissions calculations for each area source category is contained in Chapter 3.

Table 1.6–3. Summary of annual and season-day emissions from area sources in Maricopa County.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Fuel combustion	3,211.00	4,560.90	4,817.71	1,351.4	20,625.8	7,445.5
Industrial processes	930.91	589.86	412.98	6,501.7	3,919.7	2,436.7
Solvent use	31,817.28			210,530.0		
Storage/transport	2,187.56			12,577.5		
Waste treatment/disposal	655.70	67.36	616.30	4,966.7	430.0	3,293.9
Miscellaneous area sources	209.46	95.36	2,976.99	80,048.8	36,594.5	1,693,053.6
All area sources:	**39,011.90**	**5,313.47**	**8,823.98**	**315,976.1**	**61,570.0**	**1,706,229.7**

Table 1.6–4. Summary of annual and season-day emissions from area sources in the ozone NAA.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Fuel combustion	3,152.71	4,480.24	4,730.96	1,327.4	20,259.1	7,314.1
Industrial processes	915.75	589.52	407.76	6,393.8	3,917.8	2,408.0
Solvent use	30,873.65			202,023.5		
Storage/transport	2,110.96			12,139.6		
Waste treatment/disposal	596.19	45.87	159.71	4,616.9	314.2	834.6
Miscellaneous area sources	68.76	30.82	243.43	372.0	274.9	1,341.4
All area sources:	**37,718.02**	**5,146.47**	**5,541.86**	**226,873.2**	**24,766.1**	**11,898.0**

1.6.3 Nonroad mobile sources

Nonroad mobile sources include off-highway vehicles and engines that move or are moved within a 12-month period. Tables 1.6–5 and 1.6–6 summarize annual and season-day emissions from nonroad mobile sources, for Maricopa County and the ozone NAA, respectively. A detailed breakdown of emissions calculations for each source category is contained in Chapter 4.

Table 1.6–5. Summary of annual and season-day emissions from nonroad mobile sources in Maricopa County.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Agricultural	70.60	477.46	632.96	621.8	4,147.2	5,839.5
Airport ground support	139.57	147.09	3,471.09	766.9	808.1	19,071.9
Commercial	1,758.91	1,319.44	45,797.55	12,446.4	7,799.2	340,043.7
Construction & mining	1,786.47	9,834.69	15,584.58	15,336.6	83,115.7	143,428.8
Industrial	361.99	3,174.80	15,135.47	2,457.9	20,062.1	104,078.3
Lawn & garden	4,523.18	695.48	77,273.13	46,424.7	5,607.4	851,032.3
Logging	20.94	38.74	136.54	136.4	247.0	991.6
Pleasure craft	600.20	43.01	1,423.91	15,428.5	1,001.7	39,125.6
Railway maintenance	5.10	20.35	61.28	36.5	140.2	473.6
Recreational	885.25	63.35	9,788.20	11,451.8	656.1	137,421.0
Aircraft	1,924.48	4,187.59	10,097.03	10,574.1	23,008.7	55,478.2
Locomotives	136.88	3,444.32	344.35	750.0	18,873.0	1,886.8
All nonroad mobile sources:	**12,213.57**	**23,446.32**	**179,746.09**	**116,431.6**	**165,466.4**	**1,698,871.3**

Table 1.6–6. Summary of annual and season-day emissions from nonroad mobile sources in the ozone NAA.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Agricultural	31.43	212.61	281.86	276.9	1,846.8	2,600.3
Airport ground support	136.08	143.42	3,384.31	747.7	787.9	18,595.1
Commercial	1,725.31	1,294.24	44,922.82	12,208.7	7,650.3	333,548.9
Construction & mining	1,752.35	9,646.84	15,286.91	15,043.6	81,528.2	140,689.3
Industrial	355.07	3,114.16	14,846.36	2,411.0	19,678.9	102,090.4
Lawn & garden	4,440.86	682.82	75,866.76	45,579.7	5,505.3	835,543.5
Logging	20.53	38.01	133.94	133.8	242.3	972.7
Pleasure craft	205.88	14.75	488.40	5,292.0	343.7	13,420.1
Railway maintenance	5.01	19.96	60.11	35.8	137.6	464.5
Recreational	89.32	6.40	987.63	1,155.4	66.1	13,865.9
Aircraft	1,920.37	4,186.89	9,888.43	10,551.5	23,004.9	54,332.0
Locomotives	68.43	1,593.04	160.78	374.9	8,729.0	881.0
All nonroad mobile sources:	**10,750.64**	**20,953.14**	**166,308.31**	**93,811.0**	**149,521.0**	**1,517,003.7**

1.6.4 Onroad mobile sources

Emission from onroad mobile sources were calculated for the ozone nonattainment area located primarily within Maricopa County, as well as for Maricopa County as a whole. A detailed breakdown of emissions calculations by vehicle class and roadway type is contained in Chapter 5.

Table 1.6–7 summarizes annual and season-day emissions from onroad mobile sources in both Maricopa County and the ozone nonattainment area.

Table 1.6–7. Annual and season-day emissions from onroad mobile sources in the ozone NAA.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
County	31,960	79,572	352,821	180,380	437,741	2,023,444
Ozone NAA	29,402	72,691	322,867	165,922	399,742	1,850,382

1.6.5 Biogenic sources

The biogenic source category includes emissions from all vegetation (e.g., crops, indigenous vegetation, landscaping, etc.) in Maricopa County and the ozone nonattainment area. Emissions were estimated through MAG-BEIS2, a local computer model developed by the Maricopa Association of Governments (MAG) that is based on the US EPA model UAM-BEIS2, but which uses county-specific land-use and temperature data. Annual and season-day VOC and NO_x emissions from biogenic sources are shown in Table 1.6–8 for Maricopa County and the ozone nonattainment area.

Table 1.6–8. Annual and season-day emissions from biogenic sources in the ozone NAA.

	Annual emissions (tons/yr)		Season-day emissions (lbs/day)	
Geographic area	**VOC**	**NO_x**	**VOC**	**NO_x**
County	24,152	8,327	309,511	71,648
Ozone NAA	7,223	1,604	92,015	13,870

1.6.6 Summary of emissions by source category

Figures 1.6–1 through 1.6–6 provide a graphical overview of the relative contributions of the major source categories (point, area, nonroad, onroad and biogenic) to emissions in the ozone nonattainment area, on an annual and season-day basis, respectively.

Figure 1.6–1. Annual VOC emissions in the ozone nonattainment area, by source category (tons/yr).

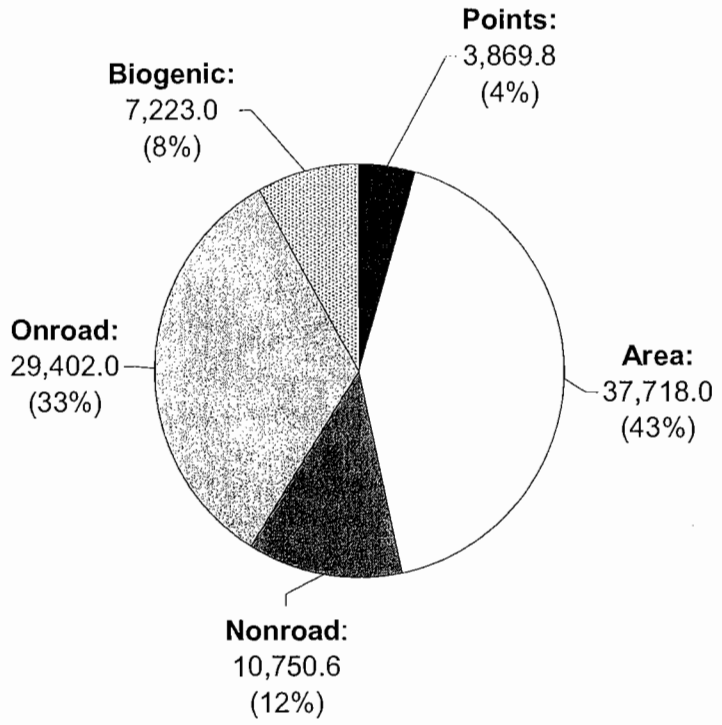


Figure 1.6–2. Annual NO_x emissions in the ozone nonattainment area, by source category (tons/yr).

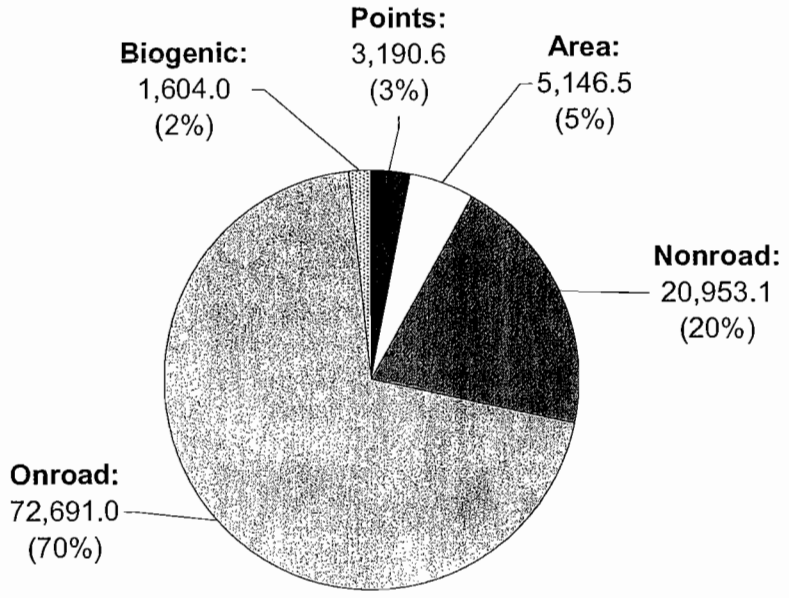


Figure 1.6–3. Annual CO emissions in the ozone nonattainment area, by source category (tons/yr).

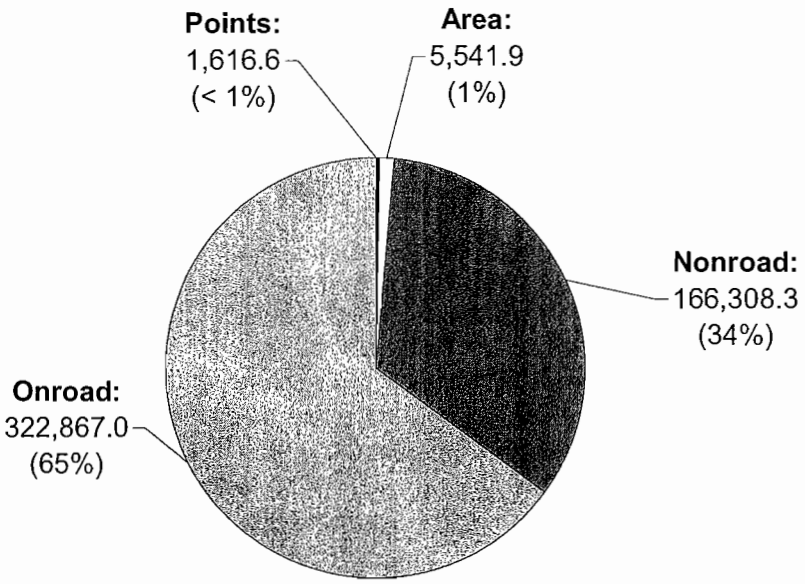


Figure 1.6–4. Season-day VOC emissions in the ozone nonattainment area, by source category (lbs/day).

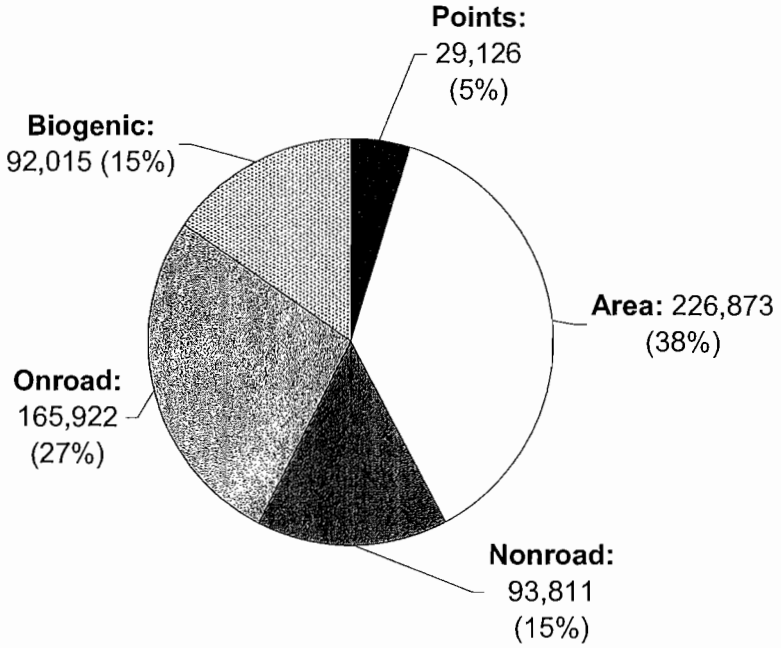


Figure 1.6–5. Season-day NO_x emissions in the ozone nonattainment area, by source category (lbs/day).

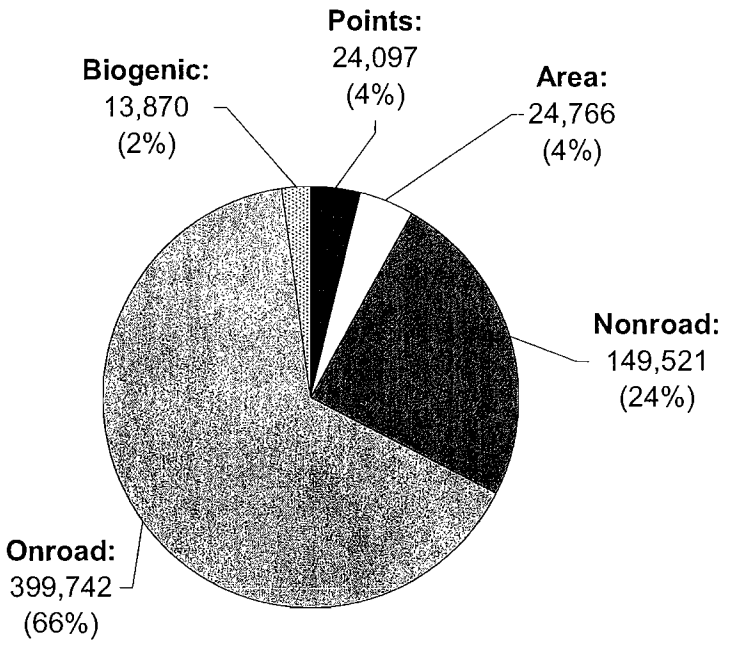
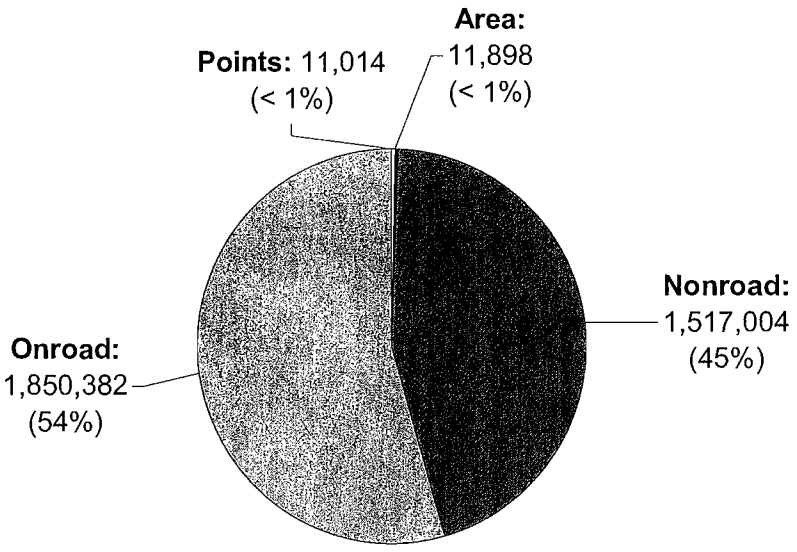


Figure 1.6–6. Season-day CO emissions in the ozone nonattainment area, by source category (lbs/day).



Figures 1.6–7 and 1.6–8 show the relative contributions of each source category for each pollutant on an annual and season-day basis, respectively.

Figure 1.6–7. Annual emissions in the ozone nonattainment area, by source category (tons/yr).

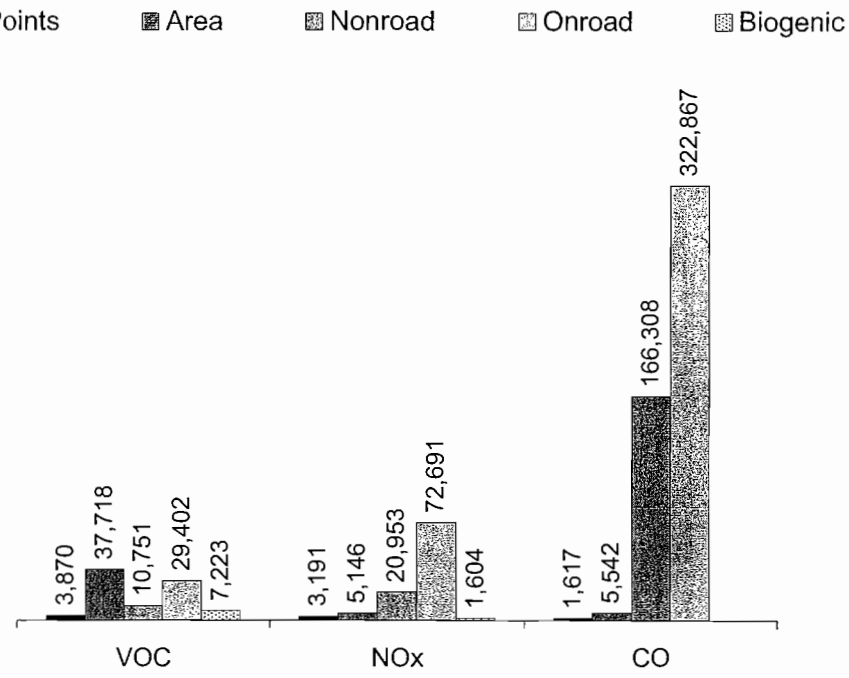
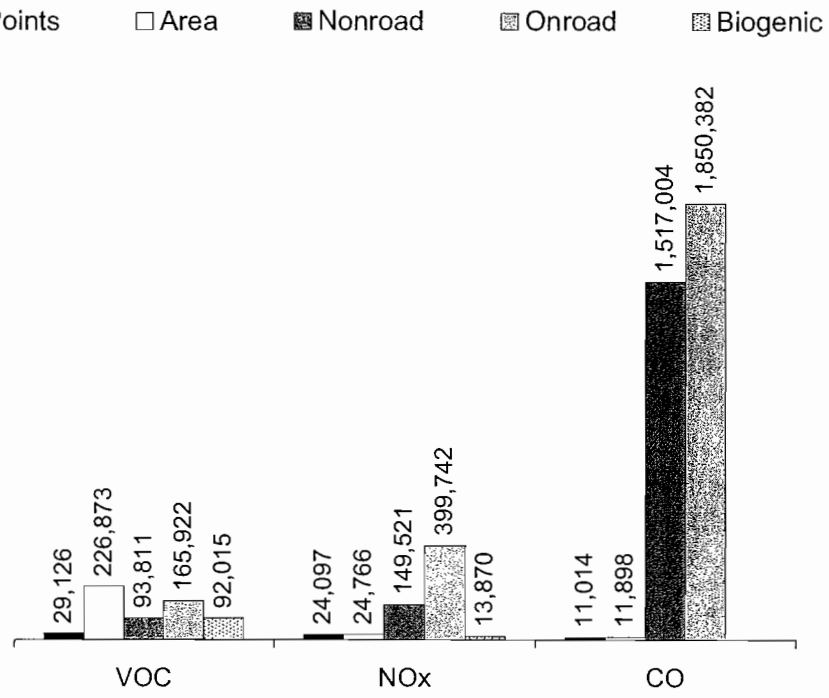


Figure 1.6–8. Season-day emissions in the ozone nonattainment area, by source category (lbs/day).



Tables 1.6–9 through 1.6–14 provide comparisons (by individual pollutant) between this emissions inventory and earlier inventories covering the ozone nonattainment area. Note that figures may not be directly comparable as calculation methods, emission factors, and source category definitions (e.g., point vs. area sources) may have changed over time.

Table 1.6–9. Summary of annual VOC emissions by source category, 1990–2002 (tons/yr).

	Inventory year				
Source category	**1990**	**1993**	**1996**	**1999**	**2002**
Points	7,930	7,699	5,866	5,949	3,870
Area	35,728	36,447	39,550	31,813	37,718
Nonroad mobile	17,923	17,377	38,945	28,605	10,751
Onroad mobile*	n/c	n/c	n/c	n/c	29,402
Biogenic*	n/c	n/c	n/c	n/c	7,223
Totals:	**61,581**	**61,523**	**84,361**	**66,367**	**52,339****

* Prior-year inventories did not include annual totals of onroad mobile or biogenic emissions.
** Not including onroad mobile and biogenic sources, to allow more direct comparison to prior inventories.

Table 1.6–10. Summary of annual NO_x emissions by source category, 1990–2002 (tons/yr).

	Inventory year				
Source category	**1990**	**1993**	**1996**	**1999**	**2002**
Points	5,954	4,721	3,319	5,474	3,191
Area	3,708	3,779	4,589	7,725	5,146
Nonroad mobile	29,082	28,619	13,908	33,942	20,953
Onroad mobile*	n/c	n/c	n/c	n/c	72,691
Biogenic*	n/c	n/c	n/c	n/c	1,604
Totals:	**38,744**	**37,119**	**21,816**	**47,141**	**29,289****

* Prior-year inventories did not include annual totals of onroad mobile or biogenic emissions.
** Not including onroad mobile and biogenic sources, to allow more direct comparison to prior inventories.

Table 1.6–11. Summary of annual CO emissions by source category, 1990–2002 (tons/yr).

	Inventory year				
Source category	**1990**	**1993**	**1996**	**1999**	**2002**
Points	1,493	1,140	736	1,789	1,617
Area	2,237	2,335	1,678	5,867	5,542
Nonroad mobile	167,303	162,021	181,912	195,042	166,308
Onroad mobile*	n/c	n/c	n/c	n/c	322,867
Biogenic*	n/c	n/c	n/c	n/c	n/c
Totals:	**171,033**	**165,496**	**184,326**	**202,698**	**173,467 ****

* Prior-year inventories did not include annual totals of onroad mobile or biogenic emissions.
** Not including onroad mobile and biogenic sources, to allow more direct comparison to prior inventories.

Table 1.6–12. Summary of VOC season-day emissions by source category, 1990–2002 (lbs/day).

	Inventory year				
Source category	**1990**	**1993**	**1996**	**1999**	**2002**
Points	56,320	51,260	47,140	43,920	29,126
Area	246,000	220,000	217,800	182,020	226,873
Nonroad mobile	127,400	124,200	132,600	169,720	93,811
Onroad mobile	300,218	239,186	190,283	180,890	165,922
Biogenic	82,000	104,000	104,200	97,340	92,015
Totals:	**811,940**	**737,460**	**691,940**	**673,880**	**607,747**

Table 1.6–13. Summary of NO_x season-day emissions by source category, 1990–2002 (lbs/day).

	Inventory year				
Source category	**1990**	**1993**	**1996**	**1999**	**2002**
Points	156,080	155,560	88,880	42,120	24,097
Area	16,000	19,600	23,000	45,260	24,766
Nonroad mobile	187,400	185,200	64,000	183,700	149,521
Onroad mobile	286,243	288,992	285,692	294,299	399,742
Biogenic	n/c	n/c	23,200	20,040	13,870
Totals:	**645,720**	**648,360**	**484,680**	**585,400**	**611,996**

Table 1.6–14. Summary of CO season-day emissions by source category, 1990–2002 (lbs/day).

	Inventory year				
Source category	**1990**	**1993**	**1996**	**1999**	**2002**
Points	30,420	28,380	17,760	13,100	11,014
Area	8,560	9,000	9,200	92,840	11,898
Nonroad mobile	1,146,400	1,316,000	1,243,200	1,135,520	1,517,004
Onroad mobile	2,005,220	1,708,688	1,243,095	1,268,227	1,850,382
Biogenic	n/c	n/c	n/c	n/c	n/c
Totals:	**3,190,600**	**3,059,380**	**2,513,160**	**2,509,680**	**3,390,98**

1.7 References

ENVIRON *et al.*, 2003. Maricopa County 2002 Comprehensive Emission Inventory for the Cap and Trade Oversight Committee, Final Rep. prepared for Arizona Dept. of Environmental Quality, October 9, 2003.

2. Point Sources

2.1 Introduction and scope

This inventory of ozone precursors (VOC, NO_x, and CO) is one of a number of emission inventory reports being prepared to meet U.S. EPA reporting requirements. In addition to preparing periodic emissions inventories for the ozone nonattainment area (NAA) as a commitment under the current ozone State Implementation Plan (SIP), the federal Consolidated Emission Reporting Rule (CERR) requires that state and local agencies prepare emissions estimates on a county basis, and submit data electronically to the U.S. EPA for inclusion in the National Emission Inventory (NEI) for 2002. This inventory is being developed concurrently with similar inventories for CO and for PM (including PM_{10}, $PM_{2.5}$, NO_x, SO_x, and NH_3), as part of Maricopa County's requirements under the respective SIPs.

In order to provide consistency among all these inventories, it was decided to standardize the definition of a "point source". While EPA has defined minimum point source reporting thresholds for various pollutants, EPA guidance also notes that:

> ... we encourage organizations to provide facility-specific emissions data for all point sources, regardless of size, where they are already included in the S/L/T [state/local/tribal] emission inventory. (US EPA, 2003a)

As Maricopa County has an established annual reporting program for sources with air quality permits, the thresholds for defining a point source are lower than the minimums required by EPA. For the purposes of this inventory, a point source is a stationary operation within Maricopa County or within 25 miles of the ozone nonattainment area, which in 2002 emitted:

- 25 English (short) tons or more of carbon monoxide (CO); or
- 10 tons or more of volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or
- 5 tons or more of particulate matter less than 10 microns (PM_{10}) or ammonia compounds (NH_x).

While the above approach results in some anomalies (e.g., a facility treated as a point source may have very low, or no, emissions of a certain pollutant), a uniform definition of "point source" ensures that all data sets, which are prepared for a variety of purposes, will be comparable.

This point source inventory includes actual emissions for the year 2002 and a typical day during the ozone season (defined as July through September). A description and map of the nonattainment area are provided in Chapter 1. Questions concerning point source emissions may be directed to Bob Downing of MCESD at (602) 506-6790.

Several tables have been constructed to provide the point source emissions and category totals. Table 2.2–1 summarizes all point sources by location and permitting authority. Table 2.2–2 provides an alphabetical list of all point sources and their location, while Table 2.3–1 summarizes the results of the rule effectiveness study conducted for individual industrial processes. Table 2.4–1 shows the 2002 annual and average ozone season-day emissions of VOC, NO_x and

CO for those point sources which reported emissions of any of these pollutants broken out by facility, while Table 2.4–2 lists the 2002 annual and ozone season-day emissions broken out by individual process types. Table 2.6–1 summarizes point source emissions by source category. Note that totals shown in the tables may not equal the sum of individual values due to independent rounding.

2.2 Identification of point sources

Maricopa County Environmental Services Department (MCESD) identified point sources within Maricopa County through its permit system database and the 2002 annual emissions reports submitted to the department. In addition, the permit system was reviewed to locate new facilities that were not included in the previous emission inventory, and to identify sources that have ceased operations since the 1999 periodic inventory was compiled.

A total of 172 point sources were identified using the emission thresholds described in Section 2.1. (To ensure consistency in calculation methodologies, 13 retail gasoline stations which met the point source emission thresholds described above, are instead treated as part of the area source category "vehicle refueling" in Chapter 3.) Of the 172 stationary point sources, 165 MCESD-permitted sources reported emissions of VOC, NO_x and/or CO – 149 within the ozone nonattainment area, and 16 outside the ozone NAA. There are 2 additional point sources (Hexcel Corp. and SRP Desert Basin Generating Station) within the 25-mile boundary around the ozone nonattainment area, with permits issued by the Pinal County Air Quality Control District (PCAQCD). While the Arizona Department of Environmental Quality (ADEQ) retains permitting authority for a limited number of industrial source categories in Maricopa County, no ADEQ-permitted facilities are considered stationary point sources, and are addressed instead as area sources.

Table 2.2–1. Number of point sources by location and permitting authority.

Location	Total no. of facilities	Facilities reporting emissions of ozone precursors
Within the ozone nonattainment area:		
– Maricopa County-permitted sites	**153**	**149**
Outside the ozone nonattainment area:		
– Maricopa County-permitted sites	17	16
– Pinal County-permitted sites	2	2
Total outside NAA:	**19**	**18**
Grand total:	**172**	**167**

Table 2.2–2 contains an alphabetical list of all point sources, including a unique business identification number, NAICS industry classification code, business name (including any changes from the 1999 periodic inventory), and physical address.

Table 2.2–2. Name and location of all point sources.

Within the ozone nonattainment area:

ID #	NAICS	Business name	Address	City	ZIP
1074	22132	23rd Ave. Wastewater Treatment Plant (formerly *City of Phoenix 23rd Ave. WWTP)*	2470 S. 22nd Ave.	Phoenix	85009
1075	22132	91st Ave. Wastewater Treatment Plant	5615 S. 91st Ave.	Tolleson	85353
245	337122	A. F. Lorts Company Inc.	8120 W. Harrison St.	Tolleson	85353
1952	811121	Adesa Phoenix LLC	400 N. Beck Ave.	Chandler	85226
1239	332321	AG Products	2525 W. Broadway Rd.	Phoenix	85041
35541	33121	Allied Tube & Conduit Corp.	2525 N. 27th Ave.	Phoenix	85009
199	327332	Ameron Intl. Water Transmission Group (formerly *Ameron Pipe*)	2325 S. 7th St.	Phoenix	85034
292	325412	Anabolic Laboratories Inc. (formerly *Health Factors International Inc.*)	429 S. Siesta Ln.	Tempe	85281
3313	221112	APS West Phoenix Power Plant	4606 W. Hadley St.	Phoenix	85043
3938	332812	Arizona Galvanizing Inc.	15775 Elwood St.	Goodyear	85338
4364	61131	Arizona State University	1551 S. Rural Rd.	Tempe	85287
36485	54185	Billboard Poster Company Inc.	3940 W. Montecito Ave.	Phoenix	85019
43124	313230	Bonded Logic Inc.	411 E. Ray Rd.	Chandler	85225
3441	42471	BP West Coast Products LLC	5333 W. Van Buren St.	Phoenix	85043
458	32191	Bryant Industries Inc.	788 W. Illini St.	Phoenix	85041
217	327123	Building Products Co.	4850 W. Buckeye Rd	Phoenix	85043
3442	493190	Caljet (formerly *Caljet/Williams*)	125 N. 53rd Ave.	Phoenix	85043
60598	337211	Case Furniture & Design LLC	4645 W. Polk St.	Phoenix	85043
1317	321991	Cavco Industries LLC (35th Ave.)	2602 S. 35th Ave.	Phoenix	85009
1318	321991	Cavco Industries LLC (Litchfield Rd.)	1366 S. Litchfield Rd.	Goodyear	85338
1316	321991	Cavco Industries LLC (Durango Plant)	2502 W. Durango St.	Phoenix	85009
4145	61111	Cave Creek School District	33606 N. 60th St.	Cave Creek	85331
1267	32732	Cemex Mesa Plants #61 & #71	1901 N. Alma School Rd.	Mesa	85201
1266	212321	Cemex USA (Phoenix)	11701 W. Indian School	Phoenix	85063
1268	212321	Cemex USA (Sun City)	24004 N. 107th Ave.	Sun City	85373
1310	32311	Century Graphics LLC	2960 Grand Ave.	Phoenix	85017
1426	32311	Cesar Color Inc.	3433 E. Wood St.	Phoenix	85040
4401	32732	Chandler Ready Mix Inc.	6500 N. 115th Ave.	Glendale	85323
51073	52312	Charles Schwab & Co. Inc.	2121 S. Price Rd.	Chandler	85248
3297	42471	Chevron USA Inc.	5110 W. Madison St.	Phoenix	85043
3976	33711	Cholla Custom Cabinets Inc.	1727 E. Deer Valley Dr.	Phoenix	85024
4083	32191	Chris Fischer Productions Inc.	4741 W. Polk St.	Phoenix	85043
399	32739	Coreslab Structures (Ariz) Inc.	5026 S. 43rd Ave.	Phoenix	85041
1198	32311	Courier Graphics Corp.	2621 S. 37th St.	Phoenix	85034
4368	32191	Craftsmen in Wood Mfg.	5441 W. Hadley St.	Phoenix	85043
4023	321918	Creative Shutters Inc.	2009 W. Ironwood Dr.	Phoenix	85021
3744	325991	Desert Sun Fiberglass	21412 N. 14th Ave.	Phoenix	85027
130	331512	Dolphin Inc.	740 S. 59th Ave.	Phoenix	85043
508	337122	Eagle Industries LLC (formerly *Samuel Lawrence Furniture Co.*)	601 S. 65th Ave.	Phoenix	85043
45493	811121	Earnhardt Ford	7300 W. Orchid Ln.	Chandler	85226
3305	311812	Earthgrains Baking Companies Inc.	738 W. Van Buren St.	Phoenix	85007
26	423810	Empire Machinery Co.	1725 S. Country Club Dr.	Mesa	85210
1505	32191	Executive Door	3939 W. Clarendon Ave.	Phoenix	85019
544	321991	Fleetwood Homes of Arizona Inc. #21	6112 N. 56th Ave.	Glendale	85311
27728	334413	FlipChip International LLC (formerly *Flip Chip Technologies*)	3701 E. University Dr.	Phoenix	85034
41751	326212	GCR Truck Tire Center	2815 N. 32nd Ave.	Phoenix	85009

Table 2.2–2. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
4050	311812	General Mills (formerly *Pillsbury Bakeries & Food Service*)	1120 W. Fairmont Dr.	Tempe	85282
4173	562212	Glendale Municipal Sanitary Landfill	11480 W. Glendale Ave.	Glendale	85301
781	62211	Good Samaritan Regional Medical Center	1111 E. McDowell Rd.	Phoenix	85006
1418	326299	Goodrich Aircraft Interior Products (formerly *BF Goodrich Aircraft Evacuation Sys.*)	3414 S. 5th St.	Phoenix	85040
36772	212321	GTI Capital Holdings LLC	3636 S. 43rd Ave.	Phoenix	85009
699	212321	Hanson Aggregates of Arizona	4002 S. 51st Ave.	Phoenix	85043
31565	32614	Henry Products Inc.	302 S. 23rd Ave.	Phoenix	85009
529	32614	Highland Products Inc.	43 N. 48th Ave.	Phoenix	85043
4543	32311	Hogue Printing Inc.	159 W. 1st Ave.	Mesa	85210
3536	311812	Holsum Bakery Inc.	2322 W. Lincoln St.	Phoenix	85009
3802	311812	Holsum Bakery Tempe	710 W. Geneva Dr.	Tempe	85252
1059	336412	Honeywell Engines Systems & Service (formerly *Honeywell Aerospace Services*)	1944 E. Sky Harbor Cir.	Phoenix	85034
355	336412	Honeywell International Inc.	111 S. 34th St.	Phoenix	85034
354	331314	Imsamet of Arizona	3829 S. Estrella Pkwy.	Goodyear	85338
777	32614	Insulfoam	3401 W. Cocopah St.	Phoenix	85009
3966	334413	Intel Corp. Ocotillo Campus (Fab 12 & 22) (formerly *Intel Corp. Ocotillo Campus Fab 12*)	4500 S. Dobson Rd.	Chandler	85248
983	334419	Isola Laminate Systems Corp.	165 S. Price Rd.	Chandler	85224
3317	221112	Kyrene Generating Station (formerly *SRP Kyrene Steam Plant*)	7005 S. Kyrene Rd.	Tempe	85283
341	325991	L & M Laminates & Marble	813 E. University Dr.	Phoenix	85034
4182	337122	Legends Furniture Inc.	5555 N. 51st Ave.	Glendale	85301
857	334412	Litton Electro-Optical Systems	1215 S. 52nd St.	Tempe	85281
3300	92811	Luke Air Force Base	14002 W. Marauder St.	Glendale	85309
744	3325	M. E. Global Inc. (formerly *M. E. West Castings Inc.*)	5857 S. Kyrene Rd.	Tempe	85283
1248	325991	Maax Spas	25605 S. Arizona Ave.	Chandler	85248
31261	21231	Madison Granite Supplies	30600 N. 23rd Ave.	Phoenix	85027
4111	337121	Magic Woods Inc.	4210 N. 39th Ave.	Phoenix	85019
205	322232	Mail-Well Envelope	221 N. 48th Ave.	Phoenix	85043
353	326199	Marlam Industries Inc.	834 E. Hammond Ln.	Phoenix	85034
61268	327390	Master Block Inc.	12620 W. Butler Dr.	El Mirage	85335
62	33711	Mastercraft Cabinets Inc.	305 S. Brooks	Mesa	85202
3326	352991	Mesa Fully Formed Inc.	1111 S. Sirrine St.	Mesa	85210
1414	212321	Mesa Materials Inc. (Mesa)	3410 N. Higley Rd.	Mesa	85205
1415	212321	Mesa Materials Inc. (Phoenix)	7845 W. Broadway Rd.	Phoenix	85043
29474	423930	Metal Management Arizona Inc.	3640 S. 35th Ave.	Phoenix	85009
1203	334413	Microchip Technology Inc. (Chandler)	2355 W. Chandler Blvd.	Chandler	85224
1875	334413	Microchip Technology Inc. (Tempe)	1200 S. 52nd St.	Tempe	85281
226	32739	Monier Lifetile LLC	1832 S. 51st Ave.	Phoenix	85043
882	311942	Morton Salt Glendale Facility	13000 W. Glendale Ave.	Glendale	85307
881	334413	Motorola Inc.	1300 N. Alma School Rd.	Chandler	85224
223	333112	MTD Southwest Inc.	550 N. 54th St.	Chandler	85226
693	333415	Munters Corp.	802 S. 59th Ave.	Phoenix	85043
34197	327420	National Gypsum Co.	1414 E. Hadley St.	Phoenix	85034
948	32614	Nesco Manufacturing Inc.	1510 W. Drake Dr.	Tempe	85283
1309	337122	New Directions Inc.	2940 W. Willetta St.	Phoenix	85009
1331	337122	Oak Canyon Manufacturing Inc. (formerly *Aspen II*)	3021 N. 29th Dr.	Phoenix	85017
3953	33711	Oakcraft Inc.	7733 W. Olive Ave.	Peoria	85345
27925	337122	Oasis Bedroom Co.	2022 N. 22nd Ave.	Phoenix	85009

Table 2.2–2. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
52382	221112	Ocotillo Power Plant	1500 E. University Dr.	Tempe	85281
3982	32311	O'Neil Printing Inc.	366 N. 2nd Ave.	Phoenix	85003
3970	337122	Pacific Designs	2425 W. Sherman St.	Phoenix	85043
1344	321991	Palm Harbor Homes Inc.	309 S. Perry Ln.	Tempe	85281
733	811412	Pan-Glo West	2401 W. Sherman St.	Phoenix	85009
419	336412	Parker Hannifin GTFSD	7777 N. Glen Harbor Bd.	Glendale	85307
1341	33992	Penn Racquet Sports Inc.	306 S. 45th Ave.	Phoenix	85043
1014	327121	Phoenix Brick Yard	1814 S. 7th Ave.	Phoenix	85007
562	51111	Phoenix Newspapers Inc.	22600 N. 19th Ave.	Phoenix	85027
148	331528	Presto Casting Co.	5440 W. Missouri Ave.	Glendale	85301
60889	326212	Purcell's Western States Tire	420 S. 35th Ave.	Phoenix	85009
1030	32311	Quebecor World Phoenix Division	1850 E. Watkins St.	Phoenix	85034
537	327999	Red Mountain Mining Inc.	4250 N. Bush Hwy.	Mesa	85215
1503	321991	Redman Homes Inc.	400 E. Ray Rd.	Chandler	85225
303	332431	Rexam Beverage Can Company	211 N. 51st Ave.	Phoenix	85043
4318	32732	River Ranch Plant	5159 N. El Mirage Rd.	Litchfield Pk	85340
759	32613	Rogers Corp. Advanced Circuit Materials	100 S. Roosevelt Ave.	Chandler	85226
1437	334412	Sanmina Phoenix Division (formerly *Hadco Phoenix Inc./Sanmina Phx. Div.*)	5020 S. 36th St.	Phoenix	85040
3315	221112	Santan Generating Station (formerly *Santan Generating Plant*)	1005 S. Val Vista Rd.	Gilbert	85296
266	332312	Schuff Steel Co.	420 S. 19th Ave.	Phoenix	85009
42636	62211	Scottsdale Health Care Hospital	7400 E. Osborn Rd.	Scottsdale	85251
4175	493190	SFPP LP	49 N. 53rd Ave.	Phoenix	85043
70634	42471	Shell Oil Phoenix Terminal (formerly *Texaco Phoenix Terminal*)	5325 W. Van Buren St.	Phoenix	85043
27933	562212	Skunk Creek Landfill	3165 W. Happy Valley Rd	Phoenix	85027
4471	332311	Skyline Steel Inc.	631 W. Commerce Ave.	Gilbert	85233
31627	115111	South Mountain Gin	6411 S. 51st Ave.	Laveen	85339
3316	221112	SRP Agua Fria	7302 W. Northern Ave.	Glendale	85303
4131	334413	ST Microelectronics	1000 E. Bell Rd.	Phoenix	85022
1444	327123	Staco Architectural Roof Tile	3530 E. Elwood St.	Phoenix	85040
582	337122	Stone Creek Inc.	4221 E. Raymond St.	Phoenix	85040
281	212321	Sun State Rock & Materials	11500 W. Beardsley Rd.	Sun City	85373
101	31161	Sunland Beef Co.	651 S. 91st Ave.	Tolleson	85353
52471	325188	Superior Lime & Chemical	320 S. 27th Ave.	Phoenix	85009
3978	337122	Team Two Design Assoc. Inc.	310 S. 43rd Ave.	Phoenix	85009
249	336411	The Boeing Company	5000 E. McDowell Rd.	Mesa	85215
937	336211	The Heil Company	1500 S. 7th St.	Phoenix	85034
232	72111	The Phoenician Resort	6000 E. Camelback Rd.	Scottsdale	85251
1102	325412	The Procter & Gamble Mfg. Co.	2050 S. 35th Ave.	Phoenix	85009
552	337122	Thornwood Furniture Mfg.	5125 E. Madison St.	Phoenix	85034
363	337122	Thunderbird Furniture	7501 E. Redfield Rd.	Scottsdale	85260
56	32739	TPAC Division of Kiewit Western Co.	3052 S. 19th Ave.	Phoenix	85009
1210	337122	Trendwood Inc. (15th Ave.)	2402 S. 15th Ave.	Phoenix	85007
1211	337122	Trendwood Inc. (University Dr.)	261 E. University Dr.	Phoenix	85004
819	336399	TRW Vehicle Safety Systems Inc.	11202 E. Germann Rd.	Queen Creek	85242
169	811111	U Haul Intl. Technical Center	11298 S. Priest Dr.	Tempe	85284
1228	325991	Ultra Installations Inc.	245 S. Mulberry	Mesa	85202
234	311514	United Dairymen of Arizona	2008 S. Hardy Dr.	Tempe	85282
260	212321	United Metro Plant #11	3640 S. 19th Ave.	Phoenix	85009
213	212321	United Metro Plant #12	11920 W. Glendale Ave.	Glendale	85307
403	331316	VAW of America	249 S. 51st Ave.	Phoenix	85043
2	32412	Vulcan Materials Co. (El Mirage)	14521 N. 115th Ave.	El Mirage	85335
90	32732	Vulcan Materials Co. (Phoenix)	4830 S. 43rd Ave.	Phoenix	85041

Table 2.2–2. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
174	325998	W. R. Meadows of Arizona Inc.	2636 S. Sarival Ave.	Goodyear	85338
141	424910	Western Organics Inc.	2807 S. 27th Ave.	Phoenix	85009
4384	321918	Western Shutter LLC	4038 E. Madison St.	Phoenix	85034
2703	42471	Western States Petroleum	450 S. 15th Ave.	Phoenix	85007
20706	32614	Wincup Holdings Inc.	7980 W. Buckeye Rd.	Phoenix	85043
1382	33711	Woodcase Fine Cabinetry Inc. (formerly *McCarthy Cabinet Co.*)	3255 W. Osborn Rd.	Phoenix	85017
72	337122	Woodstuff Manufacturing Inc.	1635 S. 43rd Ave.	Phoenix	85009

The following point sources are **outside** the ozone nonattainment area:

ID #	NAICS	Business name	Address	City	ZIP
31606	115111	Acme Gin Co. Inc.	7401 S. Wilson Rd.	Buckeye	85326
1874	212321	Alleco Stone LLC	10401 S. Miller Rd.	Buckeye	85326
31643	562212	Allied Waste Industries Inc. Southwest Regional Facility	24427 S. Hwy 85	Buckeye	85326
31637	115111	Anderson Clayton Corp. Valencia Gin	25500 W. Southern Ave.	Buckeye	85326
1218	562212	Butterfield Station	40404 S. 99th Ave.	Mobile	85239
1389	541380	DaimlerChrysler AZ Proving Grounds	33040 N. 203rd Ave.	Wittmann	85361
43063	221112	Duke Energy Arlington Valley LLC	39027 W. Elliot Rd.	Arlington	85322
1488	115111	Farmers Gin Inc.	8400 S. Turner St.	Buckeye	85326
10211		Hexcel Corp. †	1214 W. Gila Bend Hwy.	Casa Grande	85222
725	212321	Kilauea Crushers Inc.	Hwy 74	Wickenburg	85358
1879	562212	Northwest Regional Landfill	19401 W. Deer Valley Rd	Surprise	85374
98	221113	Palo Verde Nuclear Generating Station	5801 S. Wintersburg Rd.	Tonopah	85354
428	115111	Paloma Gin Properties LLC	I-8	GilaBend	85337
289	115111	Phoenix Agro Invest Inc.	51040 W. Valley Rd.	Aguila	85320
42956	221112	Pinnacle West Energy Corp.	11600 S. 363rd Ave.	Arlington	85322
44182	332312	Quincy Joist Company	22253 W. Southern Ave.	Buckeye	85326
246	321991	Schult Homes	231 N. Apache Rd.	Buckeye	85326
10469	221112	SRP Desert Basin Generating Station †	1872 N. Burris Rd.	Casa Grande	85222
398	212321	Wickenburg Facility	44605 Grand Ave.	Wickenburg	85390

† Source is located in Pinal County.

2.3 Procedures for estimating emissions from point sources

2.3.1 Sources with air quality permits issued by Maricopa County Environmental Services Department (MCESD)

Both annual and average ozone season-day emissions were estimated from annual source emission reports, MCESD investigation reports, permit files and logs, or telephone contacts with sources. For most of the sources, material balance methods were used for determining emissions. Emissions were estimated using the emission factors from AP–42, source tests, engineering calculations, or manufacturers' specifications.

MCESD distributes annual emissions survey forms to nearly all facilities for which MCESD has issued an operating permit. Facilities are required to report detailed information on stacks, control devices, operating schedules, and process-level information concerning their annual activities. (See Appendix 2.1 for a copy of the instructions to complete the emissions inventory.) These instructions include examples and explanations on how to complete the annual emissions reporting forms that facilities must submit to MCESD. Activity data reported for the June–August summer season is presumed to be representative of the July–September ozone season.

After a facility has submitted an annual emissions report to MCESD, emissions inventory staff check all reports for missing and questionable data, and check the accuracy and reasonableness of all emissions calculations with AP–42, the Factor Information and REtrieval (FIRE) software, and other EPA documentation. Control efficiencies are determined by source tests when available, or by AP–42 factors, engineering calculations, or manufacturers' specifications. MCESD has conducted annual emissions surveys for permitted facilities since 1988, and the department's database system, EMS, contains numerous automated quality assurance/quality control checks for data input and processing.

2.3.1.1 Application of rule effectiveness

Rule effectiveness reflects the actual ability of a regulatory program to achieve the emission reductions required by regulation. The concept of applying rule effectiveness in a SIP emission inventory has evolved from the observation that regulatory programs may be less than 100 percent effective for some source categories. Rule effectiveness (RE) is applied to those sources affected by a regulation and for which emissions are determined by means of emission factors and control efficiency estimates. As a default, a rule effectiveness of 80 percent has been applied to those sources that calculated emissions using control device capture and control estimates.

In certain circumstances (i.e., where control efficiencies approach 100 percent), the application of the default assumption of 80% rule effectiveness can increase emissions estimates for a single process by 100-fold or more. After the RE calculation described above was performed for all industrial processes with control devices for VOC, CO or NO_x, further review was made of a limited number of processes for which using the 80% default value increased estimated emissions by 10 tons or more. It was determined that the large emissions increases in these individual processes required further review.

For these processes, the approach outlined in EPA's "Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories" (US EPA, 1992) was applied. For each process, a "Rule Effectiveness Questionnaire" was completed in order to assign a point value to the regulatory, compliance, inspection, and recordkeeping procedures for the particular facility and process under review. A total of 18 processes were reviewed, in consultation with County air quality planning, compliance and field inspection staff. (An example of a completed questionnaire is contained in Appendix 2.2.) The resultant rule effectiveness estimates ranged from 83 to 94 percent, as shown in Table 2.3–1. These calculated rule effectiveness estimates were substituted for the default 80% rule effectiveness, as illustrated by the example described in Section 2.3.1.3.

Table 2.3–1. Process-specific rule effectiveness (RE) determinations using questionnaires.

ID	Business name	Process Description	Control device *	Pollu-tant	RE (%)
POINT SOURCES:					
983	Isola Laminate Systems Corp.	Resin coating (treater #2)	Thermal oxidizer	VOC	93
983	Isola Laminate Systems Corp.	Resin coating (treater #3)	Thermal oxidizer	VOC	93
744	M. E. Global Inc.	Casting shakeout	Thermal oxidizer	VOC	90
205	Mail-Well Envelope	Heatset lithographic printing	RTO	VOC	91
1203	Microchip Technology Inc.	Photolithography	RTO	VOC	93
1203	Microchip Technology Inc.	Isopropanol use	RTO	VOC	93
303	Rexam Beverage Can Company	Coating aluminum cans (line 2)	Thermal oxidizer	VOC	93
303	Rexam Beverage Can Company	Coating aluminum cans (line 3)	Thermal oxidizer	VOC	93
759	Rogers Corp.	Surface coating (xylene use)	Thermal oxidizer	VOC	94
4175	SFPP LP	Gasoline loading losses (800)	Thermal oxidizer	VOC	93
4175	SFPP LP	Gasoline loading losses (900)	Thermal oxidizer	VOC	93
70634	Shell Oil Phoenix Terminal	Gasoline loading losses	CAVR	VOC	92
70634	Shell Oil Phoenix Terminal	Gasoline fugitive losses	CAVR	VOC	92
70634	Shell Oil Phoenix Terminal	Internal floating roof tank	CAVR	VOC	92
AREA SOURCES: (addressed in Chapter 3, but listed here for consistency.)					
55468	City of Mesa Kellwood Substation	Natural gas engines	3-way catalyst	CO	92
696	Desert Fire Industries Inc.	Heat treating furnaces	Quench bath	VOC	83
1118	Gannon & Scott	Incineration	Venturi scrubber	NO_x	92
1109	Motorola Inc.	Photolithography	Thermal oxidizer	VOC	94

* RTO = Regenerative thermal oxizider; CAVR = Carbon adsorption vapor recovery.

The following sections illustrate how emission estimates were obtained for the Maricopa County-permitted sources listed in Table 2.2–2.

2.3.1.2 Example 1: Ocotillo Power Plant

Arizona Public Service (APS) operates a peaking electric generating plant with two steam units (gas/oil-fired boilers) and two natural-gas turbines. APS provided its total annual fuel consumption for each unit, as well as daily and seasonal operating activity. Total annual emissions from boilers and turbines are summed to obtain the facility's total annual emissions. The Ocotillo power plant provided the following data which were used to calculate CO emissions from boilers and turbines:

SCC	Source type	Annual fuel consumption	CO emission factor	CO emissions (lbs/yr)
10100604	Natural gas boilers	3,406.56 MMCF	24 lb/ MMCF	81,757.0
20100201	Natural gas turbines	673.59 MMCF	83.64 lb/ MMCF	56,339.0

Calculation of annual CO emissions:

Annual emissions (lbs) = Annual fuel consumption × emission factor

CO emissions from natural-gas boilers = 3,406.56 MMCF × 24 lb CO/MMCF
= 81,757 lbs CO/yr

CO emissions from natural-gas turbines = 673.59 MMCF × 83.64 lb CO/MMCF
= 56,339 lbs CO/yr

Total CO emissions = 81,757 lbs + 56,339 lbs
= 138,096 lbs/yr
= 69.05 tons CO/yr

Calculation of ozone season-day emissions:
APS provided seasonal operating data for each boiler and turbine. The seasonal activity reported for the June--August time period ranged from 19 to 37 percent among the four units. The average season-day emissions were calculated individually, as illustrated in the following example, and them summed to derive daily totals.

Season-day emissions	= annual emissions	× seasonal activity factor	÷ (days/week × weeks/season)
from steam unit #2	= 30,771 lb	× 23%	÷ (7 days/wk × 13 wks/season)
	= 77.8 lbs CO/season day		

2.3.1.3 Example 2: Rogers Corp. Advanced Circuit Materials

This facility produces components of electronic circuit boards. One step in this operation is the production of "prepreg", or the lamination of fabric components with a xylene-containing resin. The example below demonstrates the steps involved in calculating emissions, emissions reductions from material recycling/disposal and pollution control equipment, and the application of rule effectiveness.

Uncontrolled annual	= Material usage × VOC emission factor
VOC emissions (lbs)	= 471,783 lb xylene/yr × 1 lb/lb
	= 471,783 lb/yr

Uncontrolled emissions from many processes can be reduced in a number of ways, including: (1) capture of the pollutant-containing input material for offsite recycling or disposal, and (2) use of a control device to capture and control pollutants. The amount of pollutant captured for recycling/disposal from one or more waste streams is calculated as:

Pollutant recaptured for recycling/disposal = Σ (Quantity of waste stream n × average pollutant content in waste stream n)

The xylene used in this process was captured in three different waste streams, as follows:

Material recaptured	= (43,617 lbs/yr × 95% VOC) + (49,942 lbs/yr × 38% VOC) + (9,045 lbs/yr × 3.25% VOC)
	= 41,436 + 18,978 + 294 lbs/yr
	= 60,708 lbs VOC/yr captured for off-site recycling disposal

Since this material is captured before emissions from this process are vented to a control device, this off-site disposal "credit" is subtracted from the uncontrolled emissions before calculating the control device effectiveness:

Controlled emissions	= uncontrolled emissions	– pollutant captured for off-site disposal	× [1 – (capture efficiency × control device effectiveness)]

From the data calculated above, and the reported specifications of the control device (including source testing of the control device efficiency), total VOC controlled emissions are calculated as:

Controlled emissions	= 471,783 lb/yr – 60,708 lb/yr × [1 – (99% capture × 97.8% control)]
	= 411,075 × [1 – (0.96822)]
	= 13,064 lbs VOC/yr

This total was reported on the facility's annual emissions inventory as actual VOC emissions from this process. In developing the SIP inventory, rule effectiveness (RE) is applied to the reported control device efficiency (97.8%), following EPA guidelines. As described in Section 2.3.1.1, application of the EPA default 80% RE increased estimated emissions from this single process by more than 10 tons/yr; thus the process was selected for the application of a source-specific rule effectiveness study, which identified a RE of 94% for this process. (Appendix 2.2 shows an example of a completed RE survey form.) Thus the total annual emissions including RE was calculated as:

Annual controlled VOC emissions reflecting RE = Net uncontrolled emissions × [1 – (RE % × capture efficiency × control efficiency)]
= 411,075 lbs/yr × [1 – (94% × 99% × 97.8%)]
= 36,945 lbs VOC/yr

Calculation of ozone season-day emissions:

Season-day emissions (lbs/day) = Annual emissions × seasonal activity factor ÷ (days/week × weeks/season)
= 36,945 lbs/yr × 25% ÷ (5 days/wk × 13 wks/season)
= 142.1 lbs VOC/day

2.3.2 Sources with air quality permits issued by Pinal County Air Quality Control District

Air quality officials from the Arizona Dept. of Environmental Quality and the Pinal Count Air Quality Control District were contacted to determine if there were any point sources operating within a 25-mile boundary of the ozone nonattainment area. ADEQ representatives confirmed that there were no point sources operating in the Yavapai and Gila county portions of this 25-mile boundary, while Pinal County provided annual emissions data for two facilities (included in Table 2.2–2) that met the point source definition.

2.4 Detailed overview of point source emissions

2.4.1 Point source emissions by geographic location

Table 2.4–1 provides a summary of annual and ozone season-day emissions from all point sources, within and outside the ozone nonattainment area. Sources for which rule effectiveness has been applied are noted. Values of "0.00" and "0.0" for annual and daily emissions denote a value below the level of significance (0.005 tons/yr and 0.05 lbs/day, respectively). Note that totals shown in the tables may not equal the sum of individual values due to independent rounding.

Table 2.4–1. Annual and ozone season-day point source emissions, by facility.

Facilities inside the ozone nonattainment area:

		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
1074	23rd Ave. Wastewater Treatment Plant *	3.67	9.89	50.91	19.0	53.9	284.9
1075	91st Ave. Wastewater Treatment Plant	1.42	12.02	4.03	11.0	139.7	33.8
245	A. F. Lorts Company Inc.	54.37	0.01	0.01	522.8	0.1	0.1
1952	Adesa Phoenix LLC	10.65	0.01	0.01	81.9	0.1	0.0
1239	AG Products	11.89			91.5		
35541	Allied Tube & Conduit Corp.	21.51	0.39	0.33	198.5	3.1	2.6
199	Ameron Intl. Water Transmission Group	20.39	1.24	0.53	160.0	47.1	10.9
292	Anabolic Laboratories Inc.	21.00	0.14	0.12	161.5	1.1	0.9
3313	APS West Phoenix Power Plant	16.35	1,041.12	116.58	117.8	8,282.6	929.7
3938	Arizona Galvanizing Inc.	0.40	5.84	2.98	2.8	38.9	17.8
4364	Arizona State University	2.03	13.55	15.14	10.7	38.0	47.0
36485	Billboard Poster Company Inc	19.65			181.4		
43124	Bonded Logic Inc.	0.01	0.20	0.16	0.1	1.5	1.3
3441	BP West Coast Products LLC	31.98			167.0		
458	Bryant Industries Inc.	22.65			174.2		
217	Building Products Co.	3.68	5.03	16.73	27.6	28.1	92.3
3442	Caljet	16.60	0.86	4.30	91.2	4.7	23.6
60598	Case Furniture & Design LLC	16.95			108.7		
1318	Cavco Industries LLC (Goodyear)	22.74			174.9		
1317	Cavco Industries LLC (Phoenix)	10.86			83.5		
1316	Cavco Industries LLC (Durango Plant)	13.44			103.4		
4145	Cave Creek School District	1.02	22.73	3.21	7.7	173.2	24.3
1267	Cemex Mesa Plants #61 & #71	0.63	31.25	2.14	3.9	192.3	13.2
1268	Cemex USA	0.08			0.4		
1310	Century Graphics LLC *	15.29	0.04	0.04	117.6	0.3	0.3
1426	Cesar Color Inc.	11.24	0.48	0.41	86.5	3.7	3.1
51073	Charles Schwab & Co. Inc.	0.17	12.67	0.92	1.0	69.6	5.0
3297	Chevron USA Inc. *	36.45			179.5		
3976	Cholla Custom Cabinets Inc.	18.19	0.09	0.01	139.9	0.7	0.1
4083	Chris Fischer Productions Inc.	14.44			133.3		
399	Coreslab Structures (Ariz) Inc.	5.39			40.4		
1198	Courier Graphics Corp. *	10.16	0.24	0.20	70.3	1.6	1.4
4368	Craftsmen in Wood Mfg.	12.27	0.08	0.06	94.4	0.6	0.5
4023	Creative Shutters Inc.	12.63			77.7		
3744	Desert Sun Fiberglass	33.57			258.2		
130	Dolphin Inc. *	7.71	2.05	1.71	62.4	17.1	14.2
508	Eagle Industries LLC	41.77	0.03	0.02	321.3	0.2	0.2
45493	Earnhardt Ford	11.40			71.8		
3305	Earthgrains Baking Companies Inc. *	34.15	1.82	1.53	219.4	11.6	9.8
26	Empire Machinery Co.	11.75	39.28	21.16	91.6	241.2	158.5
1505	Executive Door	16.45			126.5		
544	Fleetwood Homes of Arizona Inc #21	10.92			84.0		
27728	FlipChip International LLC	11.94	0.33	0.28	65.6	1.8	1.5
41751	GCR Truck Tire Center *	16.30			125.4		
4050	General Mills	16.97	0.80	0.67	104.4	4.9	4.1
4173	Glendale Municipal Sanitary Landfill *	8.96	4.77	1.67	62.0	33.0	11.6
781	Good Samaritan Regional Medical Ctr. *	2.16	26.97	8.24	30.7	371.1	91.7
1418	Goodrich Aircraft Interior Products *	56.05	0.59	1.51	430.9	0.4	8.9
699	Hanson Aggregates of AZ	0.07			0.5		
31565	Henry Products Inc. *	56.12	0.58	0.49	518.0	5.3	4.5

* = Source for which rule effectiveness has been applied.

Table 2.4–1. Annual and ozone season-day point source emissions, by facility (continued).

		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
529	Highland Products Inc. *	23.43	1.37	1.15	128.9	10.5	8.9
4543	Hogue Printing Inc.	11.18			76.4		
3536	Holsum Bakery Inc. *	10.89	3.30	2.77	84.9	24.3	20.4
3802	Holsum Bakery Tempe	19.32	1.06	0.89	140.0	7.5	6.3
1059	Honeywell Engines Systems & Service	20.31	1.48	1.99	129.8	3.4	7.6
355	Honeywell International Inc.	33.12	56.23	20.13	207.5	309.0	110.6
354	Imsamet of Arizona	0.36	15.76	80.66	2.3	83.1	425.4
777	Insulfoam *	58.39	1.11	0.94	344.4	7.1	6.0
3966	Intel Corp. Ocotillo (Fab 12 & 22) *	26.31	21.49	14.69	158.8	295.3	118.9
983	Isola Laminate Systems Corp. *	46.99	22.03	9.14	301.2	141.2	58.6
3317	Kyrene Generating Station	3.58	119.15	39.17	36.6	1,278.9	443.3
341	L & M Laminates & Marble	35.68			274.5		
4182	Legends Furniture Inc.	77.00			592.3		
857	Litton Electro-Optical Systems *	22.38			172.1		
3300	Luke Air Force Base *	32.07	11.10	10.75	234.2	56.4	58.4
744	M. E. Global Inc. *	42.60	40.96	56.22	329.9	311.7	430.4
1248	Maax Spas	46.73			503.2		
31261	Madison Granite Supplies	1.99	23.65	14.59	15.3	181.9	112.3
4111	Magic Woods Inc.	12.78			98.3		
205	Mail-Well Envelope *	28.65	0.85	0.71	220.4	6.5	5.5
353	Marlam Industries Inc.	42.55	0.03	0.02	327.3	0.2	0.2
61268	Master Block Inc.	0.01	0.26	0.22	0.1	1.7	1.4
62	Mastercraft Cabinets Inc.	121.89	0.15	0.13	1,228.1	1.1	0.9
3326	Mesa Fully Formed Inc.	33.44			257.3		
1414	Mesa Materials Inc. (Mesa)	3.09	5.96	16.28	28.6	55.1	150.3
1415	Mesa Materials Inc. (Phoenix)	2.13	4.11	11.22	19.7	37.9	103.5
29474	Metal Management Arizona Inc. *	20.03	0.74	0.16	128.4	4.7	1.0
1203	Microchip Technology Inc. (Chandler) *	11.03	2.37	1.94	60.7	14.1	10.9
1875	Microchip Technology Inc (Tempe) *	48.37	4.30	3.60	266.1	27.2	20.6
226	Monier Lifetile LLC	19.19	0.94	0.79	123.0	6.0	5.0
882	Morton Salt Glendale Facility	0.82	10.21	3.82	6.3	78.6	29.4
881	Motorola Inc. *	47.39	5.68	1.85	262.7	97.6	25.2
223	MTD Southwest Inc.	4.14	1.53	46.12	27.6	9.4	354.3
693	Munters Corp. *	18.83	0.17	0.15	144.8	1.3	1.1
34197	National Gypsum Co.	1.07	19.53	16.15	6.9	127.6	103.9
948	Nesco Mfg. Inc.	14.22			109.4		
1309	New Directions Inc.	20.58			158.3		
1331	Oak Canyon Manufacturing Inc.	87.44			591.9		
3953	Oakcraft Inc.	54.38	0.08	0.07	348.6	0.6	0.5
27925	Oasis Bedroom Co.	15.92			122.5		
52382	Ocotillo Power Plant	10.13	260.57	69.05	99.1	2,187.9	589.2
3982	O'Neil Printing Inc.	12.69			97.7		
3970	Pacific Designs	29.17			224.4		
1344	Palm Harbor Homes Inc.	23.16			222.7		
733	Pan-Glo West *	16.12	0.75	0.63	88.6	5.7	4.8
419	Parker Hannifin GTFSD	29.57			189.5		
1341	Penn Racquet Sports Inc.	82.06	4.62	3.88	631.2	34.7	29.1
1014	Phoenix Brick Yard	10.28	10.17	34.27	76.4	55.9	188.3
562	Phoenix Newspapers Inc.	10.73	0.61	0.27	59.4	15.0	3.3
148	Presto Casting Co.	16.59	1.18	0.95	127.6	9.1	7.3
60889	Purcell's Western States Tire	5.25	0.18	0.15	56.5	1.4	1.2
1030	Quebecor World Phoenix Division *	18.92	1.76	39.99	92.2	8.6	194.8

* = Source for which rule effectiveness has been applied.

Table 2.4–1. Annual and ozone season-day point source emissions, by facility (continued).

		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
537	Red Mountain Mining Inc.	0.54	6.64	1.43	4.2	51.1	11.0
1503	Redman Homes Inc	28.15			216.5		
303	Rexam Beverage Can Co. *	120.76	5.11	4.29	663.5	28.1	23.6
4318	River Ranch Plant	0.12			0.9		
759	Rogers Corp. Advanced Circuit Matls. *	23.08	9.07	35.74	172.7	49.9	197.0
1437	Sanmina Phoenix Division *	20.16	1.83	1.53	129.2	11.7	9.8
3315	Santan Generating Station	9.31	333.00	339.66	57.0	2,052.3	2,093.4
266	Schuff Steel Co.	10.33	3.42	0.74	66.2	21.9	4.7
42636	Scottsdale Health Care Hospital	18.14	3.11	1.38	99.5	13.7	5.9
4175	SFPP LP *	297.91	5.41	8.96	1,636.9	29.7	49.2
70634	Shell Oil Phoenix Terminal *	157.84	0.34	0.28	820.8	1.8	1.6
27933	Skunk Creek Landfill *	11.91	1.78	0.59	65.4	9.8	3.2
4471	Skyline Steel Inc.	12.71			97.8		
31627	South Mountain Gin	0.01	0.15	0.12	0.0	0.0	0.0
3316	SRP Agua Fria	21.17	806.46	330.15	144.6	5,793.6	2,323.6
4131	ST Microelectronics *	26.48	5.31	4.46	145.5	29.2	24.5
1444	Staco Architectural Roof Tile	12.86	0.06	0.05	98.9	0.6	0.5
582	Stone Creek Inc.	21.13			162.5		
281	Sun State Rock & Materials	0.31	24.58	0.73	2.0	157.6	4.7
101	Sunland Beef Co. *	19.78	12.15	10.21	140.9	62.6	52.6
3978	Team Two Design Assoc. Inc.	16.14			124.2		
249	The Boeing Company	17.94	1.34	1.50	138.0	10.3	11.5
937	The Heil Company	12.00			92.3		
232	The Phoenician Resort	2.41	12.44	9.98	17.5	74.8	59.6
1102	The Procter & Gamble Mfg. Co.	1.64	0.84	0.70	12.6	6.4	5.4
552	Thornwood Furniture Mfg.	59.19			455.3		
363	Thunderbird Furniture	22.15			170.4		
56	TPAC Division of Kiewit Western Co.	0.05	0.96	0.80	0.4	7.4	6.2
1210	Trendwood Inc. (15th Ave.)	51.84			398.8		
1211	Trendwood Inc. (University Dr.)	56.41			433.9		
819	TRW Vehicle Safety Systems Inc. *	1.68	2.24	3.18	11.2	10.9	16.8
169	U Haul Intl. Technical Center	16.51			105.8		
1228	Ultra Installations Inc.	18.81			144.7		
234	United Dairymen of Arizona	2.23	17.78	27.51	11.8	89.2	144.0
260	United Metro Plant #11	1.29	5.37	16.52	10.1	42.3	146.8
213	United Metro Plant #12	7.86	7.70	30.45	57.9	56.5	226.2
403	VAW of America Inc. *	50.16	11.21	10.65	321.5	71.9	68.3
2	Vulcan Materials Co. (El Mirage)	1.90	8.13	2.03	15.0	62.5	15.5
90	Vulcan Materials Co. (Phoenix)	0.27			2.9		
174	W. R. Meadows of AZ Inc.	166.62	0.19	0.16	2,982.7	2.4	2.0
141	Western Organics Inc.	0.35			2.2		
4384	Western Shutter LLC	14.21			109.3		
2703	Western States Petroleum	11.47			63.0		
20706	Wincup Holdings Inc. *	107.36	13.32	11.19	660.7	82.0	68.8
1382	Woodcase Fine Cabinetry Inc.	34.67			266.7		
72	Woodstuff Manufacturing Inc.	200.54	0.08	0.07	1,542.6	0.6	0.5
	Ozone Non-Attainment Area Totals:	**3,869.81**	**3,190.56**	**1,616.64**	**29,126.1**	**24,096.6**	**11,013.6**

* = Source for which rule effectiveness has been applied.

Table 2.4–1. Annual and ozone season-day point source emissions, by facility (continued).

Facilities outside the ozone NAA:

		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	**Business name**	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
31606	Acme Gin Co. Inc.	0.00	0.10	0.02			
1874	Alleco Stone LLC	1.48	18.07	3.89	9.5	115.8	24.9
31643	Allied Waste Industries Inc.	7.84	4.11	0.90	43.4	26.3	5.8
31637	Anderson Clayton Corp. Valencia Gin	0.01	0.41	0.07	0.0	0.0	0.0
1218	Butterfield Station *	5.93	2.49	8.25	32.9	14.8	45.6
1389	DaimlerChrysler AZ Proving Grounds	0.83	0.10	0.06	6.4	0.7	0.6
43063	Duke Energy Arlington Valley LLC	1.56	17.69	23.74	10.0	113.2	148.9
1488	Farmers Gin Inc.	0.02	0.75	0.13	0.0	0.0	0.0
10211	Hexcel Corp. †	87.72	12.89	10.13	674.8	99.2	77.9
1879	Northwest Regional Landfill	0.53	6.59	1.42	3.4	42.2	9.1
98	Palo Verde Nuclear Generating Station	29.26	55.26	16.13	157.3	303.6	88.6
428	Paloma Gin Properties LLC	0.01	0.09	0.07	0.0	0.0	0.0
289	Phoenix Agro Invest Inc.	1.86	0.02	0.01	12.7	0.0	0.0
42956	Pinnacle West Energy Corp.	3.68	69.80	89.70	16.5	326.2	427.5
44182	Quincy Joist Company	65.38			502.9		
246	Schult Homes	8.56			68.5		
10469	SRP Desert Basin Generating Station †	10.70	135.40	50.20	58.8	744.0	275.8
398	Wickenburg Facility	0.59	7.25	1.56	4.6	55.8	12.0
	Other Than NAA Totals:	**225.96**	**330.99**	**206.27**	**1,601.7**	**1,841.8**	**1,116.7**
	Total Point Source Emissions:	**4,095.77**	**3,521.55**	**1,822.90**	**30,727.8**	**25,938.4**	**12,130.3**

* Source for which rule effectiveness has been applied.

† Source located in Pinal County.

2.4.2 *Point source emissions by process type*

Table 2.4–2 lists annual and ozone season-day emissions from all point sources addressed in this chapter, listed by process type.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type.

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
ELECTRICITY GENERATION:							
	Fuel Combustion: Fuel Oil:						
3313	APS West Phoenix Power Plant	0.00	0.64	0.00	0.0	0.0	0.0
43063	Duke Energy Arlington Valley LLC †	0.02	0.18	0.11	0.6	5.4	3.5
3317	Kyrene Generating Station	0.00	0.52	0.00	0.0	0.0	0.0
98	Palo Verde Nuclear Generating Station†	0.00	0.00	0.00	0.0	0.0	0.0
3316	SRP Agua Fria	0.00	2.49	0.01	0.0	13.3	0.1
	Total Fuel Combustion: Fuel Oil:	0.02	3.83	0.13	0.6	18.7	3.5
	Fuel Combustion: Natural Gas:						
3313	APS West Phoenix Power Plant	11.72	1,040.48	116.58	89.0	8,282.6	929.7
43063	Duke Energy Arlington Valley LLC †	1.54	17.51	23.63	9.5	107.8	145.4
3317	Kyrene Generating Station	2.78	118.63	39.17	32.2	1,278.9	443.3
52382	Ocotillo Power Plant	10.09	260.57	69.05	98.8	2,187.9	589.2
42956	Pinnacle West Energy Corp. †	3.31	69.80	89.70	13.9	326.2	427.5
3315	Santan Generating Station	8.69	333.00	339.66	53.6	2,052.3	2,093.4
3316	SRP Agua Fria	20.22	803.97	330.13	139.4	5,780.3	2,323.5
10469	SRP Desert Basin Generating Station †	10.70	135.40	50.20	58.8	744.0	275.8
	Total Fuel Combustion: Natural Gas:	69.05	2,779.36	1,058.12	495.0	20,759.9	7,227.7
TOTAL: ELECTRICITY GENERATION		**69.07**	**2,783.19**	**1,058.25**	**495.6**	**20,778.6**	**7,231.3**
COMMERCIAL/INSTITUTIONAL FUEL COMBUSTION:							
	Fuel Oil:						
1074	23rd Ave. Wastewater Treatment Plant	0.00	0.12	0.03	0.1	2.4	0.5
1075	91st Ave. Wastewater Treatment Plant	0.06	1.97	0.45	2.5	85.3	19.5
4364	Arizona State University	0.00	0.09	0.02	0.0	1.5	0.4
4145	Cave Creek School District	0.02	0.23	0.05	0.0	0.1	0.0
51073	Charles Schwab & Co. Inc.	0.17	12.67	0.92	1.0	69.6	5.0
781	Good Samaritan Regional Medical Center	1.83	23.07	4.96	28.8	352.2	75.8
3300	Luke Air Force Base	0.21	3.11	0.71	1.6	23.9	5.5
42636	Scottsdale Health Care Hospital	0.14	1.99	0.44	0.7	9.0	1.9
	Total Comm./Inst. Fuel Oil:	2.44	43.26	7.58	34.7	543.9	108.7
	Natural Gas:						
1074	23rd Ave. Wastewater Treatment Plant	0.09	1.69	0.76	0.5	11.5	2.0
4364	Arizona State University	0.99	13.46	15.12	3.1	36.6	46.7
4145	Cave Creek School District	0.92	22.51	3.16	7.1	173.1	24.3
781	Good Samaritan Regional Medical Center	0.21	3.90	3.28	1.0	18.9	15.8
3300	Luke Air Force Base	0.27	5.00	4.20	0.6	11.0	9.2
42636	Scottsdale Health Care Hospital	0.06	1.12	0.94	0.3	4.7	3.9
232	The Phoenician Resort	2.00	12.44	9.98	14.8	74.8	59.6
	Total Comm./Inst. Natural Gas:	4.54	60.12	37.44	27.3	330.6	161.6
	Other:						
3300	Luke Air Force Base	0.01	0.52	0.61	0.0	2.9	3.6
TOTAL: COMMERCIAL/ INSTITUTIONAL FUEL COMBUSTION:		**6.99**	**103.90**	**45.63**	**62.0**	**877.3**	**273.9**

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
INDUSTRIAL FUEL COMBUSTION:							
	Industrial Fuel Oil:						
1874	Alleco Stone LLC †	1.48	18.07	3.89	9.5	115.8	24.9
199	Ameron Intl. Water Transmission Group	0.07	0.82	0.18	3.7	46.0	9.9
3938	Arizona Galvanizing Inc.	0.25	3.08	0.66	1.9	23.7	5.1
1218	Butterfield Station †	0.10	1.21	0.26	0.6	7.7	1.7
1267	Cemex Mesa Plants #61 & #71	0.63	31.25	2.14	3.9	192.3	13.2
26	Empire Machinery Co.	0.44	14.08	2.25	3.1	37.7	8.1
1418	Goodrich Aircraft Interior Products	0.01	0.10	0.02	0.0	0.0	0.0
3966	Intel Corp. Ocotillo (Fab 12 & 22)	0.43	5.39	1.16	16.7	206.9	44.6
31261	Madison Granite Supplies	1.99	23.65	14.59	15.3	181.9	112.3
1414	Mesa Materials Inc. (Mesa)	3.09	5.96	16.28	28.6	55.1	150.3
1415	Mesa Materials Inc. (Phoenix)	2.13	4.11	11.22	19.7	37.9	103.5
29474	Metal Management Arizona Inc.	0.06	0.74	0.16	0.4	4.7	1.0
1203	Microchip Technology Inc. (Chandler)	0.00	0.03	0.01	0.1	1.3	0.3
1875	Microchip Technology Inc. (Tempe)	0.01	0.11	0.02	0.3	4.2	0.9
882	Morton Salt Glendale Facility	0.64	9.51	2.37	4.9	73.1	18.3
881	Motorola Inc.	0.06	1.95	0.44	2.2	74.9	17.1
34197	National Gypsum Co.	0.01	0.38	0.06	0.2	4.9	0.8
1879	Northwest Regional Landfill †	0.53	6.59	1.42	3.4	42.2	9.1
98	Palo Verde Nuclear Generating Station †	1.74	55.21	14.27	9.6	303.3	78.4
537	Red Mountain Mining Inc.	0.54	6.64	1.43	4.2	51.1	11.0
266	Schuff Steel Co.	0.28	3.42	0.74	1.8	21.9	4.7
281	Sun State Rock & Materials	0.31	24.58	0.73	2.0	157.6	4.7
260	United Metro Plant #11	0.01	0.65	0.16	0.0	0.0	0.0
213	United Metro Plant #12	0.01	0.77	0.19	0.0	4.9	1.2
2	Vulcan Materials Co. (El Mirage)	1.78	8.08	1.98	13.7	62.1	15.2
398	Wickenburg Facility †	0.59	7.25	1.56	4.6	55.8	12.0
	Total Industrial Fuel Oil:	17.18	233.62	78.22	150.2	1,767.1	648.3
	Industrial Natural Gas:						
245	A. F. Lorts Company Inc.	0.00	0.01	0.01	0.0	0.1	0.1
1952	Adesa Phoenix LLC	0.00	0.01	0.01	0.0	0.1	0.0
35541	Allied Tube & Conduit Corp.	0.02	0.39	0.33	0.2	3.1	2.6
199	Ameron Intl. Water Transmission Group	0.02	0.41	0.35	0.1	1.1	1.0
292	Anabolic Laboratories	0.01	0.14	0.12	0.1	1.1	0.9
3938	Arizona Galvanizing Inc.	0.15	2.76	2.32	0.8	15.2	12.7
43124	Bonded Logic Inc.	0.01	0.20	0.16	0.1	1.5	1.3
217	Building Products Co.	0.34	5.03	16.73	1.9	28.1	92.3
1310	Century Graphics LLC	0.00	0.04	0.04	0.0	0.3	0.3
1426	Cesar Color Inc.	0.03	0.48	0.41	0.2	3.7	3.1
1198	Courier Graphics Corp.	0.01	0.24	0.20	0.1	1.6	1.4
4368	Craftsmen in Wood Mfg	0.00	0.08	0.06	0.0	0.6	0.5
130	Dolphin Inc.	0.11	2.04	1.71	0.9	16.9	14.2
508	Eagle Industries LLC	0.00	0.03	0.02	0.0	0.2	0.2
3305	Earthgrains Baking Companies Inc.	0.10	1.82	1.53	0.6	11.6	9.8
26	Empire Machinery Co.	6.38	25.20	18.91	50.6	203.5	150.4
27728	FlipChip International LLC	0.02	0.33	0.28	0.1	1.8	1.5
4050	General Mills	0.04	0.80	0.67	0.3	4.9	4.1
1418	Goodrich Aircraft Interior Products	0.03	0.46	0.38	0.0	0.0	0.0
31565	Henry Products Inc.	0.03	0.58	0.49	0.3	5.3	4.5
529	Highland Products Inc.	0.08	1.37	1.15	0.6	10.5	8.9

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
Industrial Fuel Combustion: Natural Gas (cont'd.)							
3536	Holsum Bakery Inc.	0.18	3.30	2.77	1.3	24.3	20.4
3802	Holsum Bakery Tempe	0.06	1.06	0.89	0.4	7.5	6.3
1059	Honeywell Engines Systems & Service	0.05	0.95	0.80	0.0	0.0	0.0
355	Honeywell International Inc.	0.25	4.47	3.76	1.4	24.6	20.6
777	Insulfoam	0.06	1.11	0.94	0.4	7.1	6.0
3966	Intel Corp. Ocotillo (Fab 12 & 22)	0.89	16.11	13.53	4.9	88.5	74.3
983	Isola Laminate Systems Corp.	0.17	22.03	9.14	1.1	141.2	58.6
744	M. E. Global Inc.	0.26	4.75	3.99	1.7	31.0	26.0
205	Mail-Well Envelope	0.05	0.85	0.71	0.4	6.5	5.5
353	Marlam Industries Inc.	0.00	0.03	0.02	0.0	0.2	0.2
61268	Master Block Inc.	0.01	0.26	0.22	0.1	1.7	1.4
62	Mastercraft Cabinets Inc.	0.01	0.15	0.13	0.1	1.1	0.9
1203	Microchip Technology Inc. (Chandler)	0.13	2.30	1.93	0.7	12.6	10.6
1875	Microchip Technology Inc. (Tempe)	0.23	4.19	3.52	1.3	23.0	19.3
226	Monier Lifetile LLC	0.05	0.94	0.79	0.3	6.0	5.0
882	Morton Salt Glendale Facility	0.04	0.68	0.57	0.3	5.2	4.4
881	Motorola Inc.	0.51	3.73	1.40	3.2	22.7	8.1
223	MTD Southwest Inc.	0.02	0.34	0.08	0.0	0.3	0.2
693	Munters Corp.	0.01	0.17	0.15	0.1	1.3	1.1
34197	National Gypsum Co.	1.05	19.15	16.09	6.8	122.7	103.1
3953	Oakcraft Inc.	0.00	0.08	0.07	0.0	0.6	0.5
428	Paloma Gin Properties LLC †	0.01	0.09	0.07	0.0	0.0	0.0
733	Pan-Glo West	0.04	0.75	0.63	0.3	5.7	4.8
1341	Penn Racquet Sports Inc.	0.25	4.62	3.88	1.9	34.7	29.1
289	Phoenix Agro Invest Inc. †	0.00	0.02	0.01	0.0	0.0	0.0
1014	Phoenix Brick Yard	1.23	10.17	34.27	6.7	55.9	188.3
562	Phoenix Newspapers Inc.	0.03	0.61	0.27	0.6	15.0	3.3
148	Presto Casting Co.	0.06	1.14	0.95	0.5	8.7	7.3
60889	Purcell's Western States Tire	0.01	0.18	0.15	0.1	1.4	1.2
1030	Quebecor World Phoenix Division	0.09	1.76	39.99	0.5	8.6	194.8
303	Rexam Beverage Can Company	0.28	5.11	4.29	1.5	28.1	23.6
759	Rogers Corp. Advanced Circuit Materials	0.09	9.07	35.74	0.5	49.9	197.0
1437	Sanmina Phoenix Division	0.10	1.83	1.53	0.6	11.7	9.8
70634	Shell Oil Phoenix Terminal	0.02	0.34	0.28	0.1	1.8	1.6
31627	South Mountain Gin	0.01	0.15	0.12	0.0	0.0	0.0
4131	ST Microelectronics	0.29	5.31	4.46	1.6	29.2	24.5
1444	Staco Architectural Roof Tile	0.00	0.06	0.05	0.0	0.6	0.5
101	Sunland Beef Co.	0.67	12.15	10.21	3.4	62.6	52.6
249	The Boeing Company	0.07	1.26	1.05	0.5	9.7	8.1
1102	The Procter & Gamble Mfg. Co.	0.05	0.84	0.70	0.4	6.4	5.4
56	TPAC Division of Kiewit Western Co.	0.05	0.96	0.80	0.4	7.4	6.2
819	TRW Vehicle Safety Systems Inc.	0.18	2.24	2.77	0.9	10.8	13.4
234	United Dairymen of Arizona	1.80	17.78	27.51	9.4	89.2	144.0
260	United Metro Plant #11	0.72	4.72	16.36	6.4	42.3	146.8
213	United Metro Plant #12	7.32	6.93	30.25	54.4	51.5	225.0
403	VAW of America Inc.	0.69	11.04	8.03	4.4	70.8	51.5
2	Vulcan Materials Co. (El Mirage)	0.00	0.06	0.05	0.0	0.4	0.3
174	W. R. Meadows of AZ Inc.	0.01	0.19	0.16	0.1	2.4	2.0
20706	Wincup Holdings Inc.	0.73	13.32	11.19	4.5	82.0	68.8
72	Woodstuff Manufacturing Inc.	0.00	0.08	0.07	0.0	0.6	0.5
	Total Industrial Natural Gas:	26.22	241.80	343.21	181.3	1,527.2	2,092.9

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
Industrial Fuel Combustion: (cont'd.)							
	Industrial Fuel Combustion: Gasoline:						
31643	Allied Waste Industries Inc. †	0.33	4.11	0.90	2.1	26.3	5.8
1418	Goodrich Aircraft Interior Products	0.02	0.01	0.46	0.1	0.1	2.4
882	Morton Salt Glendale Facility	0.04	0.02	0.87	0.3	0.2	6.7
98	Palo Verde Nuclear Generating Station †	0.09	0.05	1.85	0.5	0.3	10.2
	Total Industrial Gasoline:	0.49	4.19	4.08	3.1	26.8	25.1
	Industrial Fuel Combustion: LPG:						
31606	Acme Gin Co Inc. †	0.00	0.10	0.02	0.0	0.0	0.0
31637	Anderson Clayton Corp. Valencia Gin †	0.01	0.41	0.07	0.0	0.0	0.0
3976	Cholla Custom Cabinets Inc.	0.00	0.09	0.01	0.0	0.7	0.1
1389	DaimlerChrysler AZ Proving Grounds †	0.03	0.10	0.06	0.4	0.7	0.6
1488	Farmers Gin Inc. †	0.02	0.75	0.13	0.0	0.0	0.0
1418	Goodrich Aircraft Interior Products	0.03	0.03	0.64	0.3	0.3	6.5
	Total Industrial LPG:	0.11	1.48	0.93	0.7	1.7	7.3
TOTAL INDUSTRIAL FUEL COMBUSTION:		**43.99**	**481.08**	**426.44**	**335.3**	**3,322.8**	**2,773.6**
FOOD/AGRICULTURE:							
	Bakeries:						
3305	Earthgrains Baking Companies Inc.	32.92			211.0		
4050	General Mills	16.92			104.1		
3536	Holsum Bakery Inc.	10.71			83.5		
3802	Holsum Bakery Tempe	19.26			139.6		
	Total Bakeries:	79.81			538.3		
	Dairies:						
234	United Dairymen of Arizona	0.03			0.2		
	Rendering:						
101	Sunland Beef Co.	18.92			136.2		
TOTAL FOOD/AGRICULTURE:		**98.76**			**674.7**		
INDUSTRIAL PROCESSES:							
	Cooling Towers:						
98	Palo Verde Nuclear Generating Station †	11.14			61.2		
	Engine Testing:						
1059	Honeywell Engines Systems & Service	1.67	0.53	1.19	10.7	3.4	7.6
355	Honeywell International Inc.	4.81	51.76	16.37	26.4	284.4	90.0
3300	Luke Air Force Base	7.21	2.29	5.12	55.4	17.6	39.4
223	MTD Southwest Inc.	1.73	1.19	46.04	13.3	9.2	354.1
249	The Boeing Company	0.00	0.08	0.29	0.0	0.6	2.3
	Total Engine Testing:	15.42	55.85	69.01	105.9	315.2	493.3
	Other Industrial Processes:						
3442	Caljet	5.16	0.86	4.30	28.3	4.7	23.6
98	Palo Verde Nuclear Generating Station †	1.25			3.4		
759	Rogers Corp. Advanced Circuit Materials	2.10			11.5		
4175	SFPP LP		4.03	8.62		22.1	47.3
101	Sunland Beef Co.	0.15			0.9		
249	The Boeing Company			0.15			1.2
	Total Other Industrial Processes:	8.65	4.89	13.06	44.2	26.8	72.1
TOTAL INDUSTRIAL PROCESSES:		**35.21**	**60.74**	**82.07**	**211.3**	**342.0**	**565.5**

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
	MANUFACTURING PROCESSES:						
	Asphalt, Concrete & Tile:						
544	Fleetwood Homes of Arizona Inc. #21	0.27			2.1		
1444	Staco Architectural Roof Tile	12.85			98.9		
	Total Asphalt, Concrete & Tile:	13.12			100.9		
	Electrical Equipment:						
27728	FlipChip International LLC	11.92			65.5		
1059	Honeywell Engines Systems & Service	0.10			0.6		
3966	Intel Corp. Ocotillo (Fab 12 & 22)	24.99			137.3		
983	Isola Laminate Systems Corp.	46.07			295.3		
1203	Microchip Technology Inc. (Chandler)	10.90	0.04		59.9	0.2	
1875	Microchip Technology Inc. (Tempe)	48.13		0.06	264.5		0.3
881	Motorola Inc.	46.82			257.3		
759	Rogers Corp. Advanced Circuit Materials	2.37			18.2		
1437	Sanmina Phoenix Division	18.90			121.2		
4131	ST Microelectronics	25.91			142.4		
	Total Electrical Equipment:	236.11	0.04	0.06	1,362.1	0.2	0.3
	Fabricated Metal Products:						
199	Ameron Intl. Water Transmission Group	4.73			36.4		
10211	Hexcel Corp. †	87.72	12.89	10.13	674.8	99.2	77.9
	Total, Fabricated Metal Products:	92.45	12.89	10.13	711.1	99.2	77.9
	Paper Products:						
693	Munters Corp.	18.82			144.7		
	Pharmaceuticals:						
292	Anabolic Laboratories	20.99			161.5		
1102	The Procter & Gamble Mfg. Co.	0.98			7.5		
	Total Pharmaceuticals:	21.97			169.0		
	Rubber/Plastic Products:						
3744	Desert Sun Fiberglass	33.57			258.2		
41751	GCR Truck Tire Center	16.30			125.4		
31565	Henry Products Inc.	55.85			515.6		
529	Highland Products Inc.	22.90			125.8		
777	Insulfoam	58.33			344.0		
341	L & M Laminates & Marble	35.68			274.5		
1248	Maax Spas	40.54			436.6		
353	Marlam Industries Inc.	42.55			327.3		
3326	Mesa Fully Formed Inc.	33.35			256.6		
1341	Penn Racquet Sports Inc.	81.81			629.3		
60889	Purcell's Western States Tire	4.58			49.3		
1228	Ultra Installations Inc.	18.81			144.7		
20706	Wincup Holdings Inc.	103.18			635.0		
	Total Rubber/Plastic Products:	547.47			4,122.3		

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
	Secondary Metal Products:						
130	Dolphin Inc.	6.10	0.01		51.9	0.1	
354	Imsamet of Arizona	0.36	15.76	80.66	2.3	83.1	425.4
744	M. E. Global Inc.	42.29	36.22	52.24	327.9	280.7	404.4
29474	Metal Management Arizona Inc.	19.10			122.4		
148	Presto Casting Co.	7.43	0.05		57.1	0.3	
403	VAW of America Inc.	2.40	0.17	2.62	15.4	1.1	16.8
	Total Secondary Metal Products:	77.68	52.20	135.51	577.2	365.4	846.6
	Other Manufacturing:						
60598	Case Furniture & Design LLC	5.97			38.3		
819	TRW Vehicle Safety Systems Inc.	0.04	0.00	0.41	0.2	0.0	3.4
	Total Other Manufacturing:	6.01	0.00	0.41	38.5	0.0	3.4
TOTAL MANUFACTURING PROCESSES:		**1,013.62**	**65.13**	**146.12**	**7,225.9**	**464.8**	**928.3**
PETROLEUM PRODUCT STORAGE:							
	Fuel Oil Storage:						
3313	APS West Phoenix Power Plant	2.50			13.7		
3297	Chevron USA Inc.	0.09			0.5		
	Total Fuel Oil Storage:	2.59			14.2		
	Gasoline Storage:						
1075	91st Ave. Wastewater Treatment Plant	0.16			0.7		
199	Ameron Intl. Water Transmission Group	0.17			1.3		
3313	APS West Phoenix Power Plant	0.36			2.0		
4364	Arizona State University	0.17			0.9		
1218	Butterfield Station †	0.11			0.7		
4145	Cave Creek School District	0.08			0.6		
1268	Cemex USA	0.08			0.4		
399	Coreslab Structures (Ariz) Inc.	0.50			2.7		
1389	DaimlerChrysler AZ Proving Grounds †	0.54			4.3		
781	Good Samaritan Regional Medical Center	0.03			0.2		
699	Hanson Aggregates of Arizona Inc.	0.07			0.5		
3317	Kyrene Generating Station	0.02			0.1		
3300	Luke Air Force Base	3.59			27.6		
744	M. E. Global Inc.	0.05			0.3		
882	Morton Salt Glendale Facility	0.04			0.2		
223	MTD Southwest Inc.	0.47			2.2		
98	Palo Verde Nuclear Generating Station †	3.96			21.7		
289	Phoenix Agro Invest Inc. †	1.86			12.7		
1014	Phoenix Brick Yard	0.17			1.3		
4318	River Ranch Plant	0.12			0.9		
3315	Santan Generating Station	0.04			0.2		
266	Schuff Steel Co.	0.16			1.0		
27933	Skunk Creek Landfill	0.89			4.9		
3316	SRP Agua Fria	0.03			0.2		
249	The Boeing Company	0.37			2.9		
232	The Phoenician Resort	0.41			2.6		
169	U Haul Intl. Technical Center	0.72			4.6		
260	United Metro Plant #11	0.55			3.5		
213	United Metro Plant #12	0.51			3.3		
2	Vulcan Materials Co. (El Mirage)	0.12			1.3		
90	Vulcan Materials Co. (Phoenix)	0.27			2.9		
141	Western Organics Inc.	0.35			2.2		
	Total Gasoline Storage:	16.96			111.0		

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
	Other Organic Chemical Storage:						
1389	DaimlerChrysler AZ Proving Grounds †	0.06			0.5		
130	Dolphin Inc.	0.00			0.0		
355	Honeywell International Inc.	0.12			0.7		
1341	Penn Racquet Sports Inc.	0.00			0.0		
759	Rogers Corp. Advanced Circuit Materials	0.02			0.1		
	Total Other Organic Chemical Storage:	0.20			1.3		
TOTAL PETROLEUM PROD. STORAGE:		**19.74**			**126.4**		
PETROLEUM TRANSPORTATION/MARKETING:							
	Avgas:						
3313	APS West Phoenix Power Plant	0.22			1.2		
3300	Luke Air Force Base	0.01			0.0		
	Total Avgas:	0.22			1.2		
	Bulk Plants:						
3300	Luke Air Force Base	3.40			19.4		
2703	Western States Petroleum	5.10			28.0		
	Total Bulk Plants:	8.50			47.4		
	Bulk Terminals:						
3441	BP West Coast Products LLC	31.98			167.0		
3442	Caljet	11.44			62.9		
3297	Chevron USA Inc.	36.36			179.0		
4175	SFPP LP	297.65			1,635.4		
70634	Shell Oil Phoenix Terminal	157.82			820.7		
2703	Western States Petroleum	6.37			35.0		
	Total Bulk Terminals:	541.61			2,900.1		
TOTAL PETROLEUM TRANSPORTATION/MARKETING:		**550.34**			**2,948.7**		
WASTE DISPOSAL:							
	Landfills:						
31643	Allied Waste Industries Inc. †	7.51			41.3		
1218	Butterfield Station †	5.58	1.28	7.98	30.7	7.0	43.9
4173	Glendale Municipal Sanitary Landfill	8.96	4.77	1.67	62.0	33.0	11.6
27933	Skunk Creek Landfill	11.01	1.78	0.59	60.5	9.8	3.2
	Total Landfills:	33.06	7.83	10.24	194.5	49.8	58.7
	Publicly Owned Treatment Works (POTWs):						
1074	23rd Ave. Wastewater Treatment Plant	3.07	8.08	50.12	14.5	39.9	282.4
1075	91st Ave. Wastewater Treatment Plant	1.20	10.04	3.58	7.9	54.5	14.2
	Total POTWs:	4.27	18.12	53.70	22.4	94.4	296.6
	Site Remediation:						
1218	Butterfield Station †	0.05			0.3		
130	Dolphin Inc.	1.22			7.2		
3300	Luke Air Force Base	1.92	0.18	0.11	10.5	1.0	0.6
1879	Northwest Regional Landfill †	0.00			0.0		
4175	SFPP LP	0.26	1.38	0.34	1.4	7.6	1.9
	Total Site Remediation:	3.45	1.56	0.46	19.5	8.6	2.5
	Other Waste Disposal:						
983	Isola Laminate Systems Corp.	0.01			0.1		
TOTAL WASTE DISPOSAL:		**40.79**	**27.51**	**64.40**	**236.4**	**152.8**	**357.8**

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
HEALTH SERVICES:							
781	Good Samaritan Regional Medical Center	0.00			0.0		
42636	Scottsdale Health Care Hospital	17.94			98.6		
TOTAL HEALTH SERVICES:		**17.94**			**98.6**		
SOLVENT USE:							
	Cold Cleaning:						
199	Ameron Intl. Water Transmission Group	3.05			23.4		
3313	APS West Phoenix Power Plant	0.38			2.9		
4364	Arizona State University	0.16			1.3		
1316	Cavco Industries LLC (Durango Plant)	0.22			1.7		
1318	Cavco Industries LLC (Goodyear)	0.31			2.4		
1317	Cavco Industries LLC (Phoenix)	0.59			4.5		
4083	Chris Fischer Productions Inc.	0.29			2.7		
399	Coreslab Structures (Ariz) Inc.	1.26			9.7		
1389	DaimlerChrysler AZ Proving Grounds †	0.15			1.0		
130	Dolphin Inc.	0.28			2.3		
3305	Earthgrains Baking Companies Inc.	0.40			3.1		
26	Empire Machinery Co.	4.37			33.6		
544	Fleetwood Homes of Arizona Inc. #21	0.52			4.0		
31565	Henry Products Inc.	0.06			0.6		
1059	Honeywell Engines Systems & Service	6.78			43.4		
355	Honeywell International Inc.	27.42			175.7		
983	Isola Laminate Systems Corp.	0.71			4.6		
857	Litton Electro-Optical Systems	22.38			172.1		
3300	Luke Air Force Base	1.15			8.8		
1248	Maax Spas	0.81			8.8		
3326	Mesa Fully Formed Inc.	0.09			0.7		
29474	Metal Management Arizona Inc.	0.86			5.5		
882	Morton Salt Glendale Facility	0.07			0.6		
223	MTD Southwest Inc.	1.92			12.1		
52382	Ocotillo Power Plant	0.05			0.3		
1344	Palm Harbor Homes Inc.	0.41			3.9		
733	Pan-Glo West	8.41			46.2		
419	Parker Hannifin GTFSD	29.57			189.5		
1014	Phoenix Brick Yard	8.89			68.4		
42956	Pinnacle West Energy Corp. †	0.37			2.7		
44182	Quincy Joist Company †	0.18			1.4		
1503	Redman Homes Inc.	1.11			8.5		
1437	Sanmina Phoenix Division	0.05			0.3		
249	The Boeing Company	12.76			98.1		
819	TRW Vehicle Safety Systems Inc.	0.67			4.0		
169	U Haul Intl. Technical Center	7.96			51.0		
234	United Dairymen of Arizona	0.40			2.2		
260	United Metro Plant #11	0.02			0.2		
20706	Wincup Holdings Inc.	3.44			21.2		
	Total Cold Cleaning:	148.50			1,023.6		

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
SOLVENT USE: Degreasing:							
1074	23rd Ave. Wastewater Treatment Plant	0.51			3.9		
1218	Butterfield Station †	0.08			0.5		
1389	DaimlerChrysler AZ Proving Grounds †	0.05			0.3		
1059	Honeywell Engines Systems & Service	9.29			59.5		
3317	Kyrene Generating Station	0.10			0.5		
98	Palo Verde Nuclear Generating Station †	2.83			15.6		
562	Phoenix Newspapers Inc.	0.26			1.4		
3315	Santan Generating Station	0.17			0.9		
3316	SRP Agua Fria	0.74			4.1		
101	Sunland Beef Co.	0.05			0.3		
213	United Metro Plant #12	0.02			0.1		
403	VAW of America Inc.	47.07			301.8		
	Total Degreasing:	61.17			389.0		
	Printing/publishing:						
36485	Billboard Poster Company Inc.	19.65			181.4		
1310	Century Graphics LLC	15.29			117.6		
1426	Cesar Color Inc.	11.21			86.2		
1198	Courier Graphics Corp.	10.14			70.2		
3305	Earthgrains Baking Companies Inc.	0.74			4.7		
31565	Henry Products Inc.	0.17			1.6		
529	Highland Products Inc.	0.45			2.5		
4543	Hogue Printing Inc.	11.18			76.4		
205	Mail-Well Envelope	28.60			220.0		
3982	O'Neil Printing Inc.	12.69			97.7		
562	Phoenix Newspapers Inc.	10.17			55.9		
1030	Quebecor World Phoenix Division	18.83			91.7		
1102	The Procter & Gamble Mfg. Co.	0.62			4.7		
819	TRW Vehicle Safety Systems Inc.	0.75			5.7		
	Total Printing/publishing:	140.49			1,016.3		
	Miscellaneous Solvent Use:						
1316	Cavco Industries LLC (Durango Plant)	0.39			3.0		
1318	Cavco Industries LLC (Goodyear)	0.03			0.3		
1505	Executive Door	0.12			0.9		
226	Monier Lifetile LLC	13.43			86.1		
98	Palo Verde Nuclear Generating Station †	2.67			14.7		
60889	Purcell's Western States Tire	0.66			7.1		
	Total Miscellaneous Solvent Use:	17.31			112.1		
TOTAL SOLVENT USE:		**367.47**			**2,541.0**		
SURFACE COATING:							
	Aircraft/parts:						
3300	Luke Air Force Base	14.32			110.2		
249	The Boeing Company	3.21			24.7		
	Total Aircraft/parts:	17.53			134.9		
	Auto Body:						
1952	Adesa Phoenix LLC	10.65			81.9		
45493	Earnhardt Ford	11.40			71.8		
937	The Heil Company	12.00			92.3		
	Total Auto Body:	34.05			246.1		

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
	SURFACE COATING: Flatwood:						
458	Bryant Industries Inc.	22.65			174.2		
4083	Chris Fischer Productions Inc.	9.64			89.0		
4023	Creative Shutters Inc.	12.63			77.7		
1505	Executive Door	16.33			125.6		
1248	Maax Spas	1.69			18.2		
62	Mastercraft Cabinets Inc.	121.88			1,228.1		
4384	Western Shutter LLC	14.21			109.3		
1382	Woodcase Fine Cabinetry Inc.	34.67			266.7		
	Total Flatwood:	233.70			2,088.8		
	Metal Cans:						
303	Rexam Beverage Can Company	120.48			662.0		
	Misc. Metal Parts:						
1239	AG Products	11.89			91.5		
35541	Allied Tube & Conduit Corp.	21.49			198.4		
26	Empire Machinery Co.	0.56			4.3		
355	Honeywell International Inc.	0.54			3.3		
733	Pan-Glo West	7.67			42.1		
44182	Quincy Joist Company †	65.20			501.5		
759	Rogers Corp. Advanced Circuit Materials	18.50			142.3		
4471	Skyline Steel Inc.	12.71			97.8		
	Total Misc. Metal Parts:	138.56			1,081.3		
	Wood Furniture:						
245	A. F. Lorts Company Inc.	54.37			522.8		
60598	Case Furniture & Design LLC	10.98			70.4		
3976	Cholla Custom Cabinets Inc.	18.19			139.9		
4083	Chris Fischer Productions Inc.	4.50			41.6		
4368	Craftsmen in Wood Mfg	12.26			94.3		
508	Eagle Industries LLC	41.77			321.3		
4182	Legends Furniture Inc.	77.00			592.3		
4111	Magic Woods Inc.	12.78			98.3		
1309	New Directions Inc.	20.58			158.3		
1331	Oak Canyon Manufacturing Inc.	87.44			591.9		
3953	Oakcraft Inc.	54.38			348.6		
27925	Oasis Bedroom Co.	15.92			122.5		
3970	Pacific Designs	29.17			224.4		
582	Stone Creek Inc.	21.13			162.5		
3978	Team Two Design Assoc Inc.	16.14			124.2		
552	Thornwood Furniture Mfg	59.19			455.3		
363	Thunderbird Furniture	22.15			170.4		
1210	Trendwood Inc. (15th Ave.)	51.84			398.8		
1211	Trendwood Inc. (University Dr.)	56.41			433.9		
72	Woodstuff Manufacturing Inc.	200.54			1,542.6		
	Total, Wood Furniture:	866.75			6,614.2		
	Miscellaneous Surface Coating:						
199	Ameron Intl. Water Transmission Group	12.36			95.1		
3313	APS West Phoenix Power Plant	1.17			9.0		
4364	Arizona State University	0.71			5.4		
217	Building Products Co.	3.34			25.7		
1316	Cavco Industries LLC (Durango Plant)	12.83			98.7		
1318	Cavco Industries LLC (Goodyear)	22.39			172.3		
1317	Cavco Industries LLC (Phoenix)	10.27			79.0		
399	Coreslab Structures (Ariz) Inc.	3.63			28.0		

† Source is outside the ozone nonattainment area.

Table 2.4–2. Annual and ozone season-day point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO
SURFACE COATING: Miscellaneous (cont'd.)							
544	Fleetwood Homes of Arizona Inc. #21	10.13			77.9		
781	Good Samaritan Regional Medical Center	0.09			0.7		
1418	Goodrich Aircraft Interior Products	55.97			430.5		
1059	Honeywell Engines Systems & Service	2.42			15.5		
3966	Intel Corp. Ocotillo (Fab 12 & 22)	0.00			0.0		
983	Isola Laminate Systems Corp.	0.03			0.2		
3317	Kyrene Generating Station	0.69			3.8		
1248	Maax Spas	3.68			39.6		
226	Monier Lifetile LLC	5.70			36.5		
948	Nesco Mfg. Inc.	14.22			109.4		
1344	Palm Harbor Homes Inc.	22.75			218.8		
98	Palo Verde Nuclear Generating Station †	5.58			30.7		
562	Phoenix Newspapers Inc.	0.26			1.4		
148	Presto Casting Co.	9.10			70.0		
1503	Redman Homes Inc.	27.04			208.0		
1437	Sanmina Phoenix Division	1.10			7.1		
3315	Santan Generating Station	0.41			2.2		
266	Schuff Steel Co.	9.89			63.4		
246	Schult Homes †	8.56			68.5		
3316	SRP Agua Fria	0.17			1.0		
4131	ST Microelectronics	0.28			1.5		
249	The Boeing Company	1.52			11.7		
819	TRW Vehicle Safety Systems Inc.	0.05			0.3		
169	U Haul Intl. Technical Center	7.82			50.2		
174	W. R. Meadows of AZ Inc.	166.61			2,982.5		
	Total, Miscellaneous Surface Coating:	420.79			4,944.62		
TOTAL SURFACE COATING:		**1,831.86**			**15,771.8**		
TOTAL, ALL POINT SOURCES:		**4,095.77**	**3,521.55**	**1,822.90**	**30,727.8**	**25,938.4**	**12,130.3**

2.5 Emission reduction credits

A major source or major modification planned in a nonattainment area must obtain emissions reductions as a condition for approval. These emissions reductions, generally obtained from existing sources located in the vicinity of a proposed source, must offset the emissions increase from the new source or modification. The obvious purpose of acquiring offsetting emissions decreases is to allow an area to move towards attainment of the national ambient air quality standards while still allowing some industrial growth.

Table 2.5–1 provides a list of emission reduction credits for VOC, NO_x, and CO. Two facilities shut down their equipment prior to 2002 and requested that their emissions continue to be listed in the emission inventory for possible future use as emission reduction credits. A third facility shut down operations in 2002 and received a credit generation certificate for their emissions from the Arizona Emissions Bank.

In order for these emission reductions to be available in the future for offsetting, they must be: 1) explicitly included and quantified as growth in projection year inventories required in rate of progress plans or attainment demonstrations that were based on 1990 actual inventories, and 2) meet the requirements outlined in MCESD Rule 240 (Permit Requirements for New Major Sources and Major Modification to Existing Major Sources).

Table 2.5–1. Emission reduction credits.

	Emission reduction credits (tons)		
Facility	**VOC**	**NO_x**	**CO**
Anderson Clayton Oilseed Plant	113.93	6.4	2.28
Motorola (Mesa)	19	12	17
The Scottsdale Princess Cogeneration Partnership	3.99	98.19	12.95
Totals:	**136.92**	**116.59**	**32.23**

2.6 Summary of point source emissions

Table 2.6–1 provides an overview of source category contributions to total point source emissions.

Table 2.6–1. Summary of annual and ozone season-day point source emissions, by source category.

	Annual emissions (tons/yr)			Ozone season-day emissions (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Electricity generation	69.07	2,783.19	1,058.25	495.6	20,778.6	7,231.3
Commercial/institutional fuel combustion	6.99	103.90	45.63	62.0	877.3	273.9
Industrial fuel combustion	43.99	481.08	426.44	335.3	3,322.8	2,773.6
Food/agriculture	98.76			674.7		
Industrial processes	35.21	60.74	82.07	211.3	342.0	565.5
Manufacturing processes	1,013.62	65.13	146.12	7,225.9	464.8	928.3
Petroleum product storage	19.74			126.4		
Petroleum product transportation/marketing	550.34			2,948.7		
Waste disposal	40.79	27.51	64.40	236.4	152.8	357.8
Health services	17.94			98.6		
Solvent use	367.47			2,541.0		
Surface coating	1,831.86			15,771.8		
All point sources:	**4,095.77**	**3,521.55**	**1,822.90**	**30,727.8**	**25,938.4**	**12,130.3**

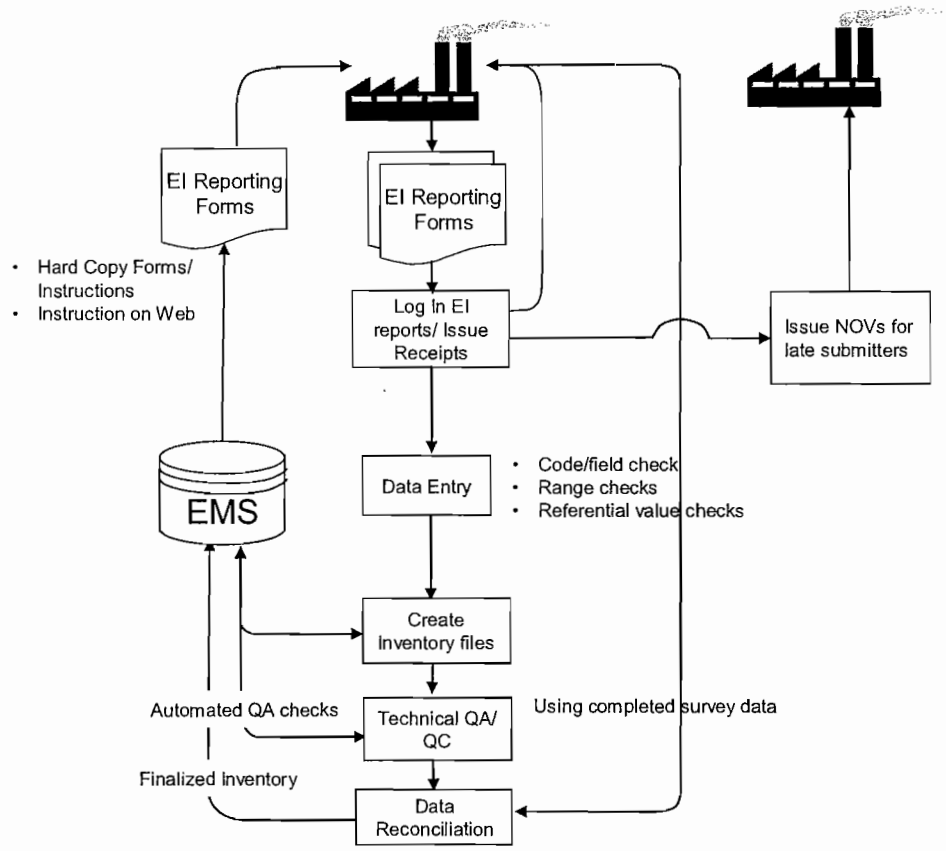
2.7 Quality assurance / quality control procedures

2.7.1 Emission survey preparation and data collection

The MCESD's Emissions Inventory (EI) Unit annually collects point source criteria pollutant emission data from sources in the county. MCESD annually reviews EPA guidance, documents from the Emission Inventory Improvement Program (EIIP), and other source materials to ensure that the most current emission factors and emission calculation methods are used for each year's survey. Each January, the EI Unit prepares a pre-populated hard copy of the preceding year's submissions and mails reporting forms to permitted sources, along with detailed instructions for completing the forms. (A copy of these instructions is included as Appendix 2.1). The EI Unit asks sources to verify and update the data. The EI Unit also holds weekly workshops from January through April to assist businesses in completing EI forms.

The general data flow for data collection and inventory preparation is shown in Figure 2.7–1.

Figure 2.7–1. Data flow for annual point source emission inventory reporting.



2.7.2 Submission processing

Submitted EI reports are logged in as they are received, and receipts are issued for emissions fees paid. The data are input "as received" into the department's data base. During data entry, numerous automated quality control (QC) checks are performed, including:

- pull-down menus to minimize data entry errors (e.g., city, pollutant, emission factor unit, etc.)
- mandatory data field requirement checks (e.g., a warning screen appears if a user tries to save an emission record with a missing emission factor).
- range checks (e.g., were valid SCC, Tier, SIC, and NAICS codes entered?)
- referential value checks (e.g., emission factor units, annual throughput units)
- automatic formatting of date, time, telephone number fields, etc.

Automated quality assurance (QA) checks on the report that has been entered include the following:

- Comparing reported emission factors to SCC reference lists
- Comparing reported emission factors to material name reference list
- Checking the report for calculation errors. This includes annual throughput, emission factors, unit conversion factors (e.g., BTU to therms), capture efficiency, primary / secondary control device efficiency, and any offsite recycling credits claimed.
- Checking the report for completeness of required data.

When data entry is complete, an electronic version of the original data is preserved separately to document changes made during the technical review and QA/QC process.

When errors are flagged, the businesses are contacted and correct information is obtained and input to the EMS. Outstanding reporting issues are documented. Confidential business information (CBI) is identified by a checkbox on the form, and these data elements are flagged during data entry and are not transmitted to the EPA. To prepare the inventory for submittal to the National Emissions Inventory (NEI), the EI Unit runs Microsoft Access queries on the data in the EMS to pull fields for the NEI Input format (NIF) tables.

2.7.3 Analysis of annual point source emissions data for this inventory

Two environmental planners checked inventory accuracy and reasonableness, and assured that all point sources had been identified and that the methodology applied to calculate emissions was appropriate and that the calculations were correct. Other reasonableness checks were conducted by recalculating emissions using methods other than those used to make the initial emissions calculations and then comparing results. QA was conducted by checking all emissions reports submitted to MCESD for the year 2002 for missing and questionable data and by checking the accuracy and reasonableness of all emissions calculations made for such reports. Notes concerning follow-up calls and corrections to calculations were documented on each 2002 annual emissions report.

The QA point source coordinator reviewed checked calculations, identified errors, and performed completeness, reasonableness and accuracy checks.

2.8 References

US EPA, 1992. Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories. USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC. Rep. EPA-452/R-92-010, November 1992. Available at: http://www.epa.gov/ttn/chief/old/eidocs/ 454r92010_nov1992.pdf.

US EPA, 2003a. 2002 National Emission Inventory (NEI) Preparation Plan (draft). USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC, Dec. 19, 2003. Available at: http://www.epa.gov/ttn/ chief/net/2002inventory.html.

US EPA, 2003b. Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC. Draft Rep. June 2003. Available at: http://www.epa.gov/ttn/chief/ eidocs/eiguid/.

3. Area Sources

3.1 Scope and methodology

This chapter considers all stationary sources which are too small or too numerous to be treated as point sources. US EPA guidance documents, including "Introduction to Area Source Inventory Development" (US EPA, 2001c) as well as permit and emissions data in the MCESD's Environmental Management System (EMS) database, and previous SIP inventories, were evaluated to develop the list of area source categories for inclusion. Some source categories were deemed "insignificant" because there are no large production facilities and/or very few small sources, and therefore emissions were not quantified. MCESD prepared the area source emission estimates for all area sources and provided quality assurance checks on all data. Table 3.1–1 contains a list of all area source categories, with Source Classification Codes (SCCs), addressed in this chapter.

Table 3.1–1. List of area source categories.

AMS code	Area source description	Section
	Fuel combustion:	
2102006000	Industrial natural gas	3.2.1
2102004000	Industrial fuel oil	3.2.2
2103006000	Commercial/institutional natural gas	3.2.3
2103004000	Commercial/institutional fuel oil	3.2.4
2104006000	Residential natural gas	3.2.5
2104008000	Residential wood	3.2.6
2104004000	Residential fuel oil	3.2.7
	Industrial processes:	
2301000000	Chemical manufacturing	3.3.1
	Food and kindred products	3.3.2
2302002000	Commercial Cooking	3.3.2.1
2302050000	Bakeries	3.3.2.2
2304000000	Secondary metal production	3.3.3
2305000000	Non-metallic mineral processes	3.3.4
2308000000	Rubber/plastics manufacturing	3.3.5
2309000000	Fabricated metal products manufacturing	3.3.6
2312000000	Electrical equipment manufacturing	3.3.7
	State-permitted portable sources	3.3.8
2399000000	Industrial processes not elsewhere classified	3.3.9
	Solvent use:	
2401001000	Architectural coatings	3.4.1.1
2401005000	Auto refinishing	3.4.1.2
2401008000	Traffic markings	3.4.1.3
2401015000	Factory-finished wood	3.4.1.4
2401020000	Wood furniture	3.4.1.5
2401075000	Aircraft	3.4.1.6
2401090000	Miscellaneous manufacturing	3.4.1.7
2415000000	Degreasing	3.4.2
2420000000	Dry cleaning	3.4.3
2425000000	Graphic arts	3.4.4
2440000000	Miscellaneous industrial solvent use	3.4.5
2461850000	Pesticide application: agricultural	3.4.6
2460000000	Consumer and commercial solvent use	3.4.7
2461020000	Asphalt application	3.4.8

Table 3.1–1. List of area source categories (continued).

AMS code	Area source description	Section
	Storage and transport:	
2501050120	Bulk plants/terminals	3.5.1
2510000000	Volatile organic liquid (VOL) storage and transport	3.5.2
2501060050	Petroleum tanker truck fuel delivery	3.5.3
2505030120	Petroleum tanker trucks in transit	3.5.4
2501060201	Service stations, breathing/emptying	3.5.5
2501060100	Vehicle refueling	3.5.6
	Summary of all storage and transport	3.5.7
	Waste treatment and disposal	3.6
2601000000	On-site incineration	3.6.1
2610000000	Open burning	3.6.2
2620000000	Landfills	3.6.3
2630000000	Publicly owned treatment works (POTWs)	3.6.4
2650000000	Other industrial waste and disposal	3.6.5
	Miscellaneous area sources:	
	Other combustion	3.7.1
2810001000	Wildfires and brush fires	3.7.1.1
2810030000	Structure fires	3.7.1.2
2810050000	Vehicle fires	3.7.1.3
2810040000	Engine testing	3.7.1.4
2850000000	Hospitals	3.7.2.1
2601020000	Crematories	3.7.2.2
2830000000	Accidental releases	3.7.3

For nearly all categories, emissions were calculated in one of the following ways:

- emissions estimates for some categories were developed by conducting surveys on local usage (e.g., natural gas consumption, pesticide usage) or derived from state-wide data (e.g., fuel oil use).
- for some widespread or diverse categories (e.g., consumer solvent use), emissions were calculated using published per-capita or per-employee emission factors.
- for source categories with some information available from annual emissions reports (e.g., bakeries), these data were combined with employment data to "scale up" reported emissions to reflect the entire source category.
- for those source categories with detailed emissions data available from most or all significant sources in the category, emissions were calculated based on detailed process and operational data provided by these sources.

The specific emissions estimation methodologies used for each source category (including any application of rule effectiveness) are described in greater detail in the respective sections.

3.2 Fuel combustion

Area source emissions for the following seven categories of fuel consumption were calculated: Industrial natural gas, industrial fuel oil, commercial/institutional natural gas, commercial institutional fuel oil, residential natural gas, residential wood, and residential fuel oil. Data for emissions calculations from natural gas combustion came from a survey of the four natural gas suppliers in Maricopa County. The following table summarizes the natural gas sales data received from Maricopa County natural gas suppliers.

Table 3.2–1. Natural gas sales data from Maricopa County natural gas suppliers.

Natural gas supplier	Sales by end user category (in MMCF/yr)					
	Electric Utilities	Industrial	Commercial/ Institutional	Residential	Transport*	Other*
Southwest Gas	n/a	3,092.760	13,774.986	14,842.508	3,802.155	1,977.644
City of Mesa	80.169	386.692	1,486.877	1,112.936	59.924	n/a
El Paso	58,334.169	161.429	n/a	n/a	n/a	n/a
Black Mountain	n/a	n/a	142.561	464.084	n/a	n/a

* For emissions calculations, sales from these two categories were grouped with industrial sales.

Area source emissions for wood and fuel oil combustion were calculated from Arizona state-level sales and consumption data as described in the following subsections. Area source emissions from coal and liquid petroleum gas were not calculated as emissions from these categories were determined to be insignificant.

3.2.1 Industrial natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas distributed, by user category, within the county in 2002. Area source industrial natural gas usage for the county is based on the reported total volume of natural gas sold to industrial sources, minus natural gas used by industrial point sources:

Area source industrial natural gas usage	=	Reported industrial natural gas sales	–	Industrial point source natural gas usage
	=	9,480.60 MMCF	–	7,929.38 MMCF
	=	1,551.23 MMCF		

Natural gas is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source natural gas usage derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal natural gas combustion reported by all industrial area sources in 2002, as shown below.

Annual emissions for the county are calculated by multiplying natural gas usage by the respective AP-42 emission factors for external and internal combustion (US EPA, 1998), as in this example for VOC emissions from external natural gas combustion:

Annual VOC emissions from external natural gas combustion	=	External industrial natural gas usage (MMCF)	×	VOC emission factor for external natural gas combustion (lb/MMCF)	÷	2,000 lbs/ton
	=	1,527.09	×	5.5	÷	2,000
	=	4.20 tons VOC/yr				

Table 3.2–2. Emission factors and annual emissions from area-source industrial natural gas combustion, by combustion type.

Combustion type	% of total	Natural gas usage (MMCF)	Emission factors (lb/MMCF)			Annual emissions (tons/yr)		
			VOC	NO_x	CO	VOC	NO_x	CO
External	98.44	1,527.09	5.5	100	84	4.20	76.35	64.14
Internal	1.56	24.14	116	2840	399	1.40	34.27	4.82
Totals:	**100.00**	**1,551.23**				**5.60**	**110.63**	**68.95**

Season-day emissions for the county are calculated by first multiplying annual emissions by the percentage of industrial natural gas sold used during the ozone season. (Figures reported by natural gas suppliers for the June–August time period are assumed to be representative for the July–September ozone season.) Ozone season emission totals are then divided by the number of days that activity occurs during the ozone season:

Ozone season-day VOC emissions from industrial natural gas	= Annual VOC emissions (tons/yr)	× % natural gas sold during ozone season	÷ (days/week × wks/season)	× 2,000 lbs/ton
	= 5.60	× 23.62%	÷ (6 × 13)	× 2000
	= 33.9 lbs/day			

Annual and season-day emissions within the ozone nonattainment area are calculated by applying the ratio of industrial employment in the nonattainment area to county-level emission calculations. (See section 1.5.1 for a discussion of the employment data used).

VOC emissions from area source industrial natural gas combustion in the ozone NAA	= Annual county VOC emissions (tons/yr)	× NAA:County industrial employment ratio
	= 5.60	× 0.9809
	= 5.49 tons VOC/yr	

Table 3.2–3. Annual and season-day emissions from area-source industrial natural gas combustion.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	5.60	110.63	68.95	33.9	670.0	417.6
Ozone NAA	5.49	108.52	67.64	33.3	657.2	409.6

3.2.2 Industrial fuel oil

Area source emissions from industrial fuel oil combustion are calculated by a multi-step process of allocating Arizona state-level industrial fuel oil sales as reported by the US Department of Energy, Energy Information Administration (EIA, 2002) to Maricopa County.

To derive industrial fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2002 are first subtracted from Arizona state-level total industrial fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local air quality regulations and market conditions.

State industrial fuel oil sales other than high-sulfur diesel (in thousand gallons, or Mgal)	= Reported state total industrial fuel oil sales	–	Reported state high-sulfur diesel sales
	= 61,748 Mgal	–	34,076 Mgal
	= 27,672 Mgal/yr		

Arizona state industrial fuel oil sales (less high-sulfur diesel fuel) are then multiplied by the ratio of industrial employment in Maricopa County to Arizona state (0.71), as determined by data from the US Census Bureau (2003b) to estimate annual Maricopa County-level industrial fuel oil sales, as follows:

Maricopa County industrial fuel oil sales	=	Arizona state industrial fuel oil sales less high-sulfur diesel	×	Maricopa County:state industrial employment ratio
	=	27,672 Mgal	×	0.71
	=	19,647.12 Mgal/yr		

To avoid double-counting, industrial fuel oil use attributable to stationary point sources (addressed in Chapter 2) and nonroad mobile sources (addressed in Chapter 4) are subtracted from County industrial fuel oil sales to estimate county fuel oil usage by area sources.

Annual Maricopa County industrial area source fuel oil sales	= Maricopa County industrial fuel oil sales	–	Fuel oil used by industrial nonroad mobile equipment	–	Fuel oil used by industrial stationary point sources
	= 19,647.12 Mgal	–	7,365.927 Mgal	–	2,021.10 Mgal
	= 10,260.097 Mgal/yr				

Industrial fuel oil is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source industrial fuel oil sales derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal fuel oil combustion reported by all industrial area sources surveyed by MCESD in 2002 (shown in Table 3.2–4 below).

County-level annual emissions from this area source category were calculated by multiplying industrial fuel oil sales by the respective AP-42 emission factors for external and internal combustion, as in this example for VOC emissions from external industrial fuel oil combustion:

Annual CO emissions from external industrial fuel oil combustion	= External industrial fuel oil sales (Mgal)	×	CO emission factor for external fuel oil combustion (lb/Mgal)	÷	2,000 lb/ton
	= 8,003.949	×	0.2	÷	2,000
	= 0.80 tons CO/yr				

Table 3.2–4. Emission factors and annual emissions from area-source industrial fuel oil combustion by combustion type.

Combustion type	% of total	Annual fuel oil sales (Mgals)	Emission factors (lb/MMCF)			Annual emissions (tons/yr)		
			VOC	NO_x	CO	VOC	NO_x	CO
External	78.01	8,003.949	0.2	24	5	0.80	96.05	20.01
Internal	21.99	2,256.147	49.3	604	130	55.61	681.36	146.65
Totals:	**100.00**	**10,260.097**				**56.41**	**777.40**	**166.66**

Season-day emissions for the county are calculated by first multiplying annual emissions by 25% to estimate ozone season totals. Ozone season emission totals are then divided by the number of days that activity occurs during the ozone season as recommended by EIIP guidance (US EPA, 2001c).

Ozone season-day VOC emissions from industrial fuel oil	= Annual VOC emissions (tons/yr)	×	% fuel oil sold during ozone season	÷ (days/week × wks/season)	× 2,000 lbs/ton
	= 56.41	×	25%	÷ (6 × 13)	× 2000
	= 361.6 lbs/day				

Annual and season-day emissions within the ozone nonattainment area are calculated by applying the ratio of industrial employment in the nonattainment area to county-level emission calculations. (See section 1.5.1 for a discussion of the employment data used).

Ozone NAA emissions from area source industrial fuel oil combustion	= Annual county VOC emissions (tons/yr)	×	NAA:County industrial employment ratio
	= 56.41	×	0.9809
	= 55.34 tons VOC/yr		

Table 3.2–5. Annual and season-day emissions from area-source industrial fuel oil combustion.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
County	56.41	777.40	166.66	361.6	4,983.4	1,068.3
Ozone NAA	55.34	762.56	163.48	354.7	4,888.2	1,047.9

3.2.3 Commercial/institutional natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas distributed, by user category, within the county in 2002. Area source commercial and institutional natural gas usage for the county is based on the reported total volume of natural gas sold to commercial and institutional (C&I) sources, minus natural gas used by C&I point sources:

County area source C&I natural gas usage	= Reported C&I natural gas sales	–	C&I point source natural gas usage
	= 15,404.42 MMCF	–	725.35 MMCF
	= 14,679.07 MMCF		

Natural gas is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source natural gas usage derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal natural gas combustion reported by all C&I area sources in 2002.

Annual emissions for the county are calculated by multiplying natural gas usage by the respective AP-42 emission factors for external and internal combustion (US EPA, 1998), as in this example for VOC emissions from external natural gas combustion:

Annual VOC emissions from external natural gas combustion	= External C&I natural gas usage (MMCF)	×	VOC emission factor for external natural gas combustion (lb/MMCF)	÷	2,000 lb/ton
	= 14,434.79	×	5.5	÷	2,000
	= 39.70 tons VOC/yr				

Table 3.2–6. Emission factors and annual emissions from area-source commercial/institutional natural gas combustion by combustion type.

Combustion type	% of total	C&I natural gas usage (MMCF)	Emission factors (lb/MMCF)			Annual emissions (tons/yr)		
			VOC	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
External	98.34	14,434.79	5.5	100	84	39.70	721.74	606.26
Internal	1.66	244.29	116	2840	399	14.17	346.89	48.74
Totals:	**100.00**	**14,679.07**				**53.86**	**1,068.83**	**655.00**

Season-day emissions for the county are calculated by first multiplying annual emissions by the percentage of C&I natural gas sold used during the ozone season. (Figures reported by natural gas suppliers for the June–August time period are assumed to be representative for the July–September ozone season.) Ozone season emission totals are then divided by the number of days that activity occurs during the ozone season:

Ozone season-day VOC emissions from C&I natural gas	= Annual VOC emissions (tons/yr)	× % natural gas sold during ozone season	÷ (days/week × wks/season)	× 2,000 lbs/ton
	= 53.86	× 20.38%	÷ (6 × 13)	× 2000
	= 281.5 lbs/day			

Annual and season-day emissions within the ozone nonattainment area are calculated by applying the combined ratio of retail, office, public and other employment in the nonattainment area to county-level emission calculations. (See section 1.5.1 for a discussion of the employment data used).

VOC emissions from area source C&I natural gas combustion in the ozone NAA	= Annual county VOC emissions (tons/yr)	× NAA:County C&I employment ratio
	= 53.86	× 0.9829
	= 52.94 tons VOC/yr	

Table 3.2–7. Annual and season-day emissions from area-source commercial/institutional natural gas combustion.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
County	53.86	1,068.63	655.00	281.5	5,585.3	3,423.4
Ozone NAA	52.94	1,050.35	643.80	276.7	5,489.8	3,364.9

3.2.4 Commercial/institutional fuel oil

Area source emissions from commercial and institutional (C&I) fuel oil combustion are calculated by a multi-step process of allocating Arizona state-level C&I fuel oil sales as reported by the US Department of Energy, Energy Information Administration (US DOE, 2002) to Maricopa County.

To derive commercial/institutional fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2002 are first subtracted from Arizona state-level total commercial/institutional fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local air quality regulations and market conditions.

State C&I fuel oil sales other than high-sulfur diesel (in thousand gallons, or Mgal)	= Reported state total C&I fuel oil sales	– Reported state high-sulfur diesel sales
	= 30,077 Mgal	– 71 Mgal
	= 30,006 Mgal/yr	

Arizona state commercial/institutional fuel oil sales (less high-sulfur diesel fuel) are then multiplied by the ratio of C&I employment in Maricopa County to Arizona state (0.71), as determined by data from the US Census Bureau (2003b) to estimate annual Maricopa County-level commercial/institutional fuel oil sales, as follows:

Maricopa County C&I fuel oil sales	=	Arizona state C&I fuel oil sales less high-sulfur diesel	×	Maricopa County:state commercial/ institutional employment ratio
	=	30,006 Mgal	×	0.71
	=	21,304.26 Mgal/yr		

To avoid double-counting, C&I fuel oil use attributable to stationary point sources (addressed in Chapter 2) and nonroad mobile sources (addressed in Chapter 4) are subtracted from County C&I fuel oil sales to estimate county fuel oil usage used by area sources:

Annual Maricopa County commercial/institutional area source fuel oil sales	= Maricopa County C&I fuel oil sales	–	Fuel oil used by C&I nonroad mobile equipment	–	Fuel oil used by C&I stationary point sources
	= 21,304.26 Mgal	–	4,435.974 Mgal	–	190.672 Mgal
	= 16,677.614 Mgal/yr				

Fuel oil is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area source C&I fuel oil sales derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal fuel oil combustion reported by all commercial/institutional area sources surveyed by MCESD in 2002 (shown in Table 3.2–8 below).

Annual emissions for the county are calculated by multiplying C&I fuel oil sales by the respective AP-42 emission factors for external and internal combustion, as in this example for VOC emissions from external fuel oil combustion:

Annual VOC emissions from external fuel oil	= External C&I fuel oil usage (Mgal)	×	VOC emission factor for external fuel oil combustion (lb/Mgal)	÷	2,000 lb/ton
	= 11,165.542	×	0.34	÷	2,000
	= 1.90 tons VOC/yr				

Table 3.2–8. Emission factors and annual emissions from area-source commercial/institutional fuel oil combustion, by combustion type.

Combustion type	% of total	Annual fuel oil sales (Mgal)	Emission factors (lb/MMCF)			Annual emissions (tons/yr)		
			VOC	NO_x	CO	VOC	NO_x	CO
External	66.95	11,165.542	0.34	24	5	1.90	133.99	27.91
Internal	33.05	5,512.073	49.3	604	130	135.87	1,664.65	358.28
Totals:	**100.00**	**16,677.614**				**137.77**	**1,798.63**	**386.20**

Season-day emissions for the county are calculated by first multiplying annual emissions by 15% to estimate ozone season totals. Ozone season emission totals are then divided by the number of days that activity occurs during the ozone season, as recommended by EIIP guidance (US EPA, 2001c):

Ozone season-day VOC emissions from C&I fuel oil	= Annual VOC emissions (tons/yr)	× % fuel oil sold during ozone season	÷ (days/week × wks/season)	× 2,000 lbs/ton
	= 137.77	× 15%	÷ (6 × 13)	× 2000
	= 529.9 lbs/day			

Annual and season-day emissions within the ozone nonattainment area are calculated by applying the combined ratio of retail, office, public and other employment in the nonattainment area to county-level emission calculations. (See section 1.5.1 for a discussion of the employment data used).

Ozone NAA emissions from area source C&I fuel oil combustion	= Annual county VOC emissions (tons/yr)	×	NAA:County commercial/institutional employment ratio
	= 137.77	×	0.9829
	= 135.41 tons VOC/yr		

Table 3.2–9. Annual and season-day emissions from area-source commercial/institutional fuel oil combustion.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
County	137.77	1,798.63	386.20	529.9	6,917.8	1,485.4
Ozone NAA	135.41	1,767.88	379.59	520.8	6,799.5	1,460.0

3.2.5 Residential natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas sold, by user category, within the county. Annual emissions from residential natural gas combustion emissions were calculated by multiplying residential natural gas sales by emission factors for residential natural gas combustion summarized in the table below (US EPA, 1998), as follows:

Table 3.2–10. Residential natural gas combustion emission factors (in lb/MMCF).

VOC	NO_x	CO
5.5	94	40

Annual VOC emissions from residential natural gas combustion	= Residential natural gas annual sales (MMCF)	×	Residential natural gas emission factor for VOC (lbs/MMCF)	÷ 2,000 lbs/ton
	= 16,419.53	×	5.5	÷ 2,000
	= 45.15 tons VOC/yr			

Ozone season-day emissions are calculated by first multiplying reported natural gas usage during the ozone season (2,390.68 MMCF) by the AP-42 emission factors for residential natural gas combustion to produce ozone season emissions. (Natural gas usage reported for the months of June–August are assumed to represent ozone season usage). Ozone season emissions are then divided by days during the ozone season that residential natural gas combustion occurs (US EPA, 2001c).

Season-day VOC emissions from residential natural gas combustion	=	Residential natural gas seasonal sales (MMCF)	×	Residential natural gas emission factor for VOC (lbs/MMCF)	÷ (days/week × weeks/season)
	=	2,390.68	×	5.5	÷ (7 × 13)
	=	144.5 lbs VOC/day			

Annual and season-day residential natural gas emissions in the ozone nonattainment area are calculated by multiplying county-level emissions by the percentage of total occupied households (98.18%) in the ozone nonattainment area as follows:

Annual emissions from residential natural gas combustion in the NAA	= County annual emissions	×	Percentage of occupied households in the NAA
	= 45.15 tons/yr	×	98.18%
	= 44.33 tons VOC/yr		

Table 3.2–11. Annual and season-day emissions from residential natural gas combustion.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	45.15	771.72	328.39	144.5	2,469.4	1,050.8
Ozone NAA	44.33	757.67	322.41	141.9	2,424.4	1,031.7

3.2.6 Residential wood combustion

Area source emissions from residential wood combustion are calculated based on the amount of wood burned in fireplaces and woodstoves in Maricopa County, as recommended by EIIP guidance (US EPA, 2001g). Residential wood combustion in the county is estimated by multiplying data on statewide residential wood combustion usage from the US Department of Energy (US DOE, 2003) by the ratio of county to state households that report use of wood for heating from the US Census Bureau (2003c). The latest available data on residential wood use for household heating from the US Census Bureau is for the calendar year 2000. Since all fireplaces in homes constructed since 1999 are required by Arizona statute to be clean-burning, it is assumed that these new homes have negligible emissions. Thus, year 2000 data is assumed to be representative of 2002 emissions.

Maricopa County residential wood usage (cords/yr)	= Arizona residential wood usage (cords/yr)	×	Ratio of county:state households using wood for heat
	= 491,000	×	1,655 / 39,842
	= 20,396 cords/yr		

To calculate emissions, the amount of wood used is converted to tons by multiplying cords by the number of cubic feet of wood in a cord and by the density of the wood used (US EPA, 2001g). Wood density is determined by weighted average of types of wood used for residential combustion in Maricopa County, provided by the US Forest Service (USFS, 1993).

County residential wood usage (tons/yr)	= County wood usage (cords)	× avg. ft^3 wood/cord	×	Wood density (lbs/ ft^3)	÷ 2,000 lbs/ton
	= 20,396	× 79	×	31.57	÷ 2,000
	= 25,433.73 tons				

Annual emissions from residential wood combustion are calculated by multiplying the tons of wood used by the emission factor for residential total woodstoves and fireplaces from EIIP Volume III, Chapter 2, Table 2.4-1 (US EPA, 2001g):

Annual VOC emissions from residential wood combustion (tons/yr)	=	Residential wood usage (tons)	×	VOC emission factor (lbs/ton)	÷ 2,000 lbs/ton
	=	25,433.73	×	229.0	÷ 2,000
	=	2,912.16 tons VOC/yr			

Table 3.2–12. Annual wood usage, emission factors, and annual emissions from residential wood combustion.

Residential wood usage (tons)	Emission factors (lb/ton)			Annual emissions (tons/yr)		
	VOC	NO_x	CO	VOC	NO_x	CO
25,433.73	229.0	2.6	252.6	2,912.16	33.06	3,212.28

Season-day emissions are calculated by apportioning wood burning activity based on heating degree days (i.e., the number of degrees per day that the daily average temperature is below 65°F). Data provided by Arizona State University (2003) indicated that there were no heating degree days reported during the 2002 ozone season (July–September). Thus ozone season-day emissions from residential wood combustion are assumed to be zero.

Annual and season-day emissions within the ozone nonattainment area (NAA) are calculated by multiplying county totals by the ratio of total occupied housing units inside the nonattainment area (1,337,099) to total residential housing units in the county (1,361,837). See Section 1.5.1 for a further discussion of the housing data used.

NAA annual emissions from residential wood combustion (tons/yr)	=	County annual emissions (tons/yr)	×	NAA:county residential housing ratio
	=	2,912.16	×	0.9818
	=	2,859.16 tons VOC/yr		

Table 3.2–13 summarizes and annual and ozone season-day emissions from residential wood combustion for both the county and the ozone nonattainment area.

Table 3.2–13. Annual and season-day emissions from residential wood combustion.

Geographic area	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
County	2,912.16	33.06	3,212.28	0.0	0.0	0.0
Ozone NAA	2,859.16	32.46	3,153.82	0.0	0.0	0.0

3.2.7 Residential fuel oil

Emissions from residential fuel oil use were calculated using an approach similar to that used for residential wood combustion described in Section 3.2.6. County-level residential fuel oil use was derived from statewide totals using the ratio of county to state households that report fuel oil use from the US Census Bureau (2003b):

Maricopa County residential fuel oil usage (Mgal/yr)	= Arizona residential fuel oil use (Mgal/yr)	×	Ratio of county:state households reporting fuel oil use
	= 340	×	490 / 1,813
	= 91.89 Mgal/yr		

Using an AP-42 emission factors, and data on heating degree days and residential housing units described in Section 3.2.6, annual and daily emissions were calculated as shown in Table 3.2–14.

Table 3.2–14. Emission factors, annual and season-day emissions from residential fuel oil combustion.

	Emission factors (lb/Mgal)			Annual emission (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	0.713	18.0	5.0	0.03	0.83	0.23	0.0	0.0	0.0
Ozone NAA	0.713	18.0	5.0	0.03	0.81	0.23	0.0	0.0	0.0

3.2.8 Summary of all area source fuel combustion

Table 3.2–15. Summary of annual and season-day area source fuel combustion.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	3,211.00	4,560.90	4,817.71	1,351.4	20,625.8	7,445.5
Ozone NAA	3,152.71	4,480.24	4,730.96	1,327.4	20,259.1	7,314.1

3.3 Industrial processes

3.3.1 Chemical manufacturing

Emissions from area-source chemical manufacturing were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–1 shows the NAICS codes and employment data used to calculate emissions from chemical manufacturing.

Table 3.3–1. NAICS codes and descriptions for chemical manufacturing.

NAICS Code	Description	US Census employment data	Value used
32551	Paint & coating manufacturing	100–249	175
32591	Printing ink manufacturing	20–99	60
422910	Farm supplies, wholesale	298	298
325991	Custom compounding of purchased resin	100–249	175
325998	All other misc. chemical product & prep. manufacturing	316	316
325188	All other basic inorganic chemical manufacturing	100–249	175
325412	Pharmaceutical manufacturing.	500–999	750
Total:			**1,949**

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in chemical mfg.	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 1,949	–	191
	= 1,758 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from chemical mfg.} = \frac{6.28 \text{ tons/yr}}{744 \text{ employees}} \times 1{,}758 \text{ employees}$$

$$= 14.84 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by chemical manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from chemical mfg.} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{14.84 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 114.2 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. See Section 1.5.1 for a discussion of the employment data used.

VOC emissions from area-source chemical mfg. in the ozone NAA (tons/yr)	= Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	= 14.84 tons/yr	×	98.09%
	= 14.56 tons VOC/yr		

Table 3.3–2 summarizes annual and season-day emissions from chemical manufacturing in both Maricopa County and the ozone nonattainment area.

Table 3.3–2. Annual and season-day emissions from area-source chemical manufacturing.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	14.84	1.08	0.07	114.2	8.3	0.5
Ozone NAA	14.56	1.06	0.07	112.0	8.2	0.5

3.3.2 Food and kindred products

3.3.2.1 Commercial cooking

Emissions from commercial cooking were estimated for five source categories based on equipment type. These equipment types include: chain-driven (conveyorized) charbroilers (SCC 2302002100), under-fired charbroilers (2302002200), flat griddles (2302003100), clamshell griddles (2302003200), and deep-fat fryers (2302003000). Emission inventory methods outlined in EPA guidance (US EPA, 2004) for these source categories include emissions from all meat types (hamburger, steak, fish, pork, and chicken) and five restaurant types (ethnic, fast food, family, seafood, and steak & barbeque).

Data obtained from MCESD's eating and drinking establishments permit database indicated that 9,038 restaurants operated in Maricopa County in 2002. The percent of restaurants in Maricopa County for the five restaurant types was obtained from a commercial business database (Harris InfoSource, 2003). The percent of restaurants for each restaurant type was multiplied by the total number of restaurants operated in Maricopa County in 2002 to derive the number of restaurants for each restaurant type as shown in Table 3.3–3.

Table 3.3–3. Maricopa County restaurants by type.

Restaurant category	Percentage	# of restaurants
Ethnic food	14.47	1,308
Fast food	15.35	329
Family	3.64	1,387
Seafood	0.61	55
Steak & barbecue	1.15	104
Unrelated restaurant types (e.g., lunchroom, bars)	64.79	5,856
All restaurants	**100.00**	**9,038**

Using the number of restaurants for each restaurant type, along with the default emission factors and equations from US EPA (2004), emissions for each combination of equipment type, restaurant type, and meat type were calculated, and the results were summed to estimate annual emissions for each type of cooking equipment, as shown in Table 3.3–4.

Table 3.3–4. Annual emissions from commercial cooking, by equipment type.

	Annual emissions (tons/yr)	
Equipment type	**VOC**	**CO**
Chain-driven charbroilers	18.19	60.75
Underfired charbroilers	60.05	196.43
Deep fat fryers	9.38	0.00
Flat griddles	7.90	16.32
Clamshell griddles	0.32	0.00
Totals:	**95.84**	**273.50**

Commercial cooking is assume to occur uniformly throughout the year, therefore, it was assumed that 25% of annual activity occurs during the ozone season, and that activity occurs 7 days/week.

Table 3.3–5. Season-day emissions from commercial cooking, by equipment type.

	Season-day emissions (lbs/day)	
Equipment type	**VOC**	**CO**
Chain-driven charbroilers	100.0	333.8
Underfired charbroilers	329.9	1,079.3
Deep fat fryers	51.5	0.0
Flat griddles	43.4	89.7
Clamshell griddles	1.7	0.0
Totals:	**526.6**	**1,502.8**

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage population within the nonattainment area (98.09%). (See Section 1.5.1 for a discussion of the population data used.) Table 3.3–6 summarizes the annual and season-day emissions from commercial cooking for the ozone NAA.

Table 3.3–6. Annual and season-day emissions from commercial cooking.

	Maricopa County				Ozone nonattainment area			
	Annual emissions (tons/yr)		Season-day emissions (lbs/day)		Annual emissions (tons/yr)		Season-day emissions (lbs/day)	
Equipment type	**VOC**	**CO**	**VOC**	**CO**	**VOC**	**CO**	**VOC**	**CO**
Chain-driven charbroilers	18.19	60.75	100.0	333.8	17.84	59.59	98.0	327.4
Underfired charbroilers	60.05	196.43	329.9	1,079.3	58.90	192.68	323.6	1,058.7
Deep fat fryers	9.38	0.00	51.5	0.0	9.20	0.00	50.6	0.0
Flat griddles	7.90	16.32	43.4	89.7	7.75	16.01	42.6	88.0
Clamshell griddles	0.32	0.00	1.7	0.0	0.31	0.00	1.7	0.0
Totals:	**95.84**	**273.50**	**526.6**	**1,502.8**	**94.01**	**268.28**	**516.5**	**1,474.1**

3.3.2.2 Bakeries

Emissions from area-source bakeries were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the Census' County Business Patterns (CBP), for 2001 employment, were used. CBP employment data for NAICS code 31181 (bread and bakery product manufacturing) indicated 1,999 employees in this industry in Maricopa County. Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in bakeries.	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 1,999	–	500
	= 1,499 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from bakeries} = \frac{15.43 \text{ tons/yr}}{783} \times 1{,}499 \text{ employees}$$

$$= 29.54 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by bakeries. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from bakeries} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{29.54 \times 25\%}{6 \times 13} \times 2{,}000$$

$$= 189.3 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\text{VOC emissions from area-source bakeries in the ozone NAA (tons/yr)} = \text{Annual Maricopa County emissions} \times \text{NAA:County ratio of industrial employment}$$

$$= 29.54 \text{ tons/yr} \times 98.09\%$$

$$= 28.97 \text{ tons VOC/yr}$$

Table 3.3–7. Annual and season-day VOC emissions from area-source bakeries.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	29.54	189.3
Ozone NAA	28.97	185.7

3.3.3 Secondary metal production

Annual emissions from secondary metal production facilities were derived from annual emission reports from permitted sources. As this category consists primarily of foundries, it was assumed that there were no significant unpermitted sources within Maricopa County. Ozone season-day emissions were calculated based on operating schedule information provided in the facilities' annual emission reports. Since all facilities considered in this section are located within the ozone nonattainment area, total emission values for the county and the ozone NAA from secondary metal production are equal.

Table 3.3–8. Annual and season-day emissions from area-source secondary metal production.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	54.69	0.03	0.00	309.0	0.2	0.0
Ozone NAA	54.69	0.03	0.00	309.0	0.2	0.0

3.3.4 Mineral processes

The primary contributors to this source category include concrete batch plants, ceramic clay and tile manufacturing, brick manufacturing, and gypsum mining. Emissions from this source category were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Total employment in Maricopa County for NAICS code group 327, non-metallic mineral product manufacturing, for 2001 (the most recent data available) was used. In addition, some portable concrete batch operations which operate within Maricopa County for only part of the year, are issued air quality permits by the Arizona Department of Environmental Quality. All ADEQ-permitted portable sources are addressed in Section 3.3.8.

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in non-metallic mineral pdts	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 4,054	–	1,412
	= 2,642 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions} = \frac{7.61 \text{ tons/yr}}{1{,}068 \text{ employees}} \times 2{,}642 \text{ employees}$$

$$= 18.82 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{18.82 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 144.7 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area sources within the ozone NAA (tons/yr) = Annual Maricopa County emissions × NAA:County ratio of industrial employment

= 18.82 tons/yr × 98.09%

= 18.46 tons VOC/yr

Table 3.3–9 summarizes annual and season-day emissions from non-metallic mineral products in both Maricopa County and the ozone nonattainment area.

Table 3.3–9. Annual and season-day VOC emissions from area-source non-metallic mineral products.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	18.82	144.7
Ozone NAA	18.46	142.0

3.3.5 Rubber/plastics

Emissions from area-source rubber and plastic manufacturing facilities were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–10 shows the NAICS codes and employment data used to calculate emissions from rubber and plastic manufacturing facilities.

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in rubber & plastic manufacturing = Total employment (from US Census' County Business Patterns) − Employment at point sources (from annual emission reports)

= 8,206 − 1,862

= 6,344 employees

Table 3.3–10. NAICS codes and descriptions for rubber and plastic manufacturing facilities.

NAICS Code	Description	US Census employment data	Value used
32613	Laminated plastics plate, sheet & shape mfg	20–99	60
32614	Polystyrene foam product mfg	250–499	375
32622	Rubber & plastics hoses & belting mfg	100–249	175
33992	Sporting & athletic goods mfg	1,293	1,293
325991	Custom compounding of purchased resin	100–249	175
326122	Plastics pipe & pipe fitting mfg	100-249	175
326160	Plastics bottle mfg	250–499	375
326191	Plastics plumbing fixture mfg	250–499	375
326199	All other plastics product mfg	4,282	4,282
326212	Tire retreading	20–99	60
326299	All other rubber product mfg	250–499	375
327991	Cut stone & stone product mfg	111	111
336612	Boat building	250–499	375
Total:			**8,206**

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from rubber \& plastic mfg.} = \frac{75.44 \text{ tons/yr}}{923 \text{ employees}} \times 6{,}344 \text{ employees}$$

$$= 518.50 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by chemical manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from rubber \& plastic manufacturing} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{518.50 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 3{,}988.5 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\text{VOC emissions from rubber \& plastic mfg. in the ozone NAA (tons/yr)} = \text{Annual Maricopa County emissions} \times \text{NAA:County ratio of industrial employment}$$

$$= 518.50 \text{ tons/yr} \times 98.09\%$$

$$= 508.60 \text{ tons VOC/yr}$$

Table 3.3–11 summarizes annual and season-day emissions from chemical manufacturing in both Maricopa County and the ozone nonattainment area.

Table 3.3–11. Annual and season-day VOC emissions from rubber and plastic manufacturing facilities.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	518.50	3,988.5
Ozone NAA	508.60	3,912.3

3.3.6 Fabricated metal products

Emissions from fabricated metal product manufacturing were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census Bureau's County Business Patterns (CBP) for 2001 employment were used. CBP employment data for NAICS code 332* (fabricated metal products manufacturing) indicated that there were 16,232 employees in this industry in Maricopa County. Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in fabricated metal products = Total employment (from US Census' County Business Patterns) − Employment at point sources (from annual emission reports)

= 16,232 − 75

= 16,157 employees

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from fabricated metal products} = \frac{0.82 \text{ tons/yr}}{638 \text{ employees}} \times 16{,}157 \text{ employees}$$

= 20.64 tons VOC/yr

Ozone season-day emissions are calculated based on the operating schedule data reported by fabricated metal products facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from fabricated metal products} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{20.64 \times 25\%}{5 \times 13} \times 2{,}000$$

= 158.8 lbs VOC/day

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from fabricated metal in the ozone NAA (tons/yr)	= Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	= 20.64 tons/yr	×	98.09%
	= 20.25 tons VOC/yr		

Table 3.3–12 summarizes annual and season-day emissions from fabricated metal products manufacturing in both Maricopa County and the ozone nonattainment area.

Table 3.3–12. Annual and season-day VOC emissions from area-source fabricated metal products manufacturing.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	20.64	158.8
Ozone NAA	20.25	155.8

3.3.7 Electrical equipment manufacturing

Emissions from area-source electrical equipment manufacturing were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–13 shows the NAICS codes and employment data used to calculate emissions from electric equipment manufacturing.

Table 3.3–13. NAICS codes and descriptions for electric equipment manufacturing.

NAICS Code	Description	US Census employment data	Value used
32613	Laminated plastics plate, sheet & shape mfg.	20-99	60
333315	Photographic & photocopying equipment mfg.	68	68
33421	Telephone apparatus mfg.	782	782
33422	Radio, TV broadcast & wireless communication equipment mfg.	3,471	3,471
334412	Bare printed circuit board mfg.	2,134	2,134
334413	Semiconductor & related device mfg.	18,479	18,479
334416	Electronic coil, transformer, other inductor mfg.	346	346
334418	Printed circuit assembly (electronic assembly) mfg.	2,500-4,999	3,750
334419	Other electronic component mfg.	0-19	10
334511	Search, detection & navigation instrument mfg.	5,000-9,999	7,500
336412	Aircraft engine & engine parts mfg.	5,000-9,999	7,500
336419	Other missile, space vehicle parts & auxiliary equipment mfg.	656	656
Total:			**44,756**

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in electrical equipment manufacturing	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 44,756	–	10,316
	= 34,440 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from electric equipment manufacturing} = \frac{65.21 \text{ tons/yr}}{23{,}516 \text{ employees}} \times 34{,}440 \text{ employees}$$

$$= 95.51 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by electric equipment manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from electric equip. mfg.} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{95.51 \times 25\%}{7 \times 13} \times 2{,}000$$

$$= 524.8 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source electric equip. mfg. in the ozone NAA (tons/yr)	= Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	= 95.51 tons/yr	×	98.09%
	= 93.68 tons VOC/yr		

Table 3.3–14. Annual and season-day emissions from area-source electric equipment manufacturing.

	Annual emissions (tons/yr)		Season-day emissions (lbs/day)	
Geographic area	**VOC**	**NO_x**	**VOC**	**NO_x**
Maricopa County	95.51	16.28	524.8	89.4
Ozone NAA	93.68	15.97	514.7	87.7

3.3.8 State-permitted portable sources

The Arizona Department of Environmental Quality (ADEQ) retains the authority to permit certain categories of sources within Maricopa County, including portable sources. MCESD requested information from ADEQ for all ADEQ-permitted sources that reported any activity in Maricopa County during 2002. Annual total emissions for each pollutant were provided, along with information on the facility type, and information on the location of the site during the year. Permits were classified into four major types: asphalt batch, concrete batch, crushing/screening, and other (including soil remediation, generators, etc.). From this information, emissions that occurred within Maricopa County were estimated as in the following example.

Data provided:

Source information:	Onyx Construction – Kevin's Spread, ID S7710
Permit type:	Portable crushing/screening plant
Operating schedule:	Operated in Mohave County 6/10/02 to 7/28/02, Maricopa County from 7/30/02 to 10/22/02, and La Paz County from 10/24/02 to 12/31/02.

Total annual emissions: (tons/yr)	VOC	NO_x	CO
	2.744	54.260	12.140

Using this information, calculations were made to determine:

Total operating days in 2002:	203	= 21 (June) + 30 (July) + … + 31 (Dec.)
Total operating days in Maricopa County:	85	= 2 (July) + 31 (Aug.) + … + 22 (Oct.)
Any operating days in Maricopa County during ozone season? (July–September):	yes	

All emissions were assumed to be equally distributed among all reported days of operation. First, the total emissions attributable to activity in Maricopa County was calculated as follows:

$$\text{Annual } NO_x \text{ emissions in Maricopa County} = \text{Total annual emissions (tons/yr)} \times \frac{\text{operating days in Maricopa County}}{\text{total operating days in 2002}}$$

$$= 54.260 \times \frac{85}{203}$$

$$= 22.72 \text{ tons } NO_x/\text{yr}$$

If the facility had any operations in Maricopa County during the July–September ozone season, season-day emissions (in lbs/day) were calculated as follows:

$$\text{Season-day emissions (lbs/day)} = \frac{\text{total emissions attributable to activity in Maricopa County}}{\text{number of operating days in Maricopa County}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{22.72 \text{ tons}}{85 \text{ days}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= 534.6 \text{ lbs } NO_x/\text{day}$$

Table 3.3–15 summarizes the annual and season-day emissions for all ADEQ-permitted portable sources that operated within Maricopa County at some point during 2002. Since no precise locational data was available, all emissions are conservatively assumed to have originated with the ozone nonattainment area.

Table 3.3–15. Emissions from ADEQ-permitted portable sources, by permit type.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Permit type	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Asphalt batch	42.62	68.87	25.34	264.0	471.5	173.8
Concrete batch	1.09	31.81	7.25	6.7	199.0	45.4
Crushing/screening	18.80	466.40	105.56	131.1	3,121.5	705.2
Other	5.11	5.35	0.28	29.3	29.3	1.5
Totals:	**67.61**	**572.42**	**138.43**	**431.0**	**3,821.3**	**925.9**

3.3.9 Industrial processes, not elsewhere classified

Annual area-source emissions from other industrial processes NEC were derived from annual emissions reports from permitted facilities. Other industrial processes include a wide array of industrial activities that are often specific to the permitted facility that reported the process. For this reason, it is assumed there are no significant emissions from other industrial processes, other than those reported by permitted facilities on their annual emissions reports. Ozone season-day emissions are calculated based on operating schedule information provided by the facilities in their annual emissions report.

All facilities that reported area-source emissions from other industrial processes are located inside the ozone nonattainment area, therefore emissions for Maricopa County and the ozone NAA are equal.

Table 3.3–16. Annual and season-day emissions from other industrial processes NEC.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	14.91	0.05	0.98	114.7	0.4	7.5
Ozone NAA	14.91	0.05	0.98	114.7	0.4	7.5

3.3.10 Summary of all area source industrial processes

Table 3.3–17. Summary of annual and season-day emissions from area-source industrial processes.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	930.91	589.86	412.98	6,501.7	3,919.7	2,436.7
Ozone NAA	915.46	589.52	407.74	6,393.8	3,917.8	2,407.8

3.4 Solvent use

3.4.1 Surface coating

3.4.1.1 Architectural coatings

The alternative calculation method outlined in EIIP guidance (US EPA, 1995a) was used to calculate VOC emissions from architectural surface coating. First, a national average usage factor (expressed in gals/person-year) was derived by dividing the 2002 national architectural coating usage from the US Census Bureau (2003b) by the United States population in 2002 (US Census Bureau, 2002).

National per-capita usage (gal/person) = National architectural coating paint usage (gals) ÷ 2002 US population

= 717,230,000 ÷ 288,368,698
= 2.4872 gals/person

Multiplying the national per capita usage by the maximum allowable emission limit for coatings in Maricopa County (Rule 335) results in an annual per-capita value of VOC emissions for architectural coating for Maricopa County.

VOC emissions (lb/person-yr) = National per capita usage (gal/person-yr) × Maricopa County emission limit for architectural coating (Rule 335) (lb/gal)

= 2.4872 × 2.1
= 5.2231 lb/person

Annual VOC emissions for architectural coating for both Maricopa County and the ozone nonattainment area were then calculated by multiplying the county per-capita emission factor by the population in the area. (See Section 1.5.2 for a discussion of the population data used.)

To calculate season-day emissions, default assumptions from EIIP (US EPA, 1995a) were used. Table 3.4–1 presents the annual and season-day VOC emissions from architectural coatings for Maricopa County and the ozone nonattainment area.

Table 3.4–1. Annual and season-day VOC emissions from architectural coating.

Geographic area	Population	Annual emissions (tons/yr)	% annual activity in ozone season	Activity level (days/wk)	Season-day emissions (lbs/day)
Maricopa County	3,549,693	9,270.23	33%	7	67,234.6
Ozone NAA	3,481,807	9,092.94	33%	7	65,948.8

3.4.1.2 Auto refinishing

VOC emissions from automobile refinishing for both Maricopa County and the ozone non-attainment area were calculated using an emission factor of 1.9 lbs VOC/person-yr (US EPA, 1991). To avoid double counting, VOC emissions from facilities treated as point sources were then subtracted out from this total, as shown below. Season-day emissions were calculated assuming that activity occurs evenly throughout the year, 5 days/wk (US EPA, 2001c).

Annual VOC emissions from automobile refinishing (tons/yr) = Population × EPA emission factor (lbs/person) ÷ 2,000 (lbs/ton) – Annual emissions from point sources (tons/yr)[1]

= 3,549,693 × 1.9 ÷ 2,000 – 32.7
= 3,339.51 tons VOC/yr

Table 3.4–2. Annual and season-day emissions from automobile refinishing.

Geographic area	Population	Annual emissions (tons/yr)	% annual activity in ozone season	Activity level (days/wk)	Season-day emissions (lbs/day)
Maricopa County	3,549,693	3,339.51	25%	5	25,688.5
Ozone NAA	3,481,807	3,275.05	25%	5	25,192.4

1. This figure reflects the total emissions reported from these facilities before the application of rule effectiveness where appropriate, and thus may be lower than the emission totals from point sources presented in Chapter 2.

3.4.1.3 Traffic markings

VOC emissions from traffic markings were calculated following an alternative calculation method outlined in EIIP guidance (US EPA, 1997). First, an average usage factor (in gals/person-yr) was derived to calculate VOC emissions from traffic markings. The national per capita usage amount was calculated by dividing the 2002 national traffic paint usage (US Census Bureau, 2003b) by the US population in 2002 (US Census Bureau, 2002).

Annual per-capita usage (gals/person) = National traffic paint usage (gals/yr) ÷ US population

= 39,397,000 ÷ 288,368,698

= 0.1366 gal/person

Multiplying the national per-capita usage by the maximum allowable emission limit for traffic coatings in Maricopa County (prescribed by County Rule 335) produces annual per-capita emission rate for VOC emissions from traffic markings for Maricopa County:

VOC emissions for traffic markings (lb/person-yr) = National per-capita usage (gal/person) × Maricopa County emission limit for traffic coatings (prescribed by County Rule 335, in lb/gal)

= 0.1366 × 2.1

= 0.2869 lb VOC/person

Total VOC emissions for traffic coating for both Maricopa County and the ozone nonattainment area are then calculated by multiplying the county per-capita emission factor by the population in the area. To calculate typical daily emissions during the ozone season, recommended EPA values were used, assuming 33 percent of annual activity occurred during the ozone season, and a typical activity level of 5 days/wk (US EPA, 1997).

Table 3.4–3. Annual and season-day VOC emissions from traffic markings.

Geographic area	Population	Annual emissions (tons/yr)	% annual activity in ozone season	Activity level (days/wk)	Season-day emissions (lbs/day)
Maricopa County	3,549,693	509.21	33%	5	5,170.4
Ozone NAA	3,481,807	499.47	33%	5	5,071.5

3.4.1.4 Factory-finished wood

Emissions from factory-finished wood coating were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US

Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.4–4 shows the NAICS codes and employment data used to calculate emissions from factory-finished wood surface coating.

Table 3.4–4. NAICS codes and descriptions for factory-finished wood surface coating.

NAICS Code	Description	US Census employment data	Value used
337212	Custom architectural woodwork & millwork mfg.	436	436
337215	Showcase, partition, shelving & locker manufacturing	610	610
337920	Blind & shade manufacturing	202	202
321911	Wood window & door manufacturing	1,303	1,303
321918	Other millwork	538	538
Total:			**3,089**

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in factory-finished wood = Total employment (from US Census' County Business Patterns) − Employment at point sources (from annual emission reports)

= 3,089 − 782

= 2,307 employees

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from factory-finished wood} = \frac{63.63 \text{ tons/yr}}{662 \text{ employees}} \times 2{,}307 \text{ employees}$$

$$= 221.74 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by factory-finished wood surface coating facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from factory-finished wood} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{221.74 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 1{,}705.7 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source factory finished wood coating in the ozone NAA (tons/yr)	= Annual Maricopa County emissions	× NAA:County ratio of industrial employment
	= 221.74 tons/yr	× 98.09%
	= 217.50 tons VOC/yr	

Table 3.4–5 summarizes annual and season-day emissions from factory-finished wood surface coating in both Maricopa County and the ozone nonattainment area.

Table 3.4–5. Annual and season-day VOC emissions from area-source factory-finished wood surface coating.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	221.74	1,705.7
Ozone NAA	217.50	1,673.1

3.4.1.5 Wood furniture

Emissions from wood furniture surface coating were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.4–6 shows the NAICS codes and employment data used to calculate emissions from wood furniture surface coating.

Table 3.4–6. NAICS codes and descriptions for wood furniture surface coating.

NAICS Code	Description	US Census employment data	Value used
337110	Wood kitchen cabinet & countertop manufacturing	1703	1,703
337121	Upholstered household furniture manufacturing	281	281
337122	Non-upholstered wood household furniture manufacturing	3,160	3,160
337127	Institutional furniture manufacturing	100–249	175
337129	Wood television, radio & sewing machine cabinet mfg.	20–99	60
337211	Wood office furniture manufacturing	100–249	175
811420	Re-upholstery & furniture repair	407	407
Total:			**5,961**

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in wood furniture manufacturing	= Total employment (from US Census' County Business Patterns)	– Employment at point sources (from annual emission reports)	
	= 5,961	– 2,567	
	= 3,394 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from wood furniture coating} = \frac{150.36 \text{ tons/yr}}{1{,}063 \text{ employees}} \times 3{,}394 \text{ employees}$$

$$= 480.09 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by wood furniture surface coating facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from wood furniture coating} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{480.09 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 3{,}693.0 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area (NAA) were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source wood furniture coating in the ozone NAA (tons/yr)	= Annual Maricopa County emissions	× NAA:County ratio of industrial employment	
	= 480.09 tons/yr	× 98.09%	
	= 470.92 tons VOC/yr		

Table 3.4–7 summarizes annual and season-day emissions from wood furniture surface coating in both Maricopa County and the ozone nonattainment area.

Table 3.4–7. Annual and season-day VOC emissions from area-source wood furniture surface coating.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	480.09	3,693.0
Ozone NAA	470.92	3,622.5

3.4.1.6 Aircraft surface coating

Emissions from aircraft surface coating were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.4–8 shows the NAICS codes and employment data used to calculate emissions from aircraft surface coating.

Table 3.4–8. NAICS codes and descriptions for aircraft surface coating.

NAICS Code	Description	US Census employment data	Value used
336411	Aircraft manufacturing	2,500–4,999	3,750
336412	Aircraft engine, and engine parts	5,000–9,999	7,500
336413	Other aircraft part & auxiliary equipment manufacturing	1,000–2,499	1,750
Total:			**13,000**

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in aircraft coating = Total employment (from US Census' County Business Patterns) − Employment at point sources (from annual emission reports)

= 13,000 − 4,438

= 8,562 employees

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from aircraft coating} = \frac{12.95 \text{ tons/yr}}{1{,}303 \text{ employees}} \times 8{,}562 \text{ employees}$$

= 85.09 tons VOC/yr

Ozone season-day emissions are calculated based on the operating schedule data reported by aircraft surface coating facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

Season-day VOC emissions from aircraft coating = $\frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$

$= \frac{85.09 \times 25\%}{5 \times 13} \times 2{,}000$

= 654.5 lbs VOC/day

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source aircraft coating in the ozone NAA (tons/yr) = Annual Maricopa County emissions × NAA:County ratio of industrial employment

= 85.09 tons/yr × 98.09%

= 83.47 tons VOC/yr

Table 3.4–9 summarizes annual and season-day emissions from aircraft surface coating in both Maricopa County and the ozone nonattainment area.

Table 3.4–9. Annual and season-day VOC emissions from area-source aircraft surface coating.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	85.09	654.5
Ozone NAA	83.47	642.0

3.4.1.7 Miscellaneous manufacturing

Area-source VOC emissions from miscellaneous surface coating were estimated by a "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions and employment data from Maricopa County permitted facilities to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category, as follows:

Average misc. coat. emission factor (lbs/employee) = Annual reported VOC emissions from misc. coating (lbs/yr) ÷ Number of employees in area-source businesses that reported misc. coating activity in 2002

= 580,947.3 lbs ÷ 34,945 employees

= 16.625 lbs/employee

The typical "scale-up" methodology was revised slightly for this source category for a number of reasons. First, miscellaneous surface coating activity occurs at some level across a wide spectrum of industries, both industrial and commercial/institutional. Additionally, annual emissions reports may be inconsistent in how activities are reported, and it is uncertain if all relevant activities are categorized as "miscellaneous surface coating" vs. some other category (e.g., manufacturing). Estimating total emissions from miscellaneous surface coating based on county employment by NAICS code (for which employment data are often presented only as a broad range), or all industrial employment (including industries which have little or no miscellaneous surface coating activities) would therefore be misleading and lead to an over-estimate of area-source emissions from this source category.

Instead, the list of SIC codes used by businesses that reported miscellaneous surface coating activities was conservatively assumed to represent the "universe" of businesses that could possibly have significant miscellaneous surface coating activity. As some facilities are considered point sources (which are addressed in Chapter 2), to avoid double-counting, employment at point sources is subtracted from total employment within these SIC categories as follows:

Total area-source employmen in industries with misc. coating activity	=	Total employment in all businesses in SIC codes that reported misc. coating activity in 2002	–	Employment at point sources in these SIC codes (from annual emission reports)
	=	132,155	–	47,087
	=	85,068 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

Total area-source emissions from misc. coating operations	=	per-employee emission factor	×	Total area-source employment in relevant SIC categories
	=	16.625 lbs/employee	×	85,068 employees
	=	1,414,223.0 lbs/yr		
	=	707.11 tons VOC/yr		

Ozone season-day emissions are calculated based on operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from area-source misc. coating} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{707.11 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 5{,}439.3 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source degreasing in the ozone NAA (tons/yr)	=	Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	=	707.11 tons/yr	×	98.09%
	=	693.61 tons VOC/yr		

Table 3.4–10 summarizes annual and season-day emissions from area-source miscellaneous surface coating in both Maricopa County and the ozone nonattainment area.

Table 3.4–10. Annual and season-day VOC emissions from miscellaneous surface coating.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	707.11	5,439.3
Ozone NAA	693.61	5,335.4

3.4.1.8 Summary of all area source surface coating

Table 3.4–11. Summary of annual and season-day VOC emissions from area-source surface coating.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	14,612.98	109,586.1
Ozone NAA	14,332.92	107,485.8

3.4.2 Degreasing

Area-source VOC emissions from degreasing were estimated by a "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions and employment data from Maricopa County permitted facilities to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category, as follows:

Average degreasing emission factor (lbs/employee)	= Annual reported VOC emissions from degreasing (lbs/yr)	÷ Number of employees in area-source businesses that reported degreasing activity in 2002
	= 64,782 lbs	÷ 11,677 employees
	= 5.548 lbs/employee	

The typical "scale-up" methodology was revised slightly for this source category for a number of reasons. First, degreasing activity occurs at some level across a wide spectrum of industries, both industrial and commercial/ institutional. Additionally, annual emissions reports may be inconsistent in how activities are reported, and it is uncertain if all relevant activities are categorized as "degreasing" vs. some other category (e.g., manufacturing). Estimating total emissions from degreasing based on county employment by NAICS code (for which employment data are often presented only as a broad range), or all industrial employment (including industries which have little or no degreasing activities) would therefore be misleading and lead to an overestimate of area-source emissions from this source category.

Instead, the list of SIC codes used by businesses that reported degreasing activities was conservatively assumed to represent the "universe" of businesses that could possibly have significant degreasing activity. As some facilities are considered point sources (which are addressed in Chapter 2), to avoid double-counting, employment at point sources is subtracted from total employment within these SIC categories as follows:

Total area-source employmen in industries with degreasing activity	=	Total employment in all businesses in SIC codes that reported degreasing activity in 2002	–	Employment at point sources in these SIC codes (from annual emission reports)
	=	144,821	–	56,764
	=	88,057 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

Total area-source emissions from degreasing operations	=	per-employee emission factor	×	Total area-source employment in relevant SIC categories
	=	5.548 lbs/employee	×	88,057 employees
	=	488,540 lbs/yr		
	=	244.26 tons VOC/yr		

Ozone season-day emissions are calculated based on operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

Season-day VOC emissions from area-source degreasing	=	$\frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}}$	× 2,000 lbs / ton
	=	$\frac{244.26 \times 25\%}{5 \times 13}$	× 2,000
	=	1,878.9 lbs VOC/day	

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source degreasing in the ozone NAA (tons/yr)	=	Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	=	244.26 tons/yr	×	98.09%
	=	239.60 tons VOC/yr		

Table 3.4–12 summarizes annual and season-day emissions from area-source degreasing in both Maricopa County and the ozone nonattainment area.

Table 3.4–12. Annual and season-day VOC emissions from area-source degreasing.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	244.26	1,878.9
Ozone NAA	239.60	1,843.1

3.4.3 Dry cleaning

Dry cleaning facilities are identified as one of two types: those that use perchloroethylene and those that use a petroleum solvent (140 or Stoddard solvent) or other VOC-based solvent. Perchloroethylene is a synthetic solvent that is not considered photochemically reactive and therefore is not included in this inventory. Annual VOC emissions from this category were estimated using annual emission reports, as all permitted dry cleaners are surveyed annually. (It is assumed there are no unpermitted dry cleaning facilities operating within the county.)

A total of 19 dry cleaning establishments reported using VOC-based cleaning solvents. Dry cleaning activity is not constant throughout the year. The 2002 emission reports contained seasonal percentages for each process as well as data on typical operating schedules. Seasonal activity data collected for the period June–August was assumed not to be significantly different from the ozone season, July–September. The modes (i.e., most frequently occurring) of these values were used to calculate ozone season-day emissions from VOC-containing dry cleaning solvents. Assuming on average 20% of annual throughput occurred during the ozone season, and a 5-day work week, ozone season-day emissions were calculated as:

Ozone season-day VOC emissions from dry cleaning = Annual emissions × % ozone-season throughput ÷ (days/week × weeks/season)

= 52,784 lbs/yr × 20% ÷ (5 × 13)

= 162.7 lbs VOC/day

Since all dry cleaning establishments are located within the ozone nonattainment area, the county and nonattainment area emission totals are the same. Table 3.4–13 summarizes the materials used, emission factors, and annual and season-day VOC emissions from dry cleaning.

Table 3.4–13. Annual and season-day VOC emissions from dry cleaning.

Material	Amount used (gal/yr)	Emission factor (lbs/gal)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Petroleum solvents	7,626	6.5	24.78	152.5
DF-2000	515	6.42	1.65	10.2
Totals:			**26.44**	**162.7**

3.4.4 Graphic arts

Emissions from graphic arts were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.4–14 shows the NAICS codes and employment data used to calculate emissions from graphic arts.

Table 3.4–14. NAICS codes and descriptions for graphic arts

NAICS Code	Description	US Census employment data	Value used
323*	Printing & related support activities	6,511	6,511
5111*	Newspaper, periodical, book & database publishers	5,875	5,875
Total:			**12,386**

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in graphic arts = Total employment (from US Census' County Business Patterns) − Employment at point sources (from annual emission reports)

= 12,386 − 1,703

= 10,683 employees

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from graphic arts} = \frac{171.55 \text{ tons/yr}}{3{,}979 \text{ employees}} \times 10{,}683 \text{ employees}$$

= 460.58 tons VOC/yr

Ozone season-day emissions are calculated based on the operating schedule data reported by graphic arts facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from graphic arts} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{460.58 \times 25\%}{5 \times 13} \times 2{,}000$$

= 3,542.9 lbs VOC/day

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source graphic arts in the ozone NAA (tons/yr) = Annual Maricopa County emissions × NAA:County ratio of industrial employment

= 460.58 tons/yr × 98.09%

= 451.78 tons VOC/yr

Table 3.4–15 summarizes annual and season-day emissions from graphic arts in both Maricopa County and the ozone nonattainment area.

Table 3.4–15. Annual and season-day VOC emissions from area-source graphic arts.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	460.58	3,542.9
Ozone NAA	451.78	3,475.2

3.4.5 Miscellaneous industrial solvent use

Area-source VOC emissions from miscellaneous industrial solvent use were estimated by a "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions and employment data from Maricopa County permitted facilities to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category, as follows:

Average solvent use emission factor (lbs/employee)	= Annual reported VOC emissions from solvent use (lbs/yr)	÷ Number of employees in area-source businesses that reported solvent use activity in 2002
	= 15,789.6 lbs	÷ 3,502 employees
	= 4.509 lbs/employee	

The typical "scale-up" methodology was revised slightly for this source category for a number of reasons. First, miscellaneous industrial solvent use occurs at some level across a wide spectrum of industries. Additionally, annual emissions reports may be inconsistent in how activities are reported, and it is uncertain if all relevant activities are categorized as "miscellaneous industrial solvent use" vs. some other category (e.g., manufacturing). Estimating total emissions from miscellaneous industrial solvent use based on county employment by NAICS code (for which employment data are often presented only as a broad range), or all industrial employment (including industries which have little or no solvent use activities) would therefore be misleading and lead to an overestimate of area-source emissions from this source category.

Instead, the list of SIC codes used by businesses that reported miscellaneous industrial solvent use activities was conservatively assumed to represent the "universe" of businesses that could possibly have significant miscellaneous industrial solvent use activity. As some facilities are considered point sources (which are addressed in Chapter 2), to avoid double-counting, employment at point sources is subtracted from total employment within these SIC categories as follows:

Total area-source employmen in industries with misc. solvent use	= Total employment in all businesses in SIC codes that reported misc. solvent use in 2002	– Employment at point sources in these SIC codes (from annual emission reports)
	= 44,731	– 17,753
	= 26,978 employees	

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

Total area-source emissions from misc. solvent use (tons/yr)	=	per-employee emission factor	×	Total area-source employment in relevant SIC categories
	=	4.509 lbs/employee	×	26,978 employees
	=	121,636.6 lbs/yr		
	=	60.82 tons VOC/yr		

Ozone season-day emissions are calculated based on operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from area-source misc. solvent use (lbs/day)} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{60.82 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 467.8 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area source misc. solvent use in the ozone NAA (tons/yr)	=	Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	=	60.82 tons/yr	×	98.09%
	=	59.66 tons VOC/yr		

Table 3.4–16 summarizes annual and season-day emissions from area-source miscellaneous industrial solvent use in both Maricopa County and the ozone nonattainment area.

Table 3.4–16. Annual and season-day VOC emissions from area source miscellaneous industrial solvent use.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	60.82	467.8
Ozone NAA	59.66	458.9

3.4.6 Pesticide application: agricultural

Pesticides are substances used to control nuisance weeds (herbicides), insects (insecticides), fungi (fungicides), and rodents (rodenticides). Formulations of pesticides are made through the combination of the pest-killing material referred to as the active ingredient, and various solvents (which act as carriers for the pest-killing material) referred to as the inert ingredient. Both types of ingredients contain VOCs that can potentially be emitted to the air either during application or as a result of evaporation. Application rates for a particular pesticide may vary from crop to crop. Application of pesticides can be from the ground or from the air.

The Arizona Agricultural Statistics Service (AASS) provided MCESD with data on agricultural pesticide usage for 2002. The data included the active ingredient, the amount of active ingredient, and the date and number of acres applied (AASS, 2003) as shown in Appendix 3.1. VOC emissions from the active ingredients were calculated using the preferred method outlined in EIIP guidance (US EPA, 2001f). VOC emissions from the inert ingredients were calculated using an EPA default for inert ingredient components (US EPA, 2001f). The EPA methods only apply to ground applications. Currently, EPA has no recommended method for calculating VOC emissions from aerial application of pesticides. According to EIIP guidance, a major factor in losses by aerial application is drift, and neither equations nor experimental data are currently available to permit predictions of these losses or the development of emission factors (US EPA, 2001f). AASS did not provide data on the method of application (air vs. ground application), thus, the amount of active ingredient (AI) applied by ground in 2002 was estimated for each active ingredient using 1999 data on ground and aerial application (MCESD, 2002), as in this example for Diazinon, the active ingredient contained in the pesticide Diazinon AG500:

Amount of Diazinon applied by ground (lbs/yr) = Total Diazinon applied in 2002 (lbs) × $\frac{\text{1999 AI applied by ground (lbs)}}{\text{1999 Total AI applied (lbs)}}$

= 369.73 lbs × $\frac{\text{880,113 lbs}}{\text{4,345,836 lbs}}$

= 74.87 lbs

The emission factors for the active ingredients were determined based on the vapor pressure of the active ingredient (US EPA, 2001, Table 9.4-4). Vapor pressure of the active ingredient was obtained from multiple sources including: EIIP guidance (US EPA 2001f), the Crop Protection Handbook (Meister Pro, 2003) and from the Arizona Department of Environmental Quality (Yu, 2004). Because data was not available regarding surface application vs. soil incorporation, the more conservative of the two emission factors (surface application) was used. Annual VOC emissions from the active ingredient of the pesticide applied were calculated as in this example for Diazinon:

Annual VOC emissions from AI Diazinon (lbs/yr) = Total Diazinon applied by ground (lbs/yr) × AI Diazinon emission factor from AP-42, Table 9.4-4 (lbs VOC/lb AI)

= 74.87 lbs × 0.35 lbs VOC/lb of AI Diazinon

= 26.20 lbs VOC/yr

Annual VOC emissions from the inert ingredient components of pesticides are calculated as in this example for Diazinon:

Annual VOC emissions from inert ingredient component for Diazinon AG500 (lbs/yr) = Lbs. Diazinon applied by ground × EPA VOC default factor for inert ingredients components

= 74.87 lbs × 1.45

= 108.56 lbs VOC/yr

Total VOC emissions for each pesticide applied was then calculated by summing the VOC emissions from the active ingredient and the inert ingredient as in this example for the pesticide Diazinon AG500:

Total annual VOC emissions from Diazinon AG 500 (lbs/yr)	=	Annual VOC emissions from AI of Diazinon (lbs/yr)	+	Annual VOC emissions from inert ingredients
	=	26.2 lbs	+	108.6 lbs
	=	134.8 lbs VOC/yr		

This procedure was followed for each pesticide that was used in 2002. Totaling these calculated emissions resulted in 377.00 tons of VOC emissions from agricultural pesticide usage in 2002. Ozone season-day emissions were calculated by dividing ozone season emissions (July–September; 546,027 lbs) by an application schedule of 6 days a week for the 13 weeks of the ozone season, as follows:

Ozone season-day VOC emissions from agricultural pesticides (lbs/day)	=	Ozone season emissions from pesticides (lbs)	÷	(6 days/week × 13 weeks/season)
	=	546,027 lbs	÷	78
	=	7,000.3 lbs of VOC/day		

Annual and ozone season-day emissions for the ozone nonattainment area were derived by multiplying the county annual and ozone season-day emissions by the percentage of agricultural land located in the ozone NAA (44.53%; see Section 1.5.2 for a discussion of land-use data used).

Table 3.4–17. Annual and season-day VOC emissions from agricultural pesticide application.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	377.00	7,000.3
Ozone NAA	167.88	3,117.3

3.4.7 Consumer and commercial solvent use

Consumer and commercial products emissions include all emissions from seven product categories: personal care products, household products, automotive aftermarket products, adhesives and sealants, FIFRA-regulated products, coatings and related products, and miscellaneous products.

Annual area source VOC emissions from consumer and commercial products are calculated by multiplying per-capita emission factors from EIIP guidance (US EPA, 1996) by the population estimates for Maricopa County (3,549,693) and the ozone nonattainment area (3,481,807) (see Section 1.5.1 for a discussion of population data). Ozone season-day emissions for the county and the ozone NAA are calculated by dividing annual emissions 365 days as activity is assumed to occur uniformly throughout the year according to EIIP guidance (US EPA, 2001c).

Table 3.4–18. Annual and season-day VOC emissions from consumer and commercial products.

Product category	Emission factor (lbs/person)	Maricopa County Annual (tons/yr)	Maricopa County Season day (lbs/day)	Ozone NAA Annual (tons/yr)	Ozone NAA Season day (lbs/day)
Personal care	2.32	4,117.64	22,562.4	4,038.90	22,130.9
Household	0.79	1,402.13	7,682.9	1,375.31	7,536.0
Automotive aftermarket	1.36	2,413.79	13,226.3	2,367.63	12,973.3
Adhesives/sealants	0.57	1,011.66	5,543.4	992.31	5,437.3
FIFRA-Regulated	1.78	3,159.23	17,310.8	3,098.81	16,979.8
Coatings and related	0.95	1,686.10	9,238.9	1,653.86	9,062.2
Miscellaneous	0.07	124.24	680.8	121.86	667.7
Totals:	**7.84**	**13,914.80**	**76,245.5**	**13,648.68**	**74,787.3**

3.4.8 Asphalt application

Asphalt is applied to pave, seal, and repair surfaces such as roads, parking lots, drives, walk-ways, roofs, and airport runways. Area-source emissions from asphalt application are calculated by first allocating 2002 state-level asphalt usage data (Asphalt Institute, 2004) to Maricopa County and the ozone nonattainment area by the use of two surrogates: vehicle miles traveled (VMT) and population. Table 3.4–19 lists 2002 vehicle miles traveled (VMT) and population for Arizona state, Maricopa County and the ozone NAA. (See Chapters 1 and 5, respectively, for a discussion of population and VMT data used).

Table 3.4–19. Vehicle miles traveled (VMT) and population data.

Geographic area	VMT	Total residential population
Arizona	142,275,000 [1]	5,472,750
Maricopa County	73,579,000	3,296,250
Ozone NAA	67,524,300	3,232,387

1. from ADOT, 2004.

Maricopa County asphalt usage is allocated from state-level usage for three categories of asphalt application: roofing, cutback and emulsified. Population was used to allocate state-wide roofing asphalt usage to county-levels, while VMT was used to allocate cutback and emulsified asphalt to county levels (US EPA, 2001a); as in this example for cutback asphalt:

2002 county cutback asphalt usage (tons/yr) = 2002 Arizona cutback asphalt usage (tons/yr) × 2002 county:state VMT ratio

= 14,192 × (73,579,000 ÷ 142,275,000)

= 7,340 tons/yr

Table 3.4–20 details state and county asphalt usage by type and they county:state allocation factor used.

Table 3.4–20. Annual asphalt usage, by type.

Asphalt type	2002 Arizona asphalt usage (tons/yr)	County:state allocation factor (surrogate measure)	County asphalt usage (tons/yr)
Cutback	14,192	51.72% (VMT)	7,339.54
Emulsified	47,079	51.72% (VMT)	24,347.40
Roofing	6,519	60.23% (population)	3,926.41

County annual VOC emissions from cutback asphalt are calculated by multiplying annual usage of cutback asphalt by an emission factor derived based on the percent volume of VOCs in the diluent. The diluent content of cutback asphalt typically ranges between 25 to 45 percent VOC by volume. The midpoint of 35 percent was used for Maricopa County as actual diluent percentages were not available, and because all cutback asphalt used in the county was assumed to be "medium cure", as "rapid cure" blends are prohibited by county rule. An emission factor of 0.20 pounds of VOC per pound of cutback asphalt was used, based on the 35 percent VOC (by volume) content of the diluent (US EPA, 2001a), to derive annual emissions as follows:

Annual VOC emissions from cutback asphalt in Maricopa County (tons/yr)	=	Maricopa County cutback asphalt usage (tons/yr)	×	Emission factor (ton/ton)
	=	7,339.54	×	0.20
	=	1,467.91 tons VOC/yr		

Emissions from emulsified asphalt were calculated similarly, using a VOC emission factor of 0.0263 ton/ton. Emissions from roofing asphalt were calculated by multiplying the amount of asphalt melted in roofing kettles during hot-applied methods by an emission factor for asphalt roofing kettles (US EPA, 2000a). It was conservatively assumed that all roofing asphalt used in Maricopa County is melted through hot-applied methods. Thus, annual emissions are calculated as follows:

Annual VOC emissions from roofing asphalt in Maricopa County (tons/yr)	=	Maricopa County roofing asphalt usage (tons/yr)	×	emission factor (lbs/ton)	÷	unit conversion factor (lbs/ton)
	=	3,926.41	×	6.2	÷	2,000
	=	12.17 tons VOC/yr				

For all three types of asphalt application, it was assumed that asphalt application occurs equally throughout the calendar year, with cutback and emulsified application occurring 7 days a week and roofing asphalt application occurring 5 days a week. Therefore, ozone season-day VOC emissions for the county are calculated by dividing county annual emissions by the number of days activity occurs during the year, as in this example for cutback asphalt:

Season-day VOC emissions from cutback asphalt (lbs/day)	=	Annual emissions (tons/yr)	×	unit conversion factor (lbs/ton)	÷	activity schedule (days/yr)
	=	1,467.91	×	2,000	÷	365
	=	8,043.3 lbs VOC/day				

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of VMT within the nonattainment area (for cutback and emulsified asphalt) and by the percentage of population within the nonattainment area (for roofing asphalt) as in this example for annual VOC emissions from cutback asphalt in the ozone nonattainment area:

Annual VOC emissions from cutback asphalt in the NAA (tons/yr)	=	Maricopa County cutback asphalt usage (tons/yr)	×	Ratio of NAA:County VMT
	=	1,467.91	×	0.9177
	=	1,347.12 tons VOC/yr		

Table 3.4–21. Annual and season-day VOC emissions from asphalt application.

	Maricopa County		Ozone nonattainment area	
Asphalt type	Annual emissions (tons/yr)	Season-day emissions (lbs/day)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Cutback	1,467.91	8,043.3	1,347.12	7,381.5
Emulsified	640.34	3,508.7	587.64	3,220.0
Roofing	12.17	93.6	11.94	91.8
Totals:	**2,120.42**	**11,645.7**	**1,946.70**	**10,693.2**

3.4.9 Summary of all area source solvent use

Table 3.4–22. Summary of annual and season-day VOC emissions from all area-source solvent use.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	31,817.28	210,530.0
Ozone NAA	30,873.65	202,023.5

3.5 Storage and transport

3.5.1 Bulk plants/terminals

Emissions from this source category were calculated by summing reported VOC emissions from bulk terminals and plants emissions inventory reports. It is assumed that there are no unpermitted bulk terminals or plants in Maricopa County. To avoid double-counting, emissions from bulk terminals and bulk plants treated as point sources (totaling 210.58 tons)[1] were subtracted from total emissions to derive total annual emissions from area-source bulk terminals and bulk plants of 40.15 tons/yr. Since all bulk terminals and bulk plants considered in this section are located within the ozone nonattainment area, total emission values for the county and the ozone NAA are equal.

Ozone season-day emissions are then calculated based on operational data provided in the annual emissions inventory as follows:

$$\text{Ozone season-day emissions (lbs/day)} = \frac{\text{Area source annual emissions (tons/yr)} \times \text{(summer \%)}}{\text{Days of operation/week} \times \text{weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{40.15 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 308.9 \text{ lbs/day}$$

Table 3.5–1. Annual and season-day VOC emissions from area-source bulk terminals and bulk plants.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	40.15	308.9
Ozone NAA	40.15	308.9

[1] This figure reflects the total emissions reported from these facilities *before* the application of rule effectiveness where appropriate, and thus may be lower than the emission totals from point sources presented in Chapter 2.

3.5.2 Volatile organic liquid (VOL) storage and transport

Emissions from this source category were calculated by summing reported VOC emissions from volatile organic liquid storage/transfer emissions inventory reports. (It is assumed that there are no significant unpermitted volatile organic liquid storage/transfer facilities in Maricopa County.) To avoid double counting, emissions from those facilities treated as point sources (totaling 0.20 tons) are addressed in Chapter 2. Since all facilities considered in this section are located within the ozone nonattainment area, total emission values for the county and the ozone NAA are equal.

Ozone season-day emissions are calculated based on the operating schedule data reported by volatile organic liquid storage / transfer facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{25.42 \times 25\%}{7 \times 13} \times 2{,}000$$

$$= 139.7 \text{ lbs VOC/day}$$

Table 3.5–2. Annual and season-day VOC emissions from area-source organic liquid storage/transfer.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	25.42	139.7
Ozone NAA	25.42	139.7

3.5.3 Petroleum tanker truck fuel delivery

Following EPA methodologies (US EPA, 2001b), annual VOC emissions from tanker truck fuel delivery to outlets are calculated by multiplying gasoline sales (1,468,658,402 gallons (ADOT, 2003)) by emission factors found in AP-42 Table 5.2-7 (US EPA, 1995b) for each filling technology. Based on 2002 emissions survey data, 98.5% of gasoline is delivered using balanced submerged filling with the remaining 1.5% delivered by submerged filling. Annual emissions in the ozone nonattainment area are allocated by multiplying annual county emissions by the percentage of retail gasoline outlets located in the nonattainment area (96.39%).

VOC emissions from balanced submerged filling = Gas sales (Mgals) × % delivered by fill technology × emission factor (lbs/Mgals)

= 1,468,658.402 × 98.5% × 0.3
= 433,988.6 lbs
= 216.99 tons VOC/yr

VOC emissions from submerged filling = Gas sales (Mgals) × % delivered by fill technology × emission factor (lbs/Mgals)

= 1,468,658.402 × 1.5% × 7.3
= 160,818.1 lbs
= 80.41 tons VOC/yr

Ozone season-day emissions are calculated by multiplying ozone-season gasoline sales (July–September) by the emission factors listed above, then dividing by the product of the number of weeks in the ozone season (13) and the number of days a week (6) deliveries occur during the

ozone season. Season-day emissions in the ozone nonattainment area are allocated based on the percentage of retail gasoline outlets located in the nonattainment area (96.39%).

Season-day VOC emissions from balanced submerged fill	= Total seasonal gas sales (Mgals)	× % fill tech.	× emission factor (lbs/MGals)	÷ (days/week × wks/season)
	= 360,957.386	× 98.5%	× 0.3	÷ (6 × 13)
	= 1,367.5 lbs VOC/day			

Table 3.5–3. Annual and season-day VOC emissions from tanker truck fuel delivery.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	297.40	1,874.2
Ozone NAA	286.67	1,806.5

3.5.4 Petroleum tanker trucks in transit

Gasoline trucks in transit VOC emissions are dependent on the number of times gasoline is distributed inside the inventory area. Gasoline distribution may occur once (from bulk terminals to retail outlets) or twice (distribution to bulk plants, then retail outlets). Annual VOC emissions from gasoline trucks in transit are calculated by the following formula (US EPA, 2001b):

$$TTE = \frac{(TGD \times LEF \times GTA) + (TGD \times UEF \times GTA)}{2{,}000}$$

where:
TTE = Total gasoline emissions from tank trucks in transit (tons/yr)
TGD = Total gasoline distributed in area (Mgals)
LEF = Loaded tank truck in-transit emission factor (lbs/Mgals) (AP-42, Table 5.2-5)
UEF = Unloaded tank truck in-transit emission factor (lbs/Mgals) (AP-42, Table 5.2-5)
GTA = Gasoline transportation adjustment factor (1.25; US EPA historical default)

Substituting Maricopa County values in the above equation yields:

$$= \frac{(1{,}468{,}658.402 \text{ Mgals/yr} \times 0.005 \text{ lbs/Mgals} \times 1.25) + (1{,}468{,}658.402 \text{ Mgals/yr} \times 0.055 \text{ lbs/Mgals} \times 1.25)}{2{,}000}$$

= 55.07 tons VOC/yr

Ozone season-day VOC emissions are calculated using the same formula as above by using only the gasoline distributed during the ozone season (July–September) (360,957,386 gallons (ADOT, 2003)), and dividing the resultant total by the product of the number of weeks (13) in the ozone season and the number of days (6) gasoline distribution occurs each week.

VOC emissions from gasoline trucks in transit in the ozone nonattainment area are allocated by the percentage (96.39%) of County retail gasoline outlets located in the ozone nonattainment area (US EPA, 2001b).

Table 3.5–4. Annual and season-day VOC emissions from gasoline trucks in transit.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	55.07	347.1
Ozone NAA	53.09	334.5

3.5.5 Service stations, breathing/emptying

Following EPA methodologies (US EPA, 2001b), annual VOC emissions from storage tank breathing and emptying are calculated by multiplying annual gasoline throughput (1,468,658,402 gallons (ADOT, 2003)) by the emission factor for underground tank breathing and emptying (1.0 lb/Mgal) found in AP-42 Table 5.2-7 (US EPA, 1995b).

$$\text{Annual emissions from breathing and emptying losses (tons/yr)} = \frac{\text{gasoline throughput (Mgal)} \times \text{emission factor (lb/Mgal)}}{2{,}000}$$

$$= \frac{1{,}468{,}658.402 \text{ Mgal} \times 1.0 \text{ lb/Mgal}}{2{,}000}$$

$$= 734.33 \text{ tons/yr}$$

Ozone season-day VOC emissions are calculated using the same formula as above, using only the gasoline distributed during the ozone season (July–September) (360,957,386 gallons (ADOT, 2003)) and dividing by the product of the number of weeks (13) in the ozone season and the number of days per week (7) gasoline storage occurs.

VOC emissions from breathing and emptying losses in the ozone nonattainment area are allocated by the percentage (96.39%) of retail gasoline outlets operating in the ozone nonattainment area (US EPA, 2001b).

Table 3.5–5. Annual and season-day VOC emissions from gasoline marketing breathing and emptying losses.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	734.33	3,966.6
Ozone NAA	707.82	3,823.4

3.5.6 Vehicle refueling

Following EPA guidance (US EPA, 2001b), annual VOC emissions from vehicle refueling are calculated by multiplying the annual gasoline throughput (1,468,658,402 gallons (ADOT, 2003)) by a vehicle refueling factor estimated from the MOBILE6 model (MAG, 2004) as follows:

$$\text{Annual VOC emissions from vehicle refueling (tons/yr)} = \text{Annual gasoline throughput (gals)} \times \text{MOBILE6 vehicle refueling factor (g/gal)} \div \text{unit conversion factor}$$

$$= 1{,}468{,}658{,}402 \text{ gals} \times 0.64 \text{ g/gal} \div \frac{908{,}000 \text{ grams}}{\text{ton}}$$

$$= 1{,}035.18 \text{ tons VOC/yr}$$

Ozone season-day emissions were calculated using the same formula as above with ozone season specific data. First, ozone season emissions were estimated using the gasoline distributed during the ozone season (July–September) (360,957,386 gallons (ADOT, 2003)) and the ozone season vehicle refueling factor (0.68 g/gal). Then, ozone season emissions were divided by 91, the product of the number of weeks (13) in the ozone season and the number of days (7) vehicle refueling occurs each week.

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage (96.39%) of retail gasoline outlets operating in the ozone nonattainment area (US EPA, 2001b).

Table 3.5–6. Annual and season-day VOC emissions from vehicle refueling.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	1,035.18	5,941.1
Ozone NAA	997.81	5,726.6

3.5.7 Summary of all area source storage and transport

Table 3.5–7. Summary of annual and season-day VOC emissions from area-source storage and transport.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	2,187.56	12,577.5
Ozone NAA	2,110.96	12,139.6

3.6 Waste treatment and disposal

3.6.1 On-site incineration

This section includes emissions from on-site industrial incinerators, primarily burn-off ovens used to reclaim electric wire or other materials. Emissions from human and animal crematories are addressed in Section 3.7.2.2. There were no incinerators at residential (e.g., apartment complexes) or commercial/institutional facilities (e.g., hospitals, service establishments) in operation during 2002.

Emissions from on-site incineration were determined from annual emission inventory reports. Of the four incinerators under permit in 2002, two were surveyed and reported annual emissions. As all four facilities are roughly similar in terms of capacity, these survey results were doubled to estimate total annual and season-day emissions from all four incinerators in Maricopa County. All four facilities are located within the ozone nonattainment area, thus total emissions for the county and NAA are equal.

Table 3.6–1. Annual and season-day emissions from on-site incineration.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
County	1.02	28.90	0.59	7.8	222.3	4.5
Ozone NAA	1.02	28.90	0.59	7.8	222.3	4.5

3.6.2 Open burning

Emissions from controlled open burning are regulated by MCESD Rule 314, which requires a burn permit for open burning in Maricopa County. Burn permits are issued primarily for purposes of agricultural ditch bank and fencerow burning, tumbleweed burning, land clearance, air curtain destructor burning of trees, and fire fighting training. Maricopa County's burn permit data base was used to identify all burn permits issued during 2002. A total of 140 permits were issued during the year; however, not all permit applications contained the information needed to

calculate emissions. Where data were missing, activity data for each permit category was grown from those permits that contained information, as follows:

$$\text{Total activity} = \sum \text{activity reported} \times \frac{\text{total number of permits issued}}{\text{number of permits with activity data}}$$

Example:

$$\text{Total ditch-bank/fencerows} = 973{,}885 \text{ linear ft} \times \frac{85 \text{ ditchbank/fencerow burn permits issued}}{29 \text{ permits with quantitative data}} = 2{,}854{,}491 \text{ linear ft}$$

Reported and estimated activity data for each open burning category are summarized in Table 3.6–2. Permits issued for fire fighting training will be addressed in Section 3.7.1.2, Structure fires.

Table 3.6–2. 2002 burn permit activity data used to estimate the amount of material burned.

Category	Unit of measure	Total reported activity	Number of permits with activity data	Total permits issued	Activity grown to total number of permits issued
Ditchbank/fencerow	Linear ft	973,885	29	85	2,854,491
Land clearance	Acres	1,345	17	34	2,690
Land clearance	Piles	69	8	34	293
Air curtain	Trees	200	1	2	400
Tumbleweeds	Piles	9	3	8	24

The above activity data were converted to tons material burned using fuel loading factors from AP-42, Table 2.5-5 (US EPA, 1992). The emission and loading factors used are shown in Table 3.6–3.

Table 3.6–3. Emission and fuel loading factors for open burning.

	Emission factors (lb/ton burned)			Fuel loading
Category	VOC	NO_x	CO	factor
Weeds, unspecified	9	4	85	3.2 tons/acre
Russian Thistle (tumbleweeds)	1.5	4	309	0.1 tons/acre
Orchard Crops: Citrus	9	4	81	1.0 tons/acre

The following assumptions were made based on previous MCESD emission inventory work:

- Ditch banks and fence rows in Maricopa County average 7 feet in width and are burned twice per year (MCESD, 1999).
- A pile of tumbleweeds 15 feet in diameter and 5 feet high weighs 200 lbs (MCESD, 1993). This is equivalent to the AP-42 fuel loading factor for tumbleweeds – 0.1 tons/acre.
- The estimated weight of a mature, partially dried citrus tree, including trunk, limbs and bulk of root is 500 lbs per tree (MCESD, 1993).

To calculate the annual amount of material burned on ditch banks and fence rows in Maricopa County, MCESD estimated the area burned and then applied AP-42 fuel loading factor. The tons of material burned in ditch banks and fence rows in Maricopa County were estimated as follows:

Material burned for ditch bank and fence row burning = $\frac{2{,}854{,}491 \text{ ft length}}{43{,}560 \text{ ft}^2 / \text{acre}}$ × 7 ft width × 3.2 tons/acre × 2 times/yr

= 2,936 tons material burned/yr

Activity data for the other categories were similarly converted to material burned using AP-42 fuel loading factors.

Annual emissions were then calculated by multiplying the amount of material burned by emission factors listed in AP-42 (Table 3.6–3.) for each open burning category. To account for unpermitted illegal outdoor burning, the county's Air Quality Complaint data base was examined, which indicated 65 illegal outdoor open burning complaints (mostly residential) and 6 issued Notices of Violation. All calculated emissions estimates were thus increased by 10 percent, as a conservative estimate.

Annual CO emissions from ditchbank and fence row burning = Total material burned × emission factor × unit conversion factor

= 2,936 tons × 85 lbs/ton × 1 ton / 2,000 lbs

= 124.78 tons CO/yr

Total annual CO emissions including unpermitted burning = Calculated emissions from permit data + unpermitted burning adjustment factor

= 124.78 tons/yr + (10% x 124.78)

= 137.25 tons CO/yr

Table 3.6–4 summarizes the annual emissions for Maricopa County from each open burning category.

Table 3.6–4. Annual emissions from open burning.

		Annual emissions (tons/yr)		
Category	**Ton-equivalents**	**VOC**	**NO_x**	**CO**
Ditchbank/fencerow	2,935.7	14.53	6.46	137.25
Land clearance	9,545.5	47.26	21.00	446.25
Air curtain	100.0	0.50	0.22	4.46
Tumbleweeds	2.4	0.00	0.01	0.41
Totals:		**62.28**	**27.68**	**588.36**

Annual emissions for the nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the ozone nonattainment area by the Maricopa County emission totals. (See Section 1.5.2 for a discussion of the land-use data used.) Table 3.6–5 summarizes the annual emissions for the ozone nonattainment area.

Table 3.6–5. Surrogate land-use classes, ratios, and annual emissions from open burning in the ozone NAA.

	Surrogate land-use	2000 NAA:County	Annual emissions (tons/yr)		
Category	**categories**	**land-use ratio**	**VOC**	**NO_x**	**CO**
Ditchbank/fencerow	agriculture	44.53%	6.47	2.88	61.12
Land clearance	vacant	15.62%	7.38	3.28	69.70
Air curtain	agriculture and vacant	19.53%	0.10	0.04	0.87
Tumbleweeds	agriculture and vacant	19.53%	0.00	0.00	0.08
Totals:			**13.95**	**6.20**	**131.77**

It was assumed that open burning occurs 5 days per week (most burn permits are issued for weekdays but permits may be issued on weekends depending on circumstances) and open burning occurs evenly during the ozone season months (July–September). A seasonal adjustment factor was derived as follows:

$$\text{Seasonal adjustment factor} = \frac{\text{\# of permits issued July–Sept. for the category}}{\text{total \# of permits issued in 2002 for the category}}$$

Example:

$$\text{Seasonal adjustment factor for ditchbank/fencerow burning} = \frac{\text{13 permits issued during July–Sept. for ditchbank/fencerow burning}}{\text{85 total permits issued in 2002 for ditchbank/fencerow burning}}$$

$$= 15.29\%$$

Ozone season-day emissions for Maricopa County are derived using the following formula:

$$\text{Ozone season-day CO emissions emissions (lbs/day)} = \frac{\text{(annual CO emissions lbs)} \times \text{(seasonal adjustment factor)}}{\text{(\# of burn days/week)} \times \text{(\# of season weeks/yr)}}$$

$$\text{Season-day CO emissions from ditchbank/fencerow burning} = \frac{274{,}500 \text{ lbs} \times 0.1529}{5 \text{ days/wk} \times 13 \text{ wks/yr}}$$

$$= 645.9 \text{ lbs CO/day}$$

Ozone season-day emissions for the nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the nonattainment area (listed in Table 3.6–5) by the total County season-day emissions. Table 3.6–6 summarizes ozone season-day emissions from open burning for both Maricopa County and the ozone nonattainment area.

Table 3.6–6. Season-day emissions (lbs/day) from open burning.

	Maricopa County			Ozone nonattainment area		
Category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Ditchbank/fencerow	68.4	30.4	645.9	30.5	13.5	287.6
Land clearance	256.5	114.0	2,423.1	40.0	17.9	378.5
Air curtain	7.6	3.4	68.5	1.5	0.7	13.4
Tumbleweeds	0.0	0.0	1.6	0.0	0.0	0.3
Totals:	**332.6**	**147.8**	**3,139.1**	**72.0**	**32.0**	**679.8**

3.6.3 Landfills

Emissions from municipal solid waste (MSW) landfills come from uncontrolled landfill gas emissions as well as from combustion from control measures, such as a flare. Total emissions were calculated from annual emissions inventory reports from all landfills located within the county. Two MSW landfills (Butterfield Station and Allied Waste Industries Southwest Regional Facility) are considered point sources and are reported in Chapter 2 . All other MSW landfills are reported here as area source landfills.

Since there are no area source landfills located outside the ozone nonattainment area, total emission values for the county and the ozone nonattainment area are equal. Season-day emissions were calculated based on reported activity data (days per week) for each individual

process, and then summed. Nearly all processes reported operating on a 7-day week. Annual and daily emissions are shown in Table 3.6–7.

Table 3.6–7. Annual and season-day emissions from landfills.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
County	10.31	10.44	27.35	56.7	57.4	150.3
Ozone NAA	10.31	10.44	27.35	56.7	57.4	150.3

3.6.4 Publicly owned treatment works (POTWs)

Emissions from publicly owned treatment works (POTWs) were calculated by multiplying per-capita emission factors from EPA guidance (US EPA, 2001i) by population estimates and per-capita wastewater usage estimates of 100 gallons per day per person (Tchobanoglous, 1979). Ozone season-day emissions were calculated by multiplying annual emissions by a 35% season adjustment factor and then dividing by 91 days per season (7 days/wk × 13 wks/season; US EPA, 2001c).

Table 3.6–8. Annual and season-day VOC emissions from publicly-owned treatment works (POTWs).

Geographic area	Population	VOC emission factor (lbs/10^6 gals treated)	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	3,549,693	8.9	576.56	4,435.1
Ozone NAA	3,481,807	8.9	565.53	4,350.3

3.6.5 Remediation of leaking underground storage tanks

Leaking underground storage tanks (LUST) are typically not considered a quantifiable source of air emissions until excavation and remediation efforts begin. The majority of air emissions from LUST site remediations occur during initial site action, which is typically tank removal. Emissions from soil occur as the tank is being removed and when soil is deposited on the ground before treatment/disposal occurs (US EPA, 2001d).

A default emission rate of 28 lbs/day per remediation event was used to estimate VOC emissions from LUST remediations (US EPA, 2001d). Data obtained from the Arizona Department of Environmental Quality Leaking Underground Storage Tank Section indicated that 57 confirmed LUST releases occurred in Maricopa County in 2002 (ADEQ, 2004). Data were not available on the number or date of remediations that occurred in 2002; therefore, it was conservatively assumed that all 57 LUST releases were remediated in 2002 during the ozone season. It was also assumed that an initial site action (tank and soil removal) for an average LUST remediation lasts five days. Thus, annual emissions attributable to remediations in Maricopa County were calculated as follows:

$$\text{Annual VOC emissions from LUST remediations} = \frac{28 \text{ lbs VOC}}{\text{day}} \times 57 \text{ remediations} \times \frac{5 \text{ days}}{\text{remediation}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}}$$

$$= 3.99 \text{ tons/yr}$$

Ozone season-day emissions were calculated by dividing annual values by 65 (5 days/wk × 13 wks/ozone season). Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County totals by the percentage of retail gasoline outlets located in the ozone NAA (96.39%).

Table 3.6–9. Annual and season-day VOC emissions from remediation of leaking underground storage tanks.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	3.99	122.8
Ozone NAA	3.85	118.3

3.6.6 Other industrial waste disposal

Annual area-source emissions from other waste disposal were derived from annual emissions reports from permitted facilities. Industrial waste disposal processes include a wide array of industrial activities that are often specific to the permitted facility that reported the process. For this reason, it is assumed there are no significant emissions from this category, other than those reported by permitted facilities on their annual emission reports. Ozone season-day emissions are calculated based on operating schedule information provided by the facilities in their annual emissions report.

All facilities that reported area-source emissions from other waste disposal are located inside the ozone nonattainment area; therefore emissions for Maricopa County and the ozone NAA are equal.

Table 3.6–10. Annual and season-day emissions from other waste disposal.

	Annual emissions (tons/yr)		Season-day emissions (lbs/day)	
Geographic area	VOC	NO_x	VOC	NO_x
Maricopa County	1.54	0.33	11.8	2.6
Ozone NAA	1.54	0.33	11.8	2.6

3.6.7 Summary of all area-source waste treatment and disposal

Table 3.6–11. Summary of annual and season-day emissions from area-source waste treatment and disposal.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
County	655.70	67.36	616.30	4,966.7	430.0	3,293.9
Ozone NAA	596.19	45.87	159.71	4,616.9	314.2	834.6

3.7 Miscellaneous area sources

3.7.1 Other combustion

3.7.1.1 Wildfires and brush fires

The Arizona Department of Environmental Quality, in cooperation with the United States Forest Service, reported that one wildfire burned 1000 acres in the Tonto National Forest on July 16–18, 2002. The wildfire occurred within Maricopa County but outside of the nonattainment area. ADEQ also reported that negligible prescribed fires occurred in Maricopa County in 2002.

In addition, 2002 survey results from Maricopa County fire departments, the Bureau of Land Management, and the Arizona State Land Department were used to calculate emissions from brush fires. In some cases, the survey results included limited information on the average size of fires. Thus, when acreage data was incomplete or unclear, each reported brush fire was assumed to be equal to 0.1 acres. Survey results are included in Appendix 3.2. It was estimated that 7,054 brush fires occurred in Maricopa County in 2002 and burned approximately 1,656.5 acres.

Wildfire emission factors and fuel loading factors were obtained from the Western Regional Air Partnership's (WRAP) 1996 Fire Emission Inventory (WGA/WRAP, 2002), while brush fire emission factor and fuel loading factors were obtained from AP-42 (US EPA, 1992). Both are listed in Table 3.5–1. Estimates of the material burned in are derived by multiplying the number of acres burned by the appropriate fuel loading factor. For wildfires, a "combustive efficiency" factor of 90% is included in the calculation to reflect the fact that not all available material (fuel) is consumed in a wildfire (WGA/WRAP, 2002).

Table 3.7–1. Emission factors and fuel loading factors for wildfires.

Type of fire	Fires reported	Number of acres burned	Fuel loading factor (tons/acre)	Emission factors (lbs/ton burned) VOC	NO_x	CO
Wildfire (Calif. chaparral)	1	1,000	19.5	13.6	6.2	289
Brush fire (weeds)	7,054	1,656.5	3.2	9*	4	85

*non-methane TOC; assumed NMOC=VOC

Annual emissions from wildfires in Maricopa County were calculated as follows.

Annual CO emissions from wildfires in Maricopa County

$$= \frac{\text{acres burned} \times \text{fuel loading factor} \times \text{combustive efficiency} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{1{,}000 \text{ acres burned} \times 19.5 \text{ tons/acre} \times 90\% \times 289 \text{ lbs/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 2{,}535.98 \text{ tons CO/yr}$$

Because the 1,000-acre wildfire occurred in the Tonto National Forest, which is located outside of the nonattainment area, emissions from wildfires within the nonattainment area were determined to be zero. However, annual emissions from brush fires for the nonattainment area were calculated by multiplying the Maricopa County annual emissions by the percentage of vacant land located in the ozone nonattainment area (15.62%). See Section 1.5.2 for a discussion of the land-use data used.

Annual CO emissions from brush fires within the ozone NAA	=	Annual CO emissions from brush fires, County total	×	Percentage of vacant land within the NAA
	=	225.28 tons/yr	×	15.62%
	=	35.19 tons CO/yr		

Table 3.7–2. Annual emissions from wildfires and brush fires (tons/yr).

	Maricopa County			Ozone nonattainment area		
Type of fire	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Wildfires	119.34	54.41	2,535.98	0.00	0.00	0.00
Brush fires	23.85	10.60	225.28	3.73	1.66	35.19
Totals:	**143.19**	**65.01**	**2,761.25**	**3.73**	**1.66**	**35.19**

Since the 1,000-acre wildfire lasted three days, annual emissions from this category were divided by 3 to derive "worst-case" daily emissions values. It was assumed that brush fires occur evenly throughout the year. Thus, average daily emissions from brush fires were derived by dividing the annual emissions for Maricopa County and the nonattainment area by a 365 days/yr, as follows:

Season-day CO emissions from wildfires in Maricopa County $= \frac{2{,}535.98 \text{ tons/yr} \times 2{,}000 \text{ lbs/ton}}{3 \text{ days/yr}}$

= 1,690,650 lbs CO/day

Table 3.7–3. Season-day emissions from wildfires and brush fires (lbs/day).

	Maricopa County			Ozone nonattainment area		
Type of fire	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Wildfires	79,560.0	36,270.0	1,690,650.0	0.0	0.0	0.0
Brush fires	130.7	58.1	1,234.4	20.4	9.1	192.8
Totals:	**79,690.7**	**36,328.1**	**1,691,884.4**	**20.4**	**9.1**	**192.8**

3.7.1.2 Structure fires

2002 structure fire data were obtained by surveying fire departments in Maricopa County and by querying Maricopa County's burn permit data base. The fire departments surveyed reported 3,597 structure fires in Maricopa County in 2002. The list of fire departments surveyed and survey results are contained in Appendix 3.2. Eleven open burn permits were issued in 2002 for fire training; these were included in the total number of estimated structure fires for 2002. It was estimated that 3,608 structure fires occurred in Maricopa County in 2002.

Estimates of the material burned in a structure fire were determined by multiplying the number of structure fires by a fuel loading factor of 1.15 tons of material per fire, which factors in percent structural loss and content loss (US EPA, 2001h). Tons of material burned were estimated as the follows:

Material burned in structure fires (tons/yr)	= 3,608 fires	×	1.15 tons/fire
	= 4,149.2 tons material burned/yr		

Table 3.7–4. Estimated material burned, emission factors and fuel loading factors for structure fires.

Structure fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	Emission factors (lbs/ton)		
			VOC	NO_x	CO
3,608	1.15	4,149.20	11	1.4	60

Annual emissions were then calculated by multiplying the amount of material burned by the emission factors listed in Table 3.7–4 (US EPA, 2001h), as follows:

Annual CO emissions from structure fires Maricopa County = Quantity of material burned × emission factor × unit conversion factor

= 4,149.20 tons × 60 lbs/ton × (1 ton/2,000 lbs.)

= 124.48 tons CO/yr

Annual emissions for the ozone nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the ozone nonattainment area (98.06%), as shown in the example below. See Section 1.5.1 for a discussion of the population data used.

Annual CO emissions from structure fires within the ozone NAA = annual CO emissions for Maricopa County × percentage of residential population within the NAA

= 124.48 tons/yr × 98.06%

= 122.07 tons CO/yr

It was assumed that structure fires occur 7 days a week; however, structure fires vary seasonally and may increase during cold weather. Because local season-specific data were not available from the fire department surveys, seasonal occurrences of residential and non-residential structure fires reported by the Federal Emergency Management Agency (FEMA) were used to derive a seasonal adjustment factor for the ozone season (US EPA, 2001h). FEMA reported that 20.9% of residential structure fires and 23.7% of non-residential structural fires occurred during July, August, and September 1994. Thus, an average occurrence of 22.3% [(20.9% + 23.7%) ÷ 2] was used as a seasonal adjustment factor to estimate ozone season-day emissions.

Ozone season-day emission for Maricopa County were derived using the following formula:

Season-day CO emissions from structure fires $= \frac{\text{annual CO emissions (lbs)} \times \text{seasonal adjustment factor}}{\text{7 days/wk} \times \text{13 weeks/season}}$

$= \frac{248{,}960 \times 22.3\%}{91}$

= 610.1 lbs CO/day

Table 3.7–5. Annual and season-day emissions from structure fires.

Geographic area	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
County	22.82	2.90	124.48	111.9	14.2	610.1
Ozone NAA	22.38	2.85	122.06	109.7	14.0	598.2

3.7.1.3 Vehicle fires

2002 vehicle fire data were obtained by surveying fire departments in Maricopa County. The fire departments surveyed reported 5,316 vehicle fires (4 boat fires were included in vehicle fires) in Maricopa County in 2002. The list of fire departments surveyed and survey results are presented in Appendix 3.2.

Annual emissions from vehicle fires are calculated by first multiplying the number of vehicle fires by a fuel loading factor of per vehicle fire to estimate the annual amount of material burned in vehicle fires. The amount of annual material burned in vehicle fires is then multiplied by emission factors for open burning of automobile components as listed in AP-42 Table 2.5-1 (US EPA, 2000b).

Annual CO emissions from vehicle fires = annual number of vehicle fires × fuel loading factor × emission factor × unit conversion factor

= 5,316 × 0.25 tons/vehicle × 125 lbs/ton × (1 ton / 2,000 lbs)

= 83.06 tons CO/yr

Table 3.7–6. Estimated material burned, fuel loading factors, and emission factors for vehicle fires.

Vehicle fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	Emission factors (lbs/ton)		
			VOC*	NO_x	CO
5,316	0.25	1,329	32	32	125

*non-methane TOC; assumed NMOC=VOC

Annual emissions for the ozone nonattainment area were derived by multiplying the Maricopa County annual emissions by the percentage of total residential population within the ozone nonattainment area (98.06%). See Section 1.5.1 for a discussion of the population data used.

Annual CO emissions from vehicle fires in the ozone NAA = annual CO emissions for Maricopa County × percentage of total residential population within the ozone NAA

= 83.06 tons/yr × 98.06%

= 81.45 tons CO/yr

It was assumed that vehicle fires occur evenly throughout the year. Thus, ozone season-day emissions were derived by dividing the Maricopa County and nonattainment area annual emissions by 365 days/year. Results are shown in Table 3.7–7.

Table 3.7–7. Annual and season-day emissions from vehicle fires.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
County	21.26	2.66	83.06	116.5	14.6	455.1
Ozone NAA	20.85	2.61	81.45	114.3	14.3	446.3

3.7.1.4 Engine testing

Annual emissions from engine testing facilities were derived from annual emission reports from permitted sources that were not considered point sources in this inventory. It was assumed that there were no significant unpermitted sources within Maricopa County. Season-day emissions

were calculated based on operating schedule information provided in the facilities' annual emission reports.

Since all facilities considered in this section are located within the ozone nonattainment area, total emission values for the county and the NAA are equal.

Table 3.7–8. Annual and season-day emissions from engine testing.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
County	1.50	4.26	3.67	17.8	87.9	95.9
Ozone NAA	1.50	4.26	3.67	17.8	87.9	95.9

3.7.2 Health services

3.7.2.1 Hospitals

Emissions from hospitals were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census' County Business Patterns (CBP) for 2001 employment, were used. CBP employment data for NAICS code 662110 (general medical and surgical hospitals) indicated 34,799 employees in this industry in Maricopa County. Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in hospitals	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 34,799	–	5,326
	= 29,473 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source VOC emissions from hospitals} = \frac{14.55 \text{ tons/yr}}{21{,}637 \text{ employees}} \times 29{,}473 \text{ employees}$$

$$= 19.82 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by hospital facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

$$\text{Season-day VOC emissions from hospital} = \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{19.82 \times 25\%}{7 \times 13} \times 2{,}000$$

$$= 108.9 \text{ lbs VOC/day}$$

Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of population within the nonattainment area. (See Section 1.5.1 for a discussion of the population data used.)

VOC emissions from area-source hospitals in the ozone NAA (tons/yr) = Annual Maricopa County emissions × NAA:County ratio of population

= 19.82 tons/yr × 98.06%

= 19.44 tons VOC/yr

Table 3.7–9 summarizes annual and season-day emissions from hospitals in both Maricopa County and the ozone nonattainment area.

Table 3.7–9. Annual and season-day VOC emissions from hospitals.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	19.82	108.9
Ozone NAA	19.44	106.8

3.7.2.2 Crematories

Emissions from human and animal crematories were calculated by the "scaling up" method as described in EPA emission inventory guidance (US EPA, 2001c). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the Census' County Business Patterns (CBP), for 2001 employment, were used. CBP employment data for NAICS code 81222 (cemeteries and crematories) indicated 683 employees in this industry in Maricopa County. This employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\text{Area-source } NO_x \text{ emissions from crematories} = \frac{3.13 \text{ tons/yr}}{110} \times 683 \text{ employees}$$

$$= 19.46 \text{ tons } NO_x/\text{yr}$$

Season-day emissions are calculated based on the operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and seasonal activity as a percentage of annual activity. This data was used to calculate typical season-day emissions as follows:

Season-day NO_x emissions from crematories $= \frac{\text{Annual emissions (tons/yr)} \times \text{season \%}}{\text{Days/week} \times \text{Weeks/season}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$

$= \frac{19.46 \times 25\%}{5 \times 13} \times 2{,}000$

$= 149.7 \text{lbs } NO_x/\text{day}$

As all facilities addressed in this source category are located within the ozone nonattainment area, emission totals for both areas are equal. Annual and daily emissions are shown in Table 3.7–10.

Table 3.7–10. Annual and season-day emissions from crematories.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
County	0.35	19.46	1.06	2.7	149.7	8.2
Ozone NAA	0.35	19.46	1.06	2.7	149.7	8.2

3.7.3 Accidental releases

As part of its air quality permit compliance program, MCESD keeps an "upset log", for each calendar year that records excess emissions and accidental releases at permitted facilities. Annual emissions inventory reports also provide for recording of accidental releases. Data from these two sources documented the release of 0.51 tons of VOC, 1.08 tons of NO_x, and 3.47 tons of CO for the year 2002.

Season-day emissions are calculated based on the whether the reported release occurred during the ozone season. If emissions occurred during the ozone season, those emissions were summed and divided by the number of days in the ozone season to produce season-day emissions. Emissions within the ozone nonattainment area are calculated based on locations of facilities that reported releases. Results are shown in Table 3.7–11.

Table 3.7–11. Annual and season-day emissions from accidental releases.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	0.51	1.08	3.47	0.3	0.0	0.0
Ozone NAA	0.51	0.00	0.00	0.3	0.0	0.0

3.7.4 Summary of all miscellaneous area sources

Table 3.7–12. Summary of annual and season-day emissions from miscellaneous area sources.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	209.46	95.36	2,976.99	80,048.8	36,594.5	1,693,053.6
Ozone NAA	68.76	30.82	243.43	372.0	274.9	1,341.4

3.8 Summary of all area sources

Tables 3.8–1 and 3.8–2 summarize the total annual and average daily emissions from all area sources addressed in this chapter, for both Maricopa County and the ozone NAA, respectively.

Table 3.8–1. Summary of annual and season-day emissions from all area sources in Maricopa County.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Fuel Combustion:						
Industrial natural gas	5.60	110.63	68.95	33.9	670.0	417.6
Industrial fuel oil	56.41	777.40	166.66	361.6	4,983.4	1,068.3
Commercial/institutional natural gas	53.86	1,068.63	655.00	281.5	5,585.3	3,423.4
Commercial/institutional fuel oil	137.77	1,798.63	386.20	529.9	6,917.8	1,485.4
Residential natural gas	45.15	771.72	328.39	144.5	2,469.4	1,050.8
Residential wood	2,912.16	33.06	3,212.28	0.0	0.0	0.0
Residential fuel oil	0.03	0.83	0.23	0.0	0.0	0.0
Total, all fuel combustion:	**3,211.00**	**4,560.90**	**4,817.71**	**1,351.4**	**20,625.8**	**7,445.5**
Industrial Processes:						
Chemical manufacturing	14.84	1.08	0.07	114.2	8.3	0.5
Commercial cooking	95.84		273.50	526.6		1,502.8
Bakeries	29.54			189.3		
Secondary metal production	54.69	0.03	0.00	309.0	0.2	0.0
Mineral Process	18.82			144.7		
Rubber/plastic product mfg.	518.50			3,988.5		
Fabricated metal product mfg.	20.64			158.8		
Electrical equipment mfg.	95.51	16.28		524.8	89.4	
State-permitted portable sources	67.61	572.42	138.43	431.0	3,821.3	925.9
Industrial processes, NEC	14.91	0.05	0.98	114.7	0.4	7.5
Total, all industrial processes:	**930.91**	**589.86**	**412.98**	**6,501.7**	**3,919.7**	**2,436.7**
Solvent Use:						
Surface Coating:						
–Architectural coatings	9,270.23			67,234.6		
–Auto refinishing	3,339.51			25,688.5		
–Traffic markings	509.21			5,170.4		
–Flatwood	221.74			1,705.7		
–Wood furniture	480.09			3,693.0		
–Aircraft	85.09			654.5		
–Misc. surface coating	707.11			5,439.3		
Total, all surface coating:	*14,612.98*			*109,586.1*		

Table 3.8–1. Summary of annual and season-day emissions from all area sources in Maricopa County (continued).

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Solvent Use: (continued)						
Degreasing	244.26			1,878.9		
Dry cleaning	26.44			162.7		
Graphics arts	460.58			3,542.9		
Misc. industrial solvent use	60.82			467.8		
Agricultural pesticides	377.00			7,000.3		
Consumer/ commercial solvent use	13,914.80			76,245.5		
Asphalt application	2,120.42			11,645.7		
Total, all solvent use:	**31,817.28**			**210,530.0**		
Storage/Transport:						
Bulk plants and terminals	40.15			308.9		
VOL storage/transport	25.42			139.7		
Fuel delivery	297.40			1,874.2		
Trucks in transit	55.07			347.1		
Station losses	734.33			3,966.6		
Vehicle refueling	1,035.18			5,941.1		
Total, all storage/transport:	**2,187.56**			**12,577.5**		
Waste Treatment/Disposal:						
On-site incineration	1.02	28.90	0.59	7.8	222.3	4.5
Open burning	62.28	27.68	588.36	332.6	147.8	3,139.1
Landfills	10.31	10.44	27.35	56.7	57.4	150.3
Publicly owned treatment works	576.56			4,435.1		
Leaking underground storage tanks	3.99			122.8		
Other waste treatment/disposal	1.54	0.33		11.8	2.6	
All waste treatment/disposal:	**655.70**	**67.36**	**616.30**	**4,966.7**	**430.0**	**3,293.9**
Miscellaneous Area Sources:						
Wildfires and brush fires	143.19	65.01	2,761.25	79,690.7	36,328.1	1,691,884.4
Structure fires	22.82	2.90	124.48	111.8	14.2	610.1
Vehicle fires	21.26	2.66	83.06	116.5	14.6	455.1
Engine testing	1.50	4.26	3.67	17.8	87.9	95.9
Hospitals	19.82			108.9		
Crematories	0.35	19.46	1.06	2.7	149.7	8.2
Accidental releases	0.51	1.08	3.47	0.3	0.0	0.0
Total, all miscellaneous sources:	**209.46**	**95.36**	**2,976.99**	**80,048.8**	**36,594.5**	**1,693,053.6**
Total, all area sources:	**39,011.90**	**5,313.47**	**8,823.98**	**315,976.1**	**61,570.0**	**1,706,229.7**

Table 3.8–2. Summary of annual and season-day emissions from all area sources within the ozone NAA.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Fuel Combustion:						
Industrial natural gas	5.49	108.52	67.64	33.3	657.2	409.6
Industrial fuel oil	55.34	762.56	163.48	354.7	4,888.2	1,047.9
Commercial/institutional natural gas	52.94	1,050.35	643.80	276.7	5,489.8	3,364.9
Commercial/institutional fuel oil	135.41	1,767.88	379.59	520.8	6,799.5	1,460.0
Residential natural gas	44.33	757.67	322.41	141.9	2,424.4	1,031.7
Residential wood	2,859.16	32.46	3,153.82	0.0	0.0	0.0
Residential fuel oil	0.03	0.81	0.23	0.0	0.0	0.0
Total, all fuel combustion:	**3,152.71**	**4,480.24**	**4,730.96**	**1,327.4**	**20,259.1**	**7,314.1**
Industrial Processes:						
Chemical manufacturing	14.56	1.06	0.07	112.0	8.2	0.5
Commercial cooking	94.01		268.28	516.5		1,474.1
Bakeries	28.97			185.7		
Secondary metal production	54.69	0.03	0.00	309.0	0.2	0.0
Mineral Process	18.46			142.0		
Rubber/plastic product mfg.	508.60			3,912.3		
Fabricated metal product mfg.	20.25			155.8		
Electrical equipment mfg.	93.68	15.97		514.7	87.7	
State-permitted portable sources	67.61	572.42	138.43	431.0	3,821.3	925.9
Industrial processes, NEC	14.91	0.05	0.98	114.7	0.4	7.5
Total, all industrial processes:	**915.75**	**589.52**	**407.76**	**6,393.8**	**3,917.8**	**2,408.0**
Solvent Use:						
Surface Coating:						
–Architectural coatings	9,092.94			65,948.8		
–Auto refinishing	3,275.02			25,192.4		
–Traffic markings	499.47			5,071.5		
–Flatwood	217.50			1,673.1		
–Wood furniture	470.92			3,622.5		
–Aircraft	83.47			642.0		
–Misc. surface coating	693.61			5,335.4		
Total, all surface coating:	14,332.92			107,485.8		
Degreasing	239.60			1,843.1		
Dry cleaning	26.44			162.7		
Graphics arts	451.78			3,475.2		
Misc. industrial solvent use	59.66			458.9		
Agricultural pesticides	167.88			3,117.3		
Consumer/ commercial solvent use	13,648.68			74,787.3		
Asphalt application	1,946.70			10,693.2		
Total, all solvent use:	**30,873.65**			**202,023.5**		
Storage/Transport:						
Bulk plants and terminals	40.15			308.9		
VOL storage/transport	25.42			139.7		
Fuel delivery	286.67			1,806.5		
Trucks in transit	53.09			334.5		
Station losses	707.82			3,823.4		
Vehicle refueling	997.81			5,726.6		
Total, all storage/transport:	**2,110.96**			**12,139.6**		

Table 3.8–2. Summary of annual and season-day emissions from all area sources within the ozone NAA (continued).

Category	Annual emissions (tons/yr) VOC	NO_x	CO	Season-day emission (lbs/day) VOC	NO_x	CO
Waste Treatment/Disposal:						
On-site incineration	1.02	28.90	0.59	7.8	222.3	4.5
Open burning	13.95	6.20	131.77	72.0	32.0	679.8
Landfills	10.31	10.44	27.35	56.7	57.4	150.3
Publicly owned treatment works	565.53			4,350.3		
Leaking underground storage tanks	3.85			118.3		
Other waste treatment/disposal	1.54	0.33		11.8	2.6	
All waste treatment/disposal:	**596.19**	**45.87**	**159.71**	**4,616.9**	**314.2**	**834.6**
Miscellaneous Area Sources:						
Wildfires and brush fires	3.73	1.66	35.19	20.4	9.1	192.8
Structure fires	22.38	2.85	122.06	109.7	14.0	598.2
Vehicle fires	20.85	2.61	81.45	114.3	14.3	446.3
Engine testing	1.50	4.26	3.67	17.8	87.9	95.9
Hospitals	19.44			106.8		
Crematories	0.35	19.46	1.06	2.7	149.7	8.2
Accidental releases	0.51	0.00	0.00	0.3	0.0	0.0
Total, all miscellaneous sources:	**68.76**	**30.82**	**243.43**	**372.0**	**274.9**	**1,341.4**
Total, all area sources:	**37,718.02**	**5,146.47**	**5,541.86**	**226,873.2**	**24,766.1**	**11,898.0**

3.9 Quality assurance / quality control procedures

Quality assurance and quality control (QA/QC) activities for the area source emissions inventory were driven by the goal of creating a comprehensive, accurate, representative and comparable inventory of area source emissions for Maricopa County and the nonattainment area. During each step of creating, building and reviewing the area source emissions inventory, quality checks and assurances were performed to establish confidence in the inventory structure and data.

Area source categories were selected for inclusion in the inventory based on the latest Emission Inventory Improvement Program (EIIP) guidance available. EPA's guidance for area source categories included in the draft 2002 National Emission Inventory (NEI) was also evaluated, as area source emissions from this inventory will be submitted to EPA for the 2002 NEI. The list of area source categories developed based on these guidance documents was modified to fit the characteristics of Maricopa County, with some area source categories determined to be insignificant (such as industrial coal combustion and oil and gas production). The 1999 Maricopa County Periodic Ozone and Carbon Monoxide Emission Inventories and other regional emission inventories were also consulted to confirm the completeness of the area source categories chosen for inclusion.

Data for area source emission calculations were gathered from a wide universe of resources. Whenever applicable, local surveyed data (such as annual emissions report) was used as this data best reflects activity in the county and the nonattainment area. When local data was not available, state data from Arizona State agencies (such as the Arizona Department of Transportation) and regional bodies (such as the Western Regional Air Partnership {WRAP}) were used. National level data (such as the US Census Bureau) was used when no local, state or regional data was available. In addition, the most recent EIIP guidance for area sources was consulted for direction in determining the most relevant data source for use in emissions calculations.

Emissions calculations for area sources were performed by three air quality planners and one unit manager. All area source emission estimates were calculated in spreadsheets to ensure the calculations could be verified and reproduced. Whenever possible or available, the "preferred method" described in the most recent EIIP guidance documents for area sources was used to calculate emissions. Emissions were estimated using emission factors from EIIP guidance, AP-42, and local source testing. Local seasonal and activity data were used when available, with EPA and EIIP guidance used when no local seasonal or activity data existed. All calculations were evaluated to ensure that emissions from point sources were not being double-counted and to determine if rule effectiveness applied.

Once area source emission estimates had been produced, several quality control checks were performed to substantiate the calculations. Most area source calculations were peer-reviewed by two other planners, with all area sources being reviewed by at least one other planner. Peer review ensured that all emission calculations were reasonable and could be reproduced. Sensitivity analyses and computational method checks were performed on area sources when emissions seemed to be outside the expected ranges. When errors were found, the appropriate changes were made by the author of the calculations to ensure consistency of the emissions calculations. The peer-reviewed emissions estimates were combined into a draft area source chapter. This draft chapter was read through in its entirety by the unit manager and the three air quality planners for final review, with any identified errors corrected by the author of the section.

The draft version of the area source chapter was sent to the Arizona Department of Environmental Quality, the Arizona Department of Transportation, and the Maricopa Association of Governments for a quality assurance review. These agencies provided comments which were addressed and incorporated into the final area source chapter. Further quality analysis was performed by inputting the emission estimates into EPA's "QA/QC basic format and content checker", prior to submitting the data to the 2002 NEI.

The QA/QC activities described here have produced high levels of confidence in the area source emissions estimates detailed in this chapter, and represent the best efforts of the inventory preparers.

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4. Nonroad Mobile Sources

4.1 Introduction

Nonroad mobile sources are defined as those that move or are moved within a 12-month period and are not licensed or certified as highway vehicles. Nonroad mobile sources are vehicles and engines that fall under the following categories:

- Agricultural equipment, such as tractors, combines and balers;
- Airport ground support equipment, such as baggage tugs, and terminal tractors;
- Commercial equipment, such as generators and pumps;
- Industrial equipment, such as forklifts and sweepers;
- Construction and mining equipment, such as graders, back hoes and trenchers;
- Lawn and garden equipment, such as leaf blowers and lawn mowers;
- Logging equipment, such as shredders and large chain saws;
- Pleasure craft, such as power boats and personal watercraft;
- Railway maintenance equipment, such as rail straighteners;
- Recreational equipment, such as all-terrain vehicles and off-road motorcycles;
- Underground mining and oil field equipment, such as mechanical drilling engines (not present in Maricopa County);
- Aircraft, such as jet and piston engines; and
- Locomotives, such as switching and line haul trains.

Emission calculations for most nonroad mobile sources are derived from a Maricopa County nonroad emission inventory of certain visibility-impairing pollutants (PM_{10}, $PM_{2.5}$, NO_x and SO_x) developed by ENVIRON International Corp. for calendar year 2002 (Environ et al., 2003). ENVIRON prepared the inventory for use and review by the Cap and Trade Oversight Committee (CTOC) formed by the Arizona Department of Environmental Quality (ADEQ). In the inventory prepared for the Cap and Trade Committee, ENVIRON used the EPA NONROAD2002 model (Core Version 2.1d March, 2002) to estimate emissions for all categories except aircraft and locomotives. Nonroad modeling for the ENVIRON inventory was based on recent NONROAD modeling performed for the Western Regional Air Partnership (WRAP) for use in the development of a regional haze rule.

Since the modeling done for the CTOC was only annual totals for Maricopa County, additional work was needed to develop estimates for the ozone nonattainment area and for an average ozone season day. Emission calculations for this report differ from the CTOC work in one major area: emission estimates prepared for the CTOC were derived from season average weekday calculations, which were then multiplied by the number of days in each season to produce season totals, and then summed to produce annual emission totals. This approach assumes that activity levels of nonroad equipment are the same on weekdays and weekends.

For this report, ENVIRON re-ran the NONROAD2002 model to produce season totals, which are then summed to produce annual emission totals. The revised method used for this report results in annual emissions levels that are about 15% less than the method used for the CTOC inventory. The method used by ENVIRON for this report takes into account the different activity levels experienced on weekdays versus weekends, which explains the lower annual emissions.

The NONROAD model defines four seasons as follows: spring – March through May, summer – June through August, fall – September through November, and winter – December through February. Since the gasoline oxygen content in Maricopa County changes on September 30, emissions from the fall quarter were calculated for each month separately, and then summed. Seasonal emissions totals are then summed to produce annual emission totals.

The methods used to estimate ozone season-day emissions are described in each section of this chapter. Emission estimates from the summer season (June–July) are assumed to represent emissions in the ozone season (July–September).

Temperature and fuel-related inputs are required for the operation of the NONROAD2002 model. The inputs listed below were used by ENVIRON after ADEQ review:

- Fuel volatility (Reid Vapor Pressure [RVP]), psi: 9.0 in winter, 8.1 in spring, 7.8 in summer and fall.
- Gasoline oxygen content (weight %): 3.36 from October through February, 0.0 otherwise.
- Gasoline sulfur content (ppm): 179 in fall and winter, 115 in spring and summer.
- Diesel sulfur content (ppm): 310 all seasons.
- Temperatures (minimum/average/maximum °F): 39/55/65 winter, 53/72/83 spring, 78/94/104 summer, 57/78/87 fall.

EPA recommends adjusting default NONROAD2002 model values (such as equipment population, activity levels of equipment, growth factors, etc.) where local data is available, as the default values in the model are derived from national averages. ENVIRON adjusted the NONROAD2002 model defaults in the following manner:

- The NONROAD model uses 1996 as a base year, and then projects emissions for any given year based on growth factors inherent in the model. The default growth factors in the model were zeroed out to reflect base year 1996 equipment population numbers. Arizona-specific growth factors developed for WRAP were then applied to the NONROAD2002 model outputs to produce 2002 year population numbers and associated emissions.
- Equipment population numbers and activity levels for commercial lawn and garden equipment were adjusted based on survey results of the commercial lawn and garden industry performed by ENVIRON as part of the CTOC work. Survey results show that for most categories of lawn and garden equipment, the equipment populations for Maricopa County are significantly lower than EPA default values, while the average annual hours of operation for most equipment types are slightly higher than EPA's values. Using these new local data results is a considerable decrease in emissions from this category, compared with earlier results using EPA default data.
- Equipment population numbers and activity levels for airport ground support equipment were adjusted based on Maricopa County-specific data provided by the Maricopa Association of Governments (MAG) for the CTOC inventory.

Spatial allocation factors were developed, based on EPA guidance documents, to apportion nonroad emissions to the ozone nonattainment area. The approaches used are described in each section of this chapter.

Temporal allocations (used to calculate ozone season-day emissions) for nonroad equipment categories modeled in the NONROAD2002 model come from EPA recommendations on weekday and weekend day activity levels for each nonroad equipment category (US EPA, 1999). Table 4.1–1 below lists the weighted activity level allocation fractions for each equipment class for weekdays and weekend days. For this report, the most conservative (highest) allocation fraction in each nonroad equipment class was used to calculate season-day emissions.

Table 4.1–1. Default weekday and weekend day activity allocation fractions.

Equipment category	Weekday	Weekend day
Agricultural	0.1666667	0.0833334
Airport ground support	0.1428571	0.1428571
Commercial	0.1666667	0.0833334
Construction and mining	0.1666667	0.0833334
Industrial	0.1666667	0.0833334
Lawn and garden (residential)	0.1111111	0.2222222
Lawn and garden (commercial)	0.1600000	0.1000000
Logging	0.1666667	0.0833334
Pleasure craft	0.0600000	0.3500000
Railway maintenance	0.1800000	0.0500000
Recreational	0.1111111	0.2222222

4.2 Agricultural equipment

Annual emissions from agricultural equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as discussed above. Emissions are reported by engine type: gasoline 2-stroke, gasoline 4-stroke, diesel, compressed natural gas (CNG), and liquid petroleum gas (LPG). Emissions from CNG and LPG equipment are reported in the gasoline 4-stroke category, as total emissions from these engine types were either trivial or none. County-wide results are shown in Table 4.2–1.

Table 4.2–1. Annual emissions (in tons/yr) from agricultural equipment in Maricopa County.

Source Classification Code (SCC)	Engine type	VOC	NO_x	CO
2260005000	Gasoline 2-stroke	1.04	< 0.005	2.12
2265005000	Gasoline 4-stroke	11.53	6.16	355.26
2270005000	Diesel	58.02	471.30	275.58
Totals:		**70.60**	**477.46**	**632.96**

Ozone nonattainment area annual emissions were calculated based on EIIP guidance (US EPA, 2002) which recommends using the ratio of agricultural land inside the nonattainment area (185,029 acres) to agricultural land inside the county (415,473 acres). See Section 1.5.2 for a discussion of land-use data used.

Ozone nonattainment area emissions from agricultural equipment = County VOC emissions × Agricultural land-use allocation factor

= 70.59 tons × 44.53%

= 31.43 tons VOC/yr

Table 4.2–2. Annual emissions (in tons/yr) from agricultural equipment in the ozone NAA.

SCC	Engine type	VOC	NO_x	CO
2260005000	Gasoline 2-stroke	0.46	<0.005	0.94
2265005000	Gasoline 4-stroke	5.13	2.74	158.20
2270005000	Diesel	25.84	209.87	122.72
Totals:		**31.43**	**212.61**	**281.86**

County season-day emissions were calculated by multiplying summer season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for agricultural equipment listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999), as follows:

Maricopa County ozone season-day emissions (lbs/day)	= Summer season VOC emissions (tons/season)	× 2000 (lb/ton)	× daily activity allocation factor for agricultural equipment expressed as (weeks/day)	÷ 13 (weeks/season)
	= 24.25	× 2000	× 0.166667	÷ 13
	= 621.8 lbs/day			

Table 4.2–3. Ozone season emissions from agricultural equipment in Maricopa County.

		Seasonal emissions (tons/season)			Season-day emissions (lbs/day)		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260005000	Gasoline 2-stroke	0.36	<0.005	0.76	9.2	0.1	19.5
2265005000	Gasoline 4-stroke	4.20	1.82	133.49	107.7	46.7	3422.8
2270005000	Diesel	19.69	159.92	93.49	504.9	4100.5	2397.2
Totals:		**24.25**	**161.74**	**227.74**	**621.8**	**4,147.2**	**5,839.5**

Ozone nonattainment area season-day emissions were calculated by multiplying county season-day emissions by the agricultural land-use allocation factor:

Ozone nonattainment area season-day emissions	= Maricopa County VOC season-day emissions	×	Agricultural land-use allocation factor
	= 621.8 lbs/day	×	44.53%
	= 276.9 lbs/day		

Table 4.2–4. Ozone season-day emissions (in lbs/day) from agricultural equipment in the ozone NAA.

SCC	Engine type	VOC emissions	NO_x emissions	CO emissions
2260005000	Gasoline 2-stroke	4.1	< 0.05	8.6
2265005000	Gasoline 4-stroke	48.0	20.8	1,524.2
2270005000	Diesel	224.8	1,826.0	1,067.5
Totals:		**276.9**	**1,846.8**	**2,600.3**

4.3 Airport ground support equipment

Annual emissions from airport ground support equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of the number of FAA landing and takeoff operations (LTO) in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 4.12 for a discussion of aircraft LTO data.

Table 4.3–1. Annual emissions (in tons/yr) from airport ground support equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260008000	Gasoline 2-stroke	0.00	0.00	0.00	0.00	0.00	0.00
2265008000	Gasoline 4-stroke	135.09	92.10	3,447.92	131.71	89.80	3,361.72
2270008000	Diesel	4.48	54.99	23.17	4.37	53.62	22.59
Totals:		**139.57**	**147.09**	**3,471.09**	**136.08**	**143.42**	**3,384.31**

County season-day emissions were calculated by first multiplying Maricopa County annual emissions by 25% to estimate ozone season totals, as airport ground support equipment activity is assumed uniform throughout the year (US EPA, 1999). Ozone season totals were then multiplied by the most conservative weekday/weekend day activity allocation factor for airport ground support equipment (0.1428571) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on LTOs as described above.

Table 4.3–2. Ozone season-day emissions (in lbs/day) from airport ground support equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260008000	Gasoline 2-stroke	0.0	0.0	0.0	0.0	0.0	0.0
2265008000	Gasoline 4-stroke	742.3	506.0	18,944.6	723.7	493.4	18,471.0
2270008000	Diesel	24.6	302.1	127.3	24.0	294.5	124.1
Totals:		**766.9**	**808.1**	**19,071.9**	**747.7**	**787.9**	**18,595.1**

4.4 Commercial equipment

Annual emissions from commercial equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of industrial employment in the nonattainment area to Maricopa County-level totals, as data on the number of wholesale establishments recommended by EIIP guidance (US EPA, 2002) was not available. See Section 1.5.1 for a discussion of the industrial employment data used.

Table 4.4–1. Annual emissions (in tons/yr) from commercial equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260006000	Gasoline 2-stroke	269.92	1.28	557.16	264.76	1.26	546.52
2265006000	Gasoline 4-stroke	1,352.35	567.59	44,729.37	1,326.52	556.75	43,875.04
2270006000	Diesel	136.64	750.57	511.02	134.03	736.23	501.26
Totals:		**1,758.91**	**1319.44**	**45,797.55**	**1,725.31**	**1,294.24**	**44,922.82**

County season-day emissions were calculated by multiplying Maricopa County summer season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for commercial equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on industrial employment ratios as described above.

Table 4.4–2. Ozone season-day emissions (in lbs/day) from commercial equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260006000	Gasoline 2-stroke	1,755.6	6.4	3,928.5	1,722.1	6.3	3,853.5
2265006000	Gasoline 4-stroke	9,814.9	2,981.5	332,839.0	9,627.4	2,924.6	326,481.8
2270006000	Diesel	875.9	4,811.3	3,276.2	859.2	4,719.4	3,213.6
Totals:		**12,446.4**	**7,799.2**	**340,043.7**	**12,208.7**	**7,650.3**	**333,548.9**

4.5 Construction and mining equipment

Annual emissions from construction and mining equipment in Maricopa County were calculated using EPA's NONROAD2002 model as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the EIIP-recommended allocation factor of total dollar value of construction was unavailable (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.5–1. Annual emissions (in tons/yr) from construction and mining equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260002000	Gasoline 2-stroke	468.57	6.28	1,170.13	459.62	6.16	1,147.78
2265002000	Gasoline 4-stroke	236.59	114.49	9,139.37	232.07	112.30	8,964.81
2270002000	Diesel	1,081.31	9,713.92	5,275.07	1,060.66	9,528.38	5,174.32
Totals:		**1,786.47**	**9,834.69**	**15,584.58**	**1,752.35**	**9,646.84**	**15,286.91**

County season-day emissions were calculated by multiplying Maricopa County summer season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for construction/mining equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on population ratios as described above.

Table 4.5–2. Ozone season-day emissions (in lbs/day) from construction and mining equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260002000	Gasoline 2-stroke	4,005.6	43.6	10,746.7	3,929.1	42.8	10,541.4
2265002000	Gasoline 4-stroke	2,171.3	801.3	88,000.8	2,129.8	786.0	86,320.0
2270002000	Diesel	9,159.7	82,270.8	44,681.3	8,984.7	80,699.4	43,827.9
Totals:		**15,336.6**	**83,115.7**	**143,428.8**	**15,043.6**	**81,528.2**	**140,689.3**

4.6 Industrial equipment

Annual emissions from industrial equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of industrial employment in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the number of employees in manufacturing recommended by EIIP guidance (US EPA, 2002) was not available. See Section 1.5.1 for a discussion of the industrial employment data used.

Table 4.6–1. Annual emissions (in tons/yr) from industrial equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260003000	Gasoline 2-stroke	3.44	0.02	7.23	3.37	.02	7.09
2265003000	Gasoline 4-stroke	240.98	2,108.32	14,638.82	236.38	2,068.05	14,359.2
2270003000	Diesel	117.57	1,066.46	489.42	115.32	1,046.09	480.07
Totals:		**361.99**	**3,174.80**	**15,135.47**	**355.07**	**3,114.16**	**14,846.36**

County season-day emissions were calculated by multiplying Maricopa County summer season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for industrial equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on industrial employment ratios as described above.

Table 4.6–2. Ozone season-day emissions (in lbs/day) from industrial equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260003000	Gasoline 2-stroke	22.3	0.1	51.0	21.9	0.1	50.0
2265003000	Gasoline 4-stroke	1,682.0	13,226.6	100,889.9	1,649.9	12,974.0	98,962.9
2270003000	Diesel	753.6	6,835.4	3137.4	739.2	6,704.8	3,077.5
Totals:		**2,457.9**	**20,062.1**	**104,078.3**	**2,411.0**	**19,678.9**	**102,090.4**

4.7 Lawn and garden equipment

Annual emissions from lawn and garden equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. These results reflect new equipment population and usage estimates from survey work done in early 2003 for the Arizona Department of Environmental Quality (discussed further in Section 4.1). Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of housing units in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the housing data used.

Table 4.7–1. Annual emissions (in tons/yr) from lawn and garden equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260004000	Gasoline 2-stroke	2,179.10	13.04	4,677.47	2,139.44	12.80	4,592.34
2265004000	Gasoline 4-stroke	2,309.44	463.63	72,476.35	2,267.41	455.19	71,157.28
2270004000	Diesel	34.64	218.81	119.31	34.01	214.83	117.14
Totals:		**4,523.18**	**695.48**	**77,273.13**	**4,440.86**	**682.82**	**75,866.76**

County season-day emissions were calculated by multiplying Maricopa County summer season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for lawn and garden equipment (0.1600000 for the commercial segment, 0.2222222 for residential) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on housing units as described above.

Table 4.7–2. Ozone season-day emissions (in lbs/day) from lawn and garden equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260004000	Gasoline 2-stroke	21,657.8	93.4	49,010.7	21,263.6	91.7	48,118.7
2265004000	Gasoline 4-stroke	24,477.7	3,686.6	801,025.2	24,032.2	3,619.5	786,446.5
2270004000	Diesel	289.2	1,827.4	996.4	283.9	1,794.1	978.3
Totals:		**46,424.7**	**5,607.4**	**851,032.3**	**45,579.7**	**5,505.3**	**835,543.5**

4.8 Logging equipment

Annual emissions from logging equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Logging equipment includes equipment such as large chain saws and shredders used by such entities such as city parks departments and large landscaping companies. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the number of employees in logging recommended by EIIP guidance was not available (US EPA, 2002). See Section 1.5.1 for a discussion of the population figures used.

Table 4.8–1. Annual emissions (in tons/yr) from logging equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260007000	Gasoline 2-stroke	14.46	0.20	34.30	14.18	0.20	33.64
2265007000	Gasoline 4-stroke	3.81	0.60	90.02	3.74	0.59	88.30
2270007000	Diesel	2.66	37.94	12.23	2.61	37.22	12.00
Totals:		**20.94**	**38.74**	**136.54**	**20.53**	**38.01**	**133.94**

County season-day emissions were calculated by multiplying Maricopa County summer-season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for logging equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on population as described above.

Table 4.8–2. Ozone season-day emissions (in lbs/day) from logging equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260007000	Gasoline 2-stroke	93.6	1.0	241.9	91.8	1.0	237.3
2265007000	Gasoline 4-stroke	25.7	2.7	671.3	25.2	2.6	658.5
2270007000	Diesel	17.1	243.3	78.4	16.8	238.7	76.9
Totals:		**136.4**	**247.0**	**991.6**	**133.8**	**242.3**	**972.7**

4.9 Pleasure craft

Annual emissions from pleasure craft equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of water surface area in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land-use data used.

Table 4.9–1. Annual emissions (in tons/yr) from pleasure craft equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2282005000	Gasoline 2-stroke	552.32	11.60	982.10	189.45	3.98	336.86
2282010000	Gasoline 4-stroke	47.25	15.90	439.26	16.21	5.45	150.67
2282020000	Diesel	0.63	15.52	2.55	0.22	5.32	0.87
Totals:		**600.20**	**43.01**	**1,423.91**	**205.88**	**14.75**	**488.40**

County season-day emissions were calculated by multiplying Maricopa County summer-season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for pleasure craft (0.3500000) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on water surface area as described above.

Table 4.9–2. Ozone season-day emissions (in lbs/day) from pleasure craft equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2282005000	Gasoline 2-stroke	14,218.0	264.0	26,686.0	4,876.8	90.6	9,153.3
2282010000	Gasoline 4-stroke	1,194.1	336.3	12,373.7	409.6	115.4	4,244.2
2282020000	Diesel	16.4	401.4	65.9	5.6	137.7	22.6
Totals:		**15,428.5**	**1,001.7**	**39,125.6**	**5,292.0**	**343.7**	**13,420.1**

4.10 Railway maintenance equipment

Annual emissions from railway maintenance equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.10–1. Annual emissions (in tons/yr) from railway maintenance equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2285003015	Gasoline 2-stroke	0.00	0.00	0.00	0.00	0.00	0.00
2285004015	Gasoline 4-stroke	1.11	0.39	43.99	1.09	0.38	43.15
2285002015	Diesel	4.00	19.96	17.29	3.92	19.58	16.96
Totals:		**5.10**	**20.35**	**61.28**	**5.01**	**19.96**	**60.11**

County season-day emissions were calculated by multiplying Maricopa County summer season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/ weekend day activity allocation factor for railway maintenance equipment (0.1800000) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on the population ratio as described above.

Table 4.10–2. Ozone season-day emissions (in lbs/day) from railway maintenance equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2285003015	Gasoline 2-stroke	0.0	0.0	0.0	0.0	0.0	0.0
2285004015	Gasoline 4-stroke	8.8	2.0	353.9	8.6	2.0	347.1
2285002015	Diesel	27.7	138.2	119.7	27.2	135.6	117.4
Totals:		**36.5**	**140.2**	**473.6**	**35.8**	**137.6**	**464.5**

4.11 Recreational equipment

Annual emissions from recreational equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the ozone nonattainment area for this category were derived by applying the ratio of passive open space, golf courses and vacant land use in the nonattainment area to Maricopa County-level totals as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land-use data used.

Table 4.11–1. Annual emissions (in tons/yr) from recreational equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260001000	Gasoline 2-stroke	679.09	4.95	971.01	68.52	0.50	97.97
2265001000	Gasoline 4-stroke	202.67	47.92	8,803.03	20.45	4.84	888.23
2270001000	Diesel	3.49	10.47	14.16	0.35	1.06	1.43
Totals:		**885.25**	**63.35**	**9,788.20**	**89.32**	**6.40**	**987.63**

County season-day emissions were calculated by multiplying Maricopa County summer-season ozone emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for recreational equipment (0.2222222) listed in Table 4.1–1, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999). Ozone nonattainment area season-day emissions were calculated based on land use as described above.

Table 4.11–2. Ozone season-day emissions (in lbs/day) from recreational equipment.

		Maricopa County			Nonattainment area		
SCC	Engine type	VOC	NO_x	CO	VOC	NO_x	CO
2260001000	Gasoline 2-stroke	8,656.4	53.0	13,092.8	873.4	5.3	1,321.1
2265001000	Gasoline 4-stroke	2,751.3	470.9	124,149.3	277.6	47.5	12,526.7
2270001000	Diesel	44.1	132.2	178.9	4.4	13.3	18.1
Total		**11,451.8**	**656.1**	**137,421.0**	**1,155.4**	**66.1**	**13,865.9**

4.12 Aircraft

A survey of all 16 airports in Maricopa County was conducted to collect data on the total number of landing and take-off operations (LTO's) as well as fleet mix to determine the types of aircraft used and idle times to calculate annual emissions. Of these airports, three locations (Buckeye Municipal Airport, Gila Bend Municipal Airport and Wickenburg Municipal Airport) are outside of the nonattainment area. Data provided by many airports were in the form of the US Federal Aviation Administration's (FAA) monthly reporting Form 7230-1, which documents the traffic flow in four major activity categories: air carrier, air taxi, general aviation and military.

Emissions were derived from both computer modeling and National Emissions Inventory (NEI) default emission factors. For airports that provided complete survey data, the FAA's latest airport Emissions and Dispersion Modeling Software (EDMS 4.1) was used to calculate emissions. Parameters required to apply this model include annual LTO figures, fleet mix of types of aircraft in each activity category, and average idle-in and idle-out times.

For those airports that provided only partial data, the EDMS model could not be used to calculate emissions. Instead, NEI default emission factors were used to calculate emissions. Examples of missing data were detailed fleet mix data or unknown idle times. For airports that did not respond to the survey, LTO figures and fleet mix were derived from an online database that provides free detailed aeronautical information on airports at http://www.airnav.com. The "Airport Operational Statistics" section of this database contains data on average daily aircraft operations at the airport by aircraft type (air carrier, air taxi, general aviation and military). These data were multiplied by 365 to derive annual LTO totals and was used to grow LTO's and fleet mix. Since the EDMS model requires specific aircraft types to run and the Airport Operational Statistics only provide general aircraft type information, the NEI default emission factors shown in Table 4.12–1 were applied to these activity data to calculate emissions.

Table 4.12–1. NEI default emission factors (lbs/LTO), by aircraft type.

Aircraft type	Abbreviation	SCC	HC	HC:VOC conversion factor	VOC	NO_x	CO
Air Taxi	AT	2275060000	1.234	0.9914	1.223	0.158	28.130
General Aviation	GA	2275050000	0.394	0.9708	0.382	0.065	12.014
Military	ML	2275001000	1.234	1.1046	1.363	0.158	28.130

Table 4.12–2 summarizes the data received from each airport, and the approach used (using the EDMS model or default emission factors from the 1999 NEI) to calculate emissions from each airport.

The following provides an example of how aircraft emissions were calculated using EDMS for Skyranch at Carefree, a small, general-aviation only airport with a mix of aircraft 12,500 lbs or less. Since the EDMS model requires an exact LTO value for each airframe considered in the model, and since the survey did not require respondents to supply exact LTO counts for each individual airframe, an averaging method was used. EDMS was run to produce an composite emission factor for an airport based on the most common type of aircraft using that facility. For Skyranch, a composite profile was created by selecting within EDMS 12 aircraft types likely to utilize the airport, based on data provided by the airport survey and follow-up correspondence. These 12 aircraft types are: Cessna 150, Commanche, Robin R 2160, Socata Tampico, Cessna 172 Skyhawk, Piper PA-28, Robin R 3000, Socata Tobago, Cherokee six, Robin DR 400, Rockwell Commander, and Spencer S-12 Air Car.

The EDMS model was run with the above 12 aircraft types and for ease of calculation each aircraft was allocated 2000 LTO/year. It was then necessary to divide the lbs/LTO result by the 12 representative aircraft used to derive an emission factor for an "average" aircraft LTO.

For example, the model run with the 12 aircraft types resulted in total CO emissions of 211.69 tons (assuming each of the 12 aircraft types had 2000 LTOs each during the period).

Table 4.12–2. 2002 airport activity data, emission calculation methods, and emission factors.

Airport name	Activity category	2002 LTOs	LTO data source[1]	Emission calculation method[2]	Lbs/LTO VOC	Lbs/LTO NO_x	Lbs/LTO CO
Arizona Army National Guard	ML	780	reported	NEI default	1.363	0.158	28.130
Buckeye Municipal Airport[3]	GA	16,796	reported	EDMS	0.249	0.044	17.641
Chandler Municipal Airport	AT	914	reported	NEI default	1.223	0.158	28.130
	GA	80,689	reported	NEI default	0.382	0.065	12.014
	ML	10	reported	NEI default	1.363	0.158	28.130
Falcon Field	AT	1,319	AirNav	NEI default	1.223	0.158	28.130
	GA	125,350	AirNav	NEI default	0.382	0.065	12.014
	ML	5,278	AirNav	NEI default	1.363	0.158	28.130
Gila Bend Municipal Airport[3]	GA	522	AirNav	NEI default	0.382	0.065	12.014
Glendale Municipal Airport	GA	59,352	reported	NEI default	0.382	0.065	12.014
Luke Air Force Base	ML	61,225	reported	EDMS	3.245	10.906	13.827
Phoenix Deer Valley Airport	AT	2,495	reported	NEI default	1.223	0.158	28.130
	GA	192,254	reported	NEI default	0.382	0.065	12.014
	ML	37	reported	NEI default	1.363	0.158	28.130
Phoenix Goodyear Airport	AC	131	reported	EDMS	2.531	37.718	7.615
	AT	270	reported	NEI default	1.223	0.158	28.130
	GA	68,317	reported	NEI default	0.382	0.065	12.014
	ML	569	reported	NEI default	1.363	0.158	28.130
Phoenix Sky Harbor Int'l.	AC	187,125	reported	EDMS	17.444	40.201	43.267
	AT	57,570	reported	EDMS	1.271	1.379	14.996
	GA	26,204	reported	EDMS	0.104	0.017	6.838
	ML	1,987	reported	EDMS	0.072	0.331	0.643
Pleasant Valley Airport	GA	19,302	reported	EDMS	0.015	0.331	0.529
Scottsdale Airport	AT	5,026	reported	NEI default	1.223	0.158	28.130
	GA	92,365	reported	NEI default	0.382	0.065	12.014
	ML	291	reported	NEI default	1.363	0.158	28.130
Skyranch at Carefree	GA	2,453	reported	EDMS	0.249	0.044	17.641
Stellar Airpark	GA	22,000	reported	NEI default	0.382	0.065	12.014
Wickenburg Municipal Airport[3]	AT	179	AirNav	NEI default	1.223	0.158	28.130
	GA	8,495	AirNav	NEI default	0.382	0.065	12.014
	ML	268	AirNav	NEI default	1.363	0.158	28.130
Williams Gateway Airport	AC	421	reported	EDMS	2.409	18.067	6.960
	AT	3,104	reported	EDMS	1.271	1.379	14.996
	GA	79,731	reported	EDMS	0.277	0.045	18.234
	ML	5,990	reported	EDMS	1.152	5.300	10.288

1. "reported" = using 2002 survey results supplied by the airport,
   "AirNav" = using available data on average daily LTOs from www.airnav.com.
2. "EDMS" = emission factors were based on EDMS model calculations,
   "NEI default" = NEI default emission factors Table 4.12–1 were used.
3. Airport is outside the nonattainment area.

Composite CO emission factor (lb/LTO) = Σ modeled CO emissions (tons/yr) × 1 yr ÷ 24,000 LTOs × 2000 lb/ton
= 17.64 lb CO/LTO

This composite emission factor was then multiplied by the actual number of LTOs at the airport to derive an annual CO emissions total:

CO emissions (lb/ yr) = 2,453 LTO/yr × 17.64 lb CO/LTO
= 43,272.88 lb CO/yr

The above approach was used to calculate CO, HC (hydrocarbons), NO_x and SO_x directly from the EDMS model. Emissions of VOC were derived by applying the appropriate HC:VOC factor listed in Table 4.12–1.

Table 4.12–2 lists the emission factors used. Table 4.12–3 lists the total annual emissions and ozone season-day emissions, for each airport and aircraft type. For all airports, activity is presumed to occur evenly over a 7-day week. To develop seasonal allocation factors, Phoenix Sky Harbor International Airport's distribution of LTO's for air carrier activity was used. Seasonal activity for the ozone season (July – September) is thus calculated as (15,985 + 16,243 + 15,283 ÷ 187,125 = 25%).

Table 4.12–3. Annual and ozone season-day emissions, by airport and aircraft type.

	Activity	Tons/yr			Lbs/day		
Facility	**category[1]**	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Arizona Army Natl. Guard	ML	0.53	0.06	10.97	2.9	0.3	60.3
Chandler Municipal Airport	AT	0.56	0.07	12.86	3.1	0.4	70.6
	GA	15.43	2.62	484.70	84.8	14.4	2,663.2
	ML	0.01	0.00	0.14	0.0	0.0	0.8
Falcon Field	AT	0.81	0.10	18.55	4.4	0.6	101.9
	GA	23.97	4.07	752.98	131.7	22.4	4,137.2
	ML	3.60	0.42	74.24	19.8	2.3	407.9
Glendale Municipal Airport	GA	11.35	1.93	356.53	62.4	10.6	1,958.9
Luke Air Force Base	ML	99.33	333.86	423.28	545.8	1,834.4	2,325.7
Phoenix Deer Valley Airport	AT	1.53	0.20	35.09	8.4	1.1	192.8
	GA	36.77	6.25	1,154.87	202.0	34.3	6,345.4
	ML	0.02	0.00	0.39	0.1	0.0	2.2
Phoenix Goodyear Airport	AC	0.17	2.47	0.50	0.9	13.6	2.7
	AT	0.17	0.02	3.80	0.9	0.1	20.9
	GA	13.07	2.22	410.38	71.8	12.2	2,254.8
	ML	0.39	0.04	8.00	2.1	0.2	44.0
Phoenix Sky Harbor Int'l.	AC	1,632.11	3,761.31	4,048.17	8,967.6	20,666.5	22,242.7
	AT	36.59	39.69	431.66	201.0	218.1	2,371.8
	GA	1.36	0.22	89.59	7.5	1.2	492.3
	ML	0.07	0.33	0.64	0.4	1.8	3.5
Pleasant Valley Airport	GA	0.14	3.19	5.11	0.8	17.6	28.1
Scottsdale Airport	AT	3.07	0.40	70.69	16.9	2.2	388.4
	GA	17.66	3.00	554.84	97.1	16.5	3,048.6
	ML	0.20	0.02	4.09	1.1	0.1	22.5
Skyranch at Carefree	GA	0.31	0.05	21.64	1.7	0.3	118.9
Stellar Airpark	GA	4.21	0.72	132.15	23.1	3.9	726.1
Williams Gateway Airport	AC	0.51	3.80	1.47	2.8	20.9	8.0
	AT	1.97	2.14	23.27	10.8	11.8	127.9
	GA	11.03	1.79	726.91	60.6	9.9	3,994.0
	ML	3.45	15.87	30.81	19.0	87.2	169.3
Ozone nonattainment area totals:		**1,920.37**	**4,186.89**	**9,888.43**	**10,551.5**	**23,004.9**	**54,332.0**
Airports outside the nonattainment area:							
Buckeye Municipal Airport	GA	2.10	0.37	148.15	11.5	2.0	814.0
Gila Bend Municipal Airport	GA	0.10	0.02	3.14	0.6	0.1	17.2
Wickenburg Mun. Airport	AT	0.11	0.01	2.52	0.6	0.1	13.8
	GA	1.62	0.28	51.03	8.9	1.5	280.4
	ML	0.18	0.02	3.77	1.0	0.1	20.7
Maricopa County totals:		**1,924.48**	**4,187.59**	**10,097.03**	**10,574.1**	**23,008.7**	**55,478.2**

1. AC = air carrier, GA = general aviation, AT = air taxi, ML = military.

4.13 Locomotives

Annual emissions from locomotives were calculated based on diesel fuel usage provided by Burlington Northern/Santa Fe Railway (BNSF) and Union Pacific Railway (UP). Railway operations from these companies fall into two categories: Class I haul lines and yard/switching operations (no Class II or Class III haul lines operated in Maricopa County in 2002). Annual emissions from Class I haul operations and yard/ switching operations were calculated by multiplying diesel fuel usage by EPA emission factors for VOC, NO_x, and CO (US EPA, 1997).

VOC Emissions from UP Class I haul lines = Diesel fuel used (gals) × EPA emission factor (lbs/gal) for VOC ÷ 2000 lbs/ton

= 9,204,320 gallons × 0.022 lbs/gal ÷ 2000 lbs/ton

= 101.25 tons of VOC/yr

Table 4.13–1. Fuel use, emission factors, and annual emissions from locomotives in Maricopa County.

Locomotive type	Diesel fuel used (gals)	Emission factor (lbs/gal)			Emissions (tons/yr)		
		VOC	NO_x	CO	VOC	NO_x	CO
BNSF Class I haul line	824,339	0.022	0.595	0.059	9.07	245.24	24.32
UP Class I haul line	9,204,320	0.022	0.595	0.059	101.25	2,738.29	271.53
BNSF yard/switch operations	824,900	0.046	0.798	0.084	18.97	329.14	34.65
UP yard/switch operations	329,960	0.046	0.798	0.084	7.59	131.65	13.86
Totals:	**11,183,519**				**136.88**	**3,444.32**	**344.35**

Ozone nonattainment area emissions were calculated by multiplying Maricopa County emissions by the percentage of track miles inside the ozone nonattainment area, determined by GIS mapping:

Ozone nonattainment area emissions from UP Class I haul lines = County VOC emissions × Percentage of track in the nonattainment area

= 101.25 tons of VOC/yr × 37.95%

= 38.42 tons of VOC/yr

Table 4.13–2. Annual emissions (in tons/yr) from locomotives in the ozone NAA.

Locomotive type	Track in nonattainment area (%)	VOC	NO_x	CO
BNSF Class I haul line	37.95	3.44	93.07	9.23
UP Class I haul line	37.95	38.42	1,039.18	103.04
BNSF yard/switch operations	100.00	18.97	329.14	34.65
UP yard/switch operations	100.00	7.59	131.65	13.86
Totals:		**68.43**	**1,593.04**	**160.78**

Ozone season-day emissions for both the county and the ozone nonattainment area were calculated by dividing annual totals by 365 days per year, as locomotive activity is assumed to be uniform throughout the year.

Ozone season-day emissions from haul lines = Annual VOC emissions (tons) × 2000 lbs/ton ÷ 365 days

= 110.32 tons × 2000 lbs/ton ÷ 365 days

= 604.5 lbs/day

Table 4.13–3. Ozone season-day emissions (in lbs/day) from locomotives.

Locomotive type	Maricopa County			Nonattainment area		
	VOC	NO_x	CO	VOC	NO_x	CO
BNSF Class I haul line	49.7	1,343.8	133.2	18.9	510.0	50.6
UP Class I haul line	554.8	15,004.3	1,487.8	210.5	5,694.1	564.6
BNSF yard/switch operations	104.0	1,803.5	189.8	104.0	1,803.5	189.8
UP yard/switch operations	41.6	721.4	75.9	41.6	721.4	75.9
Totals:	**750.0**	**18,873.0**	**1,886.8**	**374.9**	**8,729.0**	**881.0**

4.14 Summary of all nonroad mobile source emissions

Tables 4.14–1 and 4.14–2 summarize annual and ozone season-day emissions of VOC, NO_x and CO from nonroad mobile sources in Maricopa county and the ozone nonattainment area, respectively.

Table 4.14–1. Annual and season-day emissions from nonroad mobile sources in Maricopa County.

Equipment category	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Agricultural	70.60	477.46	632.96	621.8	4,147.2	5,839.5
Airport ground support equip.	139.57	147.09	3,471.09	766.9	808.1	19,071.9
Commercial	1,758.91	1,319.44	45,797.55	12,446.4	7,799.2	340,043.7
Construction & mining	1,786.47	9,834.69	15,584.58	15,336.6	83,115.7	143,428.8
Industrial	361.99	3,174.80	15,135.47	2,457.9	20,062.1	104,078.3
Lawn & garden	4,523.18	695.48	77,273.13	46,424.7	5,607.4	851,032.3
Logging	20.94	38.74	136.54	136.4	247.0	991.6
Pleasure craft	600.20	43.01	1,423.91	15,428.5	1,001.7	39,125.6
Railway maintenance	5.10	20.35	61.28	36.5	140.2	473.6
Recreational	885.25	63.35	9,788.20	11,451.8	656.1	137,421.0
Aircraft	1,924.48	4,187.59	10,097.03	10,574.1	23,008.7	55,478.2
Locomotives	136.88	3,444.32	344.35	750.0	18,873.0	1,886.8
Totals:	**12,213.57**	**23,446.32**	**179,746.09**	**116,431.6**	**165,466.4**	**1,698,871.3**

Table 4.14–2. Annual and season-day emissions from nonroad mobile sources in the ozone NAA.

Equipment category	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Agricultural	31.43	212.61	281.86	276.9	1,846.8	2,600.3
Airport ground support equip.	136.08	143.42	3,384.31	747.7	787.9	18,595.1
Commercial	1,725.31	1,294.24	44,922.82	12,208.7	7,650.3	333,548.9
Construction & mining	1,752.35	9,646.84	15,286.91	15,043.6	81,528.2	140,689.3
Industrial	355.07	3,114.16	14,846.36	2,411.0	19,678.9	102,090.4
Lawn & garden	4,440.86	682.82	75,866.76	45,579.7	5,505.3	835,543.5
Logging	20.53	38.01	133.94	133.8	242.3	972.7
Pleasure craft	205.88	14.75	488.40	5,292.0	343.7	13,420.1
Railway maintenance	5.01	19.96	60.11	35.8	137.6	464.5
Recreational	89.32	6.40	987.63	1,155.4	66.1	13,865.9
Aircraft	1,920.37	4,186.89	9,888.43	10,551.5	23,004.9	54,332.0
Locomotives	68.43	1,593.04	160.78	374.9	8,729.0	881.0
TOTALS:	**10,750.64**	**20,953.14**	**166,308.31**	**93,811.0**	**149,521.0**	**1,517,003.7**

4.15 Quality assurance procedures

Established procedures were used to check, and correct when necessary, the off-road mobile sources emissions estimates. All NONROAD model input and output files, and Excel spreadsheets used to calculate the emissions, were checked by personnel who were not involved in the development of the modeling inputs/outputs and spreadsheets. In addition, the emissions estimates were reviewed for reasonableness by external agency staff.

4.16 References

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ERG, 2001. Documentation for the Draft 1999 Base Year Aircraft, Commercial Marine Vessels, and Locomotive National Emissions Inventory for Criteria and Hazardous Air Pollutants. Prepared by Eastern Research Group, Morrisville, NC for the US Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, Oct. 29, 2001. Internet address: http://www.epa.gov/ttn/chief/eidocs/partllsec4.pdf

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5. Onroad Mobile Sources

5.1 Introduction

The Maricopa Association of Governments (MAG) prepared the onroad mobile source emission estimates for the 2002 periodic ozone precursor emissions inventory for the Maricopa County Nonattainment Area and for Maricopa County. Onroad mobile source emission estimates have been calculated for ozone (O_3) precursors for the 2002 periodic ozone inventory. These onroad mobile source estimates are for the ozone nonattainment area within Maricopa County and also for Maricopa County as a whole. Emission estimates were developed for both the ozone season and also for 2002 as a whole.

Emission estimates were calculated for the following eight vehicle classes: light duty gas vehicles (LDGV), light duty gas trucks of gross vehicle weight under 6000 pounds (LDGT1/ LDGT2) or over 6000 pounds (LDGT3/LDGT4), heavy duty gas vehicles (HDGV), light duty diesel vehicles (LDDV), light duty diesel trucks (LDDT), heavy duty diesel vehicles (HDDV), and motorcycles (MC). Emission factors for these vehicle classes were calculated using MOBILE6.2, the latest version in a series of models developed by the US Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. The resulting emission factors were multiplied by the estimates of vehicle miles of travel (VMT) to generate emission estimates.

The main reference sources for preparing the onroad mobile source portion of the inventory were as follows:

- Emission Inventory Requirements for Carbon Monoxide State Implementation Plans, EPA-450/4-91-011, March 1991, (hereinafter referred to as EPA Guidance),
- Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, US EPA, January 2002,
- User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010, August 2003, (hereinafter referred to as User's Guide), and
- Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81-026d (Revised), 1992.

5.2 VMT estimation procedure

MAG prepared the 2002 vehicle miles of travel (VMT) estimates for the ozone nonattainment area and Maricopa County. The source of data for these estimates is the 2002 Highway Performance Monitoring System (HPMS) data (see Appendix 5.1) submitted to the US Department of Transportation, Federal Highway Administration (FHWA) by the Arizona Department of Transportation (ADOT). The ADOT contact person for the HPMS VMT estimates is Mark Catchpole (602-712-8596).

Each year, ADOT coordinates the collection of HPMS data, including the annual average daily traffic (AADT) estimates which are utilized to develop HPMS VMT estimates. ADOT provides the AADT for the state highway system routes including interstates, urban freeways, and principal arterials in Maricopa County. AADTs for other non-local facilities are provided by local

jurisdictions. ADOT merges the Maricopa County data with information from other Arizona counties to create the statewide HPMS dataset submitted to FHWA each year.

HPMS contains a number of data elements which describe roadway characteristics and performance for every non-local roadway in Arizona. All non-local roadways have been divided into sections which are 0.3 to 10 miles in length, in accordance with HPMS criteria. These sections are called HPMS universe sections. HPMS contains additional data elements which provide more detailed information on a randomly-selected set of sample sections. The VMT estimates which ADOT submits to FHWA each year are generated from HPMS universe data for all interstates, urban freeways, and principal arterials. Sample section data are expanded to estimate VMT on all other non-local systems.

VMT on local streets in the urbanized portion of Maricopa County is estimated using traffic counts collected on 50 randomly-selected local streets in June-July of 1994. These counts resulted in an AADT of 587 for local roads in the urbanized area. To calculate VMT, this AADT was applied to local road mileage in 1994 obtained from the Maricopa County street centerline coverage. In 1994, an AADT of 150 was assumed for local roads which are in the "donut" area. The "donut" area is an HPMS term referring specifically to the area inside the PM_{10} nonattainment area, but outside the Phoenix urbanized area boundary. Since 1994, the AADTs on local streets have been increased annually on the basis of the rate of population growth in the Maricopa County population; the mileage on local streets is updated annually by the local jurisdictions in Maricopa County. VMT for the ozone nonattainment area, based on the 2002 HPMS data ADOT submitted to FHWA, is summarized by area type and facility type in Table 5.2–1.

Table 5.2–1. 2002 HPMS VMT by area type and facility type for the ozone nonattainment area (annual average daily traffic).

	Area Type					
Facility type:	**1**	**2**	**3**	**4**	**5**	**Total**
Interstate / Freeway	1,129,051	9,046,583	6,240,489	4,525,653	2,678,544	23,620,320
Principal Arterial / Minor Arterial	1,087,462	8,834,531	9,795,953	6,923,412	2,670,291	29,311,650
Collector	1,046,993	2,727,290	1,694,159	872,616	955,062	7,296,120
Local	195,247	1,991,136	2,564,545	1,689,510	855,772	7,296,210
Totals:	**3,458,753**	**22,599,539**	**20,295,146**	**14,011,191**	**7,159,670**	**67,524,300**

Notes:

1. Area Type = f(DENSITY of a planning district) where:
   DENSITY = (Population + 2 × Employment) / Area
   For Area Type 1, DENSITY = 20,001+ (Central Business District)
   For Area Type 2, DENSITY = 10,001–20,000 (Outlying Central Business District)
   For Area Type 3, DENSITY = 5,001–10,000 (Mixed Urban)
   For Area Type 4, DENSITY = 1,001–5,000 (Suburban)
   For Area Type 5, DENSITY = 0–1,000 (Rural)
2. Total VMT by facility type is extracted from the appropriate HPMS templates, with the urbanized area VMT reduced by 1 percent and the donut area VMT reduced by 28 percent.
3. VMT is split up into Area Types using data from MAG 2002 EMME/2 travel demand modeling results.
4. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

The 2002 HPMS System Length and Daily Vehicle Travel for individual urbanized areas (in Appendix 5.1) was submitted to FHWA by ADOT in October 2003. This table reported a 2002 average daily VMT (AADT) for the Phoenix urbanized area (#33) of 63.338 million. In comparison, the 2002 urbanized area VMT for the ozone nonattainment area used in the periodic emissions inventory is 62.705 million. The one percent difference between these totals is attributable to small sections of the Phoenix urbanized area (i.e. Apache Junction) which are not located in the ozone nonattainment area and Maricopa County. The HPMS System Length and Daily Vehicle Travel, donut area data for individual NAAQS nonattainment areas, (in Appendix 5.1), reported a 2002 VMT for the "donut" area (#33) of 6.694 million. The factors (i.e. 99 percent for the urbanized area and 72 percent for the donut area) used to determine the allocation of HPMS VMT to the ozone nonattainment area were derived from the report, "Maricopa Association of Governments Highway Performance Monitoring System Update Study", January 1995. These factors were also used to derive VMT for the CO tracking area in Chapter Three of the "MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area", June 1999. The total 2002 daily VMT for the urbanized and "donut" areas in the ozone nonattainment area is 67.524 million, as shown in Table 5.2–1. It is important to note that the 2002 HPMS daily VMT for the ozone nonattainment area is within one percent of the 2002 VMT estimated by the MAG EMME/2 travel demand models for the same domain (after conversion of EMME/2 estimates from average weekday traffic to annual average daily traffic).

The distribution of VMT by facility type for the ozone nonattainment area in Table 5.2–1 was derived from the 2002 HPMS data, while the distribution by area type was derived from a MAG EMME/2 travel demand model run for 2002. The output of this traffic assignment was evaluated using GIS to obtain VMT by area type and facility type for the Phoenix urbanized and "donut" areas. The area type distributions from the EMME/2 assignment were applied to the 2002 HPMS VMT estimates by facility type for the urbanized and "donut" areas to create Table 5.2–1.

VMT estimates for all of Maricopa County were also developed by ADOT. The VMT division by area type for all of Maricopa County were developed by applying all additional VMT for each facility type to the Area Type 5 (rural) category, since all VMT outside of the ozone nonattainment area but inside Maricopa County is expected to be in a rural setting. The total VMT estimated for Maricopa County is 73.579 million miles per day for an annual average day. The VMT estimates for Maricopa County are shown in Table 5.2–2.

Table 5.2–2. 2002 HPMS VMT by area type and facility type for Maricopa County (annual average daily traffic).

	Area Type					
Facility type:	**1**	**2**	**3**	**4**	**5**	**Total**
Interstate / Freeway	1,129,051	9,046,583	6,240,489	4,525,653	5,662,224	26,604,000
Principal Arterial / Minor Arterial	1,087,462	8,834,531	9,795,953	6,923,412	3,738,642	30,380,000
Collector	1,046,993	2,727,290	1,694,159	872,616	2,390,942	8,732,000
Local	195,247	1,991,136	2,564,545	1,689,510	1,422,562	7,863,000
Totals:	**3,458,753**	**22,599,540**	**20,295,146**	**14,011,191**	**13,214,370**	**73,579,000**

Notes:

1. For the definition of "Area Type", see Table 5.2–1, Note 1.
2. VMT is split up into Area Types using data from MAG 2002 EMME/2 travel demand modeling results. All VMT outside of the HPMS urbanized and donut areas were applied to Area Type 5.
3. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

Although HPMS reports vehicle mix data for urban and rural areas of Arizona, there are insufficient classification stations in the Phoenix urbanized area to justify use of this information in calculating VMT by vehicle class. In addition, the HPMS vehicle class data do not discriminate between gas and diesel vehicles. Therefore, MOBILE6.2 model defaults, representing the fraction of total VMT for each vehicle class, were applied to VMT estimates for each facility type and area type.

5.3 Speed estimation procedure

MAG prepared the average daily speeds for the onroad mobile sources portion of the 2002 periodic ozone emissions inventory. The average daily speeds were developed from several sources representing the latest planning assumptions for 2002.

For the Interstate/Freeway category and for the Principal/Minor Arterial category, the speeds were developed using data in the February 11, 2004 draft report 2002-2003 MAG Regional Travel Time & Travel Speed Study. This report contained data for the functional classifications "HOV", "Freeway", "Expressway", "6 Leg Arterial", and "Major Arterial". Speeds for the first three categories were combined through a weighted average to develop the average speed for the Interstate/Freeway category used in the Periodic Inventory. Similarly, the two arterial categories contained in the speed study were combined through a weighted averaging to obtain a Principal Arterial/Minor Arterial category speed. In both of these categories, speeds were unique by area type.

The third facility type included in the periodic inventory is collectors. To develop speed estimates for this facility type, speeds were extracted from the latest 2002 travel demand model run created using the EMME/2 software. In the EMME/2 runs performed by MAG, some traffic links that are classified as "locals" would actually be classified as "collectors" by HPMS. The EMME/2 runs also contain artificial links that are categorized as locals. Since the HPMS collector category includes some EMME/2 collector links and some EMME/2 locals, the EMME/2 speeds for locals and collectors were averaged and the result was used for the HPMS category of collectors. Like the speeds for the Interstate/Freeway and Principal/Minor Arterials categories, the speeds for Collectors were calculated separately for each of the five area types.

The fourth of the HPMS facility types is local roadways. The MOBILE6.2 model assumes a set speed of 12.9 miles per hour for local roadways. This speed was incorporated into the current analysis for all local roadways, regardless of area type.

Table 5.3–1. Average daily speeds (mph) for the 2002 periodic emissions inventory.

	Area Type *				
Facility type:	**1**	**2**	**3**	**4**	**5**
Interstate / Freeway	59.7	60.3	63.2	64.8	64.2
Principal Arterial / Minor Arterial	30.3	34.4	36.1	39.0	42.6
Collector	18.2	19.1	24.4	24.7	28.2
Local	12.9	12.9	12.9	12.9	12.9

* For the definition of "Area Type", see Table 5.2–1, Note 1.

5.4 Monthly VMT factors

In the development of annual emissions totals for this inventory, emission factor estimates were estimated independently for each month, with month-specific meteorological and fuel data. Since average daily VMT varies by month, and the number of days in each month varies, these monthly average emission factors were weighted to more appropriately represent an annual average emission factor. Similarly, the conversion of annual average day traffic to the three months of the peak ozone season utilized the monthly VMT factors listed below.

Average daily VMT estimate factors in Table 5.4–1 were developed from the 1998 MAG Regional Congestion Study and the monthly factors are as follows:

Table 5.4–1. Average daily VMT adjustment factors by month.

Month	Avg daily VMT estimate factor	Month	Avg daily VMT estimate factor
January	0.98	July	0.94
February	1.03	August	0.96
March	1.03	September	0.99
April	1.03	October	1.02
May	0.99	November	1.02
June	0.98	December	1.04

These factors indicate, as an example, that an average day in February has three percent more traffic than an average month while an average day in June has two percent less traffic than average. Separately, the different number of days in a month will effect the weighting of monthly emission factors to an annual average. For instance, if each month had the same number of days, each monthly emission factor would be equally weighted by 1/12 (0.0833). Since each month does not have the same number of days, the monthly emission factors are weighted accordingly, with January being weighted 31/365 (0.0849), February being weighted 28/365 (0.0767), etc. Combining the two sets of adjustments, the February emission factors would be weighted by 1.03×0.0767 in the development of the annual emission factors.

These weightings are applied by the FORTRAN program "NEIProgram", which was created by MAG. NEIProgram reads in the individual MOBILE6.2 output files for all twelve months and for the I/M versus non-I/M scenarios. NEIProgram weighs those 24 sets of MOBILE6.2 output files to a single set of annual average emission factors. The complete source code for NEIProgram may be found in Appendix 5.6.

The same monthly factors were used to convert the annual average daily traffic estimates from the HPMS system to reflect an average day during the peak ozone season. The peak ozone season reflects the three consecutive months when peak ozone concentrations occur. For consistency with the 1999 periodic ozone precursors inventory, the three consecutive months selected were July through September, 2002, in accordance with EPA guidance. Averaging the monthly factors for July through September results in a factor of 0.96.

Table 5.4–2. Average daily VMT during 2002 ozone season for the ozone nonattainment area (July–September 2002).

	Area Type					
Facility type:	**1**	**2**	**3**	**4**	**5**	**Total**
Interstate / Freeway	1,083,889	8,684,720	5,990,869	4,344,627	2,571,402	22,675,507
Principal Arterial / Minor Arterial	1,043,964	8,481,150	9,404,115	6,646,476	2,563,479	28,139,183
Collector	1,005,113	2,618,198	1,626,393	837,711	916,860	7,004,275
Local	187,437	1,911,491	2,461,963	1,621,930	821,541	7,004,362
Totals:	**3,320,403**	**21,695,559**	**19,483,340**	**13,450,744**	**6,873,282**	**64,823,327**

Notes:

1. For the definition of "Area Type", see Table 5.2–1, Note 1.
2. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

Table 5.4–3. Average daily VMT during 2002 ozone season for Maricopa County (July–September 2002).

	Area Type					
Facility type:	**1**	**2**	**3**	**4**	**5**	**Total**
Interstate / Freeway	1,083,889	8,684,720	5,990,869	4,344,627	5,435,735	25,539,840
Principal Arterial / Minor Arterial	1,043,964	8,481,150	9,404,115	6,646,476	3,589,096	29,164,801
Collector	1,005,113	2,618,198	1,626,393	837,711	2,295,304	8,382,719
Local	187,437	1,911,491	2,461,963	1,621,930	1,365,660	7,548,481
Totals:	**3,320,403**	**21,695,559**	**19,483,340**	**13,450,744**	**12,685,795**	**70,635,841**

Notes:

1. For the definition of "Area Type", see Table 5.2–1, Note 1.
2. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

5.5 Emission factor estimation procedure

5.5.1 Emission factor model

Volatile organic compounds (VOCs), oxides of nitrogen (NO_x) and carbon monoxide (CO) vehicle emission factors were calculated using MOBILE6.2. MOBILE6.2 is the latest version in a series of models developed by the US EPA for the purpose of estimating motor vehicle emission factors. The resulting emission factors were combined with vehicle miles of travel (VMT) estimates to produce total emission estimates for onroad vehicles. The MOBILE6.2 runs were executed by the Maricopa Association of Governments. The contact person for the MOBILE6.2 emission estimates is Roger Roy (602-254-6300).

For the ozone precursor season analysis, two MOBILE6.2 runs were executed for a typical day (24-hour period) during the three-month period of July through September. For the annual emissions estimates, two MOBILE6.2 runs were executed for each month of the year using month specific fuel and temperature data, reflecting vehicles registered locally (subject to the I/M program) and those not registered locally (not participating in the I/M program).

The emission factors estimated with these runs were combined to reflect the actual proportions of vehicles subject to the specified levels of inspection. The term "I/M vehicles" denotes vehicles which are required to undergo an emission test and/or inspection under the Arizona Vehicle Inspection/Maintenance Program. It is important to note that participation in the I/M program is required for all vehicles *registered* in the nonattainment area, with the exception of

certain model year and vehicle classes. However, it is assumed that of the vehicles which are of an age and type subject to an I/M program, only 91.7 percent of the vehicles *operating* within the nonattainment area participate in the I/M program. The remaining 8.3 percent do not participate in the program. These percentages reflect the control measures "Tougher Registration Enforcement" and "Expansion of Area A Boundaries", described in the Revised MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area, MAG, March 2001. In the absence of any additional data, this percentage split is assumed to apply directly to VMT as well. Refer to Appendix 5.2 for portions of the actual input and output files and a spreadsheet showing the emission factor calculations.

5.5.2 Development of model inputs

The inputs to MOBILE6.2 are grouped into three categories: Header inputs, run inputs, and scenario inputs. The input values used in the MOBILE6.2 runs are specified and explained below. Humidity was not used as an input to the monthly runs that were used to create an annual average emission estimate. After reviewing the MOBILE6.2 guidance on the use of local humidity data (see page 7 of http://www.epa.gov/otaq/models/mobile6/m6techgd.pdf) , it does not appear that inputting specific humidity values would be appropriate for the development of an annual average emissions inventory of this type. However, humidity estimates were used for the ozone season analysis, in accordance with the aforementioned MOBILE6.2 guidance.

Header Section

1. **MOBILE6 INPUT FILE:** indicates that the MOBILE6.2 input file is a regular command file rather than a batch file.

Run Data Section

1. **NO REFUELING:** indicates that refueling emissions are excluded from the MOBILE6.2 outputs. Refueling emissions are included in the Area Sources chapter of the 2002 inventory.

2. **I/M PROGRAM: 1 1977 2050 1 T/O LOADED IDLE** indicates the program start and end dates, frequency of testing, and test type. There are five components of the I/M program modeled; a loaded idle test for heavy duty gasoline vehicles (shown in the example in Appendix 5.2), a transient idle test (I/M240 modeled as a surrogate for the I/M147 test) for light duty cars and trucks through model year 1995, a loaded idle test for light duty cars and trucks of model years 1967 to 1980, an on-board diagnostic (OBD) exhaust test for model year 1996 and newer vehicles, and an OBD evaporative test for the same vehicles. The remaining four occurrences of this command are as follows:

   I/M PROGRAM: 2 1977 2050 2 T/O IM240 - relating to the transient idle I/M240 program modeled as a surrogate for the I/M147 program.

   I/M PROGRAM: 3 1977 2050 1 T/O LOADED IDLE - relating to the loaded idle program for model year 1967-1980 light duty cars and trucks.

I/M PROGRAM: 4 2001 2050 2 T/O OBD I/M - relating to the exhaust portion of the OBD test.

I/M PROGRAM: 5 2001 2050 2 T/O EVAP OBD & GC - relating to the evaporative and gas cap portion of the OBD test.

3. **I/M MODEL YEARS: 1 1967 2050** indicates the first and last model years affected by the given component of the I/M program. The inputs shown above indicate that model years 1967 and newer are tested by component 1 of the I/M program. The remaining four occurrences of this command are as follows:

   I/M MODEL YEARS: 2 1981 1995 - relating to the transient idle I/M240 program modeled as a surrogate for the I/M147 program.

   I/M MODEL YEARS: 3 1967 1980 - relating to the loaded idle program for model year 1967-1980 light duty cars and trucks.

   I/M MODEL YEARS: 4 1996 2050 - relating to the exhaust portion of the OBD test.

   I/M MODEL YEARS: 5 1996 2050 - relating to the evaporative and gas cap portion of the OBD test.

4. **I/M VEHICLES: 1 11111 22222222 2** indicates that for the first component of the I/M program (1), the five vehicle categories LDGV, LDGT1, LDGT2, LDGT3, and LDGT4 are not subject to this portion of the I/M program (indicated by "1") while HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B, and gasoline buses are covered (indicated by "2"). The remaining four occurrences of this command are as follows:

   I/M VEHICLES: 2 22222 11111111 1 indicates that the opposite vehicle classes are subject to the transient idle I/M240 program modeled as a surrogate for the I/M147 program. This selection of vehicle classes is also applied to the remaining three portions of the I/M program.

5. **I/M STRINGENCY: 1 28.0** indicates that the initial test failure rate for pre-1981 LDGVs and pre-1984 LDGTs is 28.0 percent. This stringency rate is also applied to the remaining portions of the I/M program.

6. **I/M COMPLIANCE: 1 97.0** indicates that the fraction of the total vehicle fleet subject to the I/M program that passes the I/M test or receives a waiver is 97.0 percent. This compliance rate is also applied to the remaining portion of the I/M program.

7. **I/M WAIVER RATES: 1 1.3 1.0** indicates that the fraction of vehicles that fail the I/M program is 1.3 for pre-1981 model years and 1.0 percent for 1981 and later model years. These waiver rates are also applied to the remaining portion of the I/M program.

8. **I/M GRACE PERIOD: 1 5** indicates that vehicles less than 5 years old are exempted from the I/M program. This exemption is identical for all portions of the I/M program.

9. **I/M CUTPOINTS: 2 CUTcmp02.d** indicates that for the ozone peak season analysis, MOBILE6.2 reads the external data file "CUTcmp02.d" for the I/M cutpoint values for HC, CO, and NO_x. There are 25 values for each vehicle class and pollutant, for the most recent 25 model years, starting with the youngest vehicle. This data is only input for the I/M240 program. For the monthly MOBILE6.2 runs performed to develop the annual ozone precursor emissions estimates, the file CUTcmp02.d was used for the January through September 2002 analyses and CUTcmp03.d was used for October through December.

10. **ANTI-TAMP PROGRAM: 87 75 80 22222 22222222 2 11 097. 22111222** indicates the nature of the anti-tampering program. Specifically, this portion of the anti-tampering program began in 1987 and covers model year vehicles 1975 to 1980. Vehicle classes subject to the inspection (indicated by a "2") include LDGV, LDGT1, LDGT2, LDGT3, LDGT4, HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B, and gasoline powered buses. The test is performed annually. The test has a 97 percent compliance rate. The parameters tested include air pump disablement, catalyst removal, evaporative system disablement, PCV system disablement, and missing gas cap. The parameters not tested are fuel inlet restrictor disablement, tailpipe lead deposit test, and EGR disablement. A second data line indicates that the same test is also performed on model year 1981 to 1995 vehicles, but with the LDGV, LDGT1, LDGT2, LDGT3, and LDGT4 classes omitted because those vehicles are subject to the transient I/M or OBD test.

11. **REG DIST: 02reg02.d** indicates that for the ozone peak season analysis, vehicle registration distributions by age for the 16 composite vehicle types are read by MOBILE6.2 from an external data file, called 02reg02.d. The raw data upon which the registration distributions and diesel fractions are based may be found in Appendix 5.3. The file 02reg02.d was used for the months January through September, 2002. The file 02reg03.d was used for the remaining months of October 2002 through December 2002 because those analyses are closer to a January 2003 scenario than a July 2002 scenario.

12. **DIESEL FRACTIONS:** indicates the user-supplied diesel sales fractions. This input is followed by 350 fractional values representing the fraction of the 14 vehicle classes internally examined by MOBILE6.2 and 25 most recent model years that are diesel vehicles. As an example, the first value, 0.0050, indicates that for the most recent model year of light duty vehicles, 0.5 percent of the vehicles sold are diesel.

Scenario Section

1. **SCENARIO RECORD:** Allows the user to enter a name to identify the scenario being run.

2. **CALENDAR YEAR: 2002** was input because the applicable three-month period for the ozone season inventory is July through September of 2002. To be consistent with the

User's Guide, the calendar year 2002 was chosen to model conditions representative of the applicable period. For the annual emission estimates, the calendar year 2002 was chosen for the months January through September while for the months of October through December, the calendar year 2003 was chosen because a January 2003 scenario more closely matches those months than a January 2002 scenario.

3. **EVALUATION MONTH: 7** indicates that the month to be modeled for the peak ozone season inventory is July. For the annual emissions estimates, the months April through September were run with this setting while the remaining months were processed with the evaluation month set to January. January and July are the only settings allowed for the evaluation month.

4. **ALTITUDE:1** indicates the geographic area modeled was low altitude.

5. **MIN/MAX TEMPERATURE: 80.0 104.** provides the model with the daily minimum and maximum temperatures for the peak ozone season day modeled. The temperatures used are consistent with those modeled for the previous ozone precursor periodic inventories. For the monthly analyses used to estimate annual emissions, temperatures were derived from the appropriate Sky Harbor Airport Local Climatological Data (LCD) reports. The raw meteorological data may be found in Appendix 5.4.

6. **AVERAGE SPEED: various speeds analyzed** indicates to MOBILE6.2 the average speed to be modeled for each facility type and area type combination. All facility and area type combinations with unique speeds will be modeled in this manner.

7. **VMT BY FACILITY: allfwy.def** indicates to MOBILE6.2 that the external file allfwy.def is to be referenced for the ratio of VMT by hour by facility type. The file allfwy indicates that all VMT is occurring on the MOBILE6.2 facility type freeways for use in developing the emission factors for the periodic inventory functional classifications Interstates/Freeways/Expressways. Similarly, the external file allart.def is called when estimating the emission factors for the arterials or collectors, and allloc.def is called when estimating the emission factors for the periodic inventory category locals.

8. **FUEL RVP: 6.6** Indicates that the average Reid Vapor Pressure of the gasoline sold during this time period is 6.6 pounds per square inch. This estimate is based upon raw gasoline data provided by the Arizona Department of Weights and Measures. Specifically, this value represents the average RVP of 192 samples collected from July through September of 2002. For the annual emissions estimates, monthly RVP estimates were derived from the Arizona Department of Weights and Measures data table for use in the monthly MOBILE6.2 analyses incorporated into this analysis. Monthly fuel qualities, including RVP, sulfur content, and ethanol content, are summarized in Appendix 5.7.

9. **FUEL PROGRAM: 4** Indicates that the model is to be run with user-supplied gasoline sulfur levels. The following four lines include 32 numbers, the first 16 listing the average gasoline sulfur value in parts per million for the years 2000 through 2015 and the second 16 indicate the maximum gasoline sulfur content vehicles of model year 2000 through 2015 will be exposed. For the purposes of this analysis, the gasoline data from the time period of November and December 2002 was examined and the average sampled sulfur values during that time period were entered for all time periods. Similarly, the gasoline data for all of 2002 was examined and the maximum sulfur value during that time period was entered for each model year of 2000 through 2015. Those values were 78.1 for average sulfur content and 338.0 ppm for a maximum sulfur content. For the monthly MOBILE6.2 analyses incorporated into this analysis, the average monthly sulfur content from the Arizona Department of Weights and Measures data table were used for the average sulfur value while the 338.0 ppm estimate was used for each month as the maximum sulfur content.

10. **OXYGENATED FUELS: 1.000 0.000 0.019 0.000 1** Indicates that the 100 percent of the gasoline sold during the ozone season modeled used MTBE as an oxygenate and 0 percent of the gasoline used ethanol as an oxygenate. The average MTBE content was 1.9 percent by weight and the average ethanol content was 0.0 percent by weight. The number "1" indicates that no RVP waiver has been granted to allow for the "splash" blending of ethanol oxygenates. For the monthly MOBILE6.2 analyses incorporated into this analysis, the average monthly oxygenate content from the Arizona Department of Weights and Measures data table were used, with the exception of January through March 2003, a time period during which no oxygenate data were available. For those months, an average of the months November and December were used.

5.5.3 Model outputs

MOBILE6.2 was executed with the inputs described above to obtain composite emission factors in grams per mile (g/mi) for VOC, NO_x, and CO. These values were obtained for the eight vehicle classes described in section 5.1 for the various speeds as described in item six of the **Scenario Section**, described on the preceding page. The emission factors generated for 2002 are presented in the following section. Representative output runs are contained in Appendix 5.2. These values were subsequently used in developing emission estimates.

5.5.4 Summary of emission factors

Refer to Appendix 5.2 for the emission factors developed for VOC, NO_x, and CO for each vehicle class, facility, and area type.

5.5.5 Emission estimates

MOBILE6.2 was used to generate onroad emission factors for vehicle class, facility, and area type. Daily VMT (DVMT) for the ozone season (Table 5.4–2 and 5.4–3) or for an annual average day (Table 5.2–1 and 5.2–2) was then multiplied by the VMT mix by vehicle class and the appropriate ozone precursor emission factor (Appendix 5.2) to estimate emissions on a kilogram per day (kg/day) basis. VMT mix refers to the fraction of total onroad vehicle miles of travel from a particular vehicle type. For example, since the EPA MOBILE6.2 model estimates that 45.1 percent of onroad VMT was from light duty gasoline vehicles, the VMT Mix value for LDGVs is 0.451. An example calculation for VOC emissions is given below, reflecting light duty gasoline vehicles on interstates, freeways, and expressways in area type 1 for the summer ozone season (see Table 5.5–1):

VOC emissions (kg/day)	= DMVT	×	VMT mix	× VOC emission factor (g/mi)	÷ unit conversion factor (g/kg)	
	= 1,083,889	×	0.451	× 0.976	÷ 1,000	
	= 477 kg VOC/day					

VOC emissions (lb/day)	= VOC emissions (kg/day)	÷	unit conversion factor (kg/lb)
	= 477 kg	÷	0.4536
	= 1,052 lb VOC/day		

Tables 5.5–1 through 5.5–12 show daily VMT data, associated speed estimates, MOBILE6.2 emission factors, and the calculated VOC, NO_x, and CO emissions for each vehicle class, facility, and area type for the nonattainment area or Maricopa County and for the peak ozone season or annual average day.

Table 5.5–1. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.976	1,083,889	1,051.9	477.1
		2	60.3	0.975	8,684,720	8,418.7	3,818.7
		3	63.2	0.974	5,990,869	5,801.4	2,631.5
		4	64.8	0.974	4,344,627	4,207.2	1,908.4
		5	64.2	0.974	2,571,402	2,490.1	1,129.5
	LDGT1 with VMT mix of 28.2%	1	59.7	1.142	1,083,889	770.1	349.3
		2	60.3	1.139	8,684,720	6,153.5	2,791.2
		3	63.2	1.138	5,990,869	4,240.7	1,923.6
		4	64.8	1.138	4,344,627	3,075.4	1,395.0
		5	64.2	1.138	2,571,402	1,820.2	825.6
	LDGT2 with VMT mix of 11.2%	1	59.7	1.379	1,083,889	367.6	166.7
		2	60.3	1.376	8,684,720	2,938.8	1,333.0
		3	63.2	1.373	5,990,869	2,024.2	918.2
		4	64.8	1.373	4,344,627	1,467.9	665.9
		5	64.2	1.373	2,571,402	868.8	394.1
	HDGV with VMT mix of 3.6%	1	59.7	0.920	1,083,889	78.2	35.5
		2	60.3	0.919	8,684,720	626.3	284.1
		3	63.2	0.919	5,990,869	432.0	195.9
		4	64.8	0.919	4,344,627	313.3	142.1
		5	64.2	0.919	2,571,402	185.4	84.1
	LDDV with VMT mix of 0.2%	1	59.7	0.393	1,083,889	2.1	0.9
		2	60.3	0.393	8,684,720	16.6	7.5
		3	63.2	0.393	5,990,869	11.4	5.2
		4	64.8	0.393	4,344,627	8.3	3.8
		5	64.2	0.393	2,571,402	4.9	2.2
	LDDT with VMT mix of 2.2%	1	59.7	0.267	1,083,889	13.8	6.3
		2	60.3	0.267	8,684,720	110.4	50.1
		3	63.2	0.267	5,990,869	76.2	34.5
		4	64.8	0.267	4,344,627	55.2	25.1
		5	64.2	0.267	2,571,402	32.7	14.8
	HDDV with VMT mix of 9.1%	1	59.7	0.396	1,083,889	86.0	39.0
		2	60.3	0.396	8,684,720	689.1	312.6
		3	63.2	0.396	5,990,869	475.4	215.6
		4	64.8	0.396	4,344,627	344.7	156.4
		5	64.2	0.396	2,571,402	204.0	92.6
	MC with VMT mix of 0.5%	1	59.7	2.710	1,083,889	33.0	15.0
		2	60.3	2.750	8,684,720	268.5	121.8
		3	63.2	2.780	5,990,869	187.2	84.9
		4	64.8	2.780	4,344,627	135.8	61.6
		5	64.2	2.780	2,571,402	80.4	36.5

Table 5.5–1. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIALS and MINOR ARTERIALS	LDGV with VMT mix of 45.1%	1	30.3	1.111	1,043,964	1,152.3	522.7
		2	34.4	1.071	8,481,150	9,024.2	4,093.4
		3	36.1	1.059	9,404,115	9,901.2	4,491.2
		4	39.0	1.045	6,646,476	6,902.5	3,131.0
		5	42.6	1.028	2,563,479	2,620.4	1,188.6
	LDGT1 with VMT mix of 28.2%	1	30.3	1.325	1,043,964	860.4	390.3
		2	34.4	1.275	8,481,150	6,724.5	3,050.2
		3	36.1	1.259	9,404,115	7,366.6	3,341.5
		4	39.0	1.239	6,646,476	5,122.4	2,323.5
		5	42.6	1.216	2,563,479	1,939.6	879.8
	LDGT2 with VMT mix of 11.2%	1	30.3	1.615	1,043,964	414.8	188.1
		2	34.4	1.551	8,481,150	3,235.7	1,467.7
		3	36.1	1.533	9,404,115	3,545.4	1,608.2
		4	39.0	1.508	6,646,476	2,465.9	1,118.5
		5	42.6	1.479	2,563,479	932.6	423.0
	HDGV with VMT mix of 3.6%	1	30.3	1.318	1,043,964	108.0	49.0
		2	34.4	1.199	8,481,150	797.8	361.9
		3	36.1	1.158	9,404,115	854.9	387.8
		4	39.0	1.100	6,646,476	573.7	260.2
		5	42.6	1.042	2,563,479	209.7	95.1
	LDDV with VMT mix of 0.2%	1	30.3	0.499	1,043,964	2.5	1.1
		2	34.4	0.468	8,481,150	19.2	8.7
		3	36.1	0.457	9,404,115	20.8	9.5
		4	39.0	0.440	6,646,476	14.2	6.4
		5	42.6	0.424	2,563,479	5.3	2.4
	LDDT with VMT mix of 2.2%	1	30.3	0.356	1,043,964	17.7	8.0
		2	34.4	0.330	8,481,150	133.3	60.4
		3	36.1	0.320	9,404,115	143.3	65.0
		4	39.0	0.307	6,646,476	97.2	44.1
		5	42.6	0.293	2,563,479	35.8	16.2
	HDDV with VMT mix of 9.1%	1	30.3	0.603	1,043,964	126.1	57.2
		2	34.4	0.541	8,481,150	919.4	417.0
		3	36.1	0.520	9,404,115	979.9	444.5
		4	39.0	0.488	6,646,476	649.9	294.8
		5	42.6	0.456	2,563,479	234.2	106.2
	MC with VMT mix of 0.5%	1	30.3	2.450	1,043,964	28.8	13.0
		2	34.4	2.330	8,481,150	222.2	100.8
		3	36.1	2.290	9,404,115	242.1	109.8
		4	39.0	2.240	6,646,476	167.4	75.9
		5	42.6	2.190	2,563,479	63.1	28.6

Table 5.5–1. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.322	1,005,113	1,321.0	599.2
COLLECTOR	LDGV	2	19.1	1.298	2,618,198	3,377.6	1,532.1
	with VMT	3	24.4	1.187	1,626,393	1,918.6	870.3
	mix of	4	24.7	1.182	837,711	984.0	446.3
	45.1%	5	28.2	1.134	916,860	1,033.4	468.8
		1	18.2	1.582	1,005,113	989.4	448.8
	LDGT1	2	19.1	1.549	2,618,198	2,522.5	1,144.2
	with VMT	3	24.4	1.413	1,626,393	1,430.0	648.6
	mix of	4	24.7	1.407	837,711	733.4	332.7
	28.2%	5	28.2	1.352	916,860	771.3	349.9
		1	18.2	1.931	1,005,113	477.4	216.6
	LDGT2	2	19.1	1.889	2,618,198	1,216.8	552.0
	with VMT	3	24.4	1.724	1,626,393	689.6	312.8
	mix of	4	24.7	1.717	837,711	353.8	160.5
	11.2%	5	28.2	1.650	916,860	372.1	168.8
		1	18.2	2.008	1,005,113	158.3	71.8
	HDGV	2	19.1	1.931	2,618,198	396.7	179.9
	with VMT	3	24.4	1.571	1,626,393	200.5	91.0
	mix of	4	24.7	1.556	837,711	102.3	46.4
	3.6%	5	28.2	1.396	916,860	100.4	45.5
		1	18.2	0.652	1,005,113	3.2	1.4
	LDDV	2	19.1	0.637	2,618,198	8.1	3.7
	with VMT	3	24.4	0.561	1,626,393	4.4	2.0
	mix of	4	24.7	0.557	837,711	2.3	1.0
	0.2%	5	28.2	0.519	916,860	2.3	1.0
		1	18.2	0.484	1,005,113	23.2	10.5
	LDDT	2	19.1	0.472	2,618,198	58.8	26.7
	with VMT	3	24.4	0.408	1,626,393	31.6	14.3
	mix of	4	24.7	0.405	837,711	16.2	7.3
	2.2%	5	28.2	0.372	916,860	16.2	7.4
		1	18.2	0.901	1,005,113	181.5	82.3
	HDDV	2	19.1	0.872	2,618,198	457.5	207.5
	with VMT	3	24.4	0.723	1,626,393	235.6	106.9
	mix of	4	24.7	0.716	837,711	120.2	54.5
	9.1%	5	28.2	0.641	916,860	117.8	53.4
		1	18.2	3.000	1,005,113	33.9	15.4
	MC	2	19.1	2.940	2,618,198	86.5	39.3
	with VMT	3	24.4	2.660	1,626,393	48.6	22.1
	mix of	4	24.7	2.650	837,711	25.0	11.3
	0.5%	5	28.2	2.510	916,860	25.9	11.7

Table 5.5–1. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	1.530	187,437	285.1	129.3
		2	12.9	1.530	1,911,491	2,907.5	1,318.8
		3	12.9	1.530	2,461,963	3,744.8	1,698.6
		4	12.9	1.530	1,621,930	2,467.0	1,119.0
		5	12.9	1.530	821,541	1,249.6	566.8
	LDGT1 with VMT mix of 28.2%	1	12.9	1.869	187,437	218.0	98.9
		2	12.9	1.869	1,911,491	2,222.7	1,008.2
		3	12.9	1.869	2,461,963	2,862.8	1,298.6
		4	12.9	1.869	1,621,930	1,886.0	855.5
		5	12.9	1.869	821,541	955.3	433.3
	LDGT2 with VMT mix of 11.2%	1	12.9	2.278	187,437	105.0	47.6
		2	12.9	2.278	1,911,491	1,071.0	485.8
		3	12.9	2.278	2,461,963	1,379.5	625.7
		4	12.9	2.278	1,621,930	908.8	412.2
		5	12.9	2.278	821,541	460.3	208.8
	HDGV with VMT mix of 3.6%	1	12.9	2.630	187,437	38.7	17.5
		2	12.9	2.630	1,911,491	394.5	178.9
		3	12.9	2.630	2,461,963	508.0	230.4
		4	12.9	2.630	1,621,930	334.7	151.8
		5	12.9	2.630	821,541	169.5	76.9
	LDDV with VMT mix of 0.2%	1	12.9	0.760	187,437	0.7	0.3
		2	12.9	0.760	1,911,491	7.0	3.2
		3	12.9	0.760	2,461,963	9.1	4.1
		4	12.9	0.760	1,621,930	6.0	2.7
		5	12.9	0.760	821,541	3.0	1.4
	LDDT with VMT mix of 2.2%	1	12.9	0.576	187,437	5.1	2.3
		2	12.9	0.576	1,911,491	52.4	23.8
		3	12.9	0.576	2,461,963	67.5	30.6
		4	12.9	0.576	1,621,930	44.5	20.2
		5	12.9	0.576	821,541	22.5	10.2
	HDDV with VMT mix of 9.1%	1	12.9	1.114	187,437	41.8	19.0
		2	12.9	1.114	1,911,491	426.7	193.5
		3	12.9	1.114	2,461,963	549.6	249.3
		4	12.9	1.114	1,621,930	362.0	164.2
		5	12.9	1.114	821,541	183.4	83.2
	MC with VMT mix of 0.5%	1	12.9	3.550	187,437	7.5	3.4
		2	12.9	3.550	1,911,491	76.3	34.6
		3	12.9	3.550	2,461,963	98.3	44.6
		4	12.9	3.550	1,621,930	64.7	29.4
		5	12.9	3.550	821,541	32.8	14.9

Table 5.5–2. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.976	1,083,889	1,051.9	477.1
		2	60.3	0.975	8,684,720	8,418.7	3,818.7
		3	63.2	0.974	5,990,869	5,801.4	2,631.5
		4	64.8	0.974	4,344,627	4,207.2	1,908.4
		5	64.2	0.974	5,435,735	5,263.9	2,387.7
	LDGT1 with VMT mix of 28.2%	1	59.7	1.142	1,083,889	770.1	349.3
		2	60.3	1.139	8,684,720	6,153.5	2,791.2
		3	63.2	1.138	5,990,869	4,240.7	1,923.6
		4	64.8	1.138	4,344,627	3,075.4	1,395.0
		5	64.2	1.138	5,435,735	3,847.8	1,745.4
	LDGT2 with VMT mix of 11.2%	1	59.7	1.379	1,083,889	367.6	166.7
		2	60.3	1.376	8,684,720	2,938.8	1,333.0
		3	63.2	1.373	5,990,869	2,024.2	918.2
		4	64.8	1.373	4,344,627	1,467.9	665.9
		5	64.2	1.373	5,435,735	1,836.6	833.1
	HDGV with VMT mix of 3.6%	1	59.7	0.920	1,083,889	78.2	35.5
		2	60.3	0.919	8,684,720	626.3	284.1
		3	63.2	0.919	5,990,869	432.0	195.9
		4	64.8	0.919	4,344,627	313.3	142.1
		5	64.2	0.919	5,435,735	391.9	177.8
	LDDV with VMT mix of 0.2%	1	59.7	0.393	1,083,889	2.1	0.9
		2	60.3	0.393	8,684,720	16.6	7.5
		3	63.2	0.393	5,990,869	11.4	5.2
		4	64.8	0.393	4,344,627	8.3	3.8
		5	64.2	0.393	5,435,735	10.4	4.7
	LDDT with VMT mix of 2.2%	1	59.7	0.267	1,083,889	13.8	6.3
		2	60.3	0.267	8,684,720	110.4	50.1
		3	63.2	0.267	5,990,869	76.2	34.5
		4	64.8	0.267	4,344,627	55.2	25.1
		5	64.2	0.267	5,435,735	69.1	31.3
	HDDV with VMT mix of 9.1%	1	59.7	0.396	1,083,889	86.0	39.0
		2	60.3	0.396	8,684,720	689.1	312.6
		3	63.2	0.396	5,990,869	475.4	215.6
		4	64.8	0.396	4,344,627	344.7	156.4
		5	64.2	0.396	5,435,735	431.3	195.6
	MC with VMT mix of 0.5%	1	59.7	2.710	1,083,889	33.0	15.0
		2	60.3	2.750	8,684,720	268.5	121.8
		3	63.2	2.780	5,990,869	187.2	84.9
		4	64.8	2.780	4,344,627	135.8	61.6
		5	64.2	2.780	5,435,735	169.9	77.1

Table 5.5–2. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIALS and MINOR ARTERIALS	LDGV with VMT mix of 45.1%	1	30.3	1.111	1,043,964	1,152.3	522.7
		2	34.4	1.071	8,481,150	9,024.2	4,093.4
		3	36.1	1.059	9,404,115	9,901.2	4,491.2
		4	39.0	1.045	6,646,476	6,902.5	3,131.0
		5	42.6	1.028	3,589,096	3,668.8	1,664.2
	LDGT1 with VMT mix of 28.2%	1	30.3	1.325	1,043,964	860.4	390.3
		2	34.4	1.275	8,481,150	6,724.5	3,050.2
		3	36.1	1.259	9,404,115	7,366.6	3,341.5
		4	39.0	1.239	6,646,476	5,122.4	2,323.5
		5	42.6	1.216	3,589,096	2,715.7	1,231.8
	LDGT2 with VMT mix of 11.2%	1	30.3	1.615	1,043,964	414.8	188.1
		2	34.4	1.551	8,481,150	3,235.7	1,467.7
		3	36.1	1.533	9,404,115	3,545.4	1,608.2
		4	39.0	1.508	6,646,476	2,465.9	1,118.5
		5	42.6	1.479	3,589,096	1,305.7	592.2
	HDGV with VMT mix of 3.6%	1	30.3	1.318	1,043,964	108.0	49.0
		2	34.4	1.199	8,481,150	797.8	361.9
		3	36.1	1.158	9,404,115	854.9	387.8
		4	39.0	1.100	6,646,476	573.7	260.2
		5	42.6	1.042	3,589,096	293.6	133.2
	LDDV with VMT mix of 0.2%	1	30.3	0.499	1,043,964	2.5	1.1
		2	34.4	0.468	8,481,150	19.2	8.7
		3	36.1	0.457	9,404,115	20.8	9.5
		4	39.0	0.440	6,646,476	14.2	6.4
		5	42.6	0.424	3,589,096	7.4	3.3
	LDDT with VMT mix of 2.2%	1	30.3	0.356	1,043,964	17.7	8.0
		2	34.4	0.330	8,481,150	133.3	60.4
		3	36.1	0.320	9,404,115	143.3	65.0
		4	39.0	0.307	6,646,476	97.2	44.1
		5	42.6	0.293	3,589,096	50.1	22.7
	HDDV with VMT mix of 9.1%	1	30.3	0.603	1,043,964	126.1	57.2
		2	34.4	0.541	8,481,150	919.4	417.0
		3	36.1	0.520	9,404,115	979.9	444.5
		4	39.0	0.488	6,646,476	649.9	294.8
		5	42.6	0.456	3,589,096	327.9	148.8
	MC with VMT mix of 0.5%	1	30.3	2.450	1,043,964	28.8	13.0
		2	34.4	2.330	8,481,150	222.2	100.8
		3	36.1	2.290	9,404,115	242.1	109.8
		4	39.0	2.240	6,646,476	167.4	75.9
		5	42.6	2.190	3,589,096	88.4	40.1

Table 5.5–2. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.322	1,005,113	1,321.0	599.2
COLLECTOR	LDGV	2	19.1	1.298	2,618,198	3,377.6	1,532.1
	with VMT	3	24.4	1.187	1,626,393	1,918.6	870.3
	mix of	4	24.7	1.182	837,711	984.0	446.3
	45.1%	5	28.2	1.134	2,295,304	2,587.1	1,173.5
		1	18.2	1.582	1,005,113	989.4	448.8
	LDGT1	2	19.1	1.549	2,618,198	2,522.5	1,144.2
	with VMT	3	24.4	1.413	1,626,393	1,430.0	648.6
	mix of	4	24.7	1.407	837,711	733.4	332.7
	28.2%	5	28.2	1.352	2,295,304	1,930.9	875.9
		1	18.2	1.931	1,005,113	477.4	216.6
	LDGT2	2	19.1	1.889	2,618,198	1,216.8	552.0
	with VMT	3	24.4	1.724	1,626,393	689.6	312.8
	mix of	4	24.7	1.717	837,711	353.8	160.5
	11.2%	5	28.2	1.650	2,295,304	931.5	422.5
		1	18.2	2.008	1,005,113	158.3	71.8
	HDGV	2	19.1	1.931	2,618,198	396.7	179.9
	with VMT	3	24.4	1.571	1,626,393	200.5	91.0
	mix of	4	24.7	1.556	837,711	102.3	46.4
	3.6%	5	28.2	1.396	2,295,304	251.4	114.0
		1	18.2	0.652	1,005,113	3.2	1.4
	LDDV	2	19.1	0.637	2,618,198	8.1	3.7
	with VMT	3	24.4	0.561	1,626,393	4.4	2.0
	mix of	4	24.7	0.557	837,711	2.3	1.0
	0.2%	5	28.2	0.519	2,295,304	5.8	2.6
		1	18.2	0.484	1,005,113	23.2	10.5
	LDDT	2	19.1	0.472	2,618,198	58.8	26.7
	with VMT	3	24.4	0.408	1,626,393	31.6	14.3
	mix of	4	24.7	0.405	837,711	16.2	7.3
	2.2%	5	28.2	0.372	2,295,304	40.7	18.4
		1	18.2	0.901	1,005,113	181.5	82.3
	HDDV	2	19.1	0.872	2,618,198	457.5	207.5
	with VMT	3	24.4	0.723	1,626,393	235.6	106.9
	mix of	4	24.7	0.716	837,711	120.2	54.5
	9.1%	5	28.2	0.641	2,295,304	294.8	133.7
		1	18.2	3.000	1,005,113	33.9	15.4
	MC	2	19.1	2.940	2,618,198	86.5	39.3
	with VMT	3	24.4	2.660	1,626,393	48.6	22.1
	mix of	4	24.7	2.650	837,711	25.0	11.3
	0.5%	5	28.2	2.510	2,295,304	64.8	29.4

Table 5.5–2. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	1.530	187,437	285.1	129.3
		2	12.9	1.530	1,911,491	2,907.5	1,318.8
		3	12.9	1.530	2,461,963	3,744.8	1,698.6
		4	12.9	1.530	1,621,930	2,467.0	1,119.0
		5	12.9	1.530	1,365,660	2,077.2	942.2
	LDGT1 with VMT mix of 28.2%	1	12.9	1.869	187,437	218.0	98.9
		2	12.9	1.869	1,911,491	2,222.7	1,008.2
		3	12.9	1.869	2,461,963	2,862.8	1,298.6
		4	12.9	1.869	1,621,930	1,886.0	855.5
		5	12.9	1.869	1,365,660	1,588.0	720.3
	LDGT2 with VMT mix of 11.2%	1	12.9	2.278	187,437	105.0	47.6
		2	12.9	2.278	1,911,491	1,071.0	485.8
		3	12.9	2.278	2,461,963	1,379.5	625.7
		4	12.9	2.278	1,621,930	908.8	412.2
		5	12.9	2.278	1,365,660	765.2	347.1
	HDGV with VMT mix of 3.6%	1	12.9	2.630	187,437	38.7	17.5
		2	12.9	2.630	1,911,491	394.5	178.9
		3	12.9	2.630	2,461,963	508.0	230.4
		4	12.9	2.630	1,621,930	334.7	151.8
		5	12.9	2.630	1,365,660	281.8	127.8
	LDDV with VMT mix of 0.2%	1	12.9	0.760	187,437	0.7	0.3
		2	12.9	0.760	1,911,491	7.0	3.2
		3	12.9	0.760	2,461,963	9.1	4.1
		4	12.9	0.760	1,621,930	6.0	2.7
		5	12.9	0.760	1,365,660	5.0	2.3
	LDDT with VMT mix of 2.2%	1	12.9	0.576	187,437	5.1	2.3
		2	12.9	0.576	1,911,491	52.4	23.8
		3	12.9	0.576	2,461,963	67.5	30.6
		4	12.9	0.576	1,621,930	44.5	20.2
		5	12.9	0.576	1,365,660	37.5	17.0
	HDDV with VMT mix of 9.1%	1	12.9	1.114	187,437	41.8	19.0
		2	12.9	1.114	1,911,491	426.7	193.5
		3	12.9	1.114	2,461,963	549.6	249.3
		4	12.9	1.114	1,621,930	362.0	164.2
		5	12.9	1.114	1,365,660	304.8	138.3
	MC with VMT mix of 0.5%	1	12.9	3.550	187,437	7.5	3.4
		2	12.9	3.550	1,911,491	76.3	34.6
		3	12.9	3.550	2,461,963	98.3	44.6
		4	12.9	3.550	1,621,930	64.7	29.4
		5	12.9	3.550	1,365,660	54.5	24.7

Table 5.5–3. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.906	1,129,051	1,016.3	461.0
		2	60.3	0.904	9,046,583	8,129.5	3,687.5
		3	63.2	0.903	6,240,489	5,602.9	2,541.5
		4	64.8	0.903	4,525,653	4,063.3	1,843.1
		5	64.2	0.903	2,678,544	2,404.9	1,090.9
	LDGT1 with VMT mix of 28.2%	1	59.7	1.062	1,129,051	745.5	338.2
		2	60.3	1.060	9,046,583	5,962.5	2,704.6
		3	63.2	1.058	6,240,489	4,108.0	1,863.4
		4	64.8	1.058	4,525,653	2,979.1	1,351.3
		5	64.2	1.058	2,678,544	1,763.2	799.8
	LDGT2 with VMT mix of 11.2%	1	59.7	1.254	1,129,051	348.4	158.0
		2	60.3	1.252	9,046,583	2,785.7	1,263.6
		3	63.2	1.250	6,240,489	1,918.7	870.3
		4	64.8	1.250	4,525,653	1,391.5	631.2
		5	64.2	1.250	2,678,544	823.5	373.6
	HDGV with VMT mix of 3.6%	1	59.7	0.802	1,129,051	71.1	32.2
		2	60.3	0.802	9,046,583	569.3	258.2
		3	63.2	0.802	6,240,489	392.5	178.0
		4	64.8	0.802	4,525,653	284.7	129.1
		5	64.2	0.802	2,678,544	168.5	76.4
	LDDV with VMT mix of 0.2%	1	59.7	0.398	1,129,051	2.2	1.0
		2	60.3	0.398	9,046,583	17.5	7.9
		3	63.2	0.398	6,240,489	12.0	5.5
		4	64.8	0.398	4,525,653	8.7	4.0
		5	64.2	0.398	2,678,544	5.2	2.3
	LDDT with VMT mix of 2.2%	1	59.7	0.264	1,129,051	14.2	6.4
		2	60.3	0.264	9,046,583	113.6	51.5
		3	63.2	0.264	6,240,489	78.4	35.5
		4	64.8	0.264	4,525,653	56.8	25.8
		5	64.2	0.264	2,678,544	33.6	15.3
	HDDV with VMT mix of 9.1%	1	59.7	0.390	1,129,051	88.2	40.0
		2	60.3	0.390	9,046,583	707.0	320.7
		3	63.2	0.390	6,240,489	487.7	221.2
		4	64.8	0.390	4,525,653	353.7	160.4
		5	64.2	0.390	2,678,544	209.3	94.9
	MC with VMT mix of 0.5%	1	59.7	2.670	1,129,051	33.9	15.4
		2	60.3	2.712	9,046,583	275.8	125.1
		3	63.2	2.741	6,240,489	192.3	87.2
		4	64.8	2.741	4,525,653	139.5	63.3
		5	64.2	2.741	2,678,544	82.5	37.4

Table 5.5–3. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIALS and MINOR ARTERIALS	LDGV with VMT mix of 45.1%	1	30.3	1.040	1,087,462	1,124.5	510.1
		2	34.4	1.003	8,834,531	8,806.5	3,994.6
		3	36.1	0.992	9,795,953	9,656.8	4,380.3
		4	39.0	0.974	6,923,412	6,703.3	3,040.6
		5	42.6	0.957	2,670,291	2,540.8	1,152.5
	LDGT1 with VMT mix of 28.2%	1	30.3	1.226	1,087,462	829.3	376.2
		2	34.4	1.183	8,834,531	6,499.2	2,948.1
		3	36.1	1.170	9,795,953	7,128.5	3,233.5
		4	39.0	1.150	6,923,412	4,952.5	2,246.4
		5	42.6	1.130	2,670,291	1,877.1	851.4
	LDGT2 with VMT mix of 11.2%	1	30.3	1.469	1,087,462	392.9	178.2
		2	34.4	1.412	8,834,531	3,068.8	1,392.0
		3	36.1	1.396	9,795,953	3,363.9	1,525.9
		4	39.0	1.372	6,923,412	2,336.1	1,059.7
		5	42.6	1.347	2,670,291	884.9	401.4
	HDGV with VMT mix of 3.6%	1	30.3	1.181	1,087,462	100.8	45.7
		2	34.4	1.067	8,834,531	740.0	335.6
		3	36.1	1.029	9,795,953	791.3	359.0
		4	39.0	0.974	6,923,412	529.0	240.0
		5	42.6	0.919	2,670,291	192.6	87.3
	LDDV with VMT mix of 0.2%	1	30.3	0.505	1,087,462	2.7	1.2
		2	34.4	0.473	8,834,531	20.3	9.2
		3	36.1	0.462	9,795,953	21.9	10.0
		4	39.0	0.445	6,923,412	14.9	6.8
		5	42.6	0.429	2,670,291	5.6	2.5
	LDDT with VMT mix of 2.2%	1	30.3	0.352	1,087,462	18.2	8.3
		2	34.4	0.326	8,834,531	136.9	62.1
		3	36.1	0.316	9,795,953	147.5	66.9
		4	39.0	0.303	6,923,412	99.9	45.3
		5	42.6	0.289	2,670,291	36.8	16.7
	HDDV with VMT mix of 9.1%	1	30.3	0.594	1,087,462	129.4	58.7
		2	34.4	0.533	8,834,531	943.0	427.7
		3	36.1	0.512	9,795,953	1,005.0	455.9
		4	39.0	0.481	6,923,412	666.6	302.4
		5	42.6	0.449	2,670,291	240.2	109.0
	MC with VMT mix of 0.5%	1	30.3	2.413	1,087,462	29.5	13.4
		2	34.4	2.302	8,834,531	228.6	103.7
		3	36.1	2.265	9,795,953	249.4	113.1
		4	39.0	2.209	6,923,412	171.9	78.0
		5	42.6	2.162	2,670,291	64.9	29.4

Table 5.5–3. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.249	1,046,993	1,299.6	589.5
COLLECTOR	LDGV	2	19.1	1.222	2,727,290	3,312.0	1,502.3
	with VMT	3	24.4	1.112	1,694,159	1,873.2	849.7
	mix of	4	24.7	1.108	872,616	960.7	435.8
	45.1%	5	28.2	1.062	955,062	1,007.7	457.1
		1	18.2	1.461	1,046,993	951.6	431.7
	LDGT1	2	19.1	1.427	2,727,290	2,421.0	1,098.2
	with VMT	3	24.4	1.302	1,694,159	1,372.2	622.4
	mix of	4	24.7	1.297	872,616	703.9	319.3
	28.2%	5	28.2	1.248	955,062	741.5	336.4
		1	18.2	1.758	1,046,993	452.7	205.3
	LDGT2	2	19.1	1.717	2,727,290	1,152.0	522.5
	with VMT	3	24.4	1.563	1,694,159	651.5	295.5
	mix of	4	24.7	1.557	872,616	334.2	151.6
	11.2%	5	28.2	1.496	955,062	351.6	159.5
		1	18.2	1.841	1,046,993	151.2	68.6
	HDGV	2	19.1	1.764	2,727,290	377.6	171.3
	with VMT	3	24.4	1.421	1,694,159	188.9	85.7
	mix of	4	24.7	1.406	872,616	96.3	43.7
	3.6%	5	28.2	1.255	955,062	94.0	42.7
		1	18.2	0.658	1,046,993	3.3	1.5
	LDDV	2	19.1	0.644	2,727,290	8.5	3.9
	with VMT	3	24.4	0.567	1,694,159	4.7	2.1
	mix of	4	24.7	0.563	872,616	2.4	1.1
	0.2%	5	28.2	0.524	955,062	2.4	1.1
		1	18.2	0.478	1,046,993	23.8	10.8
	LDDT	2	19.1	0.466	2,727,290	60.5	27.4
	with VMT	3	24.4	0.403	1,694,159	32.5	14.7
	mix of	4	24.7	0.400	872,616	16.6	7.5
	2.2%	5	28.2	0.367	955,062	16.7	7.6
		1	18.2	0.887	1,046,993	186.2	84.4
	HDDV	2	19.1	0.859	2,727,290	469.5	213.0
	with VMT	3	24.4	0.712	1,694,159	241.8	109.7
	mix of	4	24.7	0.705	872,616	123.3	55.9
	9.1%	5	28.2	0.631	955,062	120.8	54.8
		1	18.2	2.947	1,046,993	34.7	15.7
	MC	2	19.1	2.891	2,727,290	88.7	40.2
	with VMT	3	24.4	2.626	1,694,159	50.0	22.7
	mix of	4	24.7	2.613	872,616	25.6	11.6
	0.5%	5	28.2	2.481	955,062	26.6	12.1

Table 5.5–3. Daily VOC emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	1.474	195,247	286.1	129.8
		2	12.9	1.474	1,991,136	2,917.2	1,323.2
		3	12.9	1.474	2,564,545	3,757.3	1,704.3
		4	12.9	1.474	1,689,510	2,475.3	1,122.8
		5	12.9	1.474	855,772	1,253.8	568.7
	LDGT1 with VMT mix of 28.2%	1	12.9	1.743	195,247	211.6	96.0
		2	12.9	1.743	1,991,136	2,158.3	979.0
		3	12.9	1.743	2,564,545	2,779.9	1,260.9
		4	12.9	1.743	1,689,510	1,831.4	830.7
		5	12.9	1.743	855,772	927.6	420.8
	LDGT2 with VMT mix of 11.2%	1	12.9	2.096	195,247	100.7	45.7
		2	12.9	2.096	1,991,136	1,026.6	465.7
		3	12.9	2.096	2,564,545	1,322.2	599.8
		4	12.9	2.096	1,689,510	871.1	395.1
		5	12.9	2.096	855,772	441.2	200.1
	HDGV with VMT mix of 3.6%	1	12.9	2.457	195,247	37.6	17.1
		2	12.9	2.457	1,991,136	384.0	174.2
		3	12.9	2.457	2,564,545	494.5	224.3
		4	12.9	2.457	1,689,510	325.8	147.8
		5	12.9	2.457	855,772	165.0	74.9
	LDDV with VMT mix of 0.2%	1	12.9	0.768	195,247	0.7	0.3
		2	12.9	0.768	1,991,136	7.4	3.4
		3	12.9	0.768	2,564,545	9.6	4.3
		4	12.9	0.768	1,689,510	6.3	2.9
		5	12.9	0.768	855,772	3.2	1.4
	LDDT with VMT mix of 2.2%	1	12.9	0.568	195,247	5.3	2.4
		2	12.9	0.568	1,991,136	53.8	24.4
		3	12.9	0.568	2,564,545	69.3	31.5
		4	12.9	0.568	1,689,510	45.7	20.7
		5	12.9	0.568	855,772	23.1	10.5
	HDDV with VMT mix of 9.1%	1	12.9	1.097	195,247	42.9	19.5
		2	12.9	1.097	1,991,136	437.8	198.6
		3	12.9	1.097	2,564,545	563.8	255.8
		4	12.9	1.097	1,689,510	371.4	168.5
		5	12.9	1.097	855,772	188.1	85.3
	MC with VMT mix of 0.5%	1	12.9	3.486	195,247	7.7	3.5
		2	12.9	3.486	1,991,136	78.0	35.4
		3	12.9	3.486	2,564,545	100.5	45.6
		4	12.9	3.486	1,689,510	66.2	30.0
		5	12.9	3.486	855,772	33.5	15.2

Table 5.5–4. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.906	1,129,051	1,016.3	461.0
		2	60.3	0.904	9,046,583	8,129.5	3,687.5
		3	63.2	0.903	6,240,489	5,602.9	2,541.5
		4	64.8	0.903	4,525,653	4,063.3	1,843.1
		5	64.2	0.903	5,662,224	5,083.7	2,306.0
	LDGT1 with VMT mix of 28.2%	1	59.7	1.062	1,129,051	745.5	338.2
		2	60.3	1.060	9,046,583	5,962.5	2,704.6
		3	63.2	1.058	6,240,489	4,108.0	1,863.4
		4	64.8	1.058	4,525,653	2,979.1	1,351.3
		5	64.2	1.058	5,662,224	3,727.3	1,690.7
	LDGT2 with VMT mix of 11.2%	1	59.7	1.254	1,129,051	348.4	158.0
		2	60.3	1.252	9,046,583	2,785.7	1,263.6
		3	63.2	1.250	6,240,489	1,918.7	870.3
		4	64.8	1.250	4,525,653	1,391.5	631.2
		5	64.2	1.250	5,662,224	1,740.9	789.7
	HDGV with VMT mix of 3.6%	1	59.7	0.802	1,129,051	71.1	32.2
		2	60.3	0.802	9,046,583	569.3	258.2
		3	63.2	0.802	6,240,489	392.5	178.0
		4	64.8	0.802	4,525,653	284.7	129.1
		5	64.2	0.802	5,662,224	356.1	161.5
	LDDV with VMT mix of 0.2%	1	59.7	0.398	1,129,051	2.2	1.0
		2	60.3	0.398	9,046,583	17.5	7.9
		3	63.2	0.398	6,240,489	12.0	5.5
		4	64.8	0.398	4,525,653	8.7	4.0
		5	64.2	0.398	5,662,224	10.9	5.0
	LDDT with VMT mix of 2.2%	1	59.7	0.264	1,129,051	14.2	6.4
		2	60.3	0.264	9,046,583	113.6	51.5
		3	63.2	0.264	6,240,489	78.4	35.5
		4	64.8	0.264	4,525,653	56.8	25.8
		5	64.2	0.264	5,662,224	71.1	32.2
	HDDV with VMT mix of 9.1%	1	59.7	0.390	1,129,051	88.2	40.0
		2	60.3	0.390	9,046,583	707.0	320.7
		3	63.2	0.390	6,240,489	487.7	221.2
		4	64.8	0.390	4,525,653	353.7	160.4
		5	64.2	0.390	5,662,224	442.5	200.7
	MC with VMT mix of 0.5%	1	59.7	2.670	1,129,051	33.9	15.4
		2	60.3	2.712	9,046,583	275.8	125.1
		3	63.2	2.741	6,240,489	192.3	87.2
		4	64.8	2.741	4,525,653	139.5	63.3
		5	64.2	2.741	5,662,224	174.5	79.2

Table 5.5–4. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	1.040	1,087,462	1,124.5	510.1
PRINCIPAL	LDGV	2	34.4	1.003	8,834,531	8,806.5	3,994.6
ARTERIALS	with VMT	3	36.1	0.992	9,795,953	9,656.8	4,380.3
and	mix of	4	39.0	0.974	6,923,412	6,703.3	3,040.6
MINOR	45.1%	5	42.6	0.957	3,738,642	3,557.3	1,613.6
ARTERIALS		1	30.3	1.226	1,087,462	829.3	376.2
	LDGT1	2	34.4	1.183	8,834,531	6,499.2	2,948.1
	with VMT	3	36.1	1.170	9,795,953	7,128.5	3,233.5
	mix of	4	39.0	1.150	6,923,412	4,952.5	2,246.4
	28.2%	5	42.6	1.130	3,738,642	2,628.0	1,192.1
		1	30.3	1.469	1,087,462	392.9	178.2
	LDGT2	2	34.4	1.412	8,834,531	3,068.8	1,392.0
	with VMT	3	36.1	1.396	9,795,953	3,363.9	1,525.9
	mix of	4	39.0	1.372	6,923,412	2,336.1	1,059.7
	11.2%	5	42.6	1.347	3,738,642	1,238.9	562.0
		1	30.3	1.181	1,087,462	100.8	45.7
	HDGV	2	34.4	1.067	8,834,531	740.0	335.6
	with VMT	3	36.1	1.029	9,795,953	791.3	359.0
	mix of	4	39.0	0.974	6,923,412	529.0	240.0
	3.6%	5	42.6	0.919	3,738,642	269.6	122.3
		1	30.3	0.505	1,087,462	2.7	1.2
	LDDV	2	34.4	0.473	8,834,531	20.3	9.2
	with VMT	3	36.1	0.462	9,795,953	21.9	10.0
	mix of	4	39.0	0.445	6,923,412	14.9	6.8
	0.2%	5	42.6	0.429	3,738,642	7.8	3.5
		1	30.3	0.352	1,087,462	18.2	8.3
	LDDT	2	34.4	0.326	8,834,531	136.9	62.1
	with VMT	3	36.1	0.316	9,795,953	147.5	66.9
	mix of	4	39.0	0.303	6,923,412	99.9	45.3
	2.2%	5	42.6	0.289	3,738,642	51.5	23.4
		1	30.3	0.594	1,087,462	129.4	58.7
	HDDV	2	34.4	0.533	8,834,531	943.0	427.7
	with VMT	3	36.1	0.512	9,795,953	1,005.0	455.9
	mix of	4	39.0	0.481	6,923,412	666.6	302.4
	9.1%	5	42.6	0.449	3,738,642	336.4	152.6
		1	30.3	2.413	1,087,462	29.5	13.4
	MC	2	34.4	2.302	8,834,531	228.6	103.7
	with VMT	3	36.1	2.265	9,795,953	249.4	113.1
	mix of	4	39.0	2.209	6,923,412	171.9	78.0
	0.5%	5	42.6	2.162	3,738,642	90.9	41.2

Table 5.5–4. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.249	1,046,993	1,299.6	589.5
COLLECTOR	LDGV	2	19.1	1.222	2,727,290	3,312.0	1,502.3
	with VMT	3	24.4	1.112	1,694,159	1,873.2	849.7
	mix of	4	24.7	1.108	872,616	960.7	435.8
	45.1%	5	28.2	1.062	2,390,942	2,522.6	1,144.3
		1	18.2	1.461	1,046,993	951.6	431.7
	LDGT1	2	19.1	1.427	2,727,290	2,421.0	1,098.2
	with VMT	3	24.4	1.302	1,694,159	1,372.2	622.4
	mix of	4	24.7	1.297	872,616	703.9	319.3
	28.2%	5	28.2	1.248	2,390,942	1,856.3	842.0
		1	18.2	1.758	1,046,993	452.7	205.3
	LDGT2	2	19.1	1.717	2,727,290	1,152.0	522.5
	with VMT	3	24.4	1.563	1,694,159	651.5	295.5
	mix of	4	24.7	1.557	872,616	334.2	151.6
	11.2%	5	28.2	1.496	2,390,942	880.1	399.2
		1	18.2	1.841	1,046,993	151.2	68.6
	HDGV	2	19.1	1.764	2,727,290	377.6	171.3
	with VMT	3	24.4	1.421	1,694,159	188.9	85.7
	mix of	4	24.7	1.406	872,616	96.3	43.7
	3.6%	5	28.2	1.255	2,390,942	235.4	106.8
		1	18.2	0.658	1,046,993	3.3	1.5
	LDDV	2	19.1	0.644	2,727,290	8.5	3.9
	with VMT	3	24.4	0.567	1,694,159	4.7	2.1
	mix of	4	24.7	0.563	872,616	2.4	1.1
	0.2%	5	28.2	0.524	2,390,942	6.1	2.8
		1	18.2	0.478	1,046,993	23.8	10.8
	LDDT	2	19.1	0.466	2,727,290	60.5	27.4
	with VMT	3	24.4	0.403	1,694,159	32.5	14.7
	mix of	4	24.7	0.400	872,616	16.6	7.5
	2.2%	5	28.2	0.367	2,390,942	41.8	19.0
		1	18.2	0.887	1,046,993	186.2	84.4
	HDDV	2	19.1	0.859	2,727,290	469.5	213.0
	with VMT	3	24.4	0.712	1,694,159	241.8	109.7
	mix of	4	24.7	0.705	872,616	123.3	55.9
	9.1%	5	28.2	0.631	2,390,942	302.4	137.2
		1	18.2	2.947	1,046,993	34.7	15.7
	MC	2	19.1	2.891	2,727,290	88.7	40.2
	with VMT	3	24.4	2.626	1,694,159	50.0	22.7
	mix of	4	24.7	2.613	872,616	25.6	11.6
	0.5%	5	28.2	2.481	2,390,942	66.7	30.2

Table 5.5–4. Daily VOC emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	1.474	195,247	286.1	129.8
		2	12.9	1.474	1,991,136	2,917.2	1,323.2
		3	12.9	1.474	2,564,545	3,757.3	1,704.3
		4	12.9	1.474	1,689,510	2,475.3	1,122.8
		5	12.9	1.474	1,422,562	2,084.2	945.4
	LDGT1 with VMT mix of 28.2%	1	12.9	1.743	195,247	211.6	96.0
		2	12.9	1.743	1,991,136	2,158.3	979.0
		3	12.9	1.743	2,564,545	2,779.9	1,260.9
		4	12.9	1.743	1,689,510	1,831.4	830.7
		5	12.9	1.743	1,422,562	1,542.0	699.5
	LDGT2 with VMT mix of 11.2%	1	12.9	2.096	195,247	100.7	45.7
		2	12.9	2.096	1,991,136	1,026.6	465.7
		3	12.9	2.096	2,564,545	1,322.2	599.8
		4	12.9	2.096	1,689,510	871.1	395.1
		5	12.9	2.096	1,422,562	733.4	332.7
	HDGV with VMT mix of 3.6%	1	12.9	2.457	195,247	37.6	17.1
		2	12.9	2.457	1,991,136	384.0	174.2
		3	12.9	2.457	2,564,545	494.5	224.3
		4	12.9	2.457	1,689,510	325.8	147.8
		5	12.9	2.457	1,422,562	274.3	124.4
	LDDV with VMT mix of 0.2%	1	12.9	0.768	195,247	0.7	0.3
		2	12.9	0.768	1,991,136	7.4	3.4
		3	12.9	0.768	2,564,545	9.6	4.3
		4	12.9	0.768	1,689,510	6.3	2.9
		5	12.9	0.768	1,422,562	5.3	2.4
	LDDT with VMT mix of 2.2%	1	12.9	0.568	195,247	5.3	2.4
		2	12.9	0.568	1,991,136	53.8	24.4
		3	12.9	0.568	2,564,545	69.3	31.5
		4	12.9	0.568	1,689,510	45.7	20.7
		5	12.9	0.568	1,422,562	38.5	17.4
	HDDV with VMT mix of 9.1%	1	12.9	1.097	195,247	42.9	19.5
		2	12.9	1.097	1,991,136	437.8	198.6
		3	12.9	1.097	2,564,545	563.8	255.8
		4	12.9	1.097	1,689,510	371.4	168.5
		5	12.9	1.097	1,422,562	312.8	141.9
	MC with VMT mix of 0.5%	1	12.9	3.486	195,247	7.7	3.5
		2	12.9	3.486	1,991,136	78.0	35.4
		3	12.9	3.486	2,564,545	100.5	45.6
		4	12.9	3.486	1,689,510	66.2	30.0
		5	12.9	3.486	1,422,562	55.8	25.3

Table 5.5–5. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	1.074	1,083,889	1,157.0	524.8
		2	60.3	1.076	8,684,720	9,287.9	4,213.0
		3	63.2	1.077	5,990,869	6,412.9	2,908.9
		4	64.8	1.077	4,344,627	4,650.7	2,109.5
		5	64.2	1.077	2,571,402	2,752.5	1,248.6
	LDGT1 with VMT mix of 28.2%	1	59.7	1.342	1,083,889	904.5	410.3
		2	60.3	1.344	8,684,720	7,259.0	3,292.7
		3	63.2	1.346	5,990,869	5,014.5	2,274.6
		4	64.8	1.346	4,344,627	3,636.6	1,649.5
		5	64.2	1.346	2,571,402	2,152.3	976.3
	LDGT2 with VMT mix of 11.2%	1	59.7	1.637	1,083,889	436.4	198.0
		2	60.3	1.640	8,684,720	3,502.9	1,588.9
		3	63.2	1.642	5,990,869	2,419.3	1,097.4
		4	64.8	1.642	4,344,627	1,754.5	795.8
		5	64.2	1.642	2,571,402	1,038.4	471.0
	HDGV with VMT mix of 3.6%	1	59.7	5.611	1,083,889	477.3	216.5
		2	60.3	5.635	8,684,720	3,840.7	1,742.2
		3	63.2	5.650	5,990,869	2,656.5	1,205.0
		4	64.8	5.650	4,344,627	1,926.5	873.9
		5	64.2	5.650	2,571,402	1,140.2	517.2
	LDDV with VMT mix of 0.2%	1	59.7	1.789	1,083,889	9.4	4.3
		2	60.3	1.834	8,684,720	77.2	35.0
		3	63.2	1.864	5,990,869	54.2	24.6
		4	64.8	1.864	4,344,627	39.3	17.8
		5	64.2	1.864	2,571,402	23.2	10.5
	LDDT with VMT mix of 2.2%	1	59.7	1.191	1,083,889	61.5	27.9
		2	60.3	1.221	8,684,720	504.9	229.0
		3	63.2	1.241	5,990,869	354.0	160.6
		4	64.8	1.241	4,344,627	256.7	116.4
		5	64.2	1.241	2,571,402	151.9	68.9
	HDDV with VMT mix of 9.1%	1	59.7	23.579	1,083,889	5,121.0	2,322.9
		2	60.3	24.050	8,684,720	41,852.2	18,984.2
		3	63.2	24.357	5,990,869	29,238.9	13,262.8
		4	64.8	24.357	4,344,627	21,204.3	9,618.3
		5	64.2	24.357	2,571,402	12,549.9	5,692.6
	MC with VMT mix of 0.5%	1	59.7	1.630	1,083,889	19.9	9.0
		2	60.3	1.650	8,684,720	161.1	73.1
		3	63.2	1.660	5,990,869	111.8	50.7
		4	64.8	1.660	4,344,627	81.1	36.8
		5	64.2	1.660	2,571,402	48.0	21.8

Table 5.5–5. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIALS and MINOR ARTERIALS	LDGV with VMT mix of 45.1%	1	30.3	1.038	1,043,964	1,076.7	488.4
		2	34.4	1.009	8,481,150	8,509.6	3,859.9
		3	36.1	1.007	9,404,115	9,415.4	4,270.8
		4	39.0	1.009	6,646,476	6,667.6	3,024.4
		5	42.6	1.015	2,563,479	2,586.7	1,173.3
	LDGT1 with VMT mix of 28.2%	1	30.3	1.246	1,043,964	809.5	367.2
		2	34.4	1.227	8,481,150	6,475.5	2,937.3
		3	36.1	1.227	9,404,115	7,180.2	3,256.9
		4	39.0	1.234	6,646,476	5,103.3	2,314.9
		5	42.6	1.246	2,563,479	1,987.4	901.5
	LDGT2 with VMT mix of 11.2%	1	30.3	1.544	1,043,964	396.4	179.8
		2	34.4	1.522	8,481,150	3,176.3	1,440.8
		3	36.1	1.522	9,404,115	3,521.8	1,597.5
		4	39.0	1.527	6,646,476	2,497.4	1,132.8
		5	42.6	1.538	2,563,479	970.2	440.1
	HDGV with VMT mix of 3.6%	1	30.3	4.485	1,043,964	367.5	166.7
		2	34.4	4.634	8,481,150	3,084.5	1,399.1
		3	36.1	4.698	9,404,115	3,466.8	1,572.5
		4	39.0	4.803	6,646,476	2,505.0	1,136.3
		5	42.6	4.934	2,563,479	992.5	450.2
	LDDV with VMT mix of 0.2%	1	30.3	1.006	1,043,964	5.1	2.3
		2	34.4	0.998	8,481,150	41.0	18.6
		3	36.1	1.003	9,404,115	45.7	20.7
		4	39.0	1.018	6,646,476	32.8	14.9
		5	42.6	1.057	2,563,479	13.1	6.0
	LDDT with VMT mix of 2.2%	1	30.3	0.664	1,043,964	33.0	15.0
		2	34.4	0.659	8,481,150	266.1	120.7
		3	36.1	0.663	9,404,115	296.9	134.7
		4	39.0	0.672	6,646,476	212.7	96.5
		5	42.6	0.698	2,563,479	85.2	38.6
	HDDV with VMT mix of 9.1%	1	30.3	12.407	1,043,964	2,595.4	1,177.3
		2	34.4	12.331	8,481,150	20,955.6	9,505.5
		3	36.1	12.386	9,404,115	23,339.8	10,586.9
		4	39.0	12.537	6,646,476	16,696.8	7,573.7
		5	42.6	12.937	2,563,479	6,645.2	3,014.3
	MC with VMT mix of 0.5%	1	30.3	1.140	1,043,964	13.4	6.1
		2	34.4	1.170	8,481,150	111.6	50.6
		3	36.1	1.190	9,404,115	125.8	57.1
		4	39.0	1.200	6,646,476	89.7	40.7
		5	42.6	1.220	2,563,479	35.2	15.9

Table 5.5–5. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.223	1,005,113	1,221.8	554.2
COLLECTOR	LDGV	2	19.1	1.202	2,618,198	3,127.5	1,418.6
	with VMT	3	24.4	1.107	1,626,393	1,789.7	811.8
	mix of	4	24.7	1.103	837,711	918.4	416.6
	45.1%	5	28.2	1.059	916,860	964.9	437.7
		1	18.2	1.411	1,005,113	882.0	400.1
	LDGT1	2	19.1	1.392	2,618,198	2,266.4	1,028.0
	with VMT	3	24.4	1.307	1,626,393	1,322.2	599.8
	mix of	4	24.7	1.303	837,711	678.9	308.0
	28.2%	5	28.2	1.265	916,860	721.3	327.2
		1	18.2	1.744	1,005,113	431.1	195.6
	LDGT2	2	19.1	1.720	2,618,198	1,108.1	502.7
	with VMT	3	24.4	1.617	1,626,393	647.0	293.5
	mix of	4	24.7	1.612	837,711	332.2	150.7
	11.2%	5	28.2	1.566	916,860	353.1	160.2
		1	18.2	4.058	1,005,113	320.1	145.2
	HDGV	2	19.1	4.086	2,618,198	839.5	380.8
	with VMT	3	24.4	4.274	1,626,393	545.5	247.4
	mix of	4	24.7	4.283	837,711	281.6	127.7
	3.6%	5	28.2	4.415	916,860	317.7	144.1
		1	18.2	1.173	1,005,113	5.7	2.6
	LDDV	2	19.1	1.152	2,618,198	14.6	6.6
	with VMT	3	24.4	1.058	1,626,393	8.3	3.8
	mix of	4	24.7	1.054	837,711	4.3	1.9
	0.2%	5	28.2	1.020	916,860	4.5	2.1
		1	18.2	0.777	1,005,113	37.2	16.9
	LDDT	2	19.1	0.763	2,618,198	95.1	43.1
	with VMT	3	24.4	0.699	1,626,393	54.1	24.6
	mix of	4	24.7	0.697	837,711	27.8	12.6
	2.2%	5	28.2	0.674	916,860	29.4	13.3
		1	18.2	14.146	1,005,113	2,849.0	1,292.3
	HDDV	2	19.1	13.932	2,618,198	7,309.1	3,315.4
	with VMT	3	24.4	12.953	1,626,393	4,221.3	1,914.8
	mix of	4	24.7	12.910	837,711	2,167.0	983.0
	9.1%	5	28.2	12.558	916,860	2,307.1	1,046.5
		1	18.2	1.000	1,005,113	11.3	5.1
	MC	2	19.1	1.010	2,618,198	29.7	13.5
	with VMT	3	24.4	1.070	1,626,393	19.6	8.9
	mix of	4	24.7	1.080	837,711	10.2	4.6
	0.5%	5	28.2	1.120	916,860	11.5	5.2

Table 5.5–5. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	1.402	187,437	261.2	118.5
		2	12.9	1.402	1,911,491	2,663.9	1,208.3
		3	12.9	1.402	2,461,963	3,431.1	1,556.3
		4	12.9	1.402	1,621,930	2,260.4	1,025.3
		5	12.9	1.402	821,541	1,144.9	519.3
	LDGT1 with VMT mix of 28.2%	1	12.9	1.576	187,437	183.7	83.3
		2	12.9	1.576	1,911,491	1,873.8	850.0
		3	12.9	1.576	2,461,963	2,413.5	1,094.7
		4	12.9	1.576	1,621,930	1,590.0	721.2
		5	12.9	1.576	821,541	805.4	365.3
	LDGT2 with VMT mix of 11.2%	1	12.9	1.942	187,437	89.5	40.6
		2	12.9	1.942	1,911,491	913.1	414.2
		3	12.9	1.942	2,461,963	1,176.0	533.4
		4	12.9	1.942	1,621,930	774.8	351.4
		5	12.9	1.942	821,541	392.4	178.0
	HDGV with VMT mix of 3.6%	1	12.9	3.872	187,437	57.0	25.8
		2	12.9	3.872	1,911,491	580.8	263.4
		3	12.9	3.872	2,461,963	748.0	339.3
		4	12.9	3.872	1,621,930	492.8	223.5
		5	12.9	3.872	821,541	249.6	113.2
	LDDV with VMT mix of 0.2%	1	12.9	1.331	187,437	1.2	0.5
		2	12.9	1.331	1,911,491	12.3	5.6
		3	12.9	1.331	2,461,963	15.9	7.2
		4	12.9	1.331	1,621,930	10.5	4.7
		5	12.9	1.331	821,541	5.3	2.4
	LDDT with VMT mix of 2.2%	1	12.9	0.883	187,437	7.9	3.6
		2	12.9	0.883	1,911,491	80.4	36.5
		3	12.9	0.883	2,461,963	103.5	47.0
		4	12.9	0.883	1,621,930	68.2	30.9
		5	12.9	0.883	821,541	34.5	15.7
	HDDV with VMT mix of 9.1%	1	12.9	15.790	187,437	593.0	269.0
		2	12.9	15.790	1,911,491	6,047.9	2,743.3
		3	12.9	15.790	2,461,963	7,789.5	3,533.3
		4	12.9	15.790	1,621,930	5,131.7	2,327.7
		5	12.9	15.790	821,541	2,599.3	1,179.0
	MC with VMT mix of 0.5%	1	12.9	0.960	187,437	2.0	0.9
		2	12.9	0.960	1,911,491	20.6	9.4
		3	12.9	0.960	2,461,963	26.6	12.1
		4	12.9	0.960	1,621,930	17.5	7.9
		5	12.9	0.960	821,541	8.9	4.0

Table 5.5–6. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	1.074	1,083,889	1,157.0	524.8
		2	60.3	1.076	8,684,720	9,287.9	4,213.0
		3	63.2	1.077	5,990,869	6,412.9	2,908.9
		4	64.8	1.077	4,344,627	4,650.7	2,109.5
		5	64.2	1.077	5,435,735	5,818.6	2,639.3
	LDGT1 with VMT mix of 28.2%	1	59.7	1.342	1,083,889	904.5	410.3
		2	60.3	1.344	8,684,720	7,259.0	3,292.7
		3	63.2	1.346	5,990,869	5,014.5	2,274.6
		4	64.8	1.346	4,344,627	3,636.6	1,649.5
		5	64.2	1.346	5,435,735	4,549.8	2,063.8
	LDGT2 with VMT mix of 11.2%	1	59.7	1.637	1,083,889	436.4	198.0
		2	60.3	1.640	8,684,720	3,502.9	1,588.9
		3	63.2	1.642	5,990,869	2,419.3	1,097.4
		4	64.8	1.642	4,344,627	1,754.5	795.8
		5	64.2	1.642	5,435,735	2,195.1	995.7
	HDGV with VMT mix of 3.6%	1	59.7	5.611	1,083,889	477.3	216.5
		2	60.3	5.635	8,684,720	3,840.7	1,742.2
		3	63.2	5.650	5,990,869	2,656.5	1,205.0
		4	64.8	5.650	4,344,627	1,926.5	873.9
		5	64.2	5.650	5,435,735	2,410.3	1,093.3
	LDDV with VMT mix of 0.2%	1	59.7	1.789	1,083,889	9.4	4.3
		2	60.3	1.834	8,684,720	77.2	35.0
		3	63.2	1.864	5,990,869	54.2	24.6
		4	64.8	1.864	4,344,627	39.3	17.8
		5	64.2	1.864	5,435,735	49.1	22.3
	LDDT with VMT mix of 2.2%	1	59.7	1.191	1,083,889	61.5	27.9
		2	60.3	1.221	8,684,720	504.9	229.0
		3	63.2	1.241	5,990,869	354.0	160.6
		4	64.8	1.241	4,344,627	256.7	116.4
		5	64.2	1.241	5,435,735	321.2	145.7
	HDDV with VMT mix of 9.1%	1	59.7	23.579	1,083,889	5,121.0	2,322.9
		2	60.3	24.050	8,684,720	41,852.2	18,984.2
		3	63.2	24.357	5,990,869	29,238.9	13,262.8
		4	64.8	24.357	4,344,627	21,204.3	9,618.3
		5	64.2	24.357	5,435,735	26,529.5	12,033.8
	MC with VMT mix of 0.5%	1	59.7	1.630	1,083,889	19.9	9.0
		2	60.3	1.650	8,684,720	161.1	73.1
		3	63.2	1.660	5,990,869	111.8	50.7
		4	64.8	1.660	4,344,627	81.1	36.8
		5	64.2	1.660	5,435,735	101.4	46.0

Table 5.5–6. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIALS and MINOR ARTERIALS	LDGV with VMT mix of 45.1%	1	30.3	1.038	1,043,964	1,076.7	488.4
		2	34.4	1.009	8,481,150	8,509.6	3,859.9
		3	36.1	1.007	9,404,115	9,415.4	4,270.8
		4	39.0	1.009	6,646,476	6,667.6	3,024.4
		5	42.6	1.015	3,589,096	3,621.6	1,642.8
	LDGT1 with VMT mix of 28.2%	1	30.3	1.246	1,043,964	809.5	367.2
		2	34.4	1.227	8,481,150	6,475.5	2,937.3
		3	36.1	1.227	9,404,115	7,180.2	3,256.9
		4	39.0	1.234	6,646,476	5,103.3	2,314.9
		5	42.6	1.246	3,589,096	2,782.6	1,262.2
	LDGT2 with VMT mix of 11.2%	1	30.3	1.544	1,043,964	396.4	179.8
		2	34.4	1.522	8,481,150	3,176.3	1,440.8
		3	36.1	1.522	9,404,115	3,521.8	1,597.5
		4	39.0	1.527	6,646,476	2,497.4	1,132.8
		5	42.6	1.538	3,589,096	1,358.3	616.1
	HDGV with VMT mix of 3.6%	1	30.3	4.485	1,043,964	367.5	166.7
		2	34.4	4.634	8,481,150	3,084.5	1,399.1
		3	36.1	4.698	9,404,115	3,466.8	1,572.5
		4	39.0	4.803	6,646,476	2,505.0	1,136.3
		5	42.6	4.934	3,589,096	1,389.6	630.3
	LDDV with VMT mix of 0.2%	1	30.3	1.006	1,043,964	5.1	2.3
		2	34.4	0.998	8,481,150	41.0	18.6
		3	36.1	1.003	9,404,115	45.7	20.7
		4	39.0	1.018	6,646,476	32.8	14.9
		5	42.6	1.057	3,589,096	18.4	8.3
	LDDT with VMT mix of 2.2%	1	30.3	0.664	1,043,964	33.0	15.0
		2	34.4	0.659	8,481,150	266.1	120.7
		3	36.1	0.663	9,404,115	296.9	134.7
		4	39.0	0.672	6,646,476	212.7	96.5
		5	42.6	0.698	3,589,096	119.3	54.1
	HDDV with VMT mix of 9.1%	1	30.3	12.407	1,043,964	2,595.4	1,177.3
		2	34.4	12.331	8,481,150	20,955.6	9,505.5
		3	36.1	12.386	9,404,115	23,339.8	10,586.9
		4	39.0	12.537	6,646,476	16,696.8	7,573.7
		5	42.6	12.937	3,589,096	9,303.9	4,220.3
	MC with VMT mix of 0.5%	1	30.3	1.140	1,043,964	13.4	6.1
		2	34.4	1.170	8,481,150	111.6	50.6
		3	36.1	1.190	9,404,115	125.8	57.1
		4	39.0	1.200	6,646,476	89.7	40.7
		5	42.6	1.220	3,589,096	49.2	22.3

Table 5.5–6. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.223	1,005,113	1,221.8	554.2
COLLECTOR	LDGV	2	19.1	1.202	2,618,198	3,127.5	1,418.6
	with VMT	3	24.4	1.107	1,626,393	1,789.7	811.8
	mix of	4	24.7	1.103	837,711	918.4	416.6
	45.1%	5	28.2	1.059	2,295,304	2,415.5	1,095.7
		1	18.2	1.411	1,005,113	882.0	400.1
	LDGT1	2	19.1	1.392	2,618,198	2,266.4	1,028.0
	with VMT	3	24.4	1.307	1,626,393	1,322.2	599.8
	mix of	4	24.7	1.303	837,711	678.9	308.0
	28.2%	5	28.2	1.265	2,295,304	1,805.7	819.1
		1	18.2	1.744	1,005,113	431.1	195.6
	LDGT2	2	19.1	1.720	2,618,198	1,108.1	502.7
	with VMT	3	24.4	1.617	1,626,393	647.0	293.5
	mix of	4	24.7	1.612	837,711	332.2	150.7
	11.2%	5	28.2	1.566	2,295,304	884.0	401.0
		1	18.2	4.058	1,005,113	320.1	145.2
	HDGV	2	19.1	4.086	2,618,198	839.5	380.8
	with VMT	3	24.4	4.274	1,626,393	545.5	247.4
	mix of	4	24.7	4.283	837,711	281.6	127.7
	3.6%	5	28.2	4.415	2,295,304	795.3	360.7
		1	18.2	1.173	1,005,113	5.7	2.6
	LDDV	2	19.1	1.152	2,618,198	14.6	6.6
	with VMT	3	24.4	1.058	1,626,393	8.3	3.8
	mix of	4	24.7	1.054	837,711	4.3	1.9
	0.2%	5	28.2	1.020	2,295,304	11.4	5.2
		1	18.2	0.777	1,005,113	37.2	16.9
	LDDT	2	19.1	0.763	2,618,198	95.1	43.1
	with VMT	3	24.4	0.699	1,626,393	54.1	24.6
	mix of	4	24.7	0.697	837,711	27.8	12.6
	2.2%	5	28.2	0.674	2,295,304	73.7	33.4
		1	18.2	14.146	1,005,113	2,849.0	1,292.3
	HDDV	2	19.1	13.932	2,618,198	7,309.1	3,315.4
	with VMT	3	24.4	12.953	1,626,393	4,221.3	1,914.8
	mix of	4	24.7	12.910	837,711	2,167.0	983.0
	9.1%	5	28.2	12.558	2,295,304	5,775.7	2,619.9
		1	18.2	1.000	1,005,113	11.3	5.1
	MC	2	19.1	1.010	2,618,198	29.7	13.5
	with VMT	3	24.4	1.070	1,626,393	19.6	8.9
	mix of	4	24.7	1.080	837,711	10.2	4.6
	0.5%	5	28.2	1.120	2,295,304	28.9	13.1

Table 5.5–6. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	1.402	187,437	261.2	118.5
		2	12.9	1.402	1,911,491	2,663.9	1,208.3
		3	12.9	1.402	2,461,963	3,431.1	1,556.3
		4	12.9	1.402	1,621,930	2,260.4	1,025.3
		5	12.9	1.402	1,365,660	1,903.2	863.3
	LDGT1 with VMT mix of 28.2%	1	12.9	1.576	187,437	183.7	83.3
		2	12.9	1.576	1,911,491	1,873.8	850.0
		3	12.9	1.576	2,461,963	2,413.5	1,094.7
		4	12.9	1.576	1,621,930	1,590.0	721.2
		5	12.9	1.576	1,365,660	1,338.8	607.3
	LDGT2 with VMT mix of 11.2%	1	12.9	1.942	187,437	89.5	40.6
		2	12.9	1.942	1,911,491	913.1	414.2
		3	12.9	1.942	2,461,963	1,176.0	533.4
		4	12.9	1.942	1,621,930	774.8	351.4
		5	12.9	1.942	1,365,660	652.3	295.9
	HDGV with VMT mix of 3.6%	1	12.9	3.872	187,437	57.0	25.8
		2	12.9	3.872	1,911,491	580.8	263.4
		3	12.9	3.872	2,461,963	748.0	339.3
		4	12.9	3.872	1,621,930	492.8	223.5
		5	12.9	3.872	1,365,660	414.9	188.2
	LDDV with VMT mix of 0.2%	1	12.9	1.331	187,437	1.2	0.5
		2	12.9	1.331	1,911,491	12.3	5.6
		3	12.9	1.331	2,461,963	15.9	7.2
		4	12.9	1.331	1,621,930	10.5	4.7
		5	12.9	1.331	1,365,660	8.8	4.0
	LDDT with VMT mix of 2.2%	1	12.9	0.883	187,437	7.9	3.6
		2	12.9	0.883	1,911,491	80.4	36.5
		3	12.9	0.883	2,461,963	103.5	47.0
		4	12.9	0.883	1,621,930	68.2	30.9
		5	12.9	0.883	1,365,660	57.4	26.0
	HDDV with VMT mix of 9.1%	1	12.9	15.790	187,437	593.0	269.0
		2	12.9	15.790	1,911,491	6,047.9	2,743.3
		3	12.9	15.790	2,461,963	7,789.5	3,533.3
		4	12.9	15.790	1,621,930	5,131.7	2,327.7
		5	12.9	15.790	1,365,660	4,320.9	1,960.0
	MC with VMT mix of 0.5%	1	12.9	0.960	187,437	2.0	0.9
		2	12.9	0.960	1,911,491	20.6	9.4
		3	12.9	0.960	2,461,963	26.6	12.1
		4	12.9	0.960	1,621,930	17.5	7.9
		5	12.9	0.960	1,365,660	14.7	6.7

Table 5.5–7. Daily NO_x emissions in the ozone nonattainment area by vehicle class, facility type and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.964	1,129,051	1,082.0	490.8
		2	60.3	0.966	9,046,583	8,686.1	3,940.0
		3	63.2	0.968	6,240,489	6,001.1	2,722.1
		4	64.8	0.968	4,525,653	4,352.1	1,974.1
		5	64.2	0.968	2,678,544	2,575.8	1,168.4
	LDGT1 with VMT mix of 28.2%	1	59.7	1.188	1,129,051	834.6	378.6
		2	60.3	1.191	9,046,583	6,700.8	3,039.5
		3	63.2	1.193	6,240,489	4,630.1	2,100.2
		4	64.8	1.193	4,525,653	3,357.8	1,523.1
		5	64.2	1.193	2,678,544	1,987.3	901.5
	LDGT2 with VMT mix of 11.2%	1	59.7	1.486	1,129,051	412.6	187.2
		2	60.3	1.488	9,046,583	3,312.5	1,502.5
		3	63.2	1.490	6,240,489	2,287.9	1,037.8
		4	64.8	1.490	4,525,653	1,659.2	752.6
		5	64.2	1.490	2,678,544	982.0	445.4
	HDGV with VMT mix of 3.6%	1	59.7	5.537	1,129,051	490.6	222.5
		2	60.3	5.560	9,046,583	3,947.2	1,790.5
		3	63.2	5.575	6,240,489	2,730.3	1,238.4
		4	64.8	5.575	4,525,653	1,980.0	898.1
		5	64.2	5.575	2,678,544	1,171.9	531.6
	LDDV with VMT mix of 0.2%	1	59.7	1.787	1,129,051	9.8	4.4
		2	60.3	1.832	9,046,583	80.4	36.5
		3	63.2	1.862	6,240,489	56.4	25.6
		4	64.8	1.862	4,525,653	40.9	18.5
		5	64.2	1.862	2,678,544	24.2	11.0
	LDDT with VMT mix of 2.2%	1	59.7	1.180	1,129,051	63.4	28.8
		2	60.3	1.210	9,046,583	521.2	236.4
		3	63.2	1.230	6,240,489	365.5	165.8
		4	64.8	1.230	4,525,653	265.0	120.2
		5	64.2	1.230	2,678,544	156.9	71.2
	HDDV with VMT mix of 9.1%	1	59.7	23.357	1,129,051	5,284.2	2,396.9
		2	60.3	23.825	9,046,583	43,187.5	19,589.8
		3	63.2	24.130	6,240,489	30,173.0	13,686.5
		4	64.8	24.130	4,525,653	21,881.7	9,925.5
		5	64.2	24.130	2,678,544	12,950.8	5,874.5
	MC with VMT mix of 0.5%	1	59.7	1.680	1,129,051	21.3	9.7
		2	60.3	1.699	9,046,583	172.8	78.4
		3	63.2	1.710	6,240,489	120.0	54.4
		4	64.8	1.710	4,525,653	87.0	39.5
		5	64.2	1.710	2,678,544	51.5	23.4

Table 5.5–7. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIALS and MINOR ARTERIALS	LDGV with VMT mix of 45.1%	1	30.3	0.900	1,087,462	972.9	441.3
		2	34.4	0.883	8,834,531	7,755.4	3,517.9
		3	36.1	0.883	9,795,953	8,600.4	3,901.1
		4	39.0	0.884	6,923,412	6,080.5	2,758.1
		5	42.6	0.893	2,670,291	2,369.6	1,074.9
	LDGT1 with VMT mix of 28.2%	1	30.3	1.088	1,087,462	736.1	333.9
		2	34.4	1.076	8,834,531	5,914.5	2,682.8
		3	36.1	1.078	9,795,953	6,568.5	2,979.5
		4	39.0	1.080	6,923,412	4,650.5	2,109.5
		5	42.6	1.092	2,670,291	1,814.6	823.1
	LDGT2 with VMT mix of 11.2%	1	30.3	1.380	1,087,462	369.2	167.5
		2	34.4	1.366	8,834,531	2,969.5	1,346.9
		3	36.1	1.368	9,795,953	3,296.2	1,495.2
		4	39.0	1.369	6,923,412	2,331.2	1,057.4
		5	42.6	1.382	2,670,291	907.5	411.7
	HDGV with VMT mix of 3.6%	1	30.3	4.426	1,087,462	377.7	171.3
		2	34.4	4.573	8,834,531	3,170.5	1,438.1
		3	36.1	4.635	9,795,953	3,563.3	1,616.3
		4	39.0	4.738	6,923,412	2,574.5	1,167.8
		5	42.6	4.868	2,670,291	1,020.2	462.7
	LDDV with VMT mix of 0.2%	1	30.3	1.005	1,087,462	5.3	2.4
		2	34.4	0.997	8,834,531	42.7	19.4
		3	36.1	1.002	9,795,953	47.6	21.6
		4	39.0	1.017	6,923,412	34.1	15.5
		5	42.6	1.056	2,670,291	13.7	6.2
	LDDT with VMT mix of 2.2%	1	30.3	0.658	1,087,462	34.1	15.5
		2	34.4	0.653	8,834,531	274.7	124.6
		3	36.1	0.657	9,795,953	306.3	138.9
		4	39.0	0.666	6,923,412	219.5	99.6
		5	42.6	0.692	2,670,291	88.0	39.9
	HDDV with VMT mix of 9.1%	1	30.3	13.045	1,087,462	2,842.5	1,289.4
		2	34.4	12.970	8,834,531	22,959.1	10,414.2
		3	36.1	13.024	9,795,953	25,565.2	11,596.4
		4	39.0	12.429	6,923,412	17,242.6	7,821.3
		5	42.6	12.827	2,670,291	6,863.2	3,113.1
	MC with VMT mix of 0.5%	1	30.3	1.172	1,087,462	14.3	6.5
		2	34.4	1.209	8,834,531	120.1	54.5
		3	36.1	1.220	9,795,953	134.3	60.9
		4	39.0	1.238	6,923,412	96.4	43.7
		5	42.6	1.257	2,670,291	37.7	17.1

Table 5.5–7. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.037	1,046,993	1,079.1	489.5
COLLECTOR	LDGV	2	19.1	1.021	2,727,290	2,768.3	1,255.7
	with VMT	3	24.4	0.950	1,694,159	1,599.7	725.6
	mix of	4	24.7	0.947	872,616	821.3	372.5
	45.1%	5	28.2	0.914	955,062	867.9	393.7
		1	18.2	1.223	1,046,993	796.8	361.4
	LDGT1	2	19.1	1.207	2,727,290	2,047.9	928.9
	with VMT	3	24.4	1.136	1,694,159	1,197.1	543.0
	mix of	4	24.7	1.133	872,616	614.9	278.9
	28.2%	5	28.2	1.101	955,062	653.9	296.6
		1	18.2	1.548	1,046,993	398.7	180.9
	LDGT2	2	19.1	1.528	2,727,290	1,025.4	465.1
	with VMT	3	24.4	1.440	1,694,159	600.0	272.2
	mix of	4	24.7	1.436	872,616	308.2	139.8
	11.2%	5	28.2	1.396	955,062	328.0	148.8
		1	18.2	4.004	1,046,993	328.9	149.2
	HDGV	2	19.1	4.031	2,727,290	862.8	391.3
	with VMT	3	24.4	4.217	1,694,159	560.7	254.3
	mix of	4	24.7	4.226	872,616	289.4	131.3
	3.6%	5	28.2	4.356	955,062	326.5	148.1
		1	18.2	1.172	1,046,993	6.0	2.7
	LDDV	2	19.1	1.151	2,727,290	15.2	6.9
	with VMT	3	24.4	1.057	1,694,159	8.7	3.9
	mix of	4	24.7	1.053	872,616	4.5	2.0
	0.2%	5	28.2	1.019	955,062	4.7	2.1
		1	18.2	0.770	1,046,993	38.4	17.4
	LDDT	2	19.1	0.756	2,727,290	98.2	44.5
	with VMT	3	24.4	0.693	1,694,159	55.9	25.4
	mix of	4	24.7	0.691	872,616	28.7	13.0
	2.2%	5	28.2	0.668	955,062	30.4	13.8
		1	18.2	14.028	1,046,993	2,942.9	1,334.9
	HDDV	2	19.1	13.815	2,727,290	7,549.4	3,424.4
	with VMT	3	24.4	12.843	1,694,159	4,359.7	1,977.6
	mix of	4	24.7	12.800	872,616	2,238.1	1,015.2
	9.1%	5	28.2	12.450	955,062	2,382.6	1,080.8
		1	18.2	1.030	1,046,993	12.1	5.5
	MC	2	19.1	1.039	2,727,290	31.9	14.5
	with VMT	3	24.4	1.101	1,694,159	21.0	9.5
	mix of	4	24.7	1.107	872,616	10.9	4.9
	0.5%	5	28.2	1.148	955,062	12.3	5.6

Table 5.5–7. Daily NO_x emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	12.9	1.173	195,247	227.7	103.3
LOCAL	LDGV	2	12.9	1.173	1,991,136	2,321.7	1,053.1
	with VMT	3	12.9	1.173	2,564,545	2,990.3	1,356.4
	mix of	4	12.9	1.173	1,689,510	1,970.0	893.6
	45.1%	5	12.9	1.173	855,772	997.8	452.6
		1	12.9	1.362	195,247	165.5	75.1
	LDGT1	2	12.9	1.362	1,991,136	1,687.4	765.4
	with VMT	3	12.9	1.362	2,564,545	2,173.3	985.8
	mix of	4	12.9	1.362	1,689,510	1,431.8	649.5
	28.2%	5	12.9	1.362	855,772	725.2	329.0
		1	12.9	1.721	195,247	82.6	37.5
	LDGT2	2	12.9	1.721	1,991,136	842.8	382.3
	with VMT	3	12.9	1.721	2,564,545	1,085.5	492.4
	mix of	4	12.9	1.721	1,689,510	715.1	324.4
	11.2%	5	12.9	1.721	855,772	362.2	164.3
		1	12.9	3.820	195,247	58.5	26.5
	HDGV	2	12.9	3.820	1,991,136	596.8	270.7
	with VMT	3	12.9	3.820	2,564,545	768.7	348.7
	mix of	4	12.9	3.820	1,689,510	506.4	229.7
	3.6%	5	12.9	3.820	855,772	256.5	116.4
		1	12.9	1.330	195,247	1.3	0.6
	LDDV	2	12.9	1.330	1,991,136	12.8	5.8
	with VMT	3	12.9	1.330	2,564,545	16.5	7.5
	mix of	4	12.9	1.330	1,689,510	10.9	4.9
	0.2%	5	12.9	1.330	855,772	5.5	2.5
		1	12.9	0.875	195,247	8.1	3.7
	LDDT	2	12.9	0.875	1,991,136	83.0	37.6
	with VMT	3	12.9	0.875	2,564,545	106.8	48.5
	mix of	4	12.9	0.875	1,689,510	70.4	31.9
	2.2%	5	12.9	0.875	855,772	35.7	16.2
		1	12.9	15.660	195,247	612.7	277.9
	HDDV	2	12.9	15.660	1,991,136	6,248.1	2,834.1
	with VMT	3	12.9	15.660	2,564,545	8,047.4	3,650.3
	mix of	4	12.9	15.660	1,689,510	5,301.6	2,404.8
	9.1%	5	12.9	15.660	855,772	2,685.4	1,218.1
		1	12.9	0.990	195,247	2.2	1.0
	MC	2	12.9	0.990	1,991,136	22.2	10.1
	with VMT	3	12.9	0.990	2,564,545	28.5	12.9
	mix of	4	12.9	0.990	1,689,510	18.8	8.5
	0.5%	5	12.9	0.990	855,772	9.5	4.3

Table 5.5–8. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.906	1,129,051	1,016.3	461.0
		2	60.3	0.904	9,046,583	8,129.5	3,687.5
		3	63.2	0.903	6,240,489	5,602.9	2,541.5
		4	64.8	0.903	4,525,653	4,063.3	1,843.1
		5	64.2	0.903	5,662,224	5,083.7	2,306.0
	LDGT1 with VMT mix of 28.2%	1	59.7	1.062	1,129,051	745.5	338.2
		2	60.3	1.060	9,046,583	5,962.5	2,704.6
		3	63.2	1.058	6,240,489	4,108.0	1,863.4
		4	64.8	1.058	4,525,653	2,979.1	1,351.3
		5	64.2	1.058	5,662,224	3,727.3	1,690.7
	LDGT2 with VMT mix of 11.2%	1	59.7	1.254	1,129,051	348.4	158.0
		2	60.3	1.252	9,046,583	2,785.7	1,263.6
		3	63.2	1.250	6,240,489	1,918.7	870.3
		4	64.8	1.250	4,525,653	1,391.5	631.2
		5	64.2	1.250	5,662,224	1,740.9	789.7
	HDGV with VMT mix of 3.6%	1	59.7	0.802	1,129,051	71.1	32.2
		2	60.3	0.802	9,046,583	569.3	258.2
		3	63.2	0.802	6,240,489	392.5	178.0
		4	64.8	0.802	4,525,653	284.7	129.1
		5	64.2	0.802	5,662,224	356.1	161.5
	LDDV with VMT mix of 0.2%	1	59.7	0.398	1,129,051	2.2	1.0
		2	60.3	0.398	9,046,583	17.5	7.9
		3	63.2	0.398	6,240,489	12.0	5.5
		4	64.8	0.398	4,525,653	8.7	4.0
		5	64.2	0.398	5,662,224	10.9	5.0
	LDDT with VMT mix of 2.2%	1	59.7	0.264	1,129,051	14.2	6.4
		2	60.3	0.264	9,046,583	113.6	51.5
		3	63.2	0.264	6,240,489	78.4	35.5
		4	64.8	0.264	4,525,653	56.8	25.8
		5	64.2	0.264	5,662,224	71.1	32.2
	HDDV with VMT mix of 9.1%	1	59.7	0.390	1,129,051	88.2	40.0
		2	60.3	0.390	9,046,583	707.0	320.7
		3	63.2	0.390	6,240,489	487.7	221.2
		4	64.8	0.390	4,525,653	353.7	160.4
		5	64.2	0.390	5,662,224	442.5	200.7
	MC with VMT mix of 0.5%	1	59.7	2.670	1,129,051	33.9	15.4
		2	60.3	2.712	9,046,583	275.8	125.1
		3	63.2	2.741	6,240,489	192.3	87.2
		4	64.8	2.741	4,525,653	139.5	63.3
		5	64.2	2.741	5,662,224	174.5	79.2

Table 5.5–8. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	1.040	1,087,462	1,124.5	510.1
PRINCIPAL	LDGV	2	34.4	1.003	8,834,531	8,806.5	3,994.6
ARTERIALS	with VMT	3	36.1	0.992	9,795,953	9,656.8	4,380.3
and	mix of	4	39.0	0.974	6,923,412	6,703.3	3,040.6
MINOR	45.1%	5	42.6	0.957	3,738,642	3,557.3	1,613.6
ARTERIALS		1	30.3	1.226	1,087,462	829.3	376.2
	LDGT1	2	34.4	1.183	8,834,531	6,499.2	2,948.1
	with VMT	3	36.1	1.170	9,795,953	7,128.5	3,233.5
	mix of	4	39.0	1.150	6,923,412	4,952.5	2,246.4
	28.2%	5	42.6	1.130	3,738,642	2,628.0	1,192.1
		1	30.3	1.469	1,087,462	392.9	178.2
	LDGT2	2	34.4	1.412	8,834,531	3,068.8	1,392.0
	with VMT	3	36.1	1.396	9,795,953	3,363.9	1,525.9
	mix of	4	39.0	1.372	6,923,412	2,336.1	1,059.7
	11.2%	5	42.6	1.347	3,738,642	1,238.9	562.0
		1	30.3	1.181	1,087,462	100.8	45.7
	HDGV	2	34.4	1.067	8,834,531	740.0	335.6
	with VMT	3	36.1	1.029	9,795,953	791.3	359.0
	mix of	4	39.0	0.974	6,923,412	529.0	240.0
	3.6%	5	42.6	0.919	3,738,642	269.6	122.3
		1	30.3	0.505	1,087,462	2.7	1.2
	LDDV	2	34.4	0.473	8,834,531	20.3	9.2
	with VMT	3	36.1	0.462	9,795,953	21.9	10.0
	mix of	4	39.0	0.445	6,923,412	14.9	6.8
	0.2%	5	42.6	0.429	3,738,642	7.8	3.5
		1	30.3	0.352	1,087,462	18.2	8.3
	LDDT	2	34.4	0.326	8,834,531	136.9	62.1
	with VMT	3	36.1	0.316	9,795,953	147.5	66.9
	mix of	4	39.0	0.303	6,923,412	99.9	45.3
	2.2%	5	42.6	0.289	3,738,642	51.5	23.4
		1	30.3	0.594	1,087,462	129.4	58.7
	HDDV	2	34.4	0.533	8,834,531	943.0	427.7
	with VMT	3	36.1	0.512	9,795,953	1,005.0	455.9
	mix of	4	39.0	0.481	6,923,412	666.6	302.4
	9.1%	5	42.6	0.449	3,738,642	336.4	152.6
		1	30.3	2.413	1,087,462	29.5	13.4
	MC	2	34.4	2.302	8,834,531	228.6	103.7
	with VMT	3	36.1	2.265	9,795,953	249.4	113.1
	mix of	4	39.0	2.209	6,923,412	171.9	78.0
	0.5%	5	42.6	2.162	3,738,642	90.9	41.2

Table 5.5–8. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	1.249	1,046,993	1,299.6	589.5
COLLECTOR	LDGV	2	19.1	1.222	2,727,290	3,312.0	1,502.3
	with VMT	3	24.4	1.112	1,694,159	1,873.2	849.7
	mix of	4	24.7	1.108	872,616	960.7	435.8
	45.1%	5	28.2	1.062	2,390,942	2,522.6	1,144.3
		1	18.2	1.461	1,046,993	951.6	431.7
	LDGT1	2	19.1	1.427	2,727,290	2,421.0	1,098.2
	with VMT	3	24.4	1.302	1,694,159	1,372.2	622.4
	mix of	4	24.7	1.297	872,616	703.9	319.3
	28.2%	5	28.2	1.248	2,390,942	1,856.3	842.0
		1	18.2	1.758	1,046,993	452.7	205.3
	LDGT2	2	19.1	1.717	2,727,290	1,152.0	522.5
	with VMT	3	24.4	1.563	1,694,159	651.5	295.5
	mix of	4	24.7	1.557	872,616	334.2	151.6
	11.2%	5	28.2	1.496	2,390,942	880.1	399.2
		1	18.2	1.841	1,046,993	151.2	68.6
	HDGV	2	19.1	1.764	2,727,290	377.6	171.3
	with VMT	3	24.4	1.421	1,694,159	188.9	85.7
	mix of	4	24.7	1.406	872,616	96.3	43.7
	3.6%	5	28.2	1.255	2,390,942	235.4	106.8
		1	18.2	0.658	1,046,993	3.3	1.5
	LDDV	2	19.1	0.644	2,727,290	8.5	3.9
	with VMT	3	24.4	0.567	1,694,159	4.7	2.1
	mix of	4	24.7	0.563	872,616	2.4	1.1
	0.2%	5	28.2	0.524	2,390,942	6.1	2.8
		1	18.2	0.478	1,046,993	23.8	10.8
	LDDT	2	19.1	0.466	2,727,290	60.5	27.4
	with VMT	3	24.4	0.403	1,694,159	32.5	14.7
	mix of	4	24.7	0.400	872,616	16.6	7.5
	2.2%	5	28.2	0.367	2,390,942	41.8	19.0
		1	18.2	0.887	1,046,993	186.2	84.4
	HDDV	2	19.1	0.859	2,727,290	469.5	213.0
	with VMT	3	24.4	0.712	1,694,159	241.8	109.7
	mix of	4	24.7	0.705	872,616	123.3	55.9
	9.1%	5	28.2	0.631	2,390,942	302.4	137.2
		1	18.2	2.947	1,046,993	34.7	15.7
	MC	2	19.1	2.891	2,727,290	88.7	40.2
	with VMT	3	24.4	2.626	1,694,159	50.0	22.7
	mix of	4	24.7	2.613	872,616	25.6	11.6
	0.5%	5	28.2	2.481	2,390,942	66.7	30.2

Table 5.5–8. Daily NO_x emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	12.9	1.474	195,247	286.1	129.8
LOCAL	LDGV	2	12.9	1.474	1,991,136	2,917.2	1,323.2
	with VMT	3	12.9	1.474	2,564,545	3,757.3	1,704.3
	mix of	4	12.9	1.474	1,689,510	2,475.3	1,122.8
	45.1%	5	12.9	1.474	1,422,562	2,084.2	945.4
		1	12.9	1.743	195,247	211.6	96.0
	LDGT1	2	12.9	1.743	1,991,136	2,158.3	979.0
	with VMT	3	12.9	1.743	2,564,545	2,779.9	1,260.9
	mix of	4	12.9	1.743	1,689,510	1,831.4	830.7
	28.2%	5	12.9	1.743	1,422,562	1,542.0	699.5
		1	12.9	2.096	195,247	100.7	45.7
	LDGT2	2	12.9	2.096	1,991,136	1,026.6	465.7
	with VMT	3	12.9	2.096	2,564,545	1,322.2	599.8
	mix of	4	12.9	2.096	1,689,510	871.1	395.1
	11.2%	5	12.9	2.096	1,422,562	733.4	332.7
		1	12.9	2.457	195,247	37.6	17.1
	HDGV	2	12.9	2.457	1,991,136	384.0	174.2
	with VMT	3	12.9	2.457	2,564,545	494.5	224.3
	mix of	4	12.9	2.457	1,689,510	325.8	147.8
	3.6%	5	12.9	2.457	1,422,562	274.3	124.4
		1	12.9	0.768	195,247	0.7	0.3
	LDDV	2	12.9	0.768	1,991,136	7.4	3.4
	with VMT	3	12.9	0.768	2,564,545	9.6	4.3
	mix of	4	12.9	0.768	1,689,510	6.3	2.9
	0.2%	5	12.9	0.768	1,422,562	5.3	2.4
		1	12.9	0.568	195,247	5.3	2.4
	LDDT	2	12.9	0.568	1,991,136	53.8	24.4
	with VMT	3	12.9	0.568	2,564,545	69.3	31.5
	mix of	4	12.9	0.568	1,689,510	45.7	20.7
	2.2%	5	12.9	0.568	1,422,562	38.5	17.4
		1	12.9	1.097	195,247	42.9	19.5
	HDDV	2	12.9	1.097	1,991,136	437.8	198.6
	with VMT	3	12.9	1.097	2,564,545	563.8	255.8
	mix of	4	12.9	1.097	1,689,510	371.4	168.5
	9.1%	5	12.9	1.097	1,422,562	312.8	141.9
		1	12.9	3.486	195,247	7.7	3.5
	MC	2	12.9	3.486	1,991,136	78.0	35.4
	with VMT	3	12.9	3.486	2,564,545	100.5	45.6
	mix of	4	12.9	3.486	1,689,510	66.2	30.0
	0.5%	5	12.9	3.486	1,422,562	55.8	25.3

Table 5.5–9. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	14.817	1,083,889	15,962.9	7,240.8
		2	60.3	14.907	8,684,720	128,680.5	58,369.5
		3	63.2	14.968	5,990,869	89,128.2	40,428.6
		4	64.8	14.968	4,344,627	64,636.5	29,319.1
		5	64.2	14.968	2,571,402	38,255.6	17,352.8
	LDGT1 with VMT mix of 28.2%	1	59.7	18.240	1,083,889	12,298.5	5,578.6
		2	60.3	18.331	8,684,720	99,033.4	44,921.6
		3	63.2	18.392	5,990,869	68,541.7	31,090.5
		4	64.8	18.392	4,344,627	49,707.0	22,547.1
		5	64.2	18.392	2,571,402	29,419.5	13,344.7
	LDGT2 with VMT mix of 11.2%	1	59.7	20.799	1,083,889	5,545.8	2,515.6
		2	60.3	20.899	8,684,720	44,650.1	20,253.3
		3	63.2	20.960	5,990,869	30,890.0	14,011.7
		4	64.8	20.960	4,344,627	22,401.7	10,161.4
		5	64.2	20.960	2,571,402	13,258.6	6,014.1
	HDGV with VMT mix of 3.6%	1	59.7	15.429	1,083,889	1,312.4	595.3
		2	60.3	15.804	8,684,720	10,771.2	4,885.8
		3	63.2	16.058	5,990,869	7,549.2	3,424.3
		4	64.8	16.058	4,344,627	5,474.8	2,483.4
		5	64.2	16.058	2,571,402	3,240.3	1,469.8
	LDDV with VMT mix of 0.2%	1	59.7	1.236	1,083,889	6.5	2.9
		2	60.3	1.247	8,684,720	52.5	23.8
		3	63.2	1.254	5,990,869	36.4	16.5
		4	64.8	1.254	4,344,627	26.4	12.0
		5	64.2	1.254	2,571,402	15.6	7.1
	LDDT with VMT mix of 2.2%	1	59.7	0.667	1,083,889	34.4	15.6
		2	60.3	0.674	8,684,720	278.7	126.4
		3	63.2	0.678	5,990,869	193.4	87.7
		4	64.8	0.678	4,344,627	140.3	63.6
		5	64.2	0.678	2,571,402	83.0	37.7
	HDDV with VMT mix of 9.1%	1	59.7	2.493	1,083,889	541.4	245.6
		2	60.3	2.533	8,684,720	4,408.0	1,999.5
		3	63.2	2.559	5,990,869	3,071.9	1,393.4
		4	64.8	2.559	4,344,627	2,227.8	1,010.5
		5	64.2	2.559	2,571,402	1,318.5	598.1
	MC with VMT mix of 0.5%	1	59.7	27.060	1,083,889	329.7	149.6
		2	60.3	28.260	8,684,720	2,759.2	1,251.6
		3	63.2	29.050	5,990,869	1,956.5	887.5
		4	64.8	29.050	4,344,627	1,418.9	643.6
		5	64.2	29.050	2,571,402	839.8	380.9

Table 5.5–9. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	10.275	1,043,964	10,661.5	4,836.1
PRINCIPAL	LDGV	2	34.4	10.492	8,481,150	88,447.7	40,119.9
ARTERIALS	with VMT	3	36.1	10.683	9,404,115	99,856.8	45,295.1
and	mix of	4	39.0	11.067	6,646,476	73,112.9	33,164.0
MINOR	45.1%	5	42.6	11.561	2,563,479	29,458.0	13,362.1
ARTERIALS		1	30.3	13.509	1,043,964	8,772.7	3,979.3
	LDGT1	2	34.4	13.805	8,481,150	72,834.8	33,037.9
	with VMT	3	36.1	14.025	9,404,115	82,048.1	37,217.0
	mix of	4	39.0	14.448	6,646,476	59,735.4	27,096.0
	28.2%	5	42.6	14.981	2,563,479	23,889.8	10,836.4
		1	30.3	15.985	1,043,964	4,105.2	1,862.1
	LDGT2	2	34.4	16.258	8,481,150	33,920.9	15,386.5
	with VMT	3	36.1	16.478	9,404,115	38,121.3	17,291.8
	mix of	4	39.0	16.919	6,646,476	27,663.5	12,548.2
	11.2%	5	42.6	17.462	2,563,479	11,012.2	4,995.1
		1	30.3	12.989	1,043,964	1,064.2	482.7
	HDGV	2	34.4	11.653	8,481,150	7,755.6	3,518.0
	with VMT	3	36.1	11.269	9,404,115	8,316.1	3,772.2
	mix of	4	39.0	10.773	6,646,476	5,618.9	2,548.7
	3.6%	5	42.6	10.489	2,563,479	2,110.2	957.2
		1	30.3	1.289	1,043,964	6.5	3.0
	LDDV	2	34.4	1.210	8,481,150	49.8	22.6
	with VMT	3	36.1	1.186	9,404,115	54.1	24.5
	mix of	4	39.0	1.153	6,646,476	37.2	16.9
	0.2%	5	42.6	1.126	2,563,479	14.0	6.3
		1	30.3	0.701	1,043,964	34.8	15.8
	LDDT	2	34.4	0.650	8,481,150	262.5	119.1
	with VMT	3	36.1	0.634	9,404,115	283.9	128.8
	mix of	4	39.0	0.612	6,646,476	193.7	87.9
	2.2%	5	42.6	0.595	2,563,479	72.6	32.9
		1	30.3	2.694	1,043,964	563.5	255.6
	HDDV	2	34.4	2.392	8,481,150	4,065.0	1,843.9
	with VMT	3	36.1	2.300	9,404,115	4,334.0	1,965.9
	mix of	4	39.0	2.172	6,646,476	2,892.7	1,312.1
	9.1%	5	42.6	2.072	2,563,479	1,064.3	482.8
		1	30.3	16.530	1,043,964	194.0	88.0
	MC	2	34.4	14.800	8,481,150	1,411.1	640.1
	with VMT	3	36.1	14.230	9,404,115	1,504.4	682.4
	mix of	4	39.0	13.400	6,646,476	1,001.3	454.2
	0.5%	5	42.6	12.640	2,563,479	364.3	165.2

Table 5.5–9. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	10.767	1,005,113	10,756.6	4,879.2
COLLECTOR	LDGV	2	19.1	10.640	2,618,198	27,690.1	12,560.2
	with VMT	3	24.4	10.278	1,626,393	16,614.9	7,536.5
	mix of	4	24.7	10.266	837,711	8,548.2	3,877.5
	45.1%	5	28.2	10.249	916,860	9,339.9	4,236.6
		1	18.2	13.723	1,005,113	8,580.1	3,891.9
	LDGT1	2	19.1	13.616	2,618,198	22,176.3	10,059.2
	with VMT	3	24.4	13.392	1,626,393	13,549.0	6,145.8
	mix of	4	24.7	13.382	837,711	6,973.5	3,163.2
	28.2%	5	28.2	13.443	916,860	7,667.1	3,477.8
		1	18.2	16.474	1,005,113	4,073.5	1,847.8
	LDGT2	2	19.1	16.326	2,618,198	10,515.5	4,769.8
	with VMT	3	24.4	15.964	1,626,393	6,387.5	2,897.3
	mix of	4	24.7	15.944	837,711	3,285.7	1,490.4
	11.2%	5	28.2	15.950	916,860	3,597.7	1,631.9
		1	18.2	22.213	1,005,113	1,752.1	794.7
	HDGV	2	19.1	21.130	2,618,198	4,341.4	1,969.3
	with VMT	3	24.4	16.229	1,626,393	2,071.4	939.6
	mix of	4	24.7	16.017	837,711	1,052.9	477.6
	3.6%	5	28.2	13.971	916,860	1,005.2	456.0
		1	18.2	1.776	1,005,113	8.7	3.9
	LDDV	2	19.1	1.722	2,618,198	21.9	9.9
	with VMT	3	24.4	1.466	1,626,393	11.6	5.2
	mix of	4	24.7	1.455	837,711	5.9	2.7
	0.2%	5	28.2	1.343	916,860	6.0	2.7
		1	18.2	1.020	1,005,113	48.8	22.1
	LDDT	2	19.1	0.984	2,618,198	122.7	55.6
	with VMT	3	24.4	0.817	1,626,393	63.3	28.7
	mix of	4	24.7	0.810	837,711	32.3	14.7
	2.2%	5	28.2	0.737	916,860	32.2	14.6
		1	18.2	4.559	1,005,113	918.2	416.5
	HDDV	2	19.1	4.350	2,618,198	2,282.1	1,035.2
	with VMT	3	24.4	3.373	1,626,393	1,099.2	498.6
	mix of	4	24.7	3.330	837,711	559.0	253.5
	9.1%	5	28.2	2.900	916,860	532.8	241.7
		1	18.2	25.250	1,005,113	285.3	129.4
	MC	2	19.1	24.270	2,618,198	714.4	324.0
	with VMT	3	24.4	19.860	1,626,393	363.1	164.7
	mix of	4	24.7	19.670	837,711	185.2	84.0
	0.5%	5	28.2	17.570	916,860	181.1	82.1

Table 5.5–9. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	12.9	11.810	187,437	2,200.3	998.0
LOCAL	LDGV	2	12.9	11.810	1,911,491	22,438.4	10,178.1
	with VMT	3	12.9	11.810	2,461,963	28,900.3	13,109.2
	mix of	4	12.9	11.810	1,621,930	19,039.4	8,636.3
	45.1%	5	12.9	11.810	821,541	9,643.8	4,374.4
		1	12.9	14.665	187,437	1,709.9	775.6
	LDGT1	2	12.9	14.665	1,911,491	17,437.7	7,909.8
	with VMT	3	12.9	14.665	2,461,963	22,459.5	10,187.6
	mix of	4	12.9	14.665	1,621,930	14,796.2	6,711.6
	28.2%	5	12.9	14.665	821,541	7,494.6	3,399.5
		1	12.9	17.705	187,437	816.4	370.3
	LDGT2	2	12.9	17.705	1,911,491	8,325.5	3,776.5
	with VMT	3	12.9	17.705	2,461,963	10,723.1	4,864.0
	mix of	4	12.9	17.705	1,621,930	7,064.4	3,204.4
	11.2%	5	12.9	17.705	821,541	3,578.2	1,623.1
		1	12.9	30.858	187,437	453.9	205.9
	HDGV	2	12.9	30.858	1,911,491	4,628.9	2,099.7
	with VMT	3	12.9	30.858	2,461,963	5,962.0	2,704.3
	mix of	4	12.9	30.858	1,621,930	3,927.7	1,781.6
	3.6%	5	12.9	30.858	821,541	1,989.5	902.4
		1	12.9	2.205	187,437	2.0	0.9
	LDDV	2	12.9	2.205	1,911,491	20.4	9.3
	with VMT	3	12.9	2.205	2,461,963	26.3	11.9
	mix of	4	12.9	2.205	1,621,930	17.3	7.9
	0.2%	5	12.9	2.205	821,541	8.8	4.0
		1	12.9	1.300	187,437	11.6	5.3
	LDDT	2	12.9	1.300	1,911,491	118.3	53.7
	with VMT	3	12.9	1.300	2,461,963	152.4	69.1
	mix of	4	12.9	1.300	1,621,930	100.4	45.5
	2.2%	5	12.9	1.300	821,541	50.9	23.1
		1	12.9	6.199	187,437	232.8	105.6
	HDDV	2	12.9	6.199	1,911,491	2,374.3	1,077.0
	with VMT	3	12.9	6.199	2,461,963	3,058.1	1,387.2
	mix of	4	12.9	6.199	1,621,930	2,014.7	913.8
	9.1%	5	12.9	6.199	821,541	1,020.5	462.9
		1	12.9	34.190	187,437	72.0	32.7
	MC	2	12.9	34.190	1,911,491	734.7	333.3
	with VMT	3	12.9	34.190	2,461,963	946.3	429.2
	mix of	4	12.9	34.190	1,621,930	623.4	282.8
	0.5%	5	12.9	34.190	821,541	315.8	143.2

Table 5.5–10. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	14.817	1,083,889	15,962.9	7,240.8
		2	60.3	14.907	8,684,720	128,680.5	58,369.5
		3	63.2	14.968	5,990,869	89,128.2	40,428.6
		4	64.8	14.968	4,344,627	64,636.5	29,319.1
		5	64.2	14.968	5,435,735	80,869.3	36,682.3
	LDGT1 with VMT mix of 28.2%	1	59.7	18.240	1,083,889	12,298.5	5,578.6
		2	60.3	18.331	8,684,720	99,033.4	44,921.6
		3	63.2	18.392	5,990,869	68,541.7	31,090.5
		4	64.8	18.392	4,344,627	49,707.0	22,547.1
		5	64.2	18.392	5,435,735	62,190.4	28,209.5
	LDGT2 with VMT mix of 11.2%	1	59.7	20.799	1,083,889	5,545.8	2,515.6
		2	60.3	20.899	8,684,720	44,650.1	20,253.3
		3	63.2	20.960	5,990,869	30,890.0	14,011.7
		4	64.8	20.960	4,344,627	22,401.7	10,161.4
		5	64.2	20.960	5,435,735	28,027.7	12,713.3
	HDGV with VMT mix of 3.6%	1	59.7	15.429	1,083,889	1,312.4	595.3
		2	60.3	15.804	8,684,720	10,771.2	4,885.8
		3	63.2	16.058	5,990,869	7,549.2	3,424.3
		4	64.8	16.058	4,344,627	5,474.8	2,483.4
		5	64.2	16.058	5,435,735	6,849.7	3,107.0
	LDDV with VMT mix of 0.2%	1	59.7	1.236	1,083,889	6.5	2.9
		2	60.3	1.247	8,684,720	52.5	23.8
		3	63.2	1.254	5,990,869	36.4	16.5
		4	64.8	1.254	4,344,627	26.4	12.0
		5	64.2	1.254	5,435,735	33.1	15.0
	LDDT with VMT mix of 2.2%	1	59.7	0.667	1,083,889	34.4	15.6
		2	60.3	0.674	8,684,720	278.7	126.4
		3	63.2	0.678	5,990,869	193.4	87.7
		4	64.8	0.678	4,344,627	140.3	63.6
		5	64.2	0.678	5,435,735	175.5	79.6
	HDDV with VMT mix of 9.1%	1	59.7	2.493	1,083,889	541.4	245.6
		2	60.3	2.533	8,684,720	4,408.0	1,999.5
		3	63.2	2.559	5,990,869	3,071.9	1,393.4
		4	64.8	2.559	4,344,627	2,227.8	1,010.5
		5	64.2	2.559	5,435,735	2,787.3	1,264.3
	MC with VMT mix of 0.5%	1	59.7	27.060	1,083,889	329.7	149.6
		2	60.3	28.260	8,684,720	2,759.2	1,251.6
		3	63.2	29.050	5,990,869	1,956.5	887.5
		4	64.8	29.050	4,344,627	1,418.9	643.6
		5	64.2	29.050	5,435,735	1,775.2	805.3

Table 5.5–10. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	10.275	1,043,964	10,661.5	4,836.1
PRINCIPAL	LDGV	2	34.4	10.492	8,481,150	88,447.7	40,119.9
ARTERIALS	with VMT	3	36.1	10.683	9,404,115	99,856.8	45,295.1
and	mix of	4	39.0	11.067	6,646,476	73,112.9	33,164.0
MINOR	45.1%	5	42.6	11.561	3,589,096	41,243.8	18,708.2
ARTERIALS		1	30.3	13.509	1,043,964	8,772.7	3,979.3
	LDGT1	2	34.4	13.805	8,481,150	72,834.8	33,037.9
	with VMT	3	36.1	14.025	9,404,115	82,048.1	37,217.0
	mix of	4	39.0	14.448	6,646,476	59,735.4	27,096.0
	28.2%	5	42.6	14.981	3,589,096	33,447.8	15,171.9
		1	30.3	15.985	1,043,964	4,105.2	1,862.1
	LDGT2	2	34.4	16.258	8,481,150	33,920.9	15,386.5
	with VMT	3	36.1	16.478	9,404,115	38,121.3	17,291.8
	mix of	4	39.0	16.919	6,646,476	27,663.5	12,548.2
	11.2%	5	42.6	17.462	3,589,096	15,418.0	6,993.6
		1	30.3	12.989	1,043,964	1,064.2	482.7
	HDGV	2	34.4	11.653	8,481,150	7,755.6	3,518.0
	with VMT	3	36.1	11.269	9,404,115	8,316.1	3,772.2
	mix of	4	39.0	10.773	6,646,476	5,618.9	2,548.7
	3.6%	5	42.6	10.489	3,589,096	2,954.4	1,340.1
		1	30.3	1.289	1,043,964	6.5	3.0
	LDDV	2	34.4	1.210	8,481,150	49.8	22.6
	with VMT	3	36.1	1.186	9,404,115	54.1	24.5
	mix of	4	39.0	1.153	6,646,476	37.2	16.9
	0.2%	5	42.6	1.126	3,589,096	19.6	8.9
		1	30.3	0.701	1,043,964	34.8	15.8
	LDDT	2	34.4	0.650	8,481,150	262.5	119.1
	with VMT	3	36.1	0.634	9,404,115	283.9	128.8
	mix of	4	39.0	0.612	6,646,476	193.7	87.9
	2.2%	5	42.6	0.595	3,589,096	101.7	46.1
		1	30.3	2.694	1,043,964	563.5	255.6
	HDDV	2	34.4	2.392	8,481,150	4,065.0	1,843.9
	with VMT	3	36.1	2.300	9,404,115	4,334.0	1,965.9
	mix of	4	39.0	2.172	6,646,476	2,892.7	1,312.1
	9.1%	5	42.6	2.072	3,589,096	1,490.1	675.9
		1	30.3	16.530	1,043,964	194.0	88.0
	MC	2	34.4	14.800	8,481,150	1,411.1	640.1
	with VMT	3	36.1	14.230	9,404,115	1,504.4	682.4
	mix of	4	39.0	13.400	6,646,476	1,001.3	454.2
	0.5%	5	42.6	12.640	3,589,096	510.0	231.3

Table 5.5–10. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	10.767	1,005,113	10,756.6	4,879.2
COLLECTOR	LDGV	2	19.1	10.640	2,618,198	27,690.1	12,560.2
	with VMT	3	24.4	10.278	1,626,393	16,614.9	7,536.5
	mix of	4	24.7	10.266	837,711	8,548.2	3,877.5
	45.1%	5	28.2	10.249	2,295,304	23,381.9	10,606.0
		1	18.2	13.723	1,005,113	8,580.1	3,891.9
	LDGT1	2	19.1	13.616	2,618,198	22,176.3	10,059.2
	with VMT	3	24.4	13.392	1,626,393	13,549.0	6,145.8
	mix of	4	24.7	13.382	837,711	6,973.5	3,163.2
	28.2%	5	28.2	13.443	2,295,304	19,194.1	8,706.4
		1	18.2	16.474	1,005,113	4,073.5	1,847.8
	LDGT2	2	19.1	16.326	2,618,198	10,515.5	4,769.8
	with VMT	3	24.4	15.964	1,626,393	6,387.5	2,897.3
	mix of	4	24.7	15.944	837,711	3,285.7	1,490.4
	11.2%	5	28.2	15.950	2,295,304	9,006.6	4,085.4
		1	18.2	22.213	1,005,113	1,752.1	794.7
	HDGV	2	19.1	21.130	2,618,198	4,341.4	1,969.3
	with VMT	3	24.4	16.229	1,626,393	2,071.4	939.6
	mix of	4	24.7	16.017	837,711	1,052.9	477.6
	3.6%	5	28.2	13.971	2,295,304	2,516.5	1,141.5
		1	18.2	1.776	1,005,113	8.7	3.9
	LDDV	2	19.1	1.722	2,618,198	21.9	9.9
	with VMT	3	24.4	1.466	1,626,393	11.6	5.2
	mix of	4	24.7	1.455	837,711	5.9	2.7
	0.2%	5	28.2	1.343	2,295,304	14.9	6.8
		1	18.2	1.020	1,005,113	48.8	22.1
	LDDT	2	19.1	0.984	2,618,198	122.7	55.6
	with VMT	3	24.4	0.817	1,626,393	63.3	28.7
	mix of	4	24.7	0.810	837,711	32.3	14.7
	2.2%	5	28.2	0.737	2,295,304	80.5	36.5
		1	18.2	4.559	1,005,113	918.2	416.5
	HDDV	2	19.1	4.350	2,618,198	2,282.1	1,035.2
	with VMT	3	24.4	3.373	1,626,393	1,099.2	498.6
	mix of	4	24.7	3.330	837,711	559.0	253.5
	9.1%	5	28.2	2.900	2,295,304	1,333.8	605.0
		1	18.2	25.250	1,005,113	285.3	129.4
	MC	2	19.1	24.270	2,618,198	714.4	324.0
	with VMT	3	24.4	19.860	1,626,393	363.1	164.7
	mix of	4	24.7	19.670	837,711	185.2	84.0
	0.5%	5	28.2	17.570	2,295,304	453.4	205.7

Table 5.5–10. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (peak ozone season day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	12.9	11.810	187,437	2,200.3	998.0
LOCAL	LDGV	2	12.9	11.810	1,911,491	22,438.4	10,178.1
	with VMT	3	12.9	11.810	2,461,963	28,900.3	13,109.2
	mix of	4	12.9	11.810	1,621,930	19,039.4	8,636.3
	45.1%	5	12.9	11.810	1,365,660	16,031.1	7,271.7
		1	12.9	14.665	187,437	1,709.9	775.6
	LDGT1	2	12.9	14.665	1,911,491	17,437.7	7,909.8
	with VMT	3	12.9	14.665	2,461,963	22,459.5	10,187.6
	mix of	4	12.9	14.665	1,621,930	14,796.2	6,711.6
	28.2%	5	12.9	14.665	1,365,660	12,458.3	5,651.1
		1	12.9	17.705	187,437	816.4	370.3
	LDGT2	2	12.9	17.705	1,911,491	8,325.5	3,776.5
	with VMT	3	12.9	17.705	2,461,963	10,723.1	4,864.0
	mix of	4	12.9	17.705	1,621,930	7,064.4	3,204.4
	11.2%	5	12.9	17.705	1,365,660	5,948.2	2,698.1
		1	12.9	30.858	187,437	453.9	205.9
	HDGV	2	12.9	30.858	1,911,491	4,628.9	2,099.7
	with VMT	3	12.9	30.858	2,461,963	5,962.0	2,704.3
	mix of	4	12.9	30.858	1,621,930	3,927.7	1,781.6
	3.6%	5	12.9	30.858	1,365,660	3,307.1	1,500.1
		1	12.9	2.205	187,437	2.0	0.9
	LDDV	2	12.9	2.205	1,911,491	20.4	9.3
	with VMT	3	12.9	2.205	2,461,963	26.3	11.9
	mix of	4	12.9	2.205	1,621,930	17.3	7.9
	0.2%	5	12.9	2.205	1,365,660	14.6	6.6
		1	12.9	1.300	187,437	11.6	5.3
	LDDT	2	12.9	1.300	1,911,491	118.3	53.7
	with VMT	3	12.9	1.300	2,461,963	152.4	69.1
	mix of	4	12.9	1.300	1,621,930	100.4	45.5
	2.2%	5	12.9	1.300	1,365,660	84.5	38.3
		1	12.9	6.199	187,437	232.8	105.6
	HDDV	2	12.9	6.199	1,911,491	2,374.3	1,077.0
	with VMT	3	12.9	6.199	2,461,963	3,058.1	1,387.2
	mix of	4	12.9	6.199	1,621,930	2,014.7	913.8
	9.1%	5	12.9	6.199	1,365,660	1,696.3	769.5
		1	12.9	34.190	187,437	72.0	32.7
	MC	2	12.9	34.190	1,911,491	734.7	333.3
	with VMT	3	12.9	34.190	2,461,963	946.3	429.2
	mix of	4	12.9	34.190	1,621,930	623.4	282.8
	0.5%	5	12.9	34.190	1,365,660	524.9	238.1

Table 5.5–11. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	13.108	1,129,051	14,710.1	6,672.5
		2	60.3	13.177	9,046,583	118,484.5	53,744.6
		3	63.2	13.222	6,240,489	82,011.2	37,200.3
		4	64.8	13.222	4,525,653	59,475.2	26,977.9
		5	64.2	13.222	2,678,544	35,200.8	15,967.1
	LDGT1 with VMT mix of 28.2%	1	59.7	16.711	1,129,051	11,737.2	5,324.0
		2	60.3	16.788	9,046,583	94,474.3	42,853.5
		3	63.2	16.840	6,240,489	65,373.4	29,653.4
		4	64.8	16.840	4,525,653	47,409.3	21,504.9
		5	64.2	16.840	2,678,544	28,059.6	12,727.8
	LDGT2 with VMT mix of 11.2%	1	59.7	18.807	1,129,051	5,223.8	2,369.5
		2	60.3	18.890	9,046,583	42,041.0	19,069.8
		3	63.2	18.943	6,240,489	29,081.1	13,191.2
		4	64.8	18.943	4,525,653	21,089.8	9,566.3
		5	64.2	18.943	2,678,544	12,482.2	5,661.9
	HDGV with VMT mix of 3.6%	1	59.7	12.791	1,129,051	1,133.4	514.1
		2	60.3	13.109	9,046,583	9,306.8	4,221.6
		3	63.2	13.317	6,240,489	6,521.7	2,958.2
		4	64.8	13.317	4,525,653	4,729.6	2,145.3
		5	64.2	13.317	2,678,544	2,799.2	1,269.7
	LDDV with VMT mix of 0.2%	1	59.7	1.243	1,129,051	6.8	3.1
		2	60.3	1.254	9,046,583	55.0	25.0
		3	63.2	1.261	6,240,489	38.2	17.3
		4	64.8	1.261	4,525,653	27.7	12.6
		5	64.2	1.261	2,678,544	16.4	7.4
	LDDT with VMT mix of 2.2%	1	59.7	0.664	1,129,051	35.7	16.2
		2	60.3	0.671	9,046,583	288.8	131.0
		3	63.2	0.675	6,240,489	200.6	91.0
		4	64.8	0.675	4,525,653	145.5	66.0
		5	64.2	0.675	2,678,544	86.1	39.0
	HDDV with VMT mix of 9.1%	1	59.7	2.449	1,129,051	554.1	251.3
		2	60.3	2.489	9,046,583	4,511.0	2,046.2
		3	63.2	2.515	6,240,489	3,144.3	1,426.2
		4	64.8	2.515	4,525,653	2,280.2	1,034.3
		5	64.2	2.515	2,678,544	1,349.6	612.2
	MC with VMT mix of 0.5%	1	59.7	21.115	1,129,051	268.0	121.6
		2	60.3	22.030	9,046,583	2,240.5	1,016.3
		3	63.2	22.630	6,240,489	1,587.6	720.2
		4	64.8	22.630	4,525,653	1,151.4	522.3
		5	64.2	22.630	2,678,544	681.4	309.1

Table 5.5–11. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	9.686	1,087,462	10,469.1	4,748.8
PRINCIPAL	LDGV	2	34.4	9.835	8,834,531	86,363.5	39,174.5
ARTERIALS	with VMT	3	36.1	9.982	9,795,953	97,190.5	44,085.6
and	mix of	4	39.0	10.157	6,923,412	69,893.5	31,703.7
MINOR	45.1%	5	42.6	10.538	2,670,291	27,969.8	12,687.1
ARTERIALS		1	30.3	12.995	1,087,462	8,791.1	3,987.7
	LDGT1	2	34.4	13.205	8,834,531	72,572.5	32,918.9
	with VMT	3	36.1	13.375	9,795,953	81,506.2	36,971.2
	mix of	4	39.0	13.593	6,923,412	58,544.9	26,556.0
	28.2%	5	42.6	14.022	2,670,291	23,291.6	10,565.1
		1	30.3	14.894	1,087,462	3,984.5	1,807.4
	LDGT2	2	34.4	15.091	8,834,531	32,797.5	14,876.9
	with VMT	3	36.1	15.270	9,795,953	36,798.8	16,691.9
	mix of	4	39.0	15.509	6,923,412	26,415.6	11,982.1
	11.2%	5	42.6	15.966	2,670,291	10,488.4	4,757.5
		1	30.3	10.773	1,087,462	919.4	417.0
	HDGV	2	34.4	9.660	8,834,531	6,697.0	3,037.8
	with VMT	3	36.1	9.346	9,795,953	7,184.5	3,258.9
	mix of	4	39.0	8.936	6,923,412	4,854.9	2,202.2
	3.6%	5	42.6	8.701	2,670,291	1,823.4	827.1
		1	30.3	1.296	1,087,462	6.8	3.1
	LDDV	2	34.4	1.217	8,834,531	52.1	23.6
	with VMT	3	36.1	1.193	9,795,953	56.7	25.7
	mix of	4	39.0	1.160	6,923,412	38.9	17.7
	0.2%	5	42.6	1.133	2,670,291	14.7	6.7
		1	30.3	0.698	1,087,462	36.1	16.4
	LDDT	2	34.4	0.647	8,834,531	272.1	123.4
	with VMT	3	36.1	0.631	9,795,953	294.2	133.4
	mix of	4	39.0	0.609	6,923,412	200.8	91.1
	2.2%	5	42.6	0.592	2,670,291	75.3	34.1
		1	30.3	2.647	1,087,462	576.7	261.6
	HDDV	2	34.4	2.350	8,834,531	4,160.2	1,887.1
	with VMT	3	36.1	2.260	9,795,953	4,435.5	2,012.0
	mix of	4	39.0	2.134	6,923,412	2,960.6	1,342.9
	9.1%	5	42.6	2.036	2,670,291	1,089.2	494.1
		1	30.3	13.080	1,087,462	159.9	72.5
	MC	2	34.4	11.765	8,834,531	1,168.5	530.1
	with VMT	3	36.1	11.328	9,795,953	1,247.6	565.9
	mix of	4	39.0	10.694	6,923,412	832.4	377.6
	0.5%	5	42.6	10.114	2,670,291	303.6	137.7

Table 5.5–11. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	10.040	1,046,993	10,448.3	4,739.3
COLLECTOR	LDGV	2	19.1	9.940	2,727,290	26,946.0	12,222.7
	with VMT	3	24.4	9.609	1,694,159	16,180.2	7,339.3
	mix of	4	24.7	9.595	872,616	8,321.6	3,774.7
	45.1%	5	28.2	9.559	955,062	9,074.1	4,116.0
		1	18.2	13.268	1,046,993	8,641.7	3,919.9
	LDGT1	2	19.1	13.167	2,727,290	22,338.1	10,132.5
	with VMT	3	24.4	12.875	1,694,159	13,568.5	6,154.7
	mix of	4	24.7	12.863	872,616	6,982.4	3,167.2
	28.2%	5	28.2	12.859	955,062	7,639.7	3,465.4
		1	18.2	15.380	1,046,993	3,961.5	1,796.9
	LDGT2	2	19.1	15.251	2,727,290	10,232.5	4,641.4
	with VMT	3	24.4	14.841	1,694,159	6,185.5	2,805.7
	mix of	4	24.7	14.827	872,616	3,182.9	1,443.8
	11.2%	5	28.2	14.777	955,062	3,472.0	1,574.9
		1	18.2	18.423	1,046,993	1,513.7	686.6
	HDGV	2	19.1	17.524	2,727,290	3,750.6	1,701.3
	with VMT	3	24.4	13.463	1,694,159	1,789.9	811.9
	mix of	4	24.7	13.282	872,616	909.5	412.6
	3.6%	5	28.2	11.581	955,062	868.0	393.7
		1	18.2	1.786	1,046,993	9.1	4.1
	LDDV	2	19.1	1.731	2,727,290	22.9	10.4
	with VMT	3	24.4	1.474	1,694,159	12.1	5.5
	mix of	4	24.7	1.463	872,616	6.2	2.8
	0.2%	5	28.2	1.350	955,062	6.3	2.8
		1	18.2	1.015	1,046,993	50.6	23.0
	LDDT	2	19.1	0.979	2,727,290	127.2	57.7
	with VMT	3	24.4	0.813	1,694,159	65.6	29.8
	mix of	4	24.7	0.806	872,616	33.5	15.2
	2.2%	5	28.2	0.733	955,062	33.3	15.1
		1	18.2	4.479	1,046,993	939.7	426.3
	HDDV	2	19.1	4.274	2,727,290	2,335.5	1,059.4
	with VMT	3	24.4	3.314	1,694,159	1,125.0	510.3
	mix of	4	24.7	3.271	872,616	572.0	259.5
	9.1%	5	28.2	2.849	955,062	545.3	247.3
		1	18.2	19.735	1,046,993	232.3	105.4
	MC	2	19.1	18.983	2,727,290	582.0	264.0
	with VMT	3	24.4	15.626	1,694,159	297.6	135.0
	mix of	4	24.7	15.480	872,616	151.9	68.9
	0.5%	5	28.2	13.874	955,062	149.0	67.6

Table 5.5–11. Daily CO emissions in the ozone nonattainment area, by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	10.904	195,247	2,116.1	959.8
		2	12.9	10.904	1,991,136	21,579.8	9,788.6
		3	12.9	10.904	2,564,545	27,794.3	12,607.5
		4	12.9	10.904	1,689,510	18,310.8	8,305.8
		5	12.9	10.904	855,772	9,274.8	4,207.0
	LDGT1 with VMT mix of 28.2%	1	12.9	14.157	195,247	1,719.5	780.0
		2	12.9	14.157	1,991,136	17,535.4	7,954.1
		3	12.9	14.157	2,564,545	22,585.3	10,244.7
		4	12.9	14.157	1,689,510	14,879.1	6,749.1
		5	12.9	14.157	855,772	7,536.6	3,418.6
	LDGT2 with VMT mix of 11.2%	1	12.9	16.521	195,247	793.5	360.0
		2	12.9	16.521	1,991,136	8,092.6	3,670.8
		3	12.9	16.521	2,564,545	10,423.1	4,727.9
		4	12.9	16.521	1,689,510	6,866.7	3,114.7
		5	12.9	16.521	855,772	3,478.1	1,577.7
	HDGV with VMT mix of 3.6%	1	12.9	25.590	195,247	392.1	177.9
		2	12.9	25.590	1,991,136	3,998.6	1,813.8
		3	12.9	25.590	2,564,545	5,150.1	2,336.1
		4	12.9	25.590	1,689,510	3,392.9	1,539.0
		5	12.9	25.590	855,772	1,718.6	779.5
	LDDV with VMT mix of 0.2%	1	12.9	2.216	195,247	2.1	1.0
		2	12.9	2.216	1,991,136	21.4	9.7
		3	12.9	2.216	2,564,545	27.6	12.5
		4	12.9	2.216	1,689,510	18.2	8.2
		5	12.9	2.216	855,772	9.2	4.2
	LDDT with VMT mix of 2.2%	1	12.9	1.294	195,247	12.0	5.5
		2	12.9	1.294	1,991,136	122.7	55.6
		3	12.9	1.294	2,564,545	158.0	71.7
		4	12.9	1.294	1,689,510	104.1	47.2
		5	12.9	1.294	855,772	52.7	23.9
	HDDV with VMT mix of 9.1%	1	12.9	6.090	195,247	238.3	108.1
		2	12.9	6.090	1,991,136	2,429.9	1,102.2
		3	12.9	6.090	2,564,545	3,129.7	1,419.6
		4	12.9	6.090	1,689,510	2,061.8	935.2
		5	12.9	6.090	855,772	1,044.4	473.7
	MC with VMT mix of 0.5%	1	12.9	26.555	195,247	58.3	26.4
		2	12.9	26.555	1,991,136	594.4	269.6
		3	12.9	26.555	2,564,545	765.6	347.3
		4	12.9	26.555	1,689,510	504.4	228.8
		5	12.9	26.555	855,772	255.5	115.9

Table 5.5–12. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	13.108	1,129,051	14,710.1	6,672.5
		2	60.3	13.177	9,046,583	118,484.5	53,744.6
		3	63.2	13.222	6,240,489	82,011.2	37,200.3
		4	64.8	13.222	4,525,653	59,475.2	26,977.9
		5	64.2	13.222	5,662,224	74,411.7	33,753.2
	LDGT1 with VMT mix of 28.2%	1	59.7	16.711	1,129,051	11,737.2	5,324.0
		2	60.3	16.788	9,046,583	94,474.3	42,853.5
		3	63.2	16.840	6,240,489	65,373.4	29,653.4
		4	64.8	16.840	4,525,653	47,409.3	21,504.9
		5	64.2	16.840	5,662,224	59,315.7	26,905.6
	LDGT2 with VMT mix of 11.2%	1	59.7	18.807	1,129,051	5,223.8	2,369.5
		2	60.3	18.890	9,046,583	42,041.0	19,069.8
		3	63.2	18.943	6,240,489	29,081.1	13,191.2
		4	64.8	18.943	4,525,653	21,089.8	9,566.3
		5	64.2	18.943	5,662,224	26,386.3	11,968.8
	HDGV with VMT mix of 3.6%	1	59.7	12.791	1,129,051	1,133.4	514.1
		2	60.3	13.109	9,046,583	9,306.8	4,221.6
		3	63.2	13.317	6,240,489	6,521.7	2,958.2
		4	64.8	13.317	4,525,653	4,729.6	2,145.3
		5	64.2	13.317	5,662,224	5,917.3	2,684.1
	LDDV with VMT mix of 0.2%	1	59.7	1.243	1,129,051	6.8	3.1
		2	60.3	1.254	9,046,583	55.0	25.0
		3	63.2	1.261	6,240,489	38.2	17.3
		4	64.8	1.261	4,525,653	27.7	12.6
		5	64.2	1.261	5,662,224	34.6	15.7
	LDDT with VMT mix of 2.2%	1	59.7	0.664	1,129,051	35.7	16.2
		2	60.3	0.671	9,046,583	288.8	131.0
		3	63.2	0.675	6,240,489	200.6	91.0
		4	64.8	0.675	4,525,653	145.5	66.0
		5	64.2	0.675	5,662,224	182.0	82.5
	HDDV with VMT mix of 9.1%	1	59.7	2.449	1,129,051	554.1	251.3
		2	60.3	2.489	9,046,583	4,511.0	2,046.2
		3	63.2	2.515	6,240,489	3,144.3	1,426.2
		4	64.8	2.515	4,525,653	2,280.2	1,034.3
		5	64.2	2.515	5,662,224	2,852.9	1,294.1
	MC with VMT mix of 0.5%	1	59.7	21.115	1,129,051	268.0	121.6
		2	60.3	22.030	9,046,583	2,240.5	1,016.3
		3	63.2	22.630	6,240,489	1,587.6	720.2
		4	64.8	22.630	4,525,653	1,151.4	522.3
		5	64.2	22.630	5,662,224	1,440.5	653.4

Table 5.5–12. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	9.686	1,087,462	10,469.1	4,748.8
PRINCIPAL	LDGV	2	34.4	9.835	8,834,531	86,363.5	39,174.5
ARTERIALS	with VMT	3	36.1	9.982	9,795,953	97,190.5	44,085.6
and	mix of	4	39.0	10.157	6,923,412	69,893.5	31,703.7
MINOR	45.1%	5	42.6	10.538	3,738,642	39,160.1	17,763.0
ARTERIALS		1	30.3	12.995	1,087,462	8,791.1	3,987.7
	LDGT1	2	34.4	13.205	8,834,531	72,572.5	32,918.9
	with VMT	3	36.1	13.375	9,795,953	81,506.2	36,971.2
	mix of	4	39.0	13.593	6,923,412	58,544.9	26,556.0
	28.2%	5	42.6	14.022	3,738,642	32,610.3	14,792.0
		1	30.3	14.894	1,087,462	3,984.5	1,807.4
	LDGT2	2	34.4	15.091	8,834,531	32,797.5	14,876.9
	with VMT	3	36.1	15.270	9,795,953	36,798.8	16,691.9
	mix of	4	39.0	15.509	6,923,412	26,415.6	11,982.1
	11.2%	5	42.6	15.966	3,738,642	14,684.6	6,661.0
		1	30.3	10.773	1,087,462	919.4	417.0
	HDGV	2	34.4	9.660	8,834,531	6,697.0	3,037.8
	with VMT	3	36.1	9.346	9,795,953	7,184.5	3,258.9
	mix of	4	39.0	8.936	6,923,412	4,854.9	2,202.2
	3.6%	5	42.6	8.701	3,738,642	2,552.9	1,158.0
		1	30.3	1.296	1,087,462	6.8	3.1
	LDDV	2	34.4	1.217	8,834,531	52.1	23.6
	with VMT	3	36.1	1.193	9,795,953	56.7	25.7
	mix of	4	39.0	1.160	6,923,412	38.9	17.7
	0.2%	5	42.6	1.133	3,738,642	20.5	9.3
		1	30.3	0.698	1,087,462	36.1	16.4
	LDDT	2	34.4	0.647	8,834,531	272.1	123.4
	with VMT	3	36.1	0.631	9,795,953	294.2	133.4
	mix of	4	39.0	0.609	6,923,412	200.8	91.1
	2.2%	5	42.6	0.592	3,738,642	105.4	47.8
		1	30.3	2.647	1,087,462	576.7	261.6
	HDDV	2	34.4	2.350	8,834,531	4,160.2	1,887.1
	with VMT	3	36.1	2.260	9,795,953	4,435.5	2,012.0
	mix of	4	39.0	2.134	6,923,412	2,960.6	1,342.9
	9.1%	5	42.6	2.036	3,738,642	1,524.9	691.7
		1	30.3	13.080	1,087,462	159.9	72.5
	MC	2	34.4	11.765	8,834,531	1,168.5	530.1
	with VMT	3	36.1	11.328	9,795,953	1,247.6	565.9
	mix of	4	39.0	10.694	6,923,412	832.4	377.6
	0.5%	5	42.6	10.114	3,738,642	425.1	192.8

Table 5.5–12. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	18.2	10.040	1,046,993	10,448.3	4,739.3
COLLECTOR	LDGV	2	19.1	9.940	2,727,290	26,946.0	12,222.7
	with VMT	3	24.4	9.609	1,694,159	16,180.2	7,339.3
	mix of	4	24.7	9.595	872,616	8,321.6	3,774.7
	45.1%	5	28.2	9.559	2,390,942	22,716.5	10,304.2
		1	18.2	13.268	1,046,993	8,641.7	3,919.9
	LDGT1	2	19.1	13.167	2,727,290	22,338.1	10,132.5
	with VMT	3	24.4	12.875	1,694,159	13,568.5	6,154.7
	mix of	4	24.7	12.863	872,616	6,982.4	3,167.2
	28.2%	5	28.2	12.859	2,390,942	19,125.5	8,675.3
		1	18.2	15.380	1,046,993	3,961.5	1,796.9
	LDGT2	2	19.1	15.251	2,727,290	10,232.5	4,641.4
	with VMT	3	24.4	14.841	1,694,159	6,185.5	2,805.7
	mix of	4	24.7	14.827	872,616	3,182.9	1,443.8
	11.2%	5	28.2	14.777	2,390,942	8,691.9	3,942.6
		1	18.2	18.423	1,046,993	1,513.7	686.6
	HDGV	2	19.1	17.524	2,727,290	3,750.6	1,701.3
	with VMT	3	24.4	13.463	1,694,159	1,789.9	811.9
	mix of	4	24.7	13.282	872,616	909.5	412.6
	3.6%	5	28.2	11.581	2,390,942	2,173.0	985.7
		1	18.2	1.786	1,046,993	9.1	4.1
	LDDV	2	19.1	1.731	2,727,290	22.9	10.4
	with VMT	3	24.4	1.474	1,694,159	12.1	5.5
	mix of	4	24.7	1.463	872,616	6.2	2.8
	0.2%	5	28.2	1.350	2,390,942	15.7	7.1
		1	18.2	1.015	1,046,993	50.6	23.0
	LDDT	2	19.1	0.979	2,727,290	127.2	57.7
	with VMT	3	24.4	0.813	1,694,159	65.6	29.8
	mix of	4	24.7	0.806	872,616	33.5	15.2
	2.2%	5	28.2	0.733	2,390,942	83.5	37.9
		1	18.2	4.479	1,046,993	939.7	426.3
	HDDV	2	19.1	4.274	2,727,290	2,335.5	1,059.4
	with VMT	3	24.4	3.314	1,694,159	1,125.0	510.3
	mix of	4	24.7	3.271	872,616	572.0	259.5
	9.1%	5	28.2	2.849	2,390,942	1,365.0	619.2
		1	18.2	19.735	1,046,993	232.3	105.4
	MC	2	19.1	18.983	2,727,290	582.0	264.0
	with VMT	3	24.4	15.626	1,694,159	297.6	135.0
	mix of	4	24.7	15.480	872,616	151.9	68.9
	0.5%	5	28.2	13.874	2,390,942	372.9	169.2

Table 5.5–12. Daily CO emissions in Maricopa County by vehicle class, facility type and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL	LDGV with VMT mix of 45.1%	1	12.9	10.904	195,247	2,116.1	959.8
		2	12.9	10.904	1,991,136	21,579.8	9,788.6
		3	12.9	10.904	2,564,545	27,794.3	12,607.5
		4	12.9	10.904	1,689,510	18,310.8	8,305.8
		5	12.9	10.904	1,422,562	15,417.6	6,993.4
	LDGT1 with VMT mix of 28.2%	1	12.9	14.157	195,247	1,719.5	780.0
		2	12.9	14.157	1,991,136	17,535.4	7,954.1
		3	12.9	14.157	2,564,545	22,585.3	10,244.7
		4	12.9	14.157	1,689,510	14,879.1	6,749.1
		5	12.9	14.157	1,422,562	12,528.1	5,682.8
	LDGT2 with VMT mix of 11.2%	1	12.9	16.521	195,247	793.5	360.0
		2	12.9	16.521	1,991,136	8,092.6	3,670.8
		3	12.9	16.521	2,564,545	10,423.1	4,727.9
		4	12.9	16.521	1,689,510	6,866.7	3,114.7
		5	12.9	16.521	1,422,562	5,781.7	2,622.6
	HDGV with VMT mix of 3.6%	1	12.9	25.590	195,247	392.1	177.9
		2	12.9	25.590	1,991,136	3,998.6	1,813.8
		3	12.9	25.590	2,564,545	5,150.1	2,336.1
		4	12.9	25.590	1,689,510	3,392.9	1,539.0
		5	12.9	25.590	1,422,562	2,856.8	1,295.8
	LDDV with VMT mix of 0.2%	1	12.9	2.216	195,247	2.1	1.0
		2	12.9	2.216	1,991,136	21.4	9.7
		3	12.9	2.216	2,564,545	27.6	12.5
		4	12.9	2.216	1,689,510	18.2	8.2
		5	12.9	2.216	1,422,562	15.3	6.9
	LDDT with VMT mix of 2.2%	1	12.9	1.294	195,247	12.0	5.5
		2	12.9	1.294	1,991,136	122.7	55.6
		3	12.9	1.294	2,564,545	158.0	71.7
		4	12.9	1.294	1,689,510	104.1	47.2
		5	12.9	1.294	1,422,562	87.6	39.8
	HDDV with VMT mix of 9.1%	1	12.9	6.090	195,247	238.3	108.1
		2	12.9	6.090	1,991,136	2,429.9	1,102.2
		3	12.9	6.090	2,564,545	3,129.7	1,419.6
		4	12.9	6.090	1,689,510	2,061.8	935.2
		5	12.9	6.090	1,422,562	1,736.1	787.5
	MC with VMT mix of 0.5%	1	12.9	26.555	195,247	58.3	26.4
		2	12.9	26.555	1,991,136	594.4	269.6
		3	12.9	26.555	2,564,545	765.6	347.3
		4	12.9	26.555	1,689,510	504.4	228.8
		5	12.9	26.555	1,422,562	424.7	192.6

5.6 Summary of ozone precursor emissions from onroad mobile sources

Tables 5.6–1 through 5.6–12 summarize the calculated onroad emissions by vehicle class, area, and facility type. Total VOC emissions from onroad sources for a peak ozone season day are 75,261 kilograms (165,922 pounds) per day for the ozone nonattainment area and 81,819 kg (180,380 lb) per day for all of Maricopa County. Total annual VOC emissions from onroad sources are 29,402 English tons for the ozone nonattainment area and 31,960 English tons for Maricopa County.

Total NO_x emissions from onroad sources for a peak ozone season day are 181,320 kg (399,742 lb) per day for the ozone nonattainment area and 198,556 kg (437,741 lb) per day for all of Maricopa County. Total annual NO_x emissions from onroad sources are 72,691 English tons for the ozone nonattainment area and 79,572 English tons for Maricopa County.

Total CO emissions from onroad sources for a peak ozone season day are 839,319 kg (1,850,382 lb) per day for the ozone nonattainment area and 917,819 kg (2,023,444 lb) per day for all of Maricopa County. Total annual CO emissions from onroad sources are 322,867 English tons for the ozone nonattainment area and 352,821 English tons for Maricopa County.

Table 5.6–1. Daily VOC emissions (kg/day) in the ozone NAA by vehicle class, area type and facility type (summer day).

	Area	Vehicle Class								
Facility type	**Type**	**LDGV**	**LDGT1**	**LDGT2**	**HDGV**	**LDDV**	**LDDT**	**HDDV**	**MC**	**TOTAL**
INTERSTATE, FREEWAY, and EXPRESSWAY	1	477.1	349.3	166.7	35.5	0.9	6.3	39.0	15.0	1,089.8
	2	3,818.7	2,791.2	1,333.0	284.1	7.5	50.1	312.6	121.8	8,719.0
	3	2,631.5	1,923.6	918.2	195.9	5.2	34.5	215.6	84.9	6,009.5
	4	1,908.4	1,395.0	665.9	142.1	3.8	25.1	156.4	61.6	4,358.2
	5	1,129.5	825.6	394.1	84.1	2.2	14.8	92.6	36.5	2,579.4
	Total	9,965.3	7,284.8	3,477.9	741.7	19.6	130.8	816.2	319.7	22,756.0
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	522.7	390.3	188.1	49.0	1.1	8.0	57.2	13.0	1,229.5
	2	4,093.4	3,050.2	1,467.7	361.9	8.7	60.4	417.0	100.8	9,560.2
	3	4,491.2	3,341.5	1,608.2	387.8	9.5	65.0	444.5	109.8	10,457.4
	4	3,131.0	2,323.5	1,118.5	260.2	6.4	44.1	294.8	75.9	7,254.5
	5	1,188.6	879.8	423.0	95.1	2.4	16.2	106.2	28.6	2,740.1
	Total	13,426.9	9,985.3	4,805.6	1,154.0	28.2	193.8	1,319.8	328.2	31,241.6
COLLECTOR	1	599.2	448.8	216.6	71.8	1.4	10.5	82.3	15.4	1,446.0
	2	1,532.1	1,144.2	552.0	179.9	3.7	26.7	207.5	39.3	3,685.3
	3	870.3	648.6	312.8	91.0	2.0	14.3	106.9	22.1	2,068.0
	4	446.3	332.7	160.5	46.4	1.0	7.3	54.5	11.3	1,060.0
	5	468.8	349.9	168.8	45.5	1.0	7.4	53.4	11.7	1,106.5
	Total	3,916.6	2,924.2	1,410.6	434.7	9.2	66.2	504.6	99.7	9,365.9
LOCAL	1	129.3	98.9	47.6	17.5	0.3	2.3	19.0	3.4	318.4
	2	1,318.8	1,008.2	485.8	178.9	3.2	23.8	193.5	34.6	3,246.9
	3	1,698.6	1,298.6	625.7	230.4	4.1	30.6	249.3	44.6	4,182.0
	4	1,119.0	855.5	412.2	151.8	2.7	20.2	164.2	29.4	2,755.1
	5	566.8	433.3	208.8	76.9	1.4	10.2	83.2	14.9	1,395.5
	Total	4,832.6	3,694.5	1,780.2	655.6	11.7	87.1	709.2	126.8	11,897.9
GRAND TOTALS:		**32,141.5**	**23,888.8**	**11,474.3**	**2,986.0**	**68.7**	**477.9**	**3,349.8**	**874.5**	**75,261.3**

Table 5.6–2. Daily VOC emissions (kg/day) in Maricopa County by vehicle class, area type and facility type (summer day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	477.1	349.3	166.7	35.5	0.9	6.3	39.0	15.0	1,089.8
	2	3,818.7	2,791.2	1,333.0	284.1	7.5	50.1	312.6	121.8	8,719.0
	3	2,631.5	1,923.6	918.2	195.9	5.2	34.5	215.6	84.9	6,009.5
	4	1,908.4	1,395.0	665.9	142.1	3.8	25.1	156.4	61.6	4,358.2
	5	2,387.7	1,745.4	833.1	177.8	4.7	31.3	195.6	77.1	5,452.7
	Total	11,223.5	8,204.5	3,916.9	835.4	22.1	147.3	919.3	360.4	25,629.2
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	522.7	390.3	188.1	49.0	1.1	8.0	57.2	13.0	1,229.5
	2	4,093.4	3,050.2	1,467.7	361.9	8.7	60.4	417.0	100.8	9,560.2
	3	4,491.2	3,341.5	1,608.2	387.8	9.5	65.0	444.5	109.8	10,457.4
	4	3,131.0	2,323.5	1,118.5	260.2	6.4	44.1	294.8	75.9	7,254.5
	5	1,664.2	1,231.8	592.2	133.2	3.3	22.7	148.8	40.1	3,836.3
	Total	13,902.4	10,337.3	4,974.8	1,192.0	29.1	200.3	1,362.3	339.6	32,337.9
COLLECTOR	1	599.2	448.8	216.6	71.8	1.4	10.5	82.3	15.4	1,446.0
	2	1,532.1	1,144.2	552.0	179.9	3.7	26.7	207.5	39.3	3,685.3
	3	870.3	648.6	312.8	91.0	2.0	14.3	106.9	22.1	2,068.0
	4	446.3	332.7	160.5	46.4	1.0	7.3	54.5	11.3	1,060.0
	5	1,173.5	875.9	422.5	114.0	2.6	18.4	133.7	29.4	2,770.1
	Total	4,621.4	3,450.2	1,664.3	503.2	10.8	77.3	584.9	117.4	11,029.5
LOCAL	1	129.3	98.9	47.6	17.5	0.3	2.3	19.0	3.4	318.4
	2	1,318.8	1,008.2	485.8	178.9	3.2	23.8	193.5	34.6	3,246.9
	3	1,698.6	1,298.6	625.7	230.4	4.1	30.6	249.3	44.6	4,182.0
	4	1,119.0	855.5	412.2	151.8	2.7	20.2	164.2	29.4	2,755.1
	5	942.2	720.3	347.1	127.8	2.3	17.0	138.3	24.7	2,319.8
	Total	5,208.1	3,981.5	1,918.5	706.6	12.6	93.9	764.3	136.7	12,822.1
GRAND TOTALS:		**34,955.4**	**25,973.5**	**12,474.5**	**3,237.2**	**74.6**	**518.7**	**3,630.8**	**954.0**	**81,818.7**

Table 5.6–3. Daily VOC emissions (kg/day) in the ozone NAA by vehicle class, area type and facility type (annual average day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	461.0	338.2	158.0	32.2	1.0	6.4	40.0	15.4	1,052.3
	2	3,687.5	2,704.6	1,263.6	258.2	7.9	51.5	320.7	125.1	8,419.2
	3	2,541.5	1,863.4	870.3	178.0	5.5	35.5	221.2	87.2	5,802.7
	4	1,843.1	1,351.3	631.2	129.1	4.0	25.8	160.4	63.3	4,208.1
	5	1,090.9	799.8	373.6	76.4	2.3	15.3	94.9	37.4	2,490.6
	Total	9,624.0	7,057.3	3,296.7	674.1	20.7	134.5	837.3	328.4	21,972.9
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	510.1	376.2	178.2	45.7	1.2	8.3	58.7	13.4	1,191.8
	2	3,994.6	2,948.1	1,392.0	335.6	9.2	62.1	427.7	103.7	9,273.1
	3	4,380.3	3,233.5	1,525.9	359.0	10.0	66.9	455.9	113.1	10,144.5
	4	3,040.6	2,246.4	1,059.7	240.0	6.8	45.3	302.4	78.0	7,019.1
	5	1,152.5	851.4	401.4	87.3	2.5	16.7	109.0	29.4	2,650.3
	Total	13,078.2	9,655.6	4,557.1	1,067.6	29.6	199.2	1,353.7	337.6	30,278.7
COLLECTOR	1	589.5	431.7	205.3	68.6	1.5	10.8	84.4	15.7	1,407.6
	2	1,502.3	1,098.2	522.5	171.3	3.9	27.4	213.0	40.2	3,578.8
	3	849.7	622.4	295.5	85.7	2.1	14.7	109.7	22.7	2,002.5
	4	435.8	319.3	151.6	43.7	1.1	7.5	55.9	11.6	1,026.5
	5	457.1	336.4	159.5	42.7	1.1	7.6	54.8	12.1	1,071.1
	Total	3,834.3	2,807.9	1,334.4	411.9	9.7	68.1	517.8	102.3	9,086.4
LOCAL	1	129.8	96.0	45.7	17.1	0.3	2.4	19.5	3.5	314.2
	2	1,323.2	979.0	465.7	174.2	3.4	24.4	198.6	35.4	3,203.8
	3	1,704.3	1,260.9	599.8	224.3	4.3	31.5	255.8	45.6	4,126.5
	4	1,122.8	830.7	395.1	147.8	2.9	20.7	168.5	30.0	2,718.5
	5	568.7	420.8	200.1	74.9	1.4	10.5	85.3	15.2	1,377.0
	Total	4,848.8	3,587.4	1,706.3	638.2	12.3	89.5	727.6	129.7	11,739.9
GRAND TOTALS:		**31,385.3**	**23,108.2**	**10,894.6**	**2,791.7**	**72.3**	**491.3**	**3,436.4**	**898.1**	**73,078.0**

Table 5.6–4. Daily VOC emissions (kg/day) in Maricopa County by vehicle class, area type and facility type (annual average day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	461.0	338.2	158.0	32.2	1.0	6.4	40.0	15.4	1,052.3
	2	3,687.5	2,704.6	1,263.6	258.2	7.9	51.5	320.7	125.1	8,419.2
	3	2,541.5	1,863.4	870.3	178.0	5.5	35.5	221.2	87.2	5,802.7
	4	1,843.1	1,351.3	631.2	129.1	4.0	25.8	160.4	63.3	4,208.1
	5	2,306.0	1,690.7	789.7	161.5	5.0	32.2	200.7	79.2	5,265.0
	Total	10,839.1	7,948.2	3,712.8	759.2	23.3	151.5	943.0	370.1	24,747.3
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	510.1	376.2	178.2	45.7	1.2	8.3	58.7	13.4	1,191.8
	2	3,994.6	2,948.1	1,392.0	335.6	9.2	62.1	427.7	103.7	9,273.1
	3	4,380.3	3,233.5	1,525.9	359.0	10.0	66.9	455.9	113.1	10,144.5
	4	3,040.6	2,246.4	1,059.7	240.0	6.8	45.3	302.4	78.0	7,019.1
	5	1,613.6	1,192.1	562.0	122.3	3.5	23.4	152.6	41.2	3,710.6
	Total	13,539.3	9,996.2	4,717.7	1,102.6	30.7	205.9	1,397.3	349.4	31,339.1
COLLECTOR	1	589.5	431.7	205.3	68.6	1.5	10.8	84.4	15.7	1,407.6
	2	1,502.3	1,098.2	522.5	171.3	3.9	27.4	213.0	40.2	3,578.8
	3	849.7	622.4	295.5	85.7	2.1	14.7	109.7	22.7	2,002.5
	4	435.8	319.3	151.6	43.7	1.1	7.5	55.9	11.6	1,026.5
	5	1,144.3	842.0	399.2	106.8	2.8	19.0	137.2	30.2	2,681.4
	Total	4,521.5	3,313.6	1,574.2	476.0	11.3	79.5	600.2	120.5	10,696.8
LOCAL	1	129.8	96.0	45.7	17.1	0.3	2.4	19.5	3.5	314.2
	2	1,323.2	979.0	465.7	174.2	3.4	24.4	198.6	35.4	3,203.8
	3	1,704.3	1,260.9	599.8	224.3	4.3	31.5	255.8	45.6	4,126.5
	4	1,122.8	830.7	395.1	147.8	2.9	20.7	168.5	30.0	2,718.5
	5	945.4	699.5	332.7	124.4	2.4	17.4	141.9	25.3	2,289.0
	Total	5,225.4	3,866.1	1,838.9	687.8	13.3	96.4	784.1	139.8	12,651.9
GRAND TOTALS:		**34,125.4**	**25,124.1**	**11,843.6**	**3,025.5**	**78.6**	**533.3**	**3,724.6**	**979.9**	**79,435.0**

Table 5.6–5. Daily NO_x emissions (kg/day) in the ozone NAA by vehicle class, area type and facility type (summer day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	524.8	410.3	198.0	216.5	4.3	27.9	2,322.9	9.0	3,713.6
	2	4,213.0	3,292.7	1,588.9	1,742.2	35.0	229.0	18,984.2	73.1	30,158.0
	3	2,908.9	2,274.6	1,097.4	1,205.0	24.6	160.6	13,262.8	50.7	20,984.5
	4	2,109.5	1,649.5	795.8	873.9	17.8	116.4	9,618.3	36.8	15,218.1
	5	1,248.6	976.3	471.0	517.2	10.5	68.9	5,692.6	21.8	9,007.0
	Total	11,004.8	8,603.4	4,151.1	4,554.7	92.2	602.8	49,880.7	191.3	79,081.1
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	488.4	367.2	179.8	166.7	2.3	15.0	1,177.3	6.1	2,402.7
	2	3,859.9	2,937.3	1,440.8	1,399.1	18.6	120.7	9,505.5	50.6	19,332.5
	3	4,270.8	3,256.9	1,597.5	1,572.5	20.7	134.7	10,586.9	57.1	21,497.1
	4	3,024.4	2,314.9	1,132.8	1,136.3	14.9	96.5	7,573.7	40.7	15,334.0
	5	1,173.3	901.5	440.1	450.2	6.0	38.6	3,014.3	15.9	6,039.9
	Total	12,816.9	9,777.7	4,791.0	4,724.8	62.5	405.5	31,857.6	170.4	64,606.3
COLLECTOR	1	554.2	400.1	195.6	145.2	2.6	16.9	1,292.3	5.1	2,611.9
	2	1,418.6	1,028.0	502.7	380.8	6.6	43.1	3,315.4	13.5	6,708.8
	3	811.8	599.8	293.5	247.4	3.8	24.6	1,914.8	8.9	3,904.5
	4	416.6	308.0	150.7	127.7	1.9	12.6	983.0	4.6	2,005.1
	5	437.7	327.2	160.2	144.1	2.1	13.3	1,046.5	5.2	2,136.3
	Total	3,638.9	2,663.0	1,302.5	1,045.3	17.0	110.5	8,552.0	37.3	17,366.6
LOCAL	1	118.5	83.3	40.6	25.8	0.5	3.6	269.0	0.9	542.3
	2	1,208.3	850.0	414.2	263.4	5.6	36.5	2,743.3	9.4	5,530.6
	3	1,556.3	1,094.7	533.4	339.3	7.2	47.0	3,533.3	12.1	7,123.4
	4	1,025.3	721.2	351.4	223.5	4.7	30.9	2,327.7	7.9	4,692.8
	5	519.3	365.3	178.0	113.2	2.4	15.7	1,179.0	4.0	2,377.0
	Total	4,427.8	3,114.6	1,517.7	965.3	20.5	133.6	10,052.4	34.3	20,266.2
GRAND TOTALS:		**31,888.4**	**24,158.7**	**11,762.3**	**11,290.1**	**192.3**	**1,252.4**	**100,342.7**	**433.3**	**181,320.3**

Table 5.6–6. Daily NO_x emissions (kg/day) in Maricopa County by vehicle class, area type and facility type (summer day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	524.8	410.3	198.0	216.5	4.3	27.9	2,322.9	9.0	3,713.6
	2	4,213.0	3,292.7	1,588.9	1,742.2	35.0	229.0	18,984.2	73.1	30,158.0
	3	2,908.9	2,274.6	1,097.4	1,205.0	24.6	160.6	13,262.8	50.7	20,984.5
	4	2,109.5	1,649.5	795.8	873.9	17.8	116.4	9,618.3	36.8	15,218.1
	5	2,639.3	2,063.8	995.7	1,093.3	22.3	145.7	12,033.8	46.0	19,040.0
	Total	12,395.6	9,690.9	4,675.8	5,130.8	104.0	679.6	56,221.9	215.6	89,114.1
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	488.4	367.2	179.8	166.7	2.3	15.0	1,177.3	6.1	2,402.7
	2	3,859.9	2,937.3	1,440.8	1,399.1	18.6	120.7	9,505.5	50.6	19,332.5
	3	4,270.8	3,256.9	1,597.5	1,572.5	20.7	134.7	10,586.9	57.1	21,497.1
	4	3,024.4	2,314.9	1,132.8	1,136.3	14.9	96.5	7,573.7	40.7	15,334.0
	5	1,642.8	1,262.2	616.1	630.3	8.3	54.1	4,220.3	22.3	8,456.4
	Total	13,286.3	10,138.4	4,967.0	4,905.0	64.9	420.9	33,063.6	176.7	67,022.9
COLLECTOR	1	554.2	400.1	195.6	145.2	2.6	16.9	1,292.3	5.1	2,611.9
	2	1,418.6	1,028.0	502.7	380.8	6.6	43.1	3,315.4	13.5	6,708.8
	3	811.8	599.8	293.5	247.4	3.8	24.6	1,914.8	8.9	3,904.5
	4	416.6	308.0	150.7	127.7	1.9	12.6	983.0	4.6	2,005.1
	5	1,095.7	819.1	401.0	360.7	5.2	33.4	2,619.9	13.1	5,348.0
	Total	4,296.9	3,154.9	1,543.4	1,261.9	20.1	130.6	10,125.3	45.2	20,578.3
LOCAL	1	118.5	83.3	40.6	25.8	0.5	3.6	269.0	0.9	542.3
	2	1,208.3	850.0	414.2	263.4	5.6	36.5	2,743.3	9.4	5,530.6
	3	1,556.3	1,094.7	533.4	339.3	7.2	47.0	3,533.3	12.1	7,123.4
	4	1,025.3	721.2	351.4	223.5	4.7	30.9	2,327.7	7.9	4,692.8
	5	863.3	607.3	295.9	188.2	4.0	26.0	1,960.0	6.7	3,951.4
	Total	4,771.8	3,356.5	1,635.5	1,040.3	22.1	144.0	10,833.3	37.0	21,840.5
GRAND TOTALS:		**34,750.6**	**26,340.8**	**12,821.7**	**12,338.0**	**211.1**	**1,375.1**	**110,244.1**	**474.5**	**198,555.9**

Table 5.6–7. Daily NO_x emissions (kg/day) in the ozone NAA by vehicle class, area type and facility type (annual average day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	490.8	378.6	187.2	222.5	4.4	28.8	2,396.9	9.7	3,718.9
	2	3,940.0	3,039.5	1,502.5	1,790.5	36.5	236.4	19,589.8	78.4	30,213.6
	3	2,722.1	2,100.2	1,037.8	1,238.4	25.6	165.8	13,686.5	54.4	21,030.8
	4	1,974.1	1,523.1	752.6	898.1	18.5	120.2	9,925.5	39.5	15,251.7
	5	1,168.4	901.5	445.4	531.6	11.0	71.2	5,874.5	23.4	9,026.8
	Total	10,295.4	7,942.8	3,925.6	4,681.1	96.0	622.4	51,473.2	205.3	79,241.8
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	441.3	333.9	167.5	171.3	2.4	15.5	1,289.4	6.5	2,427.7
	2	3,517.9	2,682.8	1,346.9	1,438.1	19.4	124.6	10,414.2	54.5	19,598.4
	3	3,901.1	2,979.5	1,495.2	1,616.3	21.6	138.9	11,596.4	60.9	21,809.9
	4	2,758.1	2,109.5	1,057.4	1,167.8	15.5	99.6	7,821.3	43.7	15,072.9
	5	1,074.9	823.1	411.7	462.7	6.2	39.9	3,113.1	17.1	5,948.7
	Total	11,693.3	8,928.8	4,478.7	4,856.3	65.1	418.5	34,234.3	182.7	64,857.6
COLLECTOR	1	489.5	361.4	180.9	149.2	2.7	17.4	1,334.9	5.5	2,541.5
	2	1,255.7	928.9	465.1	391.3	6.9	44.5	3,424.4	14.5	6,531.4
	3	725.6	543.0	272.2	254.3	3.9	25.4	1,977.6	9.5	3,811.5
	4	372.5	278.9	139.8	131.3	2.0	13.0	1,015.2	4.9	1,957.7
	5	393.7	296.6	148.8	148.1	2.1	13.8	1,080.8	5.6	2,089.5
	Total	3,237.0	2,408.9	1,206.8	1,074.3	17.7	114.1	8,832.8	40.0	16,931.5
LOCAL	1	103.3	75.1	37.5	26.5	0.6	3.7	277.9	1.0	525.5
	2	1,053.1	765.4	382.3	270.7	5.8	37.6	2,834.1	10.1	5,359.1
	3	1,356.4	985.8	492.4	348.7	7.5	48.5	3,650.3	12.9	6,902.5
	4	893.6	649.5	324.4	229.7	4.9	31.9	2,404.8	8.5	4,547.3
	5	452.6	329.0	164.3	116.4	2.5	16.2	1,218.1	4.3	2,303.3
	Total	3,859.0	2,804.7	1,400.8	992.0	21.3	137.9	10,385.2	36.8	19,637.7
GRAND TOTALS:		**29,084.7**	**22,085.2**	**11,011.8**	**11,603.7**	**200.1**	**1,292.8**	**104,925.6**	**464.9**	**180,668.6**

Table 5.6–8. Daily NO_x emissions (kg/day) in Maricopa County by vehicle class, area type and facility type (annual average day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	490.8	378.6	187.2	222.5	4.4	28.8	2,396.9	9.7	3,718.9
	2	3,940.0	3,039.5	1,502.5	1,790.5	36.5	236.4	19,589.8	78.4	30,213.6
	3	2,722.1	2,100.2	1,037.8	1,238.4	25.6	165.8	13,686.5	54.4	21,030.8
	4	1,974.1	1,523.1	752.6	898.1	18.5	120.2	9,925.5	39.5	15,251.7
	5	2,469.9	1,905.6	941.6	1,123.7	23.2	150.4	12,418.2	49.4	19,082.0
	Total	11,596.9	8,947.0	4,421.7	5,273.3	108.2	701.6	58,016.9	231.3	89,297.0
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	441.3	333.9	167.5	171.3	2.4	15.5	1,289.4	6.5	2,427.7
	2	3,517.9	2,682.8	1,346.9	1,438.1	19.4	124.6	10,414.2	54.5	19,598.4
	3	3,901.1	2,979.5	1,495.2	1,616.3	21.6	138.9	11,596.4	60.9	21,809.9
	4	2,758.1	2,109.5	1,057.4	1,167.8	15.5	99.6	7,821.3	43.7	15,072.9
	5	1,504.9	1,152.4	576.3	647.9	8.7	55.9	4,358.7	24.0	8,328.7
	Total	12,123.3	9,258.1	4,643.3	5,041.4	67.6	434.5	35,479.9	189.6	67,237.6
COLLECTOR	1	489.5	361.4	180.9	149.2	2.7	17.4	1,334.9	5.5	2,541.5
	2	1,255.7	928.9	465.1	391.3	6.9	44.5	3,424.4	14.5	6,531.4
	3	725.6	543.0	272.2	254.3	3.9	25.4	1,977.6	9.5	3,811.5
	4	372.5	278.9	139.8	131.3	2.0	13.0	1,015.2	4.9	1,957.7
	5	985.6	742.6	372.5	370.8	5.4	34.5	2,705.6	14.0	5,230.9
	Total	3,828.9	2,854.9	1,430.5	1,296.9	20.9	134.8	10,457.7	48.4	20,072.9
LOCAL	1	103.3	75.1	37.5	26.5	0.6	3.7	277.9	1.0	525.5
	2	1,053.1	765.4	382.3	270.7	5.8	37.6	2,834.1	10.1	5,359.1
	3	1,356.4	985.8	492.4	348.7	7.5	48.5	3,650.3	12.9	6,902.5
	4	893.6	649.5	324.4	229.7	4.9	31.9	2,404.8	8.5	4,547.3
	5	752.4	546.8	273.1	193.4	4.2	26.9	2,024.8	7.2	3,828.8
	Total	4,158.7	3,022.6	1,509.6	1,069.1	23.0	148.6	11,192.0	39.7	21,163.2
GRAND TOTALS:		**31,707.9**	**24,082.5**	**12,005.2**	**12,680.7**	**219.7**	**1,419.5**	**115,146.4**	**509.0**	**197,770.7**

Table 5.6–9. Daily CO emissions (kg/day) in the ozone NAA by vehicle class, area type and facility type (summer day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	7,240.8	5,578.6	2,515.6	595.3	2.9	15.6	245.6	149.6	16,344.0
	2	58,369.5	44,921.6	20,253.3	4,885.8	23.8	126.4	1,999.5	1,251.6	131,831.4
	3	40,428.6	31,090.5	14,011.7	3,424.3	16.5	87.7	1,393.4	887.5	91,340.3
	4	29,319.1	22,547.1	10,161.4	2,483.4	12.0	63.6	1,010.5	643.6	66,240.7
	5	17,352.8	13,344.7	6,014.1	1,469.8	7.1	37.7	598.1	380.9	39,205.1
	Total	152,710.7	117,482.4	52,956.1	12,858.6	62.4	331.0	5,247.1	3,313.2	344,961.5
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,836.1	3,979.3	1,862.1	482.7	3.0	15.8	255.6	88.0	11,522.6
	2	40,119.9	33,037.9	15,386.5	3,518.0	22.6	119.1	1,843.9	640.1	94,687.9
	3	45,295.1	37,217.0	17,291.8	3,772.2	24.5	128.8	1,965.9	682.4	106,377.8
	4	33,164.0	27,096.0	12,548.2	2,548.7	16.9	87.9	1,312.1	454.2	77,227.9
	5	13,362.1	10,836.4	4,995.1	957.2	6.3	32.9	482.8	165.2	30,838.1
	Total	136,777.1	112,166.6	52,083.8	11,278.8	73.3	384.4	5,860.3	2,029.9	320,654.3
COLLECTOR	1	4,879.2	3,891.9	1,847.8	794.7	3.9	22.1	416.5	129.4	11,985.6
	2	12,560.2	10,059.2	4,769.8	1,969.3	9.9	55.6	1,035.2	324.0	30,783.3
	3	7,536.5	6,145.8	2,897.3	939.6	5.2	28.7	498.6	164.7	18,216.5
	4	3,877.5	3,163.2	1,490.4	477.6	2.7	14.7	253.5	84.0	9,363.6
	5	4,236.6	3,477.8	1,631.9	456.0	2.7	14.6	241.7	82.1	10,143.4
	Total	33,090.0	26,737.9	12,637.2	4,637.2	24.5	135.7	2,445.5	784.4	80,492.4
LOCAL	1	998.0	775.6	370.3	205.9	0.9	5.3	105.6	32.7	2,494.3
	2	10,178.1	7,909.8	3,776.5	2,099.7	9.3	53.7	1,077.0	333.3	25,437.2
	3	13,109.2	10,187.6	4,864.0	2,704.3	11.9	69.1	1,387.2	429.2	32,762.6
	4	8,636.3	6,711.6	3,204.4	1,781.6	7.9	45.5	913.8	282.8	21,583.8
	5	4,374.4	3,399.5	1,623.1	902.4	4.0	23.1	462.9	143.2	10,932.7
	Total	37,296.0	28,984.1	13,838.3	7,694.0	34.0	196.7	3,946.5	1,221.2	93,210.6
GRAND TOTALS:		**359,873.8**	**285,371.0**	**131,515.4**	**36,468.5**	**194.1**	**1,047.9**	**17,499.4**	**7,348.7**	**839,318.7**

Table 5.6–10. Daily CO emissions (kg/day) in Maricopa County by vehicle class, area type and facility type (summer day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	7,240.8	5,578.6	2,515.6	595.3	2.9	15.6	245.6	149.6	16,344.0
	2	58,369.5	44,921.6	20,253.3	4,885.8	23.8	126.4	1,999.5	1,251.6	131,831.4
	3	40,428.6	31,090.5	14,011.7	3,424.3	16.5	87.7	1,393.4	887.5	91,340.3
	4	29,319.1	22,547.1	10,161.4	2,483.4	12.0	63.6	1,010.5	643.6	66,240.7
	5	36,682.3	28,209.5	12,713.3	3,107.0	15.0	79.6	1,264.3	805.3	82,876.4
	Total	172,040.3	132,347.3	59,655.4	14,495.8	70.3	373.0	5,913.3	3,737.5	388,632.7
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,836.1	3,979.3	1,862.1	482.7	3.0	15.8	255.6	88.0	11,522.6
	2	40,119.9	33,037.9	15,386.5	3,518.0	22.6	119.1	1,843.9	640.1	94,687.9
	3	45,295.1	37,217.0	17,291.8	3,772.2	24.5	128.8	1,965.9	682.4	106,377.8
	4	33,164.0	27,096.0	12,548.2	2,548.7	16.9	87.9	1,312.1	454.2	77,227.9
	5	18,708.2	15,171.9	6,993.6	1,340.1	8.9	46.1	675.9	231.3	43,176.1
	Total	142,123.2	116,502.1	54,082.3	11,661.7	75.8	397.6	6,053.5	2,096.0	332,992.2
COLLECTOR	1	4,879.2	3,891.9	1,847.8	794.7	3.9	22.1	416.5	129.4	11,985.6
	2	12,560.2	10,059.2	4,769.8	1,969.3	9.9	55.6	1,035.2	324.0	30,783.3
	3	7,536.5	6,145.8	2,897.3	939.6	5.2	28.7	498.6	164.7	18,216.5
	4	3,877.5	3,163.2	1,490.4	477.6	2.7	14.7	253.5	84.0	9,363.6
	5	10,606.0	8,706.4	4,085.4	1,141.5	6.8	36.5	605.0	205.7	25,393.3
	Total	39,459.5	31,966.5	15,090.7	5,322.7	28.6	157.7	2,808.8	907.9	95,742.3
LOCAL	1	998.0	775.6	370.3	205.9	0.9	5.3	105.6	32.7	2,494.3
	2	10,178.1	7,909.8	3,776.5	2,099.7	9.3	53.7	1,077.0	333.3	25,437.2
	3	13,109.2	10,187.6	4,864.0	2,704.3	11.9	69.1	1,387.2	429.2	32,762.6
	4	8,636.3	6,711.6	3,204.4	1,781.6	7.9	45.5	913.8	282.8	21,583.8
	5	7,271.7	5,651.1	2,698.1	1,500.1	6.6	38.3	769.5	238.1	18,173.5
	Total	40,193.2	31,235.6	14,913.3	8,291.6	36.6	211.9	4,253.1	1,316.1	100,451.5
GRAND TOTALS:		**393,816.1**	**312,051.6**	**143,741.6**	**39,771.9**	**211.3**	**1,140.2**	**19,028.6**	**8,057.5**	**917,818.8**

Table 5.6–11. Daily CO emissions (kg/day) in the ozone NAA by vehicle class, area type and facility type (annual average day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	6,672.5	5,324.0	2,369.5	514.1	3.1	16.2	251.3	121.6	15,272.3
	2	53,744.6	42,853.5	19,069.8	4,221.6	25.0	131.0	2,046.2	1,016.3	123,107.9
	3	37,200.3	29,653.4	13,191.2	2,958.2	17.3	91.0	1,426.2	720.2	85,257.7
	4	26,977.9	21,504.9	9,566.3	2,145.3	12.6	66.0	1,034.3	522.3	61,829.6
	5	15,967.1	12,727.8	5,661.9	1,269.7	7.4	39.0	612.2	309.1	36,594.3
	Total	140,562.4	112,063.6	49,858.8	11,108.9	65.3	343.2	5,370.2	2,689.4	322,061.9
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,748.8	3,987.7	1,807.4	417.0	3.1	16.4	261.6	72.5	11,314.5
	2	39,174.5	32,918.9	14,876.9	3,037.8	23.6	123.4	1,887.1	530.1	92,572.3
	3	44,085.6	36,971.2	16,691.9	3,258.9	25.7	133.4	2,012.0	565.9	103,744.6
	4	31,703.7	26,556.0	11,982.1	2,202.2	17.7	91.1	1,342.9	377.6	74,273.2
	5	12,687.1	10,565.1	4,757.5	827.1	6.7	34.1	494.1	137.7	29,509.3
	Total	132,399.6	110,998.8	50,115.9	9,742.9	76.8	398.5	5,997.6	1,683.8	311,413.9
COLLECTOR	1	4,739.3	3,919.9	1,796.9	686.6	4.1	23.0	426.3	105.4	11,701.5
	2	12,222.7	10,132.5	4,641.4	1,701.3	10.4	57.7	1,059.4	264.0	30,089.4
	3	7,339.3	6,154.7	2,805.7	811.9	5.5	29.8	510.3	135.0	17,792.2
	4	3,774.7	3,167.2	1,443.8	412.6	2.8	15.2	259.5	68.9	9,144.6
	5	4,116.0	3,465.4	1,574.9	393.7	2.8	15.1	247.3	67.6	9,882.9
	Total	32,192.1	26,839.7	12,262.8	4,006.1	25.6	140.7	2,502.7	640.8	78,610.5
LOCAL	1	959.8	780.0	360.0	177.9	1.0	5.5	108.1	26.4	2,418.5
	2	9,788.6	7,954.1	3,670.8	1,813.8	9.7	55.6	1,102.2	269.6	24,664.4
	3	12,607.5	10,244.7	4,727.9	2,336.1	12.5	71.7	1,419.6	347.3	31,767.3
	4	8,305.8	6,749.1	3,114.7	1,539.0	8.2	47.2	935.2	228.8	20,928.1
	5	4,207.0	3,418.6	1,577.7	779.5	4.2	23.9	473.7	115.9	10,600.5
	Total	35,868.7	29,146.4	13,451.1	6,646.3	35.6	203.9	4,038.9	988.0	90,378.9
GRAND TOTALS:		**341,022.9**	**279,048.5**	**125,688.5**	**31,504.3**	**203.3**	**1,086.3**	**17,909.5**	**6,002.0**	**802,465.3**

Table 5.6–12. Daily CO emissions (kg/day) in Maricopa County by vehicle class, area type and facility type (annual average day).

Facility type	Area Type	Vehicle Class								
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	6,672.5	5,324.0	2,369.5	514.1	3.1	16.2	251.3	121.6	15,272.3
	2	53,744.6	42,853.5	19,069.8	4,221.6	25.0	131.0	2,046.2	1,016.3	123,107.9
	3	37,200.3	29,653.4	13,191.2	2,958.2	17.3	91.0	1,426.2	720.2	85,257.7
	4	26,977.9	21,504.9	9,566.3	2,145.3	12.6	66.0	1,034.3	522.3	61,829.6
	5	33,753.2	26,905.6	11,968.8	2,684.1	15.7	82.5	1,294.1	653.4	77,357.5
	Total	158,348.5	126,241.4	56,165.7	12,523.3	73.6	386.7	6,052.1	3,033.7	362,825.0
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	4,748.8	3,987.7	1,807.4	417.0	3.1	16.4	261.6	72.5	11,314.5
	2	39,174.5	32,918.9	14,876.9	3,037.8	23.6	123.4	1,887.1	530.1	92,572.3
	3	44,085.6	36,971.2	16,691.9	3,258.9	25.7	133.4	2,012.0	565.9	103,744.6
	4	31,703.7	26,556.0	11,982.1	2,202.2	17.7	91.1	1,342.9	377.6	74,273.2
	5	17,763.0	14,792.0	6,661.0	1,158.0	9.3	47.8	691.7	192.8	41,315.7
	Total	137,475.6	115,225.8	52,019.3	10,073.9	79.4	412.1	6,195.3	1,738.9	323,220.2
COLLECTOR	1	4,739.3	3,919.9	1,796.9	686.6	4.1	23.0	426.3	105.4	11,701.5
	2	12,222.7	10,132.5	4,641.4	1,701.3	10.4	57.7	1,059.4	264.0	30,089.4
	3	7,339.3	6,154.7	2,805.7	811.9	5.5	29.8	510.3	135.0	17,792.2
	4	3,774.7	3,167.2	1,443.8	412.6	2.8	15.2	259.5	68.9	9,144.6
	5	10,304.2	8,675.3	3,942.6	985.7	7.1	37.9	619.2	169.2	24,741.1
	Total	38,380.3	32,049.7	14,630.5	4,598.0	29.9	163.5	2,874.6	742.4	93,468.8
LOCAL	1	959.8	780.0	360.0	177.9	1.0	5.5	108.1	26.4	2,418.5
	2	9,788.6	7,954.1	3,670.8	1,813.8	9.7	55.6	1,102.2	269.6	24,664.4
	3	12,607.5	10,244.7	4,727.9	2,336.1	12.5	71.7	1,419.6	347.3	31,767.3
	4	8,305.8	6,749.1	3,114.7	1,539.0	8.2	47.2	935.2	228.8	20,928.1
	5	6,993.4	5,682.8	2,622.6	1,295.8	6.9	39.8	787.5	192.6	17,621.4
	Total	38,655.1	31,410.6	14,496.0	7,162.6	38.3	219.8	4,352.7	1,064.8	97,399.8
GRAND TOTALS:		**372,859.4**	**304,927.4**	**137,311.5**	**34,357.8**	**221.3**	**1,182.0**	**19,474.6**	**6,579.8**	**876,913.9**

5.7 Quality assurance process

5.7.1 VMT estimates

Normal quality assurance procedures, including extensive automated consistency checks, were used by ADOT in developing the 2002 HPMS data. These data were submitted to the Federal Highway Administration in October 2003.

5.7.2 Emission factor estimates

The quality assurance (QA) process performed on the MOBILE6.2 analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, a system was used that included a two-layer, independent reviewer set-up. All hard copy and computer-based data entries as well as all calculations procedures were checked independently for accuracy and completeness by two different reviewers. Any errors found were corrected and the changes were then rechecked by the reviewers.

The entire onroad mobile source portion of the 2002 periodic ozone precursor inventory was reviewed by MAG staff that did not directly participate in its development. All comments were addressed.

5.7.3 Quality review of the 2002 periodic ozone precursor emissions inventory

The draft onroad mobile source portion of the 2002 periodic ozone precursor emissions inventory was reviewed using published EPA quality review guidelines for base year emission inventories (EPA Document 450/4-91-022, September 1991). The procedural review (Levels I, II, and III) included checks for completeness, consistency, and the correct use of appropriate procedures.

Additionally, the draft onroad mobile source portion of the 2002 periodic ozone precursors emissions inventory for the ozone nonattainment area was compared with the onroad mobile source portions of the 1990, 1993, 1996, and 1999 base year and periodic emissions inventories. The results are in Table 5.7–1. Estimates for Maricopa County in its entirety and estimates for an annual average day were not prepared for previous inventories, so no comparison is possible for those portions of this inventory.

Table 5.7–1. Comparison of daily emissions from onroad mobile sources and vehicle miles traveled (VMT) in the ozone nonattainment area, 1990–2002.

Year of analysis	Onroad VOC emissions (lb/day)	Onroad NO_x emissions (lb/yr)	Onroad CO emissions (lb/yr)	Vehicle miles traveled (VMT)
1990	300,218	286,243	2,005,220	42,545,983
1993	239,186	288,992	1,708,688	46,555,338
1996	190,283	285,692	1,243,095	51,329,514
1999	180,890	294,299	1,268,227	55,934,173
2002	165,922	399,742	1,850,382	67,524,299

While the VMT increases over time, the modeled onroad CO and NO_x emissions decrease or remain relatively constant between 1990 and 1999 because of the implementation of control measures designed to reduce onroad emissions such as I/M program, cleaner gasoline, cleaner vehicle technologies, etc. This trend would have continued if MOBILE5a had been used for the 2002 inventory. Significant increases for NO_x and CO are modeled between 1999 and 2002 due to the use of MOBILE6.2 in the 2002 analysis versus MOBILE5a in the 1999 and previous analyses. It is also important to note that the base case emissions from the Ozone Maintenance Plan may not match those in the periodic inventories because of a different year modeled and different modeling domain size.

As an additional QA check, the average miles per gallon estimate was derived using average annual daily VMT estimates and gasoline sales from ADOT. The results of that QA check may be found in Appendix 5.5.

5.8 References

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6. Biogenic Sources

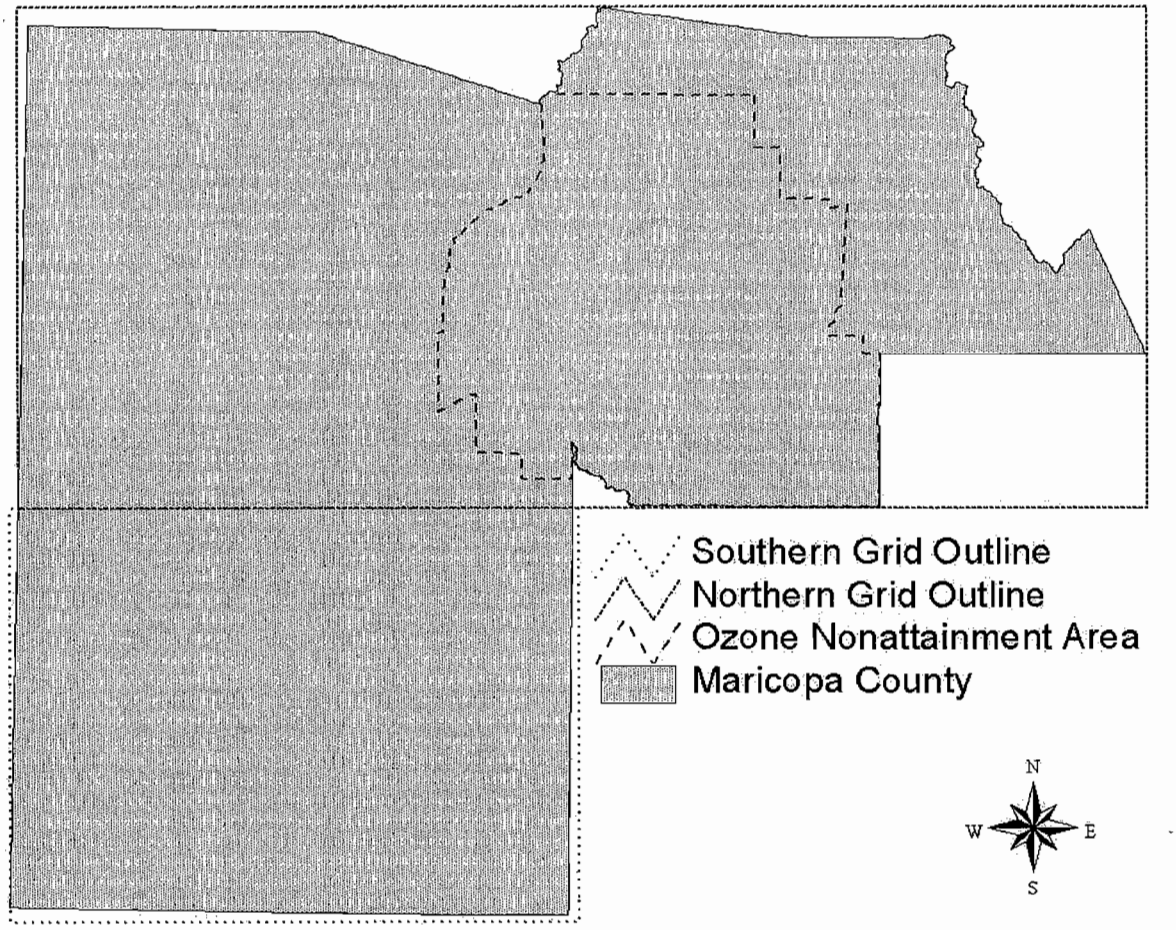
6.1 Introduction and scope

Biogenic source emission estimates have been calculated for ozone precursors for use in the 2002 Periodic Ozone Inventory. These biogenic source emission estimates are for Maricopa County and the 1,872 square-mile ozone nonattainment area within Maricopa County. These emissions were estimated using a modified version of the UAM-BEIS 2 model called MAG-BEIS2. MAGBEIS2 was developed for use in Maricopa County and is documented in Improvements to the Biogenic Emission Estimation Process for Maricopa County (STI, 1996). MAGBEIS2 main modifications to UAM-BEIS2 was the addition of procedures that allow for the input of user-supplied gridded land use and surface temperature data. These procedures included the development of a land-use preprocessor called MAGLAND2 to consolidate the MAG land-use data and to substitute data for missing or incomplete grid cells. The guiding principle used in the development of MAGBEIS2 was the replacement of some EPA defaults with locale-specific data, including: locale-specific land-use data, locale-specific biomass estimates, and the use of a taxonomic approach to develop local-specific emission factors. Overall, MAGBEIS2 constitutes an improvement over the EPA BEIS2 procedures, and is considered to provide reasonable estimates of the biogenic emissions in the study area.

6.2 Modeling domain adjustments

The emissions reported in the periodic inventory are for both the ozone nonattainment area and Maricopa County. Due to the irregular shape of the ozone nonattainment area and Maricopa County, it was not possible to use the ozone nonattainment area or county boundary as the modeling domain for the grid based MAGBEIS2 model. Two modeling domains were used to estimate biogenic emissions for the nonattainment area and Maricopa County. The modeling domains used in the present study are shown in Figure 6.2–1. The northern domain consists of 107 grid cells in the east-west direction and 47 grid cells in the north-south direction, with a uniform grid spacing of two kilometers. The northern domain encompassed the entire ozone nonattainment area. The southern domain encompassed the southern portion of Maricopa County and consisted of 54 grid cells in the east-west direction and 39 grid cells in the north-south direction, with a uniform grid spacing of two kilometers. Both domains are primarily located within Maricopa County, although small fractions of the modeling areas extend into other neighboring counties. The emissions estimated using the MAGBEIS2 model are for the rectangular modeling domain previously described. These estimates were adjusted to calculate the non-attainment area emissions and Maricopa County emissions through the use of ARCVIEW. ARCVIEW was used to remove the portions of the modeling domain outside of the Maricopa County area for the county emission estimates and outside of the nonattainment area for the nonattainment area emission estimates.

Figure 6.2–1. Ozone nonattainment area, Maricopa County, and biogenic modeling domains (northern and southern grid outlines).



6.3 Land-use categories

The most critical input for the biogenic emission modeling is the land-use data file. The most recent land-use information was incorporated into the EPA BELD3 land-use data to create a merged land-use data set. The most recent land-use data compiled by MAG included over 40 land-use types using 2000 information as listed in Table 6.3–1. MAG residential, commercial, water, and agricultural land-use categories were merged into the BELD3 USGS coniferous, deciduous, mixed forest, grassland, savanna, and shrubland land-use types, listed in Table 6.3–2, to create a county-wide composite land-use data set. The MAGLAND2 and MAGBEIS2 programs described in the 1996 study by STI and used in previous periodic ozone emission inventories had to be modified to accept the land-use categories from the merged BELD3/MAG 2000 land-use data set. Due to lack of information for the spatial distribution of the agricultural types in the BELD3/MAG 2000 land-use data there is only one category for agriculture. The agricultural emission factor was updated based on 2002 Maricopa County crop statistics.

Table 6.3–1. MAG 2000 land-use categories.

ID	Type	Assigned to	ID	Type	Assigned to
100	General Residential	Residential	510	Hotel, Motel or Resort	Commercial
110	Rural Residential	USGS Shrubland	520	Educational	Commercial
120	Estate Residential	USGS Shrubland	530	Institutional	Commercial
130	Large Lot Residential	Residential	540	Cemeteries	USGS Grassland
140	Medium Lot Residential	Residential	550	Public Facilities	Commercial
150	Small Lot Residential	Residential	560	Special Events	Commercial
160	Very Small Lot Residential	Residential	570	Other Employment Low	Nonemit
170	Medium Density Residential	Residential	580	Other Employment Medium	Commercial
180	High Density Residential	Residential	590	Other Employment High	Commercial
190	Very High Density Residential	Residential	600	General Transportation	Nonemit
200	General Commercial	Commercial	610	Transportation	Nonemit
210	Specialty Commercial	Commercial	611	Parking Structures	Nonemit
220	Neighborhood Retail Center	Commercial	612	Parking Surfaces	Nonemit
230	Community Commercial	Commercial	620	Airport	Nonemit
240	Regional Retail Center	Commercial	700	Recreation	not merged
250	Super-Regional Commercial	Commercial	710	Active Open Spaces	USGS Grassland
300	General Industrial	Commercial	720	Golf Courses	USGS Grassland
310	Warehouse/Distribution	Commercial	730	Dedicated Open Space	not merged
320	Industrial	Commercial	740	Water	Water
400	Office General	Commercial	750	Agriculture	Agriculture
410	Office Low Rise	Commercial	800	Multiple Use	Commercial
420	Office Mid Rise	Commercial	810	Business Park	Commercial
430	Office High Rise	Commercial	820	Mixed Use	Commercial
500	General Employment	Commercial	830	Planned Developments	Commercial
			900	Vacant	not merged

Table 6.3–2. Land-use categories from BELD3 used in the emission inventory.

BELD3 Land-use category
USGS_Coniferous
USGS_Deciduous
USGS_Mixed Forest
USGS_Grassland
USGS_Savanna
USGS_Shrubland

6.4 Derivation of emission factors

For each of the 11 land-use groups, MAGBEIS2 requires as input a standardized emission factor for isoprene, monoterpene, other volatile organic compounds (OVOCs), and oxides of nitrogen (NO_x). The emission factors selected for use in MAGBEIS2 are listed in Table 6.4–1. The commercial emission factor is identical to the one developed for the 1996 STI study. The "Agricultural" and "Residential" categories were adjusted based on updated data or assumptions described below.

Table 6.4–1. VOC and NO_x standardized emission factors, by land-use category ($\mu g/m^2 \cdot hr$).

	Emission Factor			
Land-use category	**Isoprene**	**Monoterpene**	**OVOC**	**NO_x**
Commercial/Industrial	102[e]	22[e]	22[a]	1.8[b]
Residential/Schools/Churches	961.3[e]	206.5[e]	206.5[a]	17.4[c]
Agricultural	20.8[e]	44.7[e]	49.9[e]	140.0[e]
USGS Coniferous	2276.6	1375.0	457.0	2.0
USGS Deciduous	1646.4	90.0	249.0	2.0
USGS Mixed Forest	1545.8	225.0	374.0	2.0
USGS Grassland	9.8	21.0	249.0	27.0
Water	0[d]	0[d]	0[d]	0[d]
USGS Savanna	353.0	60.0	83.0	27.0
USGS Shrubland	110.0	55.0	33.0	57.8
Non-emitting	0	0	0	0

a. OVOC emission rate set equal to monoterpene emissions rate.
b. US EPA emission factor for grass multiplied by the landscape fraction.
c. US EPA emission factor for commercial and industrial multiplied by the landscape fraction.
d. US EPA-recommended values.
e. Based on locale-specific data.

The development of the emission rate estimate for the "Agricultural" category utilized Arizona crop statistics for 2002 obtained for Maricopa County by land-use type as documented in 2002 Arizona Agricultural Statistics, Arizona Agricultural Statistics Service, 2003. These values are shown in Table 6.4–2. The acreage shown in this table were used to derive the percentages of these crop types relative to the total crop land-use area: Cotton - 25.04 percent, Alfalfa - 37.64 percent, Other Hay - 4.09 percent, Wheat - 7.42 percent, Barley - 9.27 percent, Corn - 0.11 percent, Vegetables - 10.91 percent, Citrus - 5.51 percent. These percentages, as fractions, were multiplied by the US EPA reported standardized emission factors for isoprene, monoterpenes, OVOC, and NO_x for each crop type to get a composite emission factor for harvested cropland areas. The emission factor for "Citrus" is the same as that reported by EPA for orange. Since the 2000 MAG land-use data only contain a single agriculture category, MAG calculated a composite emission factor based on the land distribution fractions for harvested cropland and non-harvested croplands from the latest available Census of Agriculture, 1997.

Table 6.4–2. Maricopa County crop statistics for 2002.

Crop	**Acres ***	**% of total**
Cotton	45,900	25.04
Alfalfa	69,000	37.64
Other Hay	7,500	4.09
Wheat	13,600	7.42
Barley	17,000	9.27
Corn	200	0.11
Vegetables	20,000	10.91
Citrus	10,100	5.51
Totals:	**183,300**	**100.**

* All values were derived from 2002 Arizona Agricultural Statistics, Arizona Agricultural Statistics Service, 2003.

Table 6.4–3 shows the total areas and percentages for harvested cropland and total cropland . This approach relies on the assumption that the changes occurring in harvested and non-harvested areas has not changed significantly since 1997. As a result, the emission factor for the new "Agricultural" category was computed by calculating a weighted average of the harvested

cropland emission factor and the non-harvested (grassland) emission factor for each VOC species (paraffin, olefins, aldehyde, and isoprene), OVOC, and NO_x.

Table 6.4–3. Distribution of harvested cropland and total cropland.

Category	Area* (acres)	Fraction (%)
Total Cropland	340,563	100
Harvested Cropland	296,150	87
Non-Harvested Cropland	44,413	13

* USDA 1997 Census of Agriculture.

Maricopa County lies in the arid Sonoran desert. The residential/schools/churches emission factor used the EPA "desert cities" alternative splits which assumes that 70 percent of the urban land use is barren.

All emission factors for the BELD3 land-use types were taken from the EPA BEIS version 3.09 data set.

6.5 Meteorological inputs

Consistent with previous periodic inventories, for 1990 and onward, the meteorological episode day used was September 9, 1988. The procedures of selecting the episode day was in accordance with the EPA guidance documented in the User's Guide to the Personal Computer Version of the Biogenic Emissions Inventory System (PC-BEIS), Version 2.0, EPA, 1991. Meteorological data are input to MAGBEIS2 from two separate files. The first file called "SURMET1" was created using observed data from the Sky Harbor Airport. The file includes the following meteorological fields:

- Opaque sky cover
- Total sky cover
- Fraction of sky occupied by the lowest level clouds and height of that cloud level
- Fraction of sky occupied by the second lowest level clouds and height of that cloud level
- Fraction of sky occupied by the third lowest level clouds and height of that cloud level

The above fields are used to determine the solar radiation fluxes in the current version of MAGBEIS2. The following fields in the data file are not used by the program but the format is reserved for the program to read successfully:

- Sea level pressure
- Wind direction
- Wind speed
- Surface temperature
- Dew point
- Station pressure

The second meteorological data file, "TEMPRTR", consists of 24 hours per day of gridded surface temperature fields created from a UAM preprocessor program. TEMPRTR is in binary format and can be used as an input to UAM. Data used to generate the surface temperature fields were obtained from ten monitoring sites for the episode day. Table 6.5–1 presents more information about the ten monitoring sites for this analysis.

Table 6.5–1. Information for surface temperature monitoring sites.

Site ID	Station Name	Latitude	Longitude	Network*
SKY	Sky Harbor Airport	33°26' 03"	112°03' 04"	NWS
SMPK	S. Mt. Park	33°20' 46"	112°02' 59"	FCDMC
GILA	Gila Bend Mt.	33°14' 28"	113°12' 14"	FCDMC
HORS	Horsethief Basin	34°06' 19"	112°20' 49"	FCDMC
MTUN	Mt. Union	34°24' 54"	112°24' 17"	FCDMC
CARE	Carefree Ranch	33°52' 03"	111°51' 00"	FCDMC
WADD	Waddell	33°37' 05"	112°27' 35"	AZMET
GREE	Phx. Greenway	33°29' 07"	112°06' 30"	AZMET
ENCA	Phx. Encanto	33°28' 45"	112°05' 47"	AZMET
LITC	Litchfield	33°28' 02"	112°23' 53"	AZMET

* NWS: National Weather Service, MDMS on EPA NCC/IBM server
FCDMC: Flood Control Department Maricopa County, Julie Riemenschneider
AZMET: The Arizona Meteorological Network, http://ag.arizona.edu/azmet/

6.6 Summary of emissions from biogenic sources

Total biogenic emissions for the Maricopa County 2002 periodic ozone emission inventory are summarized in Tables 6.6–1 and 6.6–2 for both the ozone nonattainment area and Maricopa County.

Table 6.6–1. Summary of biogenic source emissions (typical ozone season day).

	Maricopa County		Ozone nonattainment area	
Pollutant	kg/day	lb/day	kg/day	lb/day
NO_x	32,499	71,648	6,291	13,870
Total VOC	140,392	309,511	41,737	92,015
–Isoprenes	48,340	106,571	16,252	35,830
–Paraffins	66,581	146,786	18,921	41,713
–Aldehydes	16,063	35,413	3,951	8,711
–Olefins	9,408	20,741	2,613	5,761

Table 6.6–2. Summary of biogenic source emissions (annual totals).

	Maricopa County		Ozone nonattainment area	
Pollutant	metric tons/yr	English tons/yr	metric tons/yr	English tons/yr
NO_x	7,554	8,327	1,455	1,604
Total VOC	21,910	24,152	6,552	7,223
–Isoprenes	7,331	8,081	2,459	2,711
–Paraffins	10,551	11,630	3,040	3,351
–Aldehydes	2,538	2,798	633	698
–Olefins	1,490	1,643	420	463

6.7 Biogenic emissions comparison

The biogenic source portion of the 2002 ozone season day emissions inventory for the ozone nonattainment area was compared with the biogenic source portions of the 1993, 1996, and 1999 periodic emissions inventories. The results are in Table 6.7–1. Estimates for Maricopa County in its entirety were not prepared for previous inventories, so no county wide comparison is possible.

Table 6.7–1. Comparison of biogenic source ozone season day emissions.

	Biogenic emissions within the ozone nonattainment area (metric tons/day)			
Pollutant	**1993**	**1996**	**1999**	**2002**
NO_x		10.51	10.3	6.3
Hydrocarbons	46.99	47.23	48.67	41.7
–Paraffin		19.17	19.65	18.9
–Olefins		2.43	2.49	2.6
–Aldehyde		6.61	6.76	3.9
–Isoprene		19.03	19.77	16.2

The modeled biogenic emissions vary over time due to changes in land use and emission factors. The 1993 modeled biogenic emissions used the MAG 1990 land-use database. The 1996 and 1999 modeled biogenic emissions used the MAG 1995 land-use database and the 2002 modeled biogenic emissions used the MAG 2000 land-use database and the BELD3 land-use database. The agricultural emission factors were updated each year based on available crop reports and for 2002, the residential emission factor was adjusted as described above.

6.8 References

Arizona Agricultural Statistics Service, 2003. 2002 Arizona Agricultural Statistics. July 2003.

Maricopa County Environmental Quality & Community Services Agency, 1993. 1990 Base Year Ozone Emission Inventory, final submittal. July 1993.

Maricopa County Environmental Services Department, 1996. 1993 Periodic Ozone Emission Inventory. November 1996.

Maricopa County Environmental Services Department, 1999. 1996 Periodic Ozone Emission Inventory. October 1999.

Maricopa County Environmental Services Department, 2001. 1999 Periodic Ozone Emission Inventory. November 2001, Revised August 2002.

Sonoma Technology, Inc., 1996. Improvements to the Biogenic Emission Estimation Process for Maricopa County. draft final report STI-95160-1577-DFR. May 1996.

US Department of Agriculture, 1999. 1997 Census of Agriculture. AC-A-51. Issued March 1999.

US EPA, 1991. User's Guide to the Personal Computer Version of the Biogenic Emissions Inventory System (PC-BEIS), Version 2.0. EPA-450/4-91-017. July 1991.

US EPA, 1997. Urban Airshed Model (UAM) Biogenic Emission Inventory System Version 2 (BEIS-2) User's Guide. final report, EPA contract no. 68-D3-0034. September 30, 1997.

Appendix 2.1

Maricopa County's
Instructions for Reporting 2002 Annual Air Pollution Emissions

MARICOPA COUNTY
ENVIRONMENTAL SERVICES

INSTRUCTIONS

FOR REPORTING 2002

ANNUAL AIR POLLUTION EMISSIONS

January 2003

Emissions Inventory Unit
1001 North Central Avenue, Suite 250
Phoenix, Arizona 85004
(602) 506-6790
(602) 506-6985 (Fax)

Copies of this document, related forms
and other reference materials are available online at:
www.maricopa.gov/envsvc/air/ei.asp

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WHAT'S NEW FOR 2002?

- Some **preprinted information** on your report is different from last year. Please review the enclosed forms carefully. If you use your own computerized reproduction of our forms from a previous report, your information must conform to the current information supplied on our 2002 preprinted forms.
- **EPA emission factors for lead** (Pb) are now included for many processes.
- New guidance exists for calculating emissions from **cultured marble and fiberglass processes** that use vapor-suppressed resins. Refer to the "Emissions Inventory Help Sheet for Polyester Resin Application" for further details.
- All **2002 reporting forms are available** at: *www.maricopa.gov/envsvc/air/ei/eiguides.asp* in an editable .pdf format (requires Adobe Acrobat). Data can be entered on these forms and printed to be included in the hard copy submission of this years report.

I. INTRODUCTION

An annual emissions inventory is a formal report submitted by a business that: (1) lists all processes emitting reportable air pollutants and (2) provides details about each of those processes. Submitting the emissions inventory report is ***required*** as a condition of your Maricopa County Air Quality Permit. A separate emissions report is required for each business location determined by the air quality permit.

Follow these steps to complete your 2002 Maricopa County emissions inventory:

STEP 1: Determine which forms are needed for your business. There are eight different forms available, but not all are required for every type of business. For most permittees, this packet contains the necessary pre-printed forms based on your site's most recent emissions inventory.

1. **Business Form**: Contains general contact information about the firm. This form is required for all businesses.
2. **Stack Form**: Only required if your business location annually emits over 10 tons of any of these single pollutants (CO, VOC, NO_x, PM_{10}, or SO_x). A "stack" is defined as a stack, pipe, vent or opening through which a significant percentage of emissions (from one or more processes) are released into the atmosphere. See the "Stack Form Instructions" on page 7 for specific requirements.
3. **Control Device Form**: Required only if there is one or more emission control devices used at the business location.
4. **General Process Form** and
5. **Evaporative Process Form**: Either or both will be required for all businesses.
6. **Off-Site Recycling/Disposal Form**: Required if you want to claim off-site recycling or disposal.
7. **Emission Factor Calculations**: Required as attachment for each process for which you calculated your own emission factors.
8. **Data Certification/Fee Calculation Form**: Required for all businesses.

STEP 2: Complete the applicable forms. Detailed information on how to complete the most common forms is included in this document. This packet also contains information about other resources (workshops, one-on-one assistance, etc.) available to help you in completing the necessary forms.

STEP 3: Make a copy of your completed emissions inventory report. Make sure to KEEP COPIES of all forms submitted and copies of all records and calculations used in completing the forms. Air pollution control regulations require that you keep all documentation for at least FIVE YEARS at the location where pollution is being emitted.

STEP 4: Make sure the Data Certification/Fee Calculation Form is ***signed*** by a company representative. ***Include your air quality permit number on all correspondence and checks submitted with your report.*** Return the original, signed copy of your annual emission report, with payment for any applicable emission fees, to:

Maricopa County Environmental Services Dept.
Emissions Inventory Unit
1001 North Central Avenue, Suite 100
Phoenix, AZ 85004

II. REPORTING REQUIREMENTS

POLLUTANTS TO BE REPORTED:
Your emissions inventory must include your business's emissions of the following air pollutants:

CO	=	Carbon monoxide
NO_x	=	Nitrogen oxides
PM_{10}	=	Particulate matter less than 10 microns
SO_x	=	Sulfur oxides
VOC	=	Volatile organic compounds *
HAP&NON	=	Hazardous Air Pollutant (HAP) that is also NOT a precursor of ozone **
NH_x	=	Ammonia & ammonium compounds
Pb	=	Lead

* A ***volatile organic compound (VOC)*** is defined as any compound of carbon that participates in atmospheric photochemical reactions. This definition ***excludes***: carbon monoxide, carbon dioxide, acetone, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, as well as certain other organic compounds. (See Maricopa County Air Pollution Control Rule 100 for a full definition.)

** ***HAP&NON:*** Usage of certain materials that are both a Hazardous Air Pollutant (HAP) and not a precursor of ozone should also be reported if:
(a) your site is subject to a Federal MACT (Maximum Achievable Control Technology) standard ***OR***
(b) your air quality permit contains specific quantitative limits on these materials.

The most common materials in this category include:

- methylene chloride (dichloromethane)
- perchloroethylene
- 111-trichloroethane (111-TCA or methyl chloroform)
- hydrochloric acid
- hydrofluoric acid

VOC materials that are classified as HAPs are reported as VOC.

ASSIGNING IDENTIFICATION NUMBERS (IDs):
Unique IDs are required for the following report elements: Stacks, Control Devices and Processes. For processes, that means a process ID number may be used only once on all General Process and Evaporative Process Forms.

These numbers are usually assigned by the person who prepares the original report. If you are adding something new to a preprinted report, assign a number not already in use. Once an ID number is assigned, continue using the same number for that item from year to year, indefinitely, until it is no longer part of your report. If that item is no longer reportable, return the preprinted form with a brief explanation. Do not use that ID number again.

III. HELPFUL HINTS AND INFORMATION

Be sure to verify all preprinted information on forms. If any information is incorrect or blank, please provide correct information. Making a change on the Business Form will **NOT** transfer the permit ownership or location. You must contact the Department's Business Services Office at (602) 506-6464 to accomplish this.

WHAT IS A PROCESS? A ***process*** is a business activity at your location that emits CO, VOC, NO_x, PM_{10}, SO_x, NH_x (ammonia compounds) or HAP&NON (hazardous air pollutants which are not precursors of ozone), and has only ***one*** material type as input and ***one*** operating schedule. For each applicable process at your business, you must assign a unique Process ID number to differentiate each process.

PROCESSES AND MATERIALS THAT DO ***NOT*** HAVE TO BE REPORTED:

- Welding.
- Acetone usage.
- Fuel use for forklifts or other vehicles. (NOTE: Fuel use in ***non-vehicle*** engines ***is*** reportable.)
- Storage emissions from fuels or organic chemicals in any tank with a capacity less than 250 gals.
- Storage emissions of diesel and Jet A fuel in underground tanks of any size.
- Storage emissions of diesel and Jet A fuel in aboveground tanks, throughput less than 4,000,000 gal/yr.
- Routine pesticide usage, housekeeping cleaners, and routine maintenance painting at your facility.

Please group all similar equipment and materials together before applying the following limitations:

- Internal combustion engines (e.g., emergency generators) or external combustion equipment (e.g., boilers and heaters) that operated less than 100 hrs. and burned less than 200 gals. diesel or gas, or less than 100,000 cubic feet of natural gas.
- Materials with usage of less than 15 gallons or 100 pounds per year.

GROUPING MATERIALS AND/OR EQUIPMENT UNDER ONE PROCESS ID:
You can group together under one process ID:

- All internal combustion engines ***less than 600 horsepower*** if they burn the same fuel and have similar operating schedules.
- All external combustion equipment (boilers, heaters) ***less than 10,000,000 Btu*** per hour if they burn the same fuel and have similar operating schedules.
- All similar evaporative materials with similar emission factors that have similar operating schedules and process descriptions. For example, group low-VOC red paint, green paint and white paint together as one material "Paint: Low-VOC." Do not group thinners with paints. ***NOTE***: Attach documentation showing how the grouped emission factor was determined. See the example on page 18.
- All underground tanks with the same fuel and same type of vapor recovery system. ***DO NOT*** report diesel or Jet A underground tank emissions. ***DO NOT*** report aboveground diesel or Jet A tank emissions when throughput is less than 4,000,000 gallons annually.

INDUSTRY-SPECIFIC INSTRUCTIONS: Additional help sheets, detailed examples, and special instructions are available for a number of specific processes or industries listed below. To get copies of any of these documents, please visit our Web page at *www.maricopa.gov/envsvc/air/ei.asp* or call (602) 506-6790.

- Bakeries
- Fuel Storage and Handling
- Incinerators and Crematories
- Lg. Aboveground Storage Tanks
- Concrete Batch Plants
- Natural Gas Boilers/Heaters
- Polyester Resin
- Printing Plants
- Roofing Asphalt
- Vehicle Refinishing
- Sand and Gravel Plants
- Using EPA's TANKS 4.09b Program
- Vehicle Travel on Unpaved Roads
- Woodworking

COMMONLY USED CONVERSION FACTORS:

1 gram/liter	= 0.00834 lbs/gal	1 foot	= 0.0001894 mile
1 liter	= 0.2642 gallon US	1 square foot	= 0.000022957 acre
1 therm	= 0.0000952 MMCF	1 pound	= 0.0005 ton

NOTE: MM = 1,000,000 Example: MM CF = 1,000,000 cubic feet
M = 1,000 Example: M GAL = 1,000 gallons

CONFIDENTIALITY OF DATA SUBMITTED:

Information submitted in your annual emissions reports must be made available to the public unless it meets certain criteria of Arizona State Statutes and Maricopa County Rules. Applicable excerpts concerning confidentiality of data are reproduced below.

ARS § 49-487 D. ...the following information shall be available to the public:...

2. The chemical constituents, concentrations and amounts of any emission of any air contaminant. ...

MARICOPA COUNTY AIR POLLUTION CONTROL RULES AND REGULATIONS, Rule 100:

200.107 TRADE SECRETS - Information to which all of the following apply:

a. A person has taken reasonable measures to protect from disclosure and the person intends to continue to take such measures.

b. The information is not, and has not been, reasonably obtainable without the person's consent by other persons, other than governmental bodies, by use of legitimate means, other than discovery based on a showing of special need in a judicial or quasi-judicial proceeding.

c. No statute, including ARS §49-487, specifically requires disclosure of the information to the public.

d. The person has satisfactorily shown that disclosure of the information is likely to cause substantial harm to the business's competitive position.

402 CONFIDENTIALITY OF INFORMATION:

402.2 Any records, reports or information obtained from any person under these rules shall be available to the public ... unless a person:

a. Precisely identifies the information in the permit(s), records, or reports which is considered confidential.

b. Provides sufficient supporting information to allow the Control Officer to evaluate whether such information satisfies the requirements related to trade secrets as defined in Section 200.107 of this rule.

For emissions inventory information to be kept confidential, the following must be done:

- Specific data which you request be held confidential must be identified by marking an "X" in the corresponding gray confidentiality box(es) on the relevant report forms. Only data in fields with a gray confidentiality box is eligible to be held confidential.
- Provide a written explanation which gives factual information satisfactorily describing why releasing this information could cause substantial harm to the business's competitive position.
- Use the gray-shaded boxes on the reporting forms to indicate which data are to be held confidential. Do NOT stamp "Confidential", highlight data, or otherwise mark the page.
  No data can be held confidential without proper justification.

ADDITIONAL RESOURCES AND ASSISTANCE:

The Maricopa County Emissions Inventory Web page at *www.maricopa.gov/envsvc/air/ei.asp* contains additional reference materials, such as:

- blank copies of most emissions reporting forms.
- this document, "Instructions for Reporting 2002 Annual Air Pollution Emissions".
- an updated list of emission factors for a large number of industrial processes, including SCC codes.
- a list of Tier Codes for industrial processes.
- detailed help sheets for a number of specific industries or processes.

To receive any of the above materials by fax or mail, or for additional information or assistance in how to calculate and report your emissions, please call us at (602) 506-6790.

IV. INSTRUCTIONS FOR COMPLETING COUNTY EMISSIONS INVENTORY FORMS

Business Form Instructions

Verify all preprinted information, and make corrections where necessary. When making corrections, strike out the preprinted data and write in corrections beside it. Please make all changes readily noticeable.

NOTE: Indicating a change in ownership or business location on the Business Form will ***not*** serve to transfer the permit ownership or location. You must contact the Department's Business Services Office at (602) 506-6464 to accomplish this.

Data fields:

6 Number of employees: This should be the annual average number of full-time equivalent (FTE) employee positions.

9 NAICS Code: This 5- or 6-digit North American Industrial Classification System (NAICS) code has been introduced to replace the 4-digit Standard Industrial Classification (SIC) codes. Please list the primary and secondary NAICS codes for your business, if known.

10 Preparer of the Inventory (primary contact for technical questions concerning this report): This should be the person who knows the most about the data in the report. If this person has an e-mail address used for business purposes, please provide it.

Stack Form Instructions

A "stack" is defined as a stack, pipe, vent or opening through which a significant percentage of emissions (from one or more processes) are released into the atmosphere (with or without a control device).

NOTE: Stack information is required only if your business location annually emits over 10 tons of any one of the following pollutants: CO, VOC, NO_x, PM_{10}, or SO_x. If so, you must complete a Stack Form for:

- each stack connected to a control device.
- any stack that discharges annually more than 5 tons of combined pollutant emissions (such as a paint booth exhaust).

EXAMPLE Stack Form Information:

1	2	3	4	5a OR 5b		6a OR 6b & 6c			7
Stack ID	Stack Type Code*	Stack Height**	Exit Gas Temperature	Velocity feet/sec	Flow Rate acfm	Diameter inside inch	Length / Width inside inch		Stack Name/Description (Optional)
1	W	30 ft	90 °F		20,000	36			paint booth
2	V	14 ft	200 °F		19,186	40			thermal oxidizer

* Stack Type Codes: **V** = Vertical unobstructed; **H** = Horizontal unobstructed; **D** = Downward unobstructed; **G** = Gooseneck; **W** = Obstructed vertical (e.g. weather cap)

** Stack height is calculated relative to the surrounding terrain. For instance, the stack height of a 10-foot stack on top of a 20-foot tall building is 30 feet.

Data fields:

1 Stack ID: (See "Assigning Identification Numbers" on page 3.) A number (up to three digits, numeric only) which identifies a specific stack. It is suggested you start with 1, then 2, etc.

4 Exit Gas Temperature: Should represent average operating conditions.

5a Exit Gas Velocity: ***OR*** 5b Gas Flow Rate:
Provide ***EITHER*** the exit velocity (in feet per second) ***OR*** the flow rate of gas (in actual cubic feet per minute) exiting the stack during normal operations. Preprinted information provides both.

6a Inside Stack Diameter: For round stacks, provide Inside Stack ***Diameter*** in inches.
OR
6b & 6c Inside Stack Length and Width: For square or rectangular stacks, provide inside ***Length and*** inside ***Width*** in inches. Preprinted information also provides the calculated diameter of an equivalent circle.

Control Device Form Instructions

EXAMPLE Control Device Form Information

1	2	3	4	5	6
Control ID	Installation/ Reconstruction* Date	Size or Rated Capacity**	Control Type Code	Control Device Name/Description	Stack ID
1	*05/09/98*	*25,000.0* cfm	*021*	***Thermal oxidizer***	*2*
4	*03/10/97*	cfm	*153*	***Watering with water trucks***	

Data fields:

1 Control ID: (See "Assigning Identification Numbers" on page 3.) A unique number (up to three digits) that you assign to identify a specific control device.

2 Installation/Reconstruction Date: The completion date (given in *mm/dd/yy* format) of installation or the most recent reconstruction of the identified control device. This is not a date on which routine repair or maintenance was done. Reconstruction means any component of the control device was replaced and the cost (fixed capital) of the new component(s) was more than half of what it would have cost to purchase or construct a new control device.

3 Size or Rated Capacity: Report the air or water flow rate in ***cubic feet per minute***. Some devices (e.g., water trucks for dust control) will not include a value in this field.

4 Control Type Code: A 3-digit code designating the type of control device. A complete list of all EPA control device codes can be found on the Web at *http://www.maricopa.gov/envsvc/AIR/EI/eiguides.asp* or call 602-506-6790 for assistance.

6 Stack ID: Not all businesses require a Stack ID. This is required if the Stack Form is required for your site (see page 7) ***and*** the control device has a vent. This is the ID number shown in column 1 of the Stack Form to identify the specific stack that this control device vents to. The Stack ID can be entered on this form after the Stack Form has been filled out.

General Process Form Instructions

The General Process Form is used to record data on all emissions-producing processes except evaporative processes. A ***general*** process is normally characterized by the burning or handling of a material. One form reports all the pollutants for one process. For example, several pollutants are produced by burning fuel, and PM_{10} is emitted by processing rock products, processing materials such as wood or cotton, and driving on unpaved areas.

Data fields: (See sample forms on pages 11 and 12.)

1 Process ID: A number (up to three digits) that is preprinted or you assign. (See "Assigning Identification Numbers" on page 3.) This Process ID number can NOT be used for any other process at this location.

3 Stack ID(s): The stack ID number(s) shown in column 1 of the Stack Form that identify the stack(s) which vent pollution created by this process. Not all businesses are required to report stacks. This is only required if the Stack Form is required for your site (see page 7) ***and*** the process has a stack.

4 Process Tier Code and
5 SCC Code: If these codes are not preprinted on your form, please consult our web page at *www.maricopa.gov/envsvc/air/ei.asp* or call (602) 506-6790.

6 Seasonal Throughput Percent: Enter the percent of total annual operating time that occurred per season, rounded to the nearest percent. For example, "Dec-Feb 30% " means 30% of total annual process activity occurred between December and February. The total for all four seasons must equal 100%.

7 Normal Operating Schedule and
8 Typical Hours of Operation: These represent the usual number of hours and time of day when ***this process*** occurred during the calendar year.

9 Emissions Based on: Provide the ***name*** of the material used, fuel used, product produced, or whatever was measured for the purpose of calculating emissions, such as "hours of operation," "vehicle miles traveled," or "acres."

10 Used or Produced: Indicate whether calculated emissions are based on a material type *used*, a fuel *used* or a product *produced. Leave this field blank* if "hours of operation," "vehicle miles traveled," "acres," or similar unit of measurement is used.

11 Annual Amount: The annual amount (a mathematical number) of material that was used, fuel combusted, product produced, hours of operation, vehicle miles traveled, or acres.

12 Unit of Measure: Units of the material used, fuel used or product produced shown on line 9. For example: gallons, pounds, tons, therms, acres, vehicle miles traveled, units produced.

13 Unit Conversion Factor: You must provide this if you use an emission factor with an emission factor unit (see item 16 below) that is ***not*** the same as the unit of measure (from line 12). This is the standard number you would multiply your amount (line 11) by to convert it to the units of the emission factor. These are some common unit conversion factors:

	Unit Conversion Factor:
– To convert gallons to Mgal. (1,000 gallons)	Multiply by: 0.001
– To convert pounds to tons	Multiply by: 0.0005
– To convert therms to MMCF (million cubic feet) of natural gas	Multiply by: 0.0000952

General Process Form Instructions (continued)

14 Pollutant: See page 3 for a list of pollutants that need to be reported.

15 Emission Factor (EF): The number to be multiplied by the annual amount (line 11) to determine how much of the pollutant was emitted. If you calculate your own emission factor or change the preprinted emission factor, you must provide details of your calculations on an attachment.

16 Emission Factor (EF) Units: Enter the appropriate Emission Factor Units in pounds (lb) per unit; e.g., lb/ton, lb/MMCF, lb/gal.

17 Controlled Emission Factor (EF)? YES or NO: Indicate "YES" if: 1) you have your own emission factor from testing **and** included the control device efficiency within the factor, or 2) the emission factor used is clearly identified as a controlled emission factor. A "YES" response requires the use of Formula A (see #24 below). Indicate "NO" if: 1) there is no emission control device, or 2) the EF represents emission rates **before** controls. A "NO" response requires the use of Formula B (see #24 below).

18 Calculation Method: Enter the number code (listed at the bottom of the General Process Form) which best describes the method you used to obtain this emission factor. Code 5, "AP-42/FIRE Method or Emission Factor" means that the factor comes from EPA documents or software. ***NOTE:*** If you have conducted a source test that was required and approved by the County for a specific process or piece of equipment, you ***must*** use the emission data from that test. Report "4" in this column.

19 through 23: Leave blank if there is no control device.

19 Capture % Efficiency: The percent of the pollutant that is captured and sent to the primary control device in this process. Be sure to list a capture efficiency separately for ***each*** pollutant affected.

20 Primary Control Device ID: If this pollutant is being controlled in this process, enter the Control Device ID number which represents the first control device affecting the pollutant.

21 Secondary Control Device ID: If this pollutant is being controlled sequentially by 2 devices, enter the Control Device ID number which represents the second control device; otherwise leave this field blank.

22 Control Device(s) % Efficiency: Enter the total control efficiency of the control device(s). Be sure to list a control device efficiency separately for ***each*** pollutant affected. If you report a control device efficiency, you must ***also*** show a capture efficiency in column 19.

23 Efficiency Reference Code: Enter the code (1 through 7) that best describes how you determined the ***control device efficiency***. A list of possible codes is included at the bottom of the form.

24 Estimated Actual Emissions (in pounds/year): You may round the calculated emissions values to the nearest pound. Calculate as follows:

A. *Emissions with no controls* or *controls are reflected in the emission factor:*
Column 24 = line 11 × line 13 × column 15

B. *Emissions after control:*
Column 24 = line 11 × line 13 × column 15 × (1 – [column 19 × column 22])

Use the decimal equivalent for columns 19 and 22. Example: 96.123% = 0.96123

General Process Form 2002

EXAMPLE: Internal Combustion

Permit number(s) 999999

Place an X in any gray cell to mark data requested to be held confidential. See Instructions for requirements for information to be deemed confidential.

1- Process ID 80

2- Process Type/Description: 3 engines for crushing (each less than 600 HP), diesel @ 0.05% sulfur content

3- Stack ID(s) *(only if required on Stack Form)* _____ _____ _____ _____ _____

4- Process TIER Code: 020599 FUEL COMB. INDUSTRIAL: INTERNAL COMBUSTION

5- SCC Code 20200102 *(8 digit number)* IND:DIESEL-RECIPROCATING

6- Seasonal Throughput Percent: Dec-Feb 25 % Mar-May 25 % Jun-Aug 25 % Sep-Nov 25 %

7- Normal Operating Schedule: Hours/Day 8 Days/Week 5 Hours/Year 2080

8- Typical Hours of Operation: *(military time)* Start 0700 End 1530

9- Emissions based on *(name of material or other parameter, e.g. "rock", "diesel", "vehicle miles traveled")* DIESEL

10- ☒ Used (input) or ☐ Produced (output)

11- Annual Amount: *(a number)* 16,250

12- Unit of Measure: *(for example: tons, gallons, million cu ft, acres, units produced, etc.)* GALLONS

13- Unit Conversion Factor *(if needed to convert Unit of Measure to correlate with emission factor units)* 0.001

	Emission Factor (EF) Information				Control Device Information					
14	15	16	17	18	19	20	21	22	23	24
Pollutant	Emission Factor (EF) (number)	Emission Factor Unit (lb per)	Controlled EF? Yes or No	Calculation Method Code*	Capture % Efficiency	Primary Control Device ID	Secondary Control Device ID	Control Device(s) % Efficiency	Efficiency Reference Code**	Estimated Actual Emissions
CO	130	M GALS	N	5						2,113 lbs
NOx	604	M GALS	N	5						9,815 lbs
PM-10	42.5	M GALS	N	5						691 lbs
SOx	39.7	M GALS	N	5						645 lbs
VOC	49.3	M GALS	N	5						801 lbs

*** Calculation Method Codes:**

1 = Continuous Emissions Monitoring Measurements
2 = Best Guess / Engineering Judgment
3 = Material Balance
4 = Source Test Measurements (Stack Test)
5 = AP-42 / FIRE Method or Emission Factor
6 = State or Local Agency Emission Factor
7 = Manufacturer Specifications

**** Control Efficiency Reference Codes:**

1 = Tested efficiency / EPA reference method
2 = Tested efficiency / other source test method
3 = Design value from manufacturer
4 = Best guess / engineering estimate
5 = Calculated based on material balance
6 = Estimated, based on a published value

General Process Form 2002

EXAMPLE: Unpaved Road Travel

Permit number(s) 999999

Place an X in any gray cell to mark data requested to be held confidential. See Instructions for requirements for information to be deemed confidential.

1- Process ID 28

2- Process Type/Description: UNPAVED ROAD TRAVEL: HEAVY-DUTY TRUCKS @ 15 MPH

3- Stack ID(s) *(only if required on Stack Form)*

4- Process TIER Code: 140799 MISCELLANEOUS: FUGITIVE DUST

5- SCC Code 30502504 *(8 digit number)* SAND/GRAVEL: HAULING

6- Seasonal Throughput Percent: Dec-Feb 25 % Mar-May 25 % Jun-Aug 25 % Sep-Nov 25 %

7- Normal Operating Schedule: Hours/Day 8 Days/Week 5 Hours/Year 2080

8- Typical Hours of Operation: *(military time)* Start 0700 End 1530

9- Emissions based on *(name of material or other parameter, e.g. "rock", "diesel", "vehicle miles traveled")* VEHICLE MILES TRAVELED (VMT)

10- ☐ Used (input) or ☐ Produced (output)

11- Annual Amount: *(a number)* 7,500

12- Unit of Measure: *(for example: tons, gallons, million cu ft, acres, units produced, etc.)* VMT

13- Unit Conversion Factor *(if needed to convert Unit of Measure to correlate with emission factor units)*

	Emission Factor (EF) Information				Control Device Information					
14	15	16	17	18	19	20	21	22	23	24
Pollutant	Emission Factor (EF) (number)	Emission Factor Unit (lb per)	Controlled EF? Yes or No	Calculation Method Code*	Capture % Efficiency	Primary Control Device ID	Secondary Control Device ID	Control Device(s) % Efficiency	Efficiency Reference Code**	Estimated Actual Emissions
PM-10	3.2	VMT	N	6	100	4		70	6	7200 lbs
										lbs
										lbs
										lbs
										lbs
										lbs

NOTE: Emissions in col. 24 are calculated as follows: (line 11 × col. 15) × (1 – [col. 19 × col. 22])

*** Calculation Method Codes:**

1 = Continuous Emissions Monitoring Measurements
2 = Best Guess / Engineering Judgment
3 = Material Balance
4 = Source Test Measurements (Stack Test)
5 = AP-42 / FIRE Method or Emission Factor
6 = State or Local Agency Emission Factor
7 = Manufacturer Specifications

**** Control Efficiency Reference Codes**

1 = Tested efficiency / EPA reference method
2 = Tested efficiency / other source test method
3 = Design value from manufacturer
4 = Best guess / engineering estimate
5 = Calculated based on material balance
6 = Estimated, based on a published value

Evaporative Process Form Instructions

The Evaporative Process Form is used to report all emissions produced by evaporation. Examples include: cleaning with solvents, painting and other coatings, printing, using resin, evaporation of fuels from storage tanks, ammonia use, etc. All other processes should be shown on the General Process Form.

One Evaporative Process Form may be used to report numerous materials, with each material given a separate process ID number, as long as the information on lines 1-6 apply to all items on that form. Use a separate form for each group of materials that has a different Process Type/Description (shown on line 1), different Tier Code (line 2) or different operating schedule (lines 3, 4, or 5). Storage tank emissions also must appear on a separate form (see 6 below).

Data fields: (See sample forms on pages 15 and 16.)

1 Process Type/Description: Brief details of the activity in which the listed materials were used.

2 Process Tier Code: If this 6-digit code is not preprinted on your form, please refer to the Tier Code list at *www.maricopa.gov/envsvc/air/ei/eiguides.asp* or call (602) 506-6790.

3 Seasonal Throughput Percent: Enter the percent of total annual operating time that occurred per season (rounded to the nearest percent). For example, "Dec-Feb 30% " means 30% of total annual process activity occurred between December and February. The total for all four seasons must equal 100%.

4 Normal Operating Schedule and
5 Typical Hours of Operation: These represent the usual number of hours and time of day when the emissions reported on ***this form*** occurred during the year.

6 Storage Tanks: Report emissions from storage of VOC liquids only for tanks larger than 250 gallons. Mark only one category of tank installation, using an additional form per category if needed. "Vaulted" here means the tank is completely enclosed in a building or by thermal insulation. Do NOT include diesel or Jet A tanks with less than 4,000,000 gallons throughput per year. See the "Emissions Inventory Help Sheet for Fuel Storage and Handling" for more specific instructions applicable for fuel tanks up to 15,000 gallons capacity. Bulk plants and terminals should consult the "Help Sheet for Reports Using EPA's TANKS 4.09b Program" or the "Help Sheet for Large Aboveground Storage Tanks."

7 Process ID: A number (up to three digits) that represents this specific material (process). Each process on one form must have the same tier code and operating schedule as that shown in the top portion of the form. This Process ID number can ***not*** be used for any other process at this business location. See page 3 of these instructions for more explanation of ID numbers and page 4 for exclusions and guidance on grouping materials.

8 Stack ID(s): The stack ID number(s) shown in column 1 of the Stack Form that identify the stack(s) which vent pollution created by this process. Not all businesses are required to report stacks. This is only required if the Stack Form is required for your site (see page 7) ***and*** the process has a stack.

9 Material Type: Provide the name of the material used in this process. Give the chemical name for pure chemicals or a name that reflects its use (paint, ink, etc.), rather than just a brand name or code number. Examples of materials include: paint, thinner, degreasing solvent (plus its common name), ink, fountain solution, ammonia, alcohol, ETO (ethylene oxide), gasoline (in a storage tank).

10 Annual Material Usage/Input: Amount of this material used during the year. In most cases, the amount purchased is suitable. Write in "lbs" or "gal" (pounds or gallons).

Evaporative Process Form (continued)

11 Pollutant: The only pollutants reported on this form are VOC, HAP&NON and NH_X (see definitions on page 3). When one process (or material) has more than one of these pollutants, list each pollutant on a separate line, using the same process ID number.

12 Emission Factor (EF): An emission factor is a number used to calculate the pounds of pollutant emitted based on the quantity of material used in a process. Emission factors can be obtained from your supplier (usually provided on a Material Safety Data Sheet or environmental data sheet), and must correspond with the material units reported in column 10. If the material unit is "gal," then the emission factor must be in pounds of pollutant per gallon. If the material unit is "lb," then the emission factor must be in pounds of pollutant per pound of material.

Verify (and correct, where necessary) all pre-printed emission factors, as the composition of materials used may have changed since your last report. A "lb/gal" emission factor is almost always less than 8 and never greater than 14. A "lb/lb" emission factor is never larger than 1.0.

13 Pounds of pollutant sent off site: Required only if you wish to take credit for reduced emissions because of waste of this material sent off-site for recycling or disposal. Only waste generated during the report year may be claimed. The Off-Site Recycling/Disposal Form ***must*** be completed if you wish to claim a credit. The number of pounds reported in column 13 ***must*** equal the number of pounds reported on the Off-Site Recycling/Disposal Form(s) for the same Process ID number.

14 and 15: Leave these fields blank if there is no control device present.

14 Capture % Efficiency: The percent of the pollutant from this process that is captured and sent to the control device.

15 Control ID: If this pollutant is being controlled in this process, enter the Control Device ID number from column 1 of the Control Device Form.

Control % Efficiency: Enter the percent of this pollutant that is controlled by this control device.

Code: Select the Control Efficiency Reference Code from the list at the bottom of the form.

16 Estimated Emissions (lbs/yr): Estimated pounds of the pollutant emitted during the year, after off-site recycling/disposal and controls if applicable. **Credit will not be given for off-site recycling/disposal unless it is shown on the Off-Site Recycling/Disposal Form.** Round to the nearest pound. If the answer is 0, give a decimal answer to the first significant digit. Column 16 is calculated as follows:

Emissions without off-site recycling/disposal or controls:
Column 16 = column 10 × column 12

Emissions with off-site recycling/disposal:
Column 16 = (column 10 × column 12) – column 13

*Emissions with off-site recycling/disposal **and** controls:*
Column 16 = ([column 10 × column 12] – column 13) × (1 – [column 14 × column 15])

Use the decimal equivalent for columns 14 and 15. Example: 96.123% = 0.96123

EXAMPLE: Coating and Painting

Evaporative Process Form 2002

Permit number(s) 999999

Place an X in any gray cell to mark data requested to be held confidential. See Instructions for requirements for information to be deemed confidential.

1- Process Type/Description: Coating metal widgets

2- Process TIER Code: 080415 SOLVENT USE: SURFACE COATING - MISC METAL PARTS

3- Seasonal Throughput Percent: Dec-Feb 25 % Mar-May 25 % Jun-Aug 25 % Sep-Nov 25 %

4- Normal Operating Schedule: Hours/Day 8 Days/Week 5 Hours/Year 2080

5- Typical Hours of Operation *(military time)* Start 0800 End 1700

6- For STORAGE TANKS only. Select only one: ☐ Above Ground Vaulted ☐ Under Ground ☐ Above Ground NON-Vaulted

NOTE: Place an X in any gray cell to mark data requested to be held confidential. See Instructions for requirements for information to be deemed confidential.

7	8	9	10		11*	12		13	14	15			16
Process ID	Stack ID(s)	Material Type	Annual Usage Input	lb or gal	VOC, HAP&NON or NHx	Emission Factor	EF Units (lbs per)	Pounds of pollutant* sent off site	Capture % Efficiency	Control ID	Control % Efficiency	Control Efficiency Code**	Estimated Emissions (lbs/yr)
800	1	lacquer	95	gl	VOC	4.7	lb/gal		%		%		447
801	1	lacq thinner	120	gl	VOC	7.1	lb/gal		%		%		852
802	1	paint	940	gl	VOC	4.2	lb/gal		%		%		3,948
803	1	pnt thinner	707	gl	VOC	7.0	lb/gal		%		%		4,949
804	1	powder paint	20,200	lb	VOC	.001	lb/lb		%		%		20
									%		%		

Note: Do NOT change pre-printed Process ID numbers. See the instructions for information on how to delete materials that are no longer used, or to assign Process ID numbers for new materials.

* If you have off-site recycling/disposal of any of the materials listed above, you must complete an Off-site Recycling/Disposal Form to receive credit for reduced emissions.

NOTE: Emissions in col. 16 are calculated as follows: ([col. 10 × col. 12] - col. 13) × (1 - [col. 14 × col. 15])

** **Control Efficiency Reference Codes**

1 = Tested efficiency / EPA reference method
2 = Tested efficiency / other source test method
3 = Design value from manufacturer
4 = Best guess / engineering estimate
5 = Calculated based on material balance
6 = Estimated, based on a published value.

EXAMPLE: Cleaning solvent (with recycling)

***Evaporative Process Form* 2002**

Permit number(s) 999999

1- Process Type/Description: Cleaning metal parts

2- Process TIER Code: 080103 SOLVENT USE: DEGREASING - COLD CLEANING

3- Seasonal Throughput Percent: Dec-Feb 25 % Mar-May 25 % Jun-Aug 25 % Sep-Nov 25 %

4- Normal Operating Schedule: Hours/Day 4 Days/Week 5 Hours/Year 1040

5- Typical Hours of Operation *(military time)* Start 1300 End 1700

6- For STORAGE TANKS only. Select only one: ☐ Above Ground Vaulted ☐ Under Ground ☐ Above Ground NON-Vaulted

NOTE: Place an X in any gray cell to mark data requested to be held confidential. See Instructions for requirements for information to be deemed confidential.

7	8	9	10		11*	12		13	14	15			16
Process ID	Stack ID(s)	Material Type	Annual Usage Input	lb or gal	VOC, HAP&NON or NHx	Emission Factor	EF Units (lbs per)	Pounds of pollutant* sent off site	Capture % Efficiency	Control ID	Control % Efficiency	Control Efficiency Code**	Estimated Emissions (lbs/yr)
3	2	sanitizer	716	lb	VOC	1.0	lb		95 %	1	80 %	3	172
6		gun cleaner	180	gl	VOC	7.2	gl	448	%		%		848
7		xyz stripper	1300	gl	VOC	3.3	gl	3,237	%		%		1,053
8		cleaning solvents	358	gl	VOC	6.4	gl	892	%		%		1,399
9		generoclean	2258	gl	VOC	6.8	gl	5,623	%		%		9,731
									%		%		

Note: Do NOT change pre-printed Process ID numbers. See the instructions for information on how to delete materials that are no longer used, or to assign Process ID numbers for new materials.

* If you have off-site recycling/disposal of any of the materials listed above, you must complete an Off-site Recycling/Disposal Form to receive credit for reduced emissions.

NOTE: This example shows the case where 2,400 of the original 4,096 gallons of materials #6 through 9 were captured for off-site recycling, and the pollutant content of the waste material was estimated to be 75% of the original. The pounds of pollutant sent off-site shown in column 13 is calculated on the example Off-Site Recycling/Disposal Form on the next page.

EXAMPLE

Off-Site Recycling/Disposal Form 2002

Permit number(s) 999999

NOTE: If you need blank copies of this form, call the Emissions Inventory Unit at (602) 506-6790 or consult our web page at www.maricopa.gov/envsvc/air/ei.asp. If any waste streams contain a significant amount of solid material (recorded in pounds), contact the Emissions Inventory Unit for assistance in how to report these materials.

Provide one copy of this form for each waste stream at your business location. Make copies of this page as needed.

A waste stream is the liquid waste from one or more processes mixed together to make one liquid waste product before it is taken off site for recycling, disposal or combustion.

1) Assign a unique one or two-digit ID number to identify the waste stream that will be described below. 01
(Start with ID# 1 for first waste stream, then use 2 for second, etc.)

2) How many gallons of liquid waste did this waste stream produce in 2002? 2,400 gallons.
Keep waste disposal company manifests as proof that this amount of liquid waste was taken off-site.

3) What was the **average** pollutant content of the liquid waste stream?

VOC 4.25 lbs/gal HAP&NON _____ lbs/gal NHx _____ lbs/gal

NOTE: Liquid waste normally has less pollutant content than the new product. Some of the pollutant evaporates during the use of the product, and there is usually dirt, water and/or other contaminants in the liquid waste. The estimated pollutant content of the liquid waste is usually between 50% and 95% of the new product. This example estimates an average VOC content (reported on line 3) to be 75% of the original VOC content of 5.67 lbs/gal., to account for evaporation and contaminants. See the example on page 18 to calculate a weighted average.

4) Calculate the total annual pollutant content of the liquid waste in this waste stream.
(volume of liquid waste, from line 2) × (pollutant content, from line 3) = Total pollutants in waste stream, in lbs/yr.

VOC 10,200 lbs/yr HAP&NON _____ lbs/yr NHx _____ lbs/yr

5) List the process ID numbers of the processes contributing to this waste stream. Also estimate the pounds of pollutant that each process contributed to this waste stream.

NOTE: Column totals in the table below must equal the total for each pollutant type reported on line 4. The quantities you report below for each pollutant and process must also be reported in column 13 on the Evaporative Process Form.

Process ID		Annual VOC (lbs)		Annual HAP&NON (lbs)	Annual NHx (lbs)
6	Contributed about	448	lbs	lbs	lbs
7	Contributed about	3,237	lbs	lbs	lbs
8	Contributed about	892	lbs	lbs	lbs
9	Contributed about	5,623	lbs	lbs	lbs
	Contributed about		lbs	lbs	lbs
	Contributed about		lbs	lbs	lbs
	Contributed about		lbs	lbs	lbs

EXAMPLE: Documentation of Emission Factor Calculations

Identify the process ID(s) and pollutant(s). Show calculations made to obtain the emission factors used for the process(es). Include references to data sources used, including the document name, date published, page numbers, etc.

Emission Factor Calculation

Process ID *201* Permit number *999999*

Emission factors derived from source test performed 6/12/97 by XYZ Engineering Company (copy of summary tables also attached).

Outlet (after controls):

CO = 0.43 lb/hr × 1 hr/60 min × 1 min/77.9 cu. ft × 1,000,000 cu. ft/MMCF
= 92.0 lb/MMCF

NOx = 0.09 lb/hr × 1 hr/60 min × 1 min/77.9 cu. ft × 1,000,000 cu. ft/MMCF
= 19.3 lb/MMCF

NOTE: The example below shows how the weighted average of the materials going into the waste stream is calculated. A weighted-average emission factor has been calculated by listing usage amounts and emission factors for each material, summing each column, and then dividing the total emissions by the total gallons used.

In this example: 23,232 lbs ÷ 4,096 gal = 5.67 lb/gal average VOC content. This emission factor is then used to calculate the average pollutant content in the Off-site Recycling / Disposal Form example.

This process can also be used to find the weighted average emission factor for similar materials if you are reporting them together as a single line item on the Evaporative Process form. Refer to the explanation of grouping on page 4.

Process ID *8*

Material Type	2002 Usage	Units	VOC (lbs/unit)	VOC Emissions (= Usage × VOC content)
gun cleaner	180	gal	7.2	1,296 lbs.
xyz stripper	1,300	gal	3.3	4,290
cleaning solvent	358	gal	6.4	2,291
generoclean solvent	2,258	gal	6.8	15,354
Totals:	**4,096**	**gal**		**23,231 lbs.**

Average VOC content:	23,231 lbs. / 4,096 gals	=	5.67 lb/gal

Calculating an emission fee:

- If your total emissions on line 6 of the Data Certification/Fee Calculation Form are less than 10,000 lbs., you have no emission fee to pay.

- If your total emissions from line 6 are 10,000 lbs. or more, divide the total emissions by 2000 to convert pounds into tons of VOC. **Round to the nearest ton.** Multiply this number by $38.69 to calculate your emission fee.

The table below summarizes annual emission fees for reports up to 25 tons:

If your annual emissions total in POUNDS is:	Your annual total in TONS is:	Your 2002 emissions fee is:
Less than 10,000 lbs.		**$0.00**
between 10,000 – 10,999.9 lbs.	5	$193.45
between 11,000 – 12,999.9 lbs.	6	$232.14
between 13,000 – 14,999.9 lbs.	7	$270.83
between 15,000 – 16,999.9 lbs.	8	$309.52
between 17,000 – 18,999.9 lbs.	9	$348.21
between 19,000 – 20,999.9 lbs.	10	$386.90
between 21,000 – 22,999.9 lbs.	11	$425.59
between 23,000 – 24,999.9 lbs.	12	$464.28
between 25,000 – 26,999.9 lbs.	13	$502.97
between 27,000 – 28,999.9 lbs.	14	$541.66
between 29,000 – 30,999.9 lbs.	15	$580.35
between 31,000 – 32,999.9 lbs.	16	$619.04
between 33,000 – 34,999.9 lbs.	17	$657.73
between 35,000 – 36,999.9 lbs.	18	$696.42
between 37,000 – 38,999.9 lbs.	19	$735.11
between 39,000 – 40,999.9 lbs.	20	$773.80
between 41,000 – 42,999.9 lbs.	21	$812.49
between 43,000 – 44,999.9 lbs.	22	$851.18
between 45,000 – 46,999.9 lbs.	23	$889.87
between 47,000 – 48,999.9 lbs.	24	$928.56
between 49,000 – 50,999.9 lbs.	25	$967.25

EXAMPLE

Data Certification/Fee Calculation Form 2002

Permit number 999999

For EACH pollutant listed, total up all emissions recorded on your General Process and Evaporative Process Forms. Enter these numbers in column 1, "Totals from Process Forms." Report any emissions from accidental releases in column 2.
Add the figures in each row across, and enter the result in column 3, "Total Emissions".
Carefully follow the instructions on lines 6 through 8 to calculate any emission fee owed.

NOTE: "Accidental Releases" reported in column 2 should include all excess emissions reported to the Department under Rule 140, Section 500.

Summary of 2002 Annual Emissions:	(1) Totals from Process Forms	(2) + Accidental Releases	(3) = TOTAL 2002 Emissions
CO	2,113	0	2,113
NH_x		0	
Lead		0	

Emissions fees are based on your emissions of the following pollutants ONLY:

1	HAP&NON		0	
2	VOC	24,220	0	24,220
3	NO_x	9,815	0	9,815
4	SO_x	645	0	645
5	PM_{10}	7,891	0	7,891
6	**Add "TOTAL" column from lines 1 through 5 ONLY:**			42,571 lbs.
7	If line 6 is less than 10,000 pounds, no emission fee is due. Enter zero (0) on line 8. If line 6 is 10,000 pounds or more, divide line 6 by 2000 (pounds per ton) to get tons, and round the number to the nearest ton. (Drop any decimal .499 or less. Increase to the next whole number any decimal of .500 or more.) Enter the resulting WHOLE NUMBER here.			21 TONS
8	Multiply line 7 (a WHOLE number) by **$ 38.69**. This is your **2002 ANNUAL EMISSIONS FEE**. **NOTE:** If your total annual emissions are less than 10,000 lbs., no emissions fee is due.			$ 799.68

NOTE: Review specific requirements for data confidentiality on page 5. We cannot hold any data confidential without the required documentation.

TO COMPLETE YOUR EMISSIONS INVENTORY REPORT:

- If your annual emissions are 10,000 lbs. or more, include a check (made payable to Maricopa County Environmental Services) for the amount calculated on line 8 above.
- Complete the Confidentiality Statement below.
- Sign and date this form below where indicated.
- Send the **original** copy of your completed forms, along with any emission fee due to: Maricopa County Environmental Services Dept., Emissions Inventory Unit, 1001 No. Central Ave., Suite 100, Phoenix, AZ 85004. Keep a copy of all forms for your records.

CONFIDENTIALITY STATEMENT:

This annual emissions report contains requests to keep some data confidential. ☐ YES ☒ NO
If you check "YES", you must submit documentation and meet certain requirements before your data can be deemed confidential. See enclosed instructions for further details.

NOTE: The Data Certification form must be signed by a responsible company official.

CERTIFICATION STATEMENT:

I declare under penalty of perjury that the data (e.g. inputs, emission factors, controls, and annual emissions) presented herein represents the best available information and is true, accurate and complete to the best of my knowledge.

Signature of owner/business officer | Date of signature | Telephone number

Type or print full name of owner/business officer | Type or print full title

Appendix 2.2
Rule Effectiveness Evaluation Form
Point Sources

RULE EFFECTIVENESS EVALUATION FORM
Point Sources

Source Category _____
Source Name _____
Source Location _____
Source Identifier _____

Choose the one most appropriate response for each question. Answers should be confirmed by information in the State or local agency's files. When the questionnaire has been completed, total the scores to determine RE for the source; the average score for all evaluated sources in a category is the RE for that category.

Preliminary Screening:

1. Is this source currently uncontrolled? _____ No
_____ Yes
(If "yes", choose another source to evaluate, and indicate a RE of 0 percent for this source in the inventory.)

2. Are emissions from this source controlled by an irreversible process change? _____ No
_____ Yes
(If "yes", choose another source to evaluate, and indicate a RE of 100 percent for this source in the inventory.)

3. Have emissions from this source been calculated by means of a direct determination? _____ No
_____ Yes
(If "yes", choose another source to evaluate, do not apply RE to this source, and indicate a RE of 100 percent in the inventory.)[1]

A. Nature of the Regulation

1. Does the regulation contain uncorrected deficiencies (not including record keeping deficiency) as specified in the SIP-call follow-up letter from the EPA Regional Air Division Director to your State Air Program Director?

_____ No (5)
_____ Yes or unsure (0) Score _____

[1] If a source's emissions have been estimated using direct determination, maintain the supporting data and calculations in your files.

2. Does the State require source to keep records sufficient to enable an inspector to determine compliance status?

_____ Yes (5)
_____ No or unsure (0)

Score _____

3. How complex is the determination of compliance? (*If State can verify through detailed records that all necessary compliance determination procedures have been carried out, score 5 points for this question regardless of answer checked below.*)

_____ Determination can be made by looking at facility, as in the case of an equipment standard. (5)
_____ Determination can be made by collecting and analyzing one sample or by evaluating continuous emission monitoring reports. (4)
_____ Stack testing, including capture and control, must be performed to determine compliance. (3)
_____ Determination requires that multiple samples be taken and analyzed and that plant records be evaluated, as in the case of cross-line averaging, time averaging, or other bubbles. (2)

Score _____

B. Nature of Procedures Used to Comply With Regulation

1. This question concerns the relative level of confidence in the long-term performance capabilities intrinsic to different control techniques (e.g., how time in operation and maintenance degradation might affect emissions control). (*Check each technique used at the facility, total the scores assigned to each control, divide by the number of controls and report the average as a single score. If State can verify through detailed records that the source has actually been in continuous compliance at all times during the past two years, score 10 points on this question regardless of control methods used.*)

_____ Floating roof (10)
_____ Thermal incinerator (8)
_____ Vapor balance (8)
_____ Reversible process change (e.g., coating reformulation) (8)
_____ Condensation system (7)
_____ Carbon adsorber (7)
_____ Catalytic incinerator (7)
_____ Other (assign point value $\leq$ 10, as appropriate, relative to above controls) (_)

Score _____

2. Are fugitive emissions that might cause noncompliance a possibility where add-on controls are used (*check one*)?

____	No or not applicable because there is no add-on equipment	(5)
____	No, because they have been shown by an EPA-approved capture efficiency test to be below allowable limits and to be so on a continual basis	(5)
____	Yes or unsure	(0)

Score _____

C. Performance of Source in Complying With Regulation

1. What procedures does the source follow for operation and maintenance (O&M) of the control equipment (*check one*)?

____	Plant personnel complete a formal training program and follow daily written instructions for O&M	(5)
____	Same as above, except no training	(4)
____	Plant personnel follow weekly established O&M routine	(3)
____	Equipment is assumed to be operating correctly unless major malfunction is detected	(1)

Score _____

2. What is the nature of self-monitoring efforts conducted by the plant to assess compliance (*check one*)?

____	Source test (using EPA-approved method)[2] is conducted annually	(5)
____	Sample analysis (using EPA-approved method)[2] is conducted for each ink or coating used	(5)
____	Above tests are performed, but less frequently	(3)
____	None or unsure	(0)

Score _____

3. Does the plant keep records of data (including self-monitoring, O&M, coating usage, etc.) that would allow verification of compliance?

____	Yes	(5)
____	No or unsure	(0)

Score _____

---

[2]For examples of approved test methods, see "Test Methods or Procedures for Group I, II, and III CTG's," *Issues Relating to VOC Regulations, Cutpoints, Deficiencies, and Deviations*, EPA/OAQPS/AQMD/OCMPB/PIS, May 25, 1988.

[3]Ibid.

4a. Has source been found to be out of compliance in the last 12 months? (*If "yes", then answer question 4b; otherwise, skip to Part D*)

____ No (10)
____ Yes or unsure (0)

Score _____

4b. In responding to Notices of Violation, did the source demonstrate compliance within the required time frame? (*Answer this question only if you answered "yes" to question 4a. above*)

____ Yes (5)
____ No or unsure (0)

Score _____

D. Performance of Implementing Agency in Enforcing Regulation

1. Please answer the following questions regarding verification of the source's compliance?

a. Are all permits and abatement orders available?

____ No (0)
____ Yes or not applicable (2)

Score _____

b. Are all applicable requirements identified in the permit (e.g., emission limits, averaging times, compliance schedule, monitoring, recordkeeping, reporting, operation and maintenance, test requirements)?

____ No (0)
____ Yes or not applicable (2)

Score _____

c. Are accurate and complete flow diagrams available for the emission points and control, capture, ventilation and process systems?

____ No (0)
____ Yes or not applicable (2)

Score _____

d. Are all source test and sample analysis results available?

____ No (0)
____ Yes or not applicable (2)

Score _____

e. Are all appropriate control system operating data available?

____ No
____ Yes or not applicable (2)

Score _____

Total Score _____

2. What is the professional background of the person who most frequently inspects this source? (*Choose the one most applicable answer with highest score.*)

____	Has ≥ 3 years of experience in conducting plant inspections	(5)
____	Has engineering degree and has completed formal training program on how to conduct plant inspections	(4)
____	Has engineering degree	(3)
____	Has completed formal training program on how to conduct plant inspections	(3)
____	No training, < 3 years of experience, and no engineering degree	(0)
____	Unsure	(0)

Score _____

3. How many times has source been inspected in the past 24 months? (*Inspections must be confirmed by inspection reports in implementing Agency's file.*)

____	>2 times, unannounced	(10)
____	Once or twice, unannounced	(8)
____	Once or more, with prior notice or unknown if notice given	(6)
____	None or unsure	(0)

Score _____

4. What was the highest level of inspection performed at the source in the last 24 months? (*This must be confirmed by inspection reports in the implementing agency's file.*)

____	Level 4: sampling inspection including preplanned sample collection	(5)
____	Level 3: compliance evaluation	(4)
____	Level 2: walk-through	(2)
____	Level 1: observation from outside	(1)
____	None or unsure	(0)

Score _____

5. Does the agency generally determine compliance by the method(s) specified in the regulation?

____	Yes	(5)
____	No or unsure	(0)

Score _____

6. If this source has been found out of compliance within the last 12 months, has formal documented enforcement action (e.g., consent decrees, variances, court actions, penalties) been taken against the source?

____	Not applicable because source has not been found out of compliance	(5)
____	Yes	(5)
____	No or unsure	(0)

Score _____

Appendix 3.1

2002 Maricopa County Agricultural Pesticide Application

2002 Maricopa County Agricultural Pesticide Application

EPA name	epanum	Active ingredient name	lbs_ai	type [2]	sum_ac	county	adate1
Ridomil Gold Copper	100-804	Copper hydroxide	384.35	F	503.60	MAR	2/25/2002
2,4-D/Barrage	5905-529	2,4-D	246.75	H	652.30	MAR	3/9/2002
Fusilade DX	10182-367	Fluazifop-P-butyl	46.00	H	252.00	MAR	3/11/2002
Dual II Magnum	100-818	S-Metolachlor	61.12	H	65.00	MAR	3/26/2002
Furadan 4F	279-2876	Carbofuran	3,112.39	I	9,781.60	MAR	4/4/2002
2,4-D/Weedar 64	71368-1	2,4-D, Dimeth. salt	531.92	H	937.00	MAR	4/20/2002
Temik 15G	264-330	Aldicarb	202.50	I	73.00	MAR	4/24/2002
Nemacur 3 Turf	3125-283	Fenamiphos	90.00	I	54.00	MAR	5/31/2002
Comite (6.55EC)	400-104	Propargite	9,282.45	I	4,104.60	MAR	6/12/2002
Benlate SP	352-564	Benomyl	15.00	F	58.00	MAR	6/14/2002
Metasystox-R (2EC)	10163-220	Oxydemeton-methyl	145.00	I	291.20	MAR	6/14/2002
Dibrom 8 Emulsive	5481-479	Naled	7.20	I	32.00	MAR	7/13/2002
Thimet 20-G	241-257	Phorate	269.55	I	234.20	MAR	7/18/2002
MSMA 6 Plus	50534-6	MSMA	36.00	H	36.00	MAR	7/19/2002
Staple	352-576	Pyrithiobac-sodium	18.16	H	341.10	MAR	7/19/2002
Dipel DF	275-103	Bt (Bacillus thur.)	696,749.79	I	717.60	MAR	7/25/2002
Cy-Pro 4L	1812-366	Cyanazine	1,205.67	H	1,317.90	MAR	7/26/2002
Ammo 2.5EC	279-3027	Cypermethrin	43.13	I	581.00	MAR	7/27/2002
Hot Sauce Animal Repellent	72-574	Capsaicin	0.72	M	76.85	MAR	7/30/2002
Prefar 4E	10163-200	Bensulide	160.52	H	107.00	MAR	8/9/2002
Prowl 3.3 EC	241-337	Pendimethalin	9,358.79	H	10,378.00	MAR	8/15/2002
Cotton-Pro (4E)	1812-274	Prometryn	4,171.42	H	5,927.20	MAR	8/15/2002
AAtrex 4LC	100-497	Atrazine	2,792.20	H	2,345.70	MAR	8/27/2002
Clarity 4L	7969-137	Dicamba	1,558.57	H	5,502.60	MAR	8/29/2002
Sempra CA	524-465	Halosulfuron	2.17	H	50.50	MAR	9/4/2002
Capture 2EC	279-3069	Bifenthrin	306.28	I	3,907.60	MAR	9/5/2002
Kelthane MF	707-202	Dicofol	2,865.30	I	2,850.50	MAR	9/5/2002
Trilogy	70051-2	Neem oil	389.23	F	878.70	MAR	9/5/2002
Knack (aka Esteem 0.86EC)	59639-95	Pyriproxyfen	798.23	I	14,798.10	MAR	9/5/2002
Pix Plus	7969-173	Bacillus cereus	1,078,233.27	MG	11,832.80	MAR	9/7/2002
Pix Plus	7969-173	Mepiquat chloride	384.73	MG	12,113.30	MAR	9/7/2002
Larvin 3.2	264-379	Thiodicarb	55.94	I	92.30	MAR	9/8/2002
Decis 1.5EC	34147-12	Deltamethrin	9.38	I	389.00	MAR	9/10/2002
NoMate PBW MEC	55638-20	Gossyplure	2.88	M	727.00	MAR	9/10/2002
NoMate PBW MEC	55638-20	Hexadecadien (Z,Z)	2.88	M	727.00	MAR	9/10/2002
Zephyr 0.15 EC	100-897	Abamectin	18.61	I	2,194.05	MAR	9/11/2002
Quadris (aka Abound)	10182-415	Azoxystrobin	379.00	F	1,782.00	MAR	9/12/2002
Kaligreen	70231-1	Potassium bicarbon.	1,385.39	F	304.90	MAR	9/20/2002
Princep DF TO	100-603	Simazine	94.50	H	60.00	MAR	9/20/2002
Trilin GRP (80%)	5905-250	Malathion	23,300.27	I	21,324.35	MAR	9/25/2002
Orthene 90 WSP	59639-86	Acephate	16,389.43	I	19,554.20	MAR	9/26/2002
Danitol 2.4 EC Spray	59639-35	Fenpropathrin	371.52	I	1,921.70	MAR	9/26/2002
Rally 40W	707-215	Myclobutanil	536.55	F	5,996.90	MAR	9/28/2002
Vydate C-LV (3.77lbs)	352-532	Oxamyl	1,754.78	I	2,127.50	MAR	9/28/2002
Lorsban 4E-HF	62719-220	Chlorpyrifos	6,551.78	I	37,227.70	MAR	10/11/2002
Microthial Special	4581-373	Sulfur	15,169.93	F	2,280.10	MAR	10/11/2002
Diazinon AG500 (4E)	34704-41	Diazinon	369.73	I	562.90	MAR	10/14/2002
Cytoplex HMS	58199-7	Cytokinins	0.05	M	3,774.55	MAR	10/18/2002
Cytoplex HMS	58199-7	Gibberellic acid	0.03	M	4,461.80	MAR	10/18/2002
Cytoplex HMS	58199-7	Indolebutyric Acid	0.03	M	4,461.80	MAR	10/18/2002
Topsin M 70W	4581-322	Thiophanate-methyl	915.12	F	2,598.10	MAR	10/18/2002

2002 Maricopa County Agricultural Pesticide Application (continued)

EPA name	epanum	Active ingredient name	lbs_ai	type [2]	sum_ac	county	adate1
AIM	279-3194	Carfentrazone-ethyl	15.81	MD	2,199.20	MAR	10/23/2002
Endosulfan 3EC	51036-92	Endosulfan	16,011.42	I	14,593.70	MAR	10/23/2002
Dithane WF Turf & Ornamental	707-156	Mancozeb	2,221.85	F	1,009.25	MAR	10/23/2002
Roundup UltraMax	524-512	Glyphosate	14,651.47	H	17,420.30	MAR	11/2/2002
Asana XL (.66EC)	352-515	Esfenvalerate	384.27	I	9,267.40	MAR	11/8/2002
Dimethoate 4EC	5905-493	Dimethoate	7,909.68	I	21,147.40	MAR	11/16/2002
Accelerate	4581-284	Endothall	90.58	MD	2,727.80	MAR	11/18/2002
Ginstar EC	264-634	Diuron	2,273.42	MD	20,292.70	MAR	11/19/2002
Ginstar EC	264-634	Thidiazuron	1,456.74	MD	20,886.70	MAR	11/19/2002
Vapam HL	5481-468	Metam-sodium	59,239.39	MS	1,580.40	MAR	11/20/2002
Zorial Rapid 80 (DF)	55947-77	Norflurazon	976.94	H	898.20	MAR	11/20/2002
Cotton-Aide HC	17545-2	Cacodylic acid	64.00	MD	177.80	MAR	11/22/2002
Def 6	3125-282	Tribufos	7,003.40	MD	6,751.20	MAR	11/22/2002
CottonQuik (aka ETK-2201)	68891-7	Ethephon	3,638.04	MG	4,890.50	MAR	11/23/2002
CottonQuik (aka ETK-2201)	68891-7	Monocarbamide dihyd.	938.50	MG	760.00	MAR	11/23/2002
Starfire Concentrate (3.0L)	10182-372	Paraquat	315.27	MD	1,191.30	MAR	11/26/2002
Conclude B&G	7969-58	Acifluorfen	71.66	H	1,092.50	MAR	12/2/2002
Conclude B&G	7969-58	Bentazon	320.88	H	1,092.50	MAR	12/2/2002
Conclude B&G	7969-58	Sethoxydim	160.44	H	1,092.50	MAR	12/2/2002
Astro T&O 3.2EC	279-3014	Permethrin	1,555.93	I	14,953.70	MAR	12/4/2002
Butoxone 200 (2EC)	56077-26	2,4-DB	722.90	H	1,103.70	MAR	12/5/2002
Pursuit DG	241-350	Imazethapyr	344.84	H	4,899.90	MAR	12/5/2002
Baythroid 2 (EC)	3125-351	Cyfluthrin	201.29	I	5,802.60	MAR	12/6/2002
Eptam 20-G	10182-199	EPTC	2,261.57	H	1,120.80	MAR	12/6/2002
Warrior T	10182-434	Lambda-cyhalothrin	259.82	I	10,260.35	MAR	12/6/2002
Confirm 2F	707-238	Tebufenozide	28.38	I	250.20	MAR	12/7/2002
Telone II	62719-32	Dichloropropene	282,934.95	MS	5,173.15	MAR	12/8/2002
Raptor	241-379	Imazamox	85.05	H	1,968.90	MAR	12/10/2002
Sodium Chlorate 2lb	5905-87	Sodium chlorate	42,144.96	MD	8,876.20	MAR	12/12/2002
Goal 2XL	707-243	Oxyfluorfen	2.18	H	35.00	MAR	12/13/2002
Sencor DF (75%)	3125-325	Metribuzin	1,029.75	H	2,629.00	MAR	12/18/2002
Achieve 40DG	10182-426	Tralkoxydim	236.59	H	1,028.20	MAR	12/19/2002
Select 2 EC	59639-3	Clethodim	924.74	H	5,166.30	MAR	12/20/2002
Treflan HFP (aka Triap)	62719-250	Trifluralin	31,176.04	H	18,410.10	MAR	12/26/2002
Manex Maneb Flowable (4L)	1812-251	Maneb	1,982.66	F	1,497.90	MAR	12/27/2002
Success	62719-292	Spinosad	516.12	I	7,289.30	MAR	12/27/2002
Ridomil Gold EC	100-801	Chlorothalonil	8,380.39	F	2,768.60	MAR	12/28/2002
Provado 1.6 Flowable	3125-457	Imidacloprid	399.89	I	3,910.60	MAR	12/28/2002
Ridomil Gold EC	100-801	Mefenoxam	728.68	F	2,736.20	MAR	12/28/2002
Lannate (90WSP)	352-342	Methomyl	3,021.40	I	3,971.30	MAR	12/28/2002
Evergreen Emulsifiable 60-6	1021-1091	Piperonyl butoxide	748.13	PH	5,034.30	MAR	12/28/2002
Evergreen Emulsifiable 60-6	1021-1091	Pyrethrins	65.06	PH	4,735.50	MAR	12/28/2002
Mustang 1.5 EW	279-3126	Zeta-cypermethrin	137.80	I	3,077.80	MAR	12/28/2002
MCP Amine 4	228-143	MCPA	1,131.60	H	1,957.10	MAR	12/30/2002

[1] Source: Arizona Agricultural Statistical Service, 2003. Email from Clare Jervis, Statistician, (602) 280-8875; clare_Jervis@nass.usda.gov, November 10, 2003.

[2] F= Fungicide; H=Herbicide; I=Insecticide; MS = Soil fumigant; PH = Pheremone; M=Misc., other; MD=Defoliant; MG=Growth regulator; MB=Bacterial

Appendix 3.2

2002 Fire Department Survey Results

Fire Department	Structure Fires	Vehicle Fires	Brush Fires	Approx. Acreage (per fire)	Boat Fires	Total acreage [6]
Aguila Fire District	0	2	21	< 1 acre		2.1
Avondale Fire Department	83	104	42	unknown		4.2
AZ Bureau of Land Management		0	12	9.5 acres total		9.5
AZ State Land Dept.		2	35	115.75 total		115.8
Buckeye Fire Dept. [5]	41	44	73			7.3
Buckeye Valley Rural Fire District	26	32	45	1		45.0
Chandler Fire Department	62	59	103	unknown		10.3
Circle City-Morristown Fire District [1]						
City of Phoenix Fire Department	1,754	3,338	4,323	unknown		432.3
Daisy Mountain Fire District	4	28	17	10		170.0
El Mirage Fire Department	6	6	20	0		2.0
Gila Bend Fire Department	15	18	55	0		5.5
Gilbert Fire Department	48	58	130	unknown		13.0
Glendale Fire Department	113	159	70	N/A		7.0
Goodyear Fire Department	17	43	28	0		2.8
Guadalupe Fire Department [2]	18	26	60			6.0
Harquahala Valley Fire District	8	30	70	400 acres total		400.0
Laveen Fire Department [3]	31	42	89			8.9
Luke AFB Fire Alarm Comm. Ctr.	10	9	0			0.0
Mesa Fire Department	271	439	623	N/A		62.3
Peoria Fire Department	70	129	183	unknown		18.3
Pleasant Harbor Marina	0	0	3	5	4	15.0
Rural Metro: West and East Valley [4]	701	401	476			47.6
Sun City Fire District	51	7	24	3		72.0
Sun City West Fire Department	21	16	4			0.4
Sun Lakes Fire District	1	1	1			0.1
Surprise Fire Department	19	40	60	<1		6.0
Tempe Fire Dept	114	180	309	N/A		30.9
Tolleson Fire Department	87	50	76	2		152.0
Wickenburg Fire Dept.	12	30	60	0.5-1		6.0
Wickenburg Volunteer Fire Dept.						
Wittman Volunteer Fire Dept.	14	19	42	< 1		4.2
TOTAL	**3,597**	**5,312**	**7,054**		**4**	**1,656.5**

Notes:

[1] Survey data not available in 1996 or 1999, so fire data was not substituted.

[2] No 2002 data reported, pre-1996 data used.

[3] Laveen fire department reported 162 total number of fire calls in 2002; 1999 percentages were used to allocate 2002 numbers as follows: 19% structure; 26% auto; 55% brush.

[4] 1999 data was used for Rural Metro because no survey was returned from Rural Metro West Valley and Rural Metro East Valley only reported 156 structure fires and 27 brush fires in 2002

[5] Brush fires include outside rubbish and equipment fires.

[6] When acreage was not provided or data was incomplete or unclear, assumed each reported brush fire was equal to 0.1 acres.

Appendix 5.1

Traffic Information

HPMS
ARIZONA
02-01
CY 2002

SYSTEM LENGTH AND DAILY VEHICLE TRAVEL

INDIVIDUAL URBANIZED AREAS WITH GREATER THAN 50,000 POPULATION

(Aggregate length and travel information covering all public highways by class of road for each urbanized area)

Areawide
Table # 2

URBANIZED AREA NAME	POPULATION (1,000)	NET LAND AREA (SQ MILES)	DATA TYPE	FUNCTIONAL SYSTEM						
				PRINCIPAL ARTERIALS						
				INTERSTATE	OTHER FREEWAYS & EXPRESSWAYS	OTHER	MINOR ARTERIAL	COLLECTOR	LOCAL	TOTAL
PHOENIX	2,949	1,054	LENGTH	53	136	601	599	662	8,633	10,684
			TRAVEL (1,000)	8,998	13,530	17,890	10,309	5,636	6,975	63,338
TUCSON	709	312	LENGTH	20	15	172	309	195	2,384	3,095
			TRAVEL (1,000)	1,828	532	5,354	4,310	864	1,681	14,569
YUMA	88	34	LENGTH	4	-	22	24	19	249	318
			TRAVEL (1,000)	76	-	460	274	109	176	1,095
FLAGSTAFF	67	73	LENGTH	17	-	12	26	45	177	277
			TRAVEL (1,000)	468	-	298	151	153	132	1,202
			LENGTH							-
			TRAVEL (1,000)							-
TOTAL	3,813	1,473	LENGTH	94	151	807	958	921	11,443	14,374
			TRAVEL (1,000)	11,370	14,062	24,002	15,044	6,762	8,964	80,204

Units for defining length and travel in this report are miles and vehicle-miles (in thousands), respectively
Figures shown originally submitted to Federal Highway Administration in October, 2003
Figures may not add up to totals due to numerical rounding

HPMS
ARIZONA
03-2
CY 2002

SYSTEM LENGTH AND DAILY VEHICLE TRAVEL

FOR "DONUT" PORTION OF URBAN AREAS DESIGNATED AS NAAQS NON-ATTAINMENT AREAS

(Aggregate length and travel information covering all public highways by class of road for each urbanized area)

Areawide
Table # 3

DONUT AREA NAME	POPULATION (1,000)	NET LAND AREA (SQ MILES)	DATA TYPE	FUNCTIONAL SYSTEM						
				ARTERIALS			COLLECTORS		LOCAL	TOTAL
				INTERSTATE / URBAN FRWY	OTHER PRINCIPAL	MINOR	RURAL MAJ / MIN	URBAN		
PHOENIX	2,949	1,054	LENGTH	39	83	84	443	196	2,371	3,216
			TRAVEL (1,000)	1,830	972	965	1,753	631	543	6,694
TUCSON	709	312	LENGTH	37	17	21	257		1	333
			TRAVEL (1,000)	1,524	160	243	705		16	2,648
			LENGTH		-					-
			TRAVEL (1,000)		-					-
			LENGTH		-					-
			TRAVEL (1,000)		-					-
			LENGTH							-
			TRAVEL (1,000)							-
TOTAL	3,658	1,366	LENGTH	76	100	105	700	196	2,372	3,549
			TRAVEL (1,000)	3,354	1,132	1,208	2,458	631	559	9,342

Units for defining length and travel in this report are miles and vehicle-miles (in thousands), respectively
Figures shown originally submitted to Federal Highway Administration in August, 2000
Figures may not add up to totals due to numerical rounding

HPMS Arizona CY2002

2002 MARICOPA COUNTY ESTIMATES OF DAILY VEHICLE TRAVEL BY HIGHWAY FUNCTIONAL CLASSIFICATION & NON-ATTAINMENT AREA

Maricopa County Request

FHWA HIGHWAY FUNCTIONAL SYSTEM

RURAL					
Code	Description	Estimated DVMT (In Thousands)	Code	Description	Estimated DVMT (In Thousands)
1	Principal Arterial - Interstate	2,876	11	Principal Arterial - Interstate	9,927
2	Principal Arterial - Other	1,641	12	Freeways & Expressways	13,801
6	Minor Arterial	769	14	Principal Arterial - Other	17,518
7	Major Collector	2,236	16	Minor Arterial	10,452
8	Minor Collector	255	17	Collector	6,241
9	Local	511	19	Local	7,352
	County Rural Total:	8,288		**County Urban Total:**	65,291

	(In Thousands)
Total Estimated County DVMT:	73,579

Units for defining length and travel in this report are miles and vehicle-miles (in thousands), respectively

Figures shown originally submitted to Federal Highway Administration in October, 2003

Figures may not add up to totals due to numercial rounding

Appendix 5.2

MOBILE6.2 Inputs, Outputs, and Spreadsheet

In order to calculate vehicle emission factors for the 2002 peak ozone season, two MOBILE6.2 runs were performed:

1. I/M program in place.

2. No I/M program in place.

A portion of the MOBILE6.2 input and output files are provided in this appendix as an example. Scenarios for each Area and Facility type combination were defined within each input file. The MOBILE6.2 emission factors produced by the two runs were subsequently weighted together in a spreadsheet program using the appropriate proportions as described in the Emission Factor Estimation Procedure section. The spreadsheet calculations are included after the MOBILE6.2 input and output files in this appendix.

In order to calculate annual average day emission factors for 2002, twenty four MOBILE6.2 runs were performed:

1. I/M program in place, and

2. No I/M program in place,

for all twelve months of the year for a total of 24 runs.

Scenarios for each Area and Facility type combination were defined within each input file. The MOBILE6.2 emission factors produced by the runs were subsequently weighted together using the FORTRAN program "NEIProgram" using the appropriate proportions as described in the Emission Factor Estimation Procedure section.

MOBILE6 INPUT FILE :

```
RUN DATA
NO REFUELING     :
I/M PROGRAM      : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS  : 1 1967 2007
I/M VEHICLES     : 1 11111 22222222 2
I/M STRINGENCY   : 1 28.0
I/M COMPLIANCE   : 1 97.0
I/M WAIVER RATES : 1 1.3 1.0
I/M GRACE PERIOD : 1 5
I/M PROGRAM      : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS  : 2 1981 1995
I/M VEHICLES     : 2 22222 11111111 1
I/M STRINGENCY   : 2 28.0
I/M COMPLIANCE   : 2 97.0
I/M WAIVER RATES : 2 1.3 1.0
I/M GRACE PERIOD : 2 5
I/M CUTPOINTS    : 2 CUTcmp02.d
I/M PROGRAM      : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS  : 3 1967 1980
I/M VEHICLES     : 3 22222 11111111 1
I/M STRINGENCY   : 3 28.0
I/M COMPLIANCE   : 3 97.0
I/M WAIVER RATES : 3 1.3 1.0
I/M PROGRAM      : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS  : 4 1996 2050
I/M VEHICLES     : 4 22222 11111111 1
I/M STRINGENCY   : 4 28.0
I/M COMPLIANCE   : 4 97.0
I/M WAIVER RATES : 4 1.3 1.0
I/M GRACE PERIOD : 4 5
I/M PROGRAM      : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS  : 5 1996 2050
I/M VEHICLES     : 5 22222 11111111 1
I/M STRINGENCY   : 5 28.0
I/M COMPLIANCE   : 5 97.0
I/M WAIVER RATES : 5 1.3 1.0
I/M GRACE PERIOD : 5 5

ANTI-TAMP PROG   :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG   :
87 81 95 11111 22222222 2 11 097. 22111222

*the tech12.d file must be located with Mobile6 execution file
*the user tech file tech12.1me should be renamed as tech12.d
*Two more I/M programs should not have overlapped motor vehicles.

REG DIST         : 02reg02.d
DIESEL FRACTIONS :
0.0050 0.0040 0.0060 0.0040 0.0040 0.0030 0.0030 0.0030 0.0030 0.0030
0.0040 0.0040 0.0030 0.0030 0.0040 0.0080 0.0090 0.0160 0.0210 0.0430
0.0580 0.0470 0.0480 0.0260 0.0170
0.0740 0.0660 0.0690 0.1030 0.0280 0.0600 0.0500 0.0390 0.0250 0.0400
0.0330 0.0280 0.0250 0.0170 0.0150 0.0220 0.0290 0.0330 0.0480 0.0550
0.0720 0.0350 0.0290 0.0170 0.0110
0.0740 0.0660 0.0690 0.1030 0.0280 0.0600 0.0500 0.0390 0.0250 0.0400
0.0330 0.0280 0.0250 0.0170 0.0150 0.0220 0.0290 0.0330 0.0480 0.0550
0.0720 0.0350 0.0290 0.0170 0.0110
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
```

0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291

SCENARIO RECORD : AT1 Int/Free
CALENDAR YEAR : 2002
EVALUATION MONTH : 7
ALTITUDE : 1
ABSOLUTE HUMIDITY : 45.6
MIN/MAX TEMPERATURE: 80.0 104.0
AVERAGE SPEED : 59.7 freeway
VMT BY FACILITY : allfwy.def
FUEL RVP : 6.6
FUEL PROGRAM : 4
78.1 78.1 78.1 78.1 78.1 78.1 78.1 78.1
78.1 78.1 78.1 78.1 78.1 78.1 78.1 78.1
338.0 338.0 338.0 338.0 338.0 338.0 338.0 338.0
338.0 338.0 338.0 338.0 338.0 338.0 338.0 338.0
SULFUR CONTENT : 78.1
OXYGENATED FUELS : 1.000 0.000 0.019 0.000 1

SCENARIO RECORD : AT2 Int/Free
CALENDAR YEAR : 2002
EVALUATION MONTH : 7
ALTITUDE : 1
ABSOLUTE HUMIDITY : 45.6
MIN/MAX TEMPERATURE: 80.0 104.0
AVERAGE SPEED : 60.3 freeway
VMT BY FACILITY : allfwy.def
FUEL RVP : 6.6
FUEL PROGRAM : 4
78.1 78.1 78.1 78.1 78.1 78.1 78.1 78.1
78.1 78.1 78.1 78.1 78.1 78.1 78.1 78.1
338.0 338.0 338.0 338.0 338.0 338.0 338.0 338.0
338.0 338.0 338.0 338.0 338.0 338.0 338.0 338.0
SULFUR CONTENT : 78.1
OXYGENATED FUELS : 1.000 0.000 0.019 0.000 1

SCENARIO RECORD : AT3 Int/Free
CALENDAR YEAR : 2002
EVALUATION MONTH : 7
ALTITUDE : 1
ABSOLUTE HUMIDITY : 45.6
MIN/MAX TEMPERATURE: 80.0 104.0
AVERAGE SPEED : 63.2 freeway
VMT BY FACILITY : allfwy.def
FUEL RVP : 6.6
FUEL PROGRAM : 4
78.1 78.1 78.1 78.1 78.1 78.1 78.1 78.1

```
 78.1  78.1  78.1  78.1  78.1  78.1  78.1  78.1
338.0 338.0 338.0 338.0 338.0 338.0 338.0 338.0
338.0 338.0 338.0 338.0 338.0 338.0 338.0 338.0
SULFUR CONTENT    : 78.1
OXYGENATED FUELS  : 1.000 0.000 0.019 0.000 1



 SCENARIO RECORD   : AT4 Int/Free
 CALENDAR YEAR     : 2002
 EVALUATION MONTH  : 7
 ALTITUDE          : 1
 ABSOLUTE HUMIDITY : 45.6
 MIN/MAX TEMPERATURE: 80.0 104.0
*******************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                   *
* Input file: IMOZ02H.IN (file 1, run 1).                      *
*******************************************************************************
 M603 Comment:
         User has disabled the calculation of REFUELING emissions.


* Reading non-default I/M CUTPOINTS from the following external
* data file: CUTCMP02.D

* Reading Registration Distributions from the following external
* data file: 02REG02.D
 M 49 Warning:
          1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
         0.999    MYR sum not = 1. (will normalize)
 M 49 Warning:
         0.999    MYR sum not = 1. (will normalize)
 M 49 Warning:
         0.999    MYR sum not = 1. (will normalize)
 M 49 Warning:
         0.999    MYR sum not = 1. (will normalize)
 M 49 Warning:
          1.00    MYR sum not = 1. (will normalize)
 M614 Comment:
         User supplied diesel sale fractions.

* ##########################
* AT1 Int/Free
* File 1, Run 1, Scenario 1.
* ##########################
 M582 Warning:
       The user supplied freeway average speed of 59.7
       will be used for all hours of the day. 100% of VMT
       has been assigned to a fixed combination of freeways
       and freeway ramps for all hours of the day and all
        vehicle types.

* Reading Hourly Roadway VMT distribution from the following external
* data file: ALLFWY.DEF

 Reading User Supplied ROADWAY VMT Factors
 M616 Comment:
         User has supplied post-1999 sulfur levels.

      User supplied gasoline sulfur content =  78.1 ppm.

*** I/M credits for Tech1&2 vehicles were read from the following external
   data file: TECH12.D
 M 48 Warning:
         there are no sales for vehicle class HDGV8b

             Calendar Year: 2002
                   Month: July
                Altitude: Low
         Minimum Temperature:  80.0 (F)
         Maximum Temperature: 104.0 (F)
```

```
          Absolute Humidity:  46. grains/lb
           Nominal Fuel RVP:  6.6 psi
             Weathered RVP:  6.0 psi
         Fuel Sulfur Content:  78. ppm

         Exhaust I/M Program:  Yes
           Evap I/M Program:  Yes
              ATP Program:  Yes
           Reformulated Gas:  No

 Ether Blend Market Share: 1.000      Alcohol Blend Market Share: 0.000
 Ether Blend Oxygen Content: 0.019    Alcohol Blend Oxygen Content: 0.000
                        Alcohol Blend RVP Waiver: No

    Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV      MC   All Veh
        GVWR:          <6000   >6000    (All)
               ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
 VMT Distribution:   0.4509  0.2822  0.1116          0.0356  0.0022  0.0216  0.0909  0.0051  1.0000
 ---------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.962   1.122   1.363   1.190   0.916   0.393   0.267   0.396    2.71   0.992
    Composite CO  :   14.51   17.86   20.26   18.54   15.24   1.236   0.667   2.493   27.06  14.765
    Composite NOX :    1.064   1.331   1.627   1.415   5.606   1.789   1.191  23.579    1.63   3.417
 ---------------------------------------------------------------------------------------------------------------

 * ##########################
 * AT2 Int/Free
 * File 1, Run 1, Scenario 2.
 * ##########################
  M582 Warning:
         The user supplied freeway average speed of 60.3
         will be used for all hours of the day. 100% of VMT
         has been assigned to a fixed combination of freeways
         and freeway ramps for all hours of the day and all
          vehicle types.

 * Reading Hourly Roadway VMT distribution from the following external
 * data file: ALLFWY.DEF

  Reading User Supplied ROADWAY VMT Factors
  M616 Comment:
           User has supplied post-1999 sulfur levels.

        User supplied gasoline sulfur content =  78.1 ppm.
  M 48 Warning:
          there are no sales for vehicle class HDGV8b

              Calendar Year:  2002
                   Month:  July
                Altitude:  Low
          Minimum Temperature:  80.0 (F)
          Maximum Temperature:  104.0 (F)
           Absolute Humidity:  46. grains/lb
            Nominal Fuel RVP:  6.6 psi
              Weathered RVP:  6.0 psi
          Fuel Sulfur Content:  78. ppm

          Exhaust I/M Program:  Yes
```

Evap I/M Program: Yes
ATP Program: Yes
Reformulated Gas: No

Ether Blend Market Share: 1.000 Alcohol Blend Market Share: 0.000
Ether Blend Oxygen Content: 0.019 Alcohol Blend Oxygen Content: 0.000
Alcohol Blend RVP Waiver: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4509	0.2822	0.1116		0.0356	0.0022	0.0216	0.0909	0.0051	1.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.961	1.119	1.360	1.188	0.915	0.393	0.267	0.396	2.75	0.990
Composite CO :	14.60	17.95	20.36	18.63	15.61	1.247	0.674	2.533	28.26	14.866
Composite NOX :	1.066	1.333	1.630	1.417	5.630	1.834	1.221	24.050	1.65	3.464

* ##########################
* AT3 Int/Free
* File 1, Run 1, Scenario 3.
* ##########################
M515 Warning:
The combined freeway and ramp average speed entered
cannot be greater than 60.7 miles per hour.
The average speed will be reset to this value.
M582 Warning:
The user supplied freeway average speed of 60.7
will be used for all hours of the day. 100% of VMT
has been assigned to a fixed combination of freeways
and freeway ramps for all hours of the day and all
vehicle types.

* Reading Hourly Roadway VMT distribution from the following external
* data file: ALLFWY.DEF

Reading User Supplied ROADWAY VMT Factors
M616 Comment:
User has supplied post-1999 sulfur levels.

User supplied gasoline sulfur content = 78.1 ppm.

M 48 Warning:
there are no sales for vehicle class HDGV8b

Calendar Year: 2002
Month: July
Altitude: Low
Minimum Temperature: 80.0 (F)
Maximum Temperature: 104.0 (F)
Absolute Humidity: 46. grains/lb
Nominal Fuel RVP: 6.6 psi
Weathered RVP: 6.0 psi
Fuel Sulfur Content: 78. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: Yes
Reformulated Gas: No

Ether Blend Market Share: 1.000 Alcohol Blend Market Share: 0.000
Ether Blend Oxygen Content: 0.019 Alcohol Blend Oxygen Content: 0.000
Alcohol Blend RVP Waiver: No

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4509	0.2822	0.1116		0.0356	0.0022	0.0216	0.0909	0.0051	1.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.960	1.118	1.358	1.186	0.915	0.393	0.267	0.396	2.78	0.989
Composite CO :	14.66	18.01	20.42	18.70	15.86	1.254	0.678	2.559	29.05	14.931
Composite NOX :	1.067	1.335	1.632	1.419	5.645	1.864	1.241	24.357	1.66	3.494

*##########################
* AT4 Int/Free
* File 1, Run 1, Scenario 4.
*##########################
M515 Warning:
The combined freeway and ramp average speed entered
cannot be greater than 60.7 miles per hour.
The average speed will be reset to this value.
M582 Warning:
The user supplied freeway average speed of 60.7
will be used for all hours of the day. 100% of VMT
has been assigned to a fixed combination of freeways

Facility Type - Interstate / Freeway / Expressway			Pollutant - VOC				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	59.7	0.962	0.882	1.135	0.094	0.976
	2	60.3	0.961	0.881	1.133	0.094	0.975
Light Duty	3	63.2	0.960	0.880	1.132	0.094	0.974
Gasoline	4	64.8	0.960	0.880	1.132	0.094	0.974
Vehicles	5	64.2	0.960	0.880	1.132	0.094	0.974
LDGT1	1	59.7	1.122	1.029	1.364	0.113	1.142
	2	60.3	1.119	1.026	1.360	0.113	1.139
Light Duty	3	63.2	1.118	1.025	1.358	0.113	1.138
Gasoline	4	64.8	1.118	1.025	1.358	0.113	1.138
Trucks 1	5	64.2	1.118	1.025	1.358	0.113	1.138
LDGT2	1	59.7	1.363	1.250	1.551	0.129	1.379
	2	60.3	1.360	1.247	1.547	0.128	1.376
Light Duty	3	63.2	1.358	1.245	1.544	0.128	1.373
Gasoline	4	64.8	1.358	1.245	1.544	0.128	1.373
Trucks 2	5	64.2	1.358	1.245	1.544	0.128	1.373
HDGV	1	59.7	0.916	0.840	0.962	0.080	0.920
	2	60.3	0.915	0.839	0.962	0.080	0.919
Heavy Duty	3	63.2	0.915	0.839	0.961	0.080	0.919
Gasoline	4	64.8	0.915	0.839	0.961	0.080	0.919
Vehicles	5	64.2	0.915	0.839	0.961	0.080	0.919
LDDV	1	59.7	0.393	0.360	0.393	0.033	0.393
	2	60.3	0.393	0.360	0.393	0.033	0.393
Light Duty	3	63.2	0.393	0.360	0.393	0.033	0.393
Diesel	4	64.8	0.393	0.360	0.393	0.033	0.393
Vehicles	5	64.2	0.393	0.360	0.393	0.033	0.393
LDDT	1	59.7	0.267	0.245	0.267	0.022	0.267
	2	60.3	0.267	0.245	0.267	0.022	0.267
Light Duty	3	63.2	0.267	0.245	0.267	0.022	0.267
Diesel	4	64.8	0.267	0.245	0.267	0.022	0.267
Trucks	5	64.2	0.267	0.245	0.267	0.022	0.267
HDDV	1	59.7	0.396	0.363	0.396	0.033	0.396
	2	60.3	0.396	0.363	0.396	0.033	0.396
Heavy Duty	3	63.2	0.396	0.363	0.396	0.033	0.396
Diesel	4	64.8	0.396	0.363	0.396	0.033	0.396
Vehicles	5	64.2	0.396	0.363	0.396	0.033	0.396
MC	1	59.7	2.710	2.485	2.710	0.225	2.710
	2	60.3	2.750	2.522	2.750	0.228	2.750
Motorcycles	3	63.2	2.780	2.549	2.780	0.231	2.780
	4	64.8	2.780	2.549	2.780	0.231	2.780
	5	64.2	2.780	2.549	2.780	0.231	2.780

Facility Type - Principal Arterials / Minor Arterials			Pollutant - VOC				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	30.3	1.092	1.001	1.315	0.109	1.111
	2	34.4	1.053	0.966	1.264	0.105	1.071
Light Duty	3	36.1	1.042	0.956	1.250	0.104	1.059
Gasoline	4	39.0	1.028	0.943	1.231	0.102	1.045
Vehicles	5	42.6	1.012	0.928	1.210	0.100	1.028
LDGT1	1	30.3	1.300	1.192	1.599	0.133	1.325
	2	34.4	1.251	1.147	1.535	0.127	1.275
Light Duty	3	36.1	1.236	1.133	1.516	0.126	1.259
Gasoline	4	39.0	1.216	1.115	1.492	0.124	1.239
Trucks 1	5	42.6	1.194	1.095	1.463	0.121	1.216
LDGT2	1	30.3	1.595	1.463	1.837	0.152	1.615
	2	34.4	1.532	1.405	1.759	0.146	1.551
Light Duty	3	36.1	1.514	1.388	1.737	0.144	1.533
Gasoline	4	39.0	1.490	1.366	1.708	0.142	1.508
Trucks 2	5	42.6	1.461	1.340	1.675	0.139	1.479
HDGV	1	30.3	1.311	1.202	1.394	0.116	1.318
	2	34.4	1.193	1.094	1.262	0.105	1.199
Heavy Duty	3	36.1	1.153	1.057	1.218	0.101	1.158
Gasoline	4	39.0	1.095	1.004	1.154	0.096	1.100
Vehicles	5	42.6	1.038	0.952	1.091	0.091	1.042
LDDV	1	30.3	0.499	0.458	0.499	0.041	0.499
	2	34.4	0.468	0.429	0.468	0.039	0.468
Light Duty	3	36.1	0.457	0.419	0.457	0.038	0.457
Diesel	4	39.0	0.440	0.403	0.440	0.037	0.440
Vehicles	5	42.6	0.424	0.389	0.424	0.035	0.424
LDDT	1	30.3	0.356	0.326	0.356	0.030	0.356
	2	34.4	0.330	0.303	0.330	0.027	0.330
Light Duty	3	36.1	0.320	0.293	0.320	0.027	0.320
Diesel	4	39.0	0.307	0.282	0.307	0.025	0.307
Trucks	5	42.6	0.293	0.269	0.293	0.024	0.293
HDDV	1	30.3	0.603	0.553	0.603	0.050	0.603
	2	34.4	0.541	0.496	0.541	0.045	0.541
Heavy Duty	3	36.1	0.520	0.477	0.520	0.043	0.520
Diesel	4	39.0	0.488	0.447	0.488	0.041	0.488
Vehicles	5	42.6	0.456	0.418	0.456	0.038	0.456
MC	1	30.3	2.450	2.247	2.450	0.203	2.450
	2	34.4	2.330	2.137	2.330	0.193	2.330
Motorcycles	3	36.1	2.290	2.100	2.290	0.190	2.290
	4	39.0	2.240	2.054	2.240	0.186	2.240
	5	42.6	2.190	2.008	2.190	0.182	2.190

Facility Type - Collectors			Pollutant - VOC				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	18.2	1.300	1.192	1.568	0.130	1.322
	2	19.1	1.276	1.170	1.540	0.128	1.298
Light Duty	3	24.4	1.167	1.070	1.406	0.117	1.187
Gasoline	4	24.7	1.162	1.066	1.400	0.116	1.182
Vehicles	5	28.2	1.115	1.022	1.344	0.112	1.134
LDGT1	1	18.2	1.553	1.424	1.908	0.158	1.582
	2	19.1	1.520	1.394	1.867	0.155	1.549
Light Duty	3	24.4	1.387	1.272	1.705	0.142	1.413
Gasoline	4	24.7	1.381	1.266	1.698	0.141	1.407
Trucks 1	5	28.2	1.327	1.217	1.632	0.135	1.352
LDGT2	1	18.2	1.906	1.748	2.204	0.183	1.931
	2	19.1	1.865	1.710	2.157	0.179	1.889
Light Duty	3	24.4	1.702	1.561	1.963	0.163	1.724
Gasoline	4	24.7	1.695	1.554	1.955	0.162	1.717
Trucks 2	5	28.2	1.629	1.494	1.877	0.156	1.650
HDGV	1	18.2	1.994	1.828	2.157	0.179	2.008
	2	19.1	1.918	1.759	2.072	0.172	1.931
Heavy Duty	3	24.4	1.562	1.432	1.674	0.139	1.571
Gasoline	4	24.7	1.547	1.419	1.657	0.138	1.556
Vehicles	5	28.2	1.388	1.273	1.480	0.123	1.396
LDDV	1	18.2	0.652	0.598	0.652	0.054	0.652
	2	19.1	0.637	0.584	0.637	0.053	0.637
Light Duty	3	24.4	0.561	0.514	0.561	0.047	0.561
Diesel	4	24.7	0.557	0.511	0.557	0.046	0.557
Vehicles	5	28.2	0.519	0.476	0.519	0.043	0.519
LDDT	1	18.2	0.484	0.444	0.484	0.040	0.484
	2	19.1	0.472	0.433	0.472	0.039	0.472
Light Duty	3	24.4	0.408	0.374	0.408	0.034	0.408
Diesel	4	24.7	0.405	0.371	0.405	0.034	0.405
Trucks	5	28.2	0.372	0.341	0.372	0.031	0.372
HDDV	1	18.2	0.901	0.826	0.901	0.075	0.901
	2	19.1	0.872	0.800	0.872	0.072	0.872
Heavy Duty	3	24.4	0.723	0.663	0.723	0.060	0.723
Diesel	4	24.7	0.716	0.657	0.716	0.059	0.716
Vehicles	5	28.2	0.641	0.588	0.641	0.053	0.641
MC	1	18.2	3.000	2.751	3.000	0.249	3.000
	2	19.1	2.940	2.696	2.940	0.244	2.940
Motorcycles	3	24.4	2.660	2.439	2.660	0.221	2.660
	4	24.7	2.650	2.430	2.650	0.220	2.650
	5	28.2	2.510	2.302	2.510	0.208	2.510

Facility Type - Local			Pollutant - VOC				
			I/M		No I/M		Net Emission Factor
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	(grams/mile)
LDGV	1	12.9	1.504	1.379	1.821	0.151	1.530
	2	12.9	1.504	1.379	1.821	0.151	1.530
Light Duty	3	12.9	1.504	1.379	1.821	0.151	1.530
Gasoline	4	12.9	1.504	1.379	1.821	0.151	1.530
Vehicles	5	12.9	1.504	1.379	1.821	0.151	1.530
LDGT1	1	12.9	1.835	1.683	2.248	0.187	1.869
	2	12.9	1.835	1.683	2.248	0.187	1.869
Light Duty	3	12.9	1.835	1.683	2.248	0.187	1.869
Gasoline	4	12.9	1.835	1.683	2.248	0.187	1.869
Trucks 1	5	12.9	1.835	1.683	2.248	0.187	1.869
LDGT2	1	12.9	2.248	2.061	2.605	0.216	2.278
	2	12.9	2.248	2.061	2.605	0.216	2.278
Light Duty	3	12.9	2.248	2.061	2.605	0.216	2.278
Gasoline	4	12.9	2.248	2.061	2.605	0.216	2.278
Trucks 2	5	12.9	2.248	2.061	2.605	0.216	2.278
HDGV	1	12.9	2.610	2.393	2.846	0.236	2.630
	2	12.9	2.610	2.393	2.846	0.236	2.630
Heavy Duty	3	12.9	2.610	2.393	2.846	0.236	2.630
Gasoline	4	12.9	2.610	2.393	2.846	0.236	2.630
Vehicles	5	12.9	2.610	2.393	2.846	0.236	2.630
LDDV	1	12.9	0.760	0.697	0.760	0.063	0.760
	2	12.9	0.760	0.697	0.760	0.063	0.760
Light Duty	3	12.9	0.760	0.697	0.760	0.063	0.760
Diesel	4	12.9	0.760	0.697	0.760	0.063	0.760
Vehicles	5	12.9	0.760	0.697	0.760	0.063	0.760
LDDT	1	12.9	0.576	0.528	0.576	0.048	0.576
	2	12.9	0.576	0.528	0.576	0.048	0.576
Light Duty	3	12.9	0.576	0.528	0.576	0.048	0.576
Diesel	4	12.9	0.576	0.528	0.576	0.048	0.576
Trucks	5	12.9	0.576	0.528	0.576	0.048	0.576
HDDV	1	12.9	1.114	1.022	1.114	0.092	1.114
	2	12.9	1.114	1.022	1.114	0.092	1.114
Heavy Duty	3	12.9	1.114	1.022	1.114	0.092	1.114
Diesel	4	12.9	1.114	1.022	1.114	0.092	1.114
Vehicles	5	12.9	1.114	1.022	1.114	0.092	1.114
MC	1	12.9	3.550	3.255	3.550	0.295	3.550
	2	12.9	3.550	3.255	3.550	0.295	3.550
Motorcycles	3	12.9	3.550	3.255	3.550	0.295	3.550
	4	12.9	3.550	3.255	3.550	0.295	3.550
	5	12.9	3.550	3.255	3.550	0.295	3.550

Facility Type - Interstate / Freeway / Expressway			Pollutant - NOx				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	59.7	1.064	0.976	1.184	0.098	1.074
	2	60.3	1.066	0.978	1.186	0.098	1.076
Light Duty	3	63.2	1.067	0.978	1.187	0.099	1.077
Gasoline	4	64.8	1.067	0.978	1.187	0.099	1.077
Vehicles	5	64.2	1.067	0.978	1.187	0.099	1.077
LDGT1	1	59.7	1.331	1.221	1.458	0.121	1.342
	2	60.3	1.333	1.222	1.461	0.121	1.344
Light Duty	3	63.2	1.335	1.224	1.462	0.121	1.346
Gasoline	4	64.8	1.335	1.224	1.462	0.121	1.346
Trucks 1	5	64.2	1.335	1.224	1.462	0.121	1.346
LDGT2	1	59.7	1.627	1.492	1.743	0.145	1.637
	2	60.3	1.630	1.495	1.745	0.145	1.640
Light Duty	3	63.2	1.632	1.497	1.747	0.145	1.642
Gasoline	4	64.8	1.632	1.497	1.747	0.145	1.642
Trucks 2	5	64.2	1.632	1.497	1.747	0.145	1.642
HDGV	1	59.7	5.606	5.141	5.672	0.471	5.611
	2	60.3	5.630	5.163	5.695	0.473	5.635
Heavy Duty	3	63.2	5.645	5.176	5.711	0.474	5.650
Gasoline	4	64.8	5.645	5.176	5.711	0.474	5.650
Vehicles	5	64.2	5.645	5.176	5.711	0.474	5.650
LDDV	1	59.7	1.789	1.641	1.789	0.148	1.789
	2	60.3	1.834	1.682	1.834	0.152	1.834
Light Duty	3	63.2	1.864	1.709	1.864	0.155	1.864
Diesel	4	64.8	1.864	1.709	1.864	0.155	1.864
Vehicles	5	64.2	1.864	1.709	1.864	0.155	1.864
LDDT	1	59.7	1.191	1.092	1.191	0.099	1.191
	2	60.3	1.221	1.120	1.221	0.101	1.221
Light Duty	3	63.2	1.241	1.138	1.241	0.103	1.241
Diesel	4	64.8	1.241	1.138	1.241	0.103	1.241
Trucks	5	64.2	1.241	1.138	1.241	0.103	1.241
HDDV	1	59.7	23.579	21.622	23.579	1.957	23.579
	2	60.3	24.050	22.054	24.050	1.996	24.050
Heavy Duty	3	63.2	24.357	22.335	24.357	2.022	24.357
Diesel	4	64.8	24.357	22.335	24.357	2.022	24.357
Vehicles	5	64.2	24.357	22.335	24.357	2.022	24.357
MC	1	59.7	1.630	1.495	1.630	0.135	1.630
	2	60.3	1.650	1.513	1.650	0.137	1.650
Motorcycles	3	63.2	1.660	1.522	1.660	0.138	1.660
	4	64.8	1.660	1.522	1.660	0.138	1.660
	5	64.2	1.660	1.522	1.660	0.138	1.660

Facility Type - Principal Arterials / Minor Arterials			Pollutant - NOx				
			I/M		No I/M		Net Emission Factor
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	(grams/mile)
LDGV	1	30.3	1.027	0.942	1.155	0.096	1.038
	2	34.4	0.999	0.916	1.125	0.093	1.009
Light Duty	3	36.1	0.997	0.914	1.121	0.093	1.007
Gasoline	4	39.0	0.999	0.916	1.123	0.093	1.009
Vehicles	5	42.6	1.005	0.922	1.128	0.094	1.015
LDGT1	1	30.3	1.236	1.133	1.362	0.113	1.246
	2	34.4	1.217	1.116	1.342	0.111	1.227
Light Duty	3	36.1	1.217	1.116	1.342	0.111	1.227
Gasoline	4	39.0	1.224	1.122	1.348	0.112	1.234
Trucks 1	5	42.6	1.236	1.133	1.360	0.113	1.246
LDGT2	1	30.3	1.534	1.407	1.649	0.137	1.544
	2	34.4	1.513	1.387	1.626	0.135	1.522
Light Duty	3	36.1	1.513	1.387	1.625	0.135	1.522
Gasoline	4	39.0	1.518	1.392	1.631	0.135	1.527
Trucks 2	5	42.6	1.529	1.402	1.642	0.136	1.538
HDGV	1	30.3	4.481	4.109	4.533	0.376	4.485
	2	34.4	4.630	4.246	4.684	0.389	4.634
Heavy Duty	3	36.1	4.693	4.303	4.748	0.394	4.698
Gasoline	4	39.0	4.798	4.400	4.854	0.403	4.803
Vehicles	5	42.6	4.929	4.520	4.987	0.414	4.934
LDDV	1	30.3	1.006	0.923	1.006	0.083	1.006
	2	34.4	0.998	0.915	0.998	0.083	0.998
Light Duty	3	36.1	1.003	0.920	1.003	0.083	1.003
Diesel	4	39.0	1.018	0.934	1.018	0.084	1.018
Vehicles	5	42.6	1.057	0.969	1.057	0.088	1.057
LDDT	1	30.3	0.664	0.609	0.664	0.055	0.664
	2	34.4	0.659	0.604	0.659	0.055	0.659
Light Duty	3	36.1	0.663	0.608	0.663	0.055	0.663
Diesel	4	39.0	0.672	0.616	0.672	0.056	0.672
Trucks	5	42.6	0.698	0.640	0.698	0.058	0.698
HDDV	1	30.3	12.407	11.377	12.407	1.030	12.407
	2	34.4	12.331	11.308	12.331	1.023	12.331
Heavy Duty	3	36.1	12.386	11.358	12.386	1.028	12.386
Diesel	4	39.0	12.537	11.496	12.537	1.041	12.537
Vehicles	5	42.6	12.937	11.863	12.937	1.074	12.937
MC	1	30.3	1.140	1.045	1.140	0.095	1.140
	2	34.4	1.170	1.073	1.170	0.097	1.170
Motorcycles	3	36.1	1.190	1.091	1.190	0.099	1.190
	4	39.0	1.200	1.100	1.200	0.100	1.200
	5	42.6	1.220	1.119	1.220	0.101	1.220

Facility Type - Collectors			Pollutant - NOx				
			I/M		No I/M		Net Emission Factor
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	(grams/mile)
LDGV	1	18.2	1.211	1.110	1.355	0.112	1.223
	2	19.1	1.190	1.091	1.332	0.111	1.202
Light Duty	3	24.4	1.096	1.005	1.230	0.102	1.107
Gasoline	4	24.7	1.092	1.001	1.225	0.102	1.103
Vehicles	5	28.2	1.048	0.961	1.178	0.098	1.059
LDGT1	1	18.2	1.399	1.283	1.540	0.128	1.411
	2	19.1	1.380	1.265	1.519	0.126	1.392
Light Duty	3	24.4	1.296	1.188	1.427	0.118	1.307
Gasoline	4	24.7	1.292	1.185	1.423	0.118	1.303
Trucks 1	5	28.2	1.254	1.150	1.382	0.115	1.265
LDGT2	1	18.2	1.733	1.589	1.860	0.154	1.744
	2	19.1	1.710	1.568	1.836	0.152	1.720
Light Duty	3	24.4	1.607	1.474	1.727	0.143	1.617
Gasoline	4	24.7	1.602	1.469	1.722	0.143	1.612
Trucks 2	5	28.2	1.556	1.427	1.672	0.139	1.566
HDGV	1	18.2	4.054	3.718	4.101	0.340	4.058
	2	19.1	4.082	3.743	4.129	0.343	4.086
Heavy Duty	3	24.4	4.270	3.916	4.320	0.359	4.274
Gasoline	4	24.7	4.279	3.924	4.329	0.359	4.283
Vehicles	5	28.2	4.411	4.045	4.462	0.370	4.415
LDDV	1	18.2	1.173	1.076	1.173	0.097	1.173
	2	19.1	1.152	1.056	1.152	0.096	1.152
Light Duty	3	24.4	1.058	0.970	1.058	0.088	1.058
Diesel	4	24.7	1.054	0.967	1.054	0.087	1.054
Vehicles	5	28.2	1.020	0.935	1.020	0.085	1.020
LDDT	1	18.2	0.777	0.713	0.777	0.064	0.777
	2	19.1	0.763	0.700	0.763	0.063	0.763
Light Duty	3	24.4	0.699	0.641	0.699	0.058	0.699
Diesel	4	24.7	0.697	0.639	0.697	0.058	0.697
Trucks	5	28.2	0.674	0.618	0.674	0.056	0.674
HDDV	1	18.2	14.146	12.972	14.146	1.174	14.146
	2	19.1	13.932	12.776	13.932	1.156	13.932
Heavy Duty	3	24.4	12.953	11.878	12.953	1.075	12.953
Diesel	4	24.7	12.910	11.838	12.910	1.072	12.910
Vehicles	5	28.2	12.558	11.516	12.558	1.042	12.558
MC	1	18.2	1.000	0.917	1.000	0.083	1.000
	2	19.1	1.010	0.926	1.010	0.084	1.010
Motorcycles	3	24.4	1.070	0.981	1.070	0.089	1.070
	4	24.7	1.080	0.990	1.080	0.090	1.080
	5	28.2	1.120	1.027	1.120	0.093	1.120

Facility Type - Local			Pollutant - NOx				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	12.9	1.389	1.274	1.547	0.128	1.402
	2	12.9	1.389	1.274	1.547	0.128	1.402
Light Duty	3	12.9	1.389	1.274	1.547	0.128	1.402
Gasoline	4	12.9	1.389	1.274	1.547	0.128	1.402
Vehicles	5	12.9	1.389	1.274	1.547	0.128	1.402
LDGT1	1	12.9	1.563	1.433	1.718	0.143	1.576
	2	12.9	1.563	1.433	1.718	0.143	1.576
Light Duty	3	12.9	1.563	1.433	1.718	0.143	1.576
Gasoline	4	12.9	1.563	1.433	1.718	0.143	1.576
Trucks 1	5	12.9	1.563	1.433	1.718	0.143	1.576
LDGT2	1	12.9	1.930	1.770	2.071	0.172	1.942
	2	12.9	1.930	1.770	2.071	0.172	1.942
Light Duty	3	12.9	1.930	1.770	2.071	0.172	1.942
Gasoline	4	12.9	1.930	1.770	2.071	0.172	1.942
Trucks 2	5	12.9	1.930	1.770	2.071	0.172	1.942
HDGV	1	12.9	3.868	3.547	3.913	0.325	3.872
	2	12.9	3.868	3.547	3.913	0.325	3.872
Heavy Duty	3	12.9	3.868	3.547	3.913	0.325	3.872
Gasoline	4	12.9	3.868	3.547	3.913	0.325	3.872
Vehicles	5	12.9	3.868	3.547	3.913	0.325	3.872
LDDV	1	12.9	1.331	1.221	1.331	0.110	1.331
	2	12.9	1.331	1.221	1.331	0.110	1.331
Light Duty	3	12.9	1.331	1.221	1.331	0.110	1.331
Diesel	4	12.9	1.331	1.221	1.331	0.110	1.331
Vehicles	5	12.9	1.331	1.221	1.331	0.110	1.331
LDDT	1	12.9	0.883	0.810	0.883	0.073	0.883
	2	12.9	0.883	0.810	0.883	0.073	0.883
Light Duty	3	12.9	0.883	0.810	0.883	0.073	0.883
Diesel	4	12.9	0.883	0.810	0.883	0.073	0.883
Trucks	5	12.9	0.883	0.810	0.883	0.073	0.883
HDDV	1	12.9	15.790	14.479	15.790	1.311	15.790
	2	12.9	15.790	14.479	15.790	1.311	15.790
Heavy Duty	3	12.9	15.790	14.479	15.790	1.311	15.790
Diesel	4	12.9	15.790	14.479	15.790	1.311	15.790
Vehicles	5	12.9	15.790	14.479	15.790	1.311	15.790
MC	1	12.9	0.960	0.880	0.960	0.080	0.960
	2	12.9	0.960	0.880	0.960	0.080	0.960
Motorcycles	3	12.9	0.960	0.880	0.960	0.080	0.960
	4	12.9	0.960	0.880	0.960	0.080	0.960
	5	12.9	0.960	0.880	0.960	0.080	0.960

Facility Type - Interstate / Freeway / Expressway			Pollutant - CO				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	59.7	14.510	13.306	18.210	1.511	14.817
	2	60.3	14.600	13.388	18.300	1.519	14.907
Light Duty	3	63.2	14.660	13.443	18.370	1.525	14.968
Gasoline	4	64.8	14.660	13.443	18.370	1.525	14.968
Vehicles	5	64.2	14.660	13.443	18.370	1.525	14.968
LDGT1	1	59.7	17.860	16.378	22.440	1.863	18.240
	2	60.3	17.950	16.460	22.540	1.871	18.331
Light Duty	3	63.2	18.010	16.515	22.610	1.877	18.392
Gasoline	4	64.8	18.010	16.515	22.610	1.877	18.392
Trucks 1	5	64.2	18.010	16.515	22.610	1.877	18.392
LDGT2	1	59.7	20.260	18.578	26.750	2.220	20.799
	2	60.3	20.360	18.670	26.850	2.229	20.899
Light Duty	3	63.2	20.420	18.725	26.920	2.234	20.960
Gasoline	4	64.8	20.420	18.725	26.920	2.234	20.960
Trucks 2	5	64.2	20.420	18.725	26.920	2.234	20.960
HDGV	1	59.7	15.240	13.975	17.520	1.454	15.429
	2	60.3	15.610	14.314	17.950	1.490	15.804
Heavy Duty	3	63.2	15.860	14.544	18.240	1.514	16.058
Gasoline	4	64.8	15.860	14.544	18.240	1.514	16.058
Vehicles	5	64.2	15.860	14.544	18.240	1.514	16.058
LDDV	1	59.7	1.236	1.133	1.236	0.103	1.236
	2	60.3	1.247	1.143	1.247	0.104	1.247
Light Duty	3	63.2	1.254	1.150	1.254	0.104	1.254
Diesel	4	64.8	1.254	1.150	1.254	0.104	1.254
Vehicles	5	64.2	1.254	1.150	1.254	0.104	1.254
LDDT	1	59.7	0.667	0.612	0.667	0.055	0.667
	2	60.3	0.674	0.618	0.674	0.056	0.674
Light Duty	3	63.2	0.678	0.622	0.678	0.056	0.678
Diesel	4	64.8	0.678	0.622	0.678	0.056	0.678
Trucks	5	64.2	0.678	0.622	0.678	0.056	0.678
HDDV	1	59.7	2.493	2.286	2.493	0.207	2.493
	2	60.3	2.533	2.323	2.533	0.210	2.533
Heavy Duty	3	63.2	2.559	2.347	2.559	0.212	2.559
Diesel	4	64.8	2.559	2.347	2.559	0.212	2.559
Vehicles	5	64.2	2.559	2.347	2.559	0.212	2.559
MC	1	59.7	27.060	24.814	27.060	2.246	27.060
	2	60.3	28.260	25.914	28.260	2.346	28.260
Motorcycles	3	63.2	29.050	26.639	29.050	2.411	29.050
	4	64.8	29.050	26.639	29.050	2.411	29.050
	5	64.2	29.050	26.639	29.050	2.411	29.050

Facility Type - Principal Arterials / Minor Arterials			Pollutant - CO				
			I/M		No I/M		Net Emission Factor
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	(grams/mile)
LDGV	1	30.3	10.000	9.170	13.310	1.105	10.275
	2	34.4	10.220	9.372	13.500	1.121	10.492
Light Duty	3	36.1	10.410	9.546	13.700	1.137	10.683
Gasoline	4	39.0	10.790	9.894	14.130	1.173	11.067
Vehicles	5	42.6	11.280	10.344	14.670	1.218	11.561
LDGT1	1	30.3	13.150	12.059	17.470	1.450	13.509
	2	34.4	13.450	12.334	17.730	1.472	13.805
Light Duty	3	36.1	13.670	12.535	17.950	1.490	14.025
Gasoline	4	39.0	14.090	12.921	18.400	1.527	14.448
Trucks 1	5	42.6	14.620	13.407	18.970	1.575	14.981
LDGT2	1	30.3	15.460	14.177	21.780	1.808	15.985
	2	34.4	15.740	14.434	21.980	1.824	16.258
Light Duty	3	36.1	15.960	14.635	22.200	1.843	16.478
Gasoline	4	39.0	16.400	15.039	22.650	1.880	16.919
Trucks 2	5	42.6	16.940	15.534	23.230	1.928	17.462
HDGV	1	30.3	12.830	11.765	14.750	1.224	12.989
	2	34.4	11.510	10.555	13.230	1.098	11.653
Heavy Duty	3	36.1	11.130	10.206	12.800	1.062	11.269
Gasoline	4	39.0	10.640	9.757	12.240	1.016	10.773
Vehicles	5	42.6	10.360	9.500	11.920	0.989	10.489
LDDV	1	30.3	1.289	1.182	1.289	0.107	1.289
	2	34.4	1.210	1.110	1.210	0.100	1.210
Light Duty	3	36.1	1.186	1.088	1.186	0.098	1.186
Diesel	4	39.0	1.153	1.057	1.153	0.096	1.153
Vehicles	5	42.6	1.126	1.033	1.126	0.093	1.126
LDDT	1	30.3	0.701	0.643	0.701	0.058	0.701
	2	34.4	0.650	0.596	0.650	0.054	0.650
Light Duty	3	36.1	0.634	0.581	0.634	0.053	0.634
Diesel	4	39.0	0.612	0.561	0.612	0.051	0.612
Trucks	5	42.6	0.595	0.546	0.595	0.049	0.595
HDDV	1	30.3	2.694	2.470	2.694	0.224	2.694
	2	34.4	2.392	2.193	2.392	0.199	2.392
Heavy Duty	3	36.1	2.300	2.109	2.300	0.191	2.300
Diesel	4	39.0	2.172	1.992	2.172	0.180	2.172
Vehicles	5	42.6	2.072	1.900	2.072	0.172	2.072
MC	1	30.3	16.530	15.158	16.530	1.372	16.530
	2	34.4	14.800	13.572	14.800	1.228	14.800
Motorcycles	3	36.1	14.230	13.049	14.230	1.181	14.230
	4	39.0	13.400	12.288	13.400	1.112	13.400
	5	42.6	12.640	11.591	12.640	1.049	12.640

Facility Type - Collectors			Pollutant - CO				
			I/M		No I/M		Net Emission Factor
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	(grams/mile)
LDGV	1	18.2	10.450	9.583	14.270	1.184	10.767
	2	19.1	10.330	9.473	14.070	1.168	10.640
Light Duty	3	24.4	9.990	9.161	13.460	1.117	10.278
Gasoline	4	24.7	9.980	9.152	13.430	1.115	10.266
Vehicles	5	28.2	9.970	9.142	13.330	1.106	10.249
LDGT1	1	18.2	13.320	12.214	18.170	1.508	13.723
	2	19.1	13.220	12.123	17.990	1.493	13.616
Light Duty	3	24.4	13.020	11.939	17.500	1.453	13.392
Gasoline	4	24.7	13.010	11.930	17.490	1.452	13.382
Trucks 1	5	28.2	13.080	11.994	17.450	1.448	13.443
LDGT2	1	18.2	15.890	14.571	22.930	1.903	16.474
	2	19.1	15.750	14.443	22.690	1.883	16.326
Light Duty	3	24.4	15.420	14.140	21.980	1.824	15.964
Gasoline	4	24.7	15.400	14.122	21.950	1.822	15.944
Trucks 2	5	28.2	15.420	14.140	21.810	1.810	15.950
HDGV	1	18.2	21.940	20.119	25.230	2.094	22.213
	2	19.1	20.870	19.138	24.000	1.992	21.130
Heavy Duty	3	24.4	16.030	14.700	18.430	1.530	16.229
Gasoline	4	24.7	15.820	14.507	18.190	1.510	16.017
Vehicles	5	28.2	13.800	12.655	15.860	1.316	13.971
LDDV	1	18.2	1.776	1.629	1.776	0.147	1.776
	2	19.1	1.722	1.579	1.722	0.143	1.722
Light Duty	3	24.4	1.466	1.344	1.466	0.122	1.466
Diesel	4	24.7	1.455	1.334	1.455	0.121	1.455
Vehicles	5	28.2	1.343	1.232	1.343	0.111	1.343
LDDT	1	18.2	1.020	0.935	1.020	0.085	1.020
	2	19.1	0.984	0.902	0.984	0.082	0.984
Light Duty	3	24.4	0.817	0.749	0.817	0.068	0.817
Diesel	4	24.7	0.810	0.743	0.810	0.067	0.810
Trucks	5	28.2	0.737	0.676	0.737	0.061	0.737
HDDV	1	18.2	4.559	4.181	4.559	0.378	4.559
	2	19.1	4.350	3.989	4.350	0.361	4.350
Heavy Duty	3	24.4	3.373	3.093	3.373	0.280	3.373
Diesel	4	24.7	3.330	3.054	3.330	0.276	3.330
Vehicles	5	28.2	2.900	2.659	2.900	0.241	2.900
MC	1	18.2	25.250	23.154	25.250	2.096	25.250
	2	19.1	24.270	22.256	24.270	2.014	24.270
Motorcycles	3	24.4	19.860	18.212	19.860	1.648	19.860
	4	24.7	19.670	18.037	19.670	1.633	19.670
	5	28.2	17.570	16.112	17.570	1.458	17.570

Facility Type - Local			Pollutant - CO				
			I/M		No I/M		Net Emission
Vehicle Class	Area Type	Speed	EF	0.917*EF	EF	0.083*EF	Factor (grams/mile)
LDGV	1	12.9	11.440	10.490	15.900	1.320	11.810
	2	12.9	11.440	10.490	15.900	1.320	11.810
Light Duty	3	12.9	11.440	10.490	15.900	1.320	11.810
Gasoline	4	12.9	11.440	10.490	15.900	1.320	11.810
Vehicles	5	12.9	11.440	10.490	15.900	1.320	11.810
LDGT1	1	12.9	14.210	13.031	19.690	1.634	14.665
	2	12.9	14.210	13.031	19.690	1.634	14.665
Light Duty	3	12.9	14.210	13.031	19.690	1.634	14.665
Gasoline	4	12.9	14.210	13.031	19.690	1.634	14.665
Trucks 1	5	12.9	14.210	13.031	19.690	1.634	14.665
LDGT2	1	12.9	17.050	15.635	24.940	2.070	17.705
	2	12.9	17.050	15.635	24.940	2.070	17.705
Light Duty	3	12.9	17.050	15.635	24.940	2.070	17.705
Gasoline	4	12.9	17.050	15.635	24.940	2.070	17.705
Trucks 2	5	12.9	17.050	15.635	24.940	2.070	17.705
HDGV	1	12.9	30.480	27.950	35.040	2.908	30.858
	2	12.9	30.480	27.950	35.040	2.908	30.858
Heavy Duty	3	12.9	30.480	27.950	35.040	2.908	30.858
Gasoline	4	12.9	30.480	27.950	35.040	2.908	30.858
Vehicles	5	12.9	30.480	27.950	35.040	2.908	30.858
LDDV	1	12.9	2.205	2.022	2.205	0.183	2.205
	2	12.9	2.205	2.022	2.205	0.183	2.205
Light Duty	3	12.9	2.205	2.022	2.205	0.183	2.205
Diesel	4	12.9	2.205	2.022	2.205	0.183	2.205
Vehicles	5	12.9	2.205	2.022	2.205	0.183	2.205
LDDT	1	12.9	1.300	1.192	1.300	0.108	1.300
	2	12.9	1.300	1.192	1.300	0.108	1.300
Light Duty	3	12.9	1.300	1.192	1.300	0.108	1.300
Diesel	4	12.9	1.300	1.192	1.300	0.108	1.300
Trucks	5	12.9	1.300	1.192	1.300	0.108	1.300
HDDV	1	12.9	6.199	5.684	6.199	0.515	6.199
	2	12.9	6.199	5.684	6.199	0.515	6.199
Heavy Duty	3	12.9	6.199	5.684	6.199	0.515	6.199
Diesel	4	12.9	6.199	5.684	6.199	0.515	6.199
Vehicles	5	12.9	6.199	5.684	6.199	0.515	6.199
MC	1	12.9	34.190	31.352	34.190	2.838	34.190
	2	12.9	34.190	31.352	34.190	2.838	34.190
Motorcycles	3	12.9	34.190	31.352	34.190	2.838	34.190
	4	12.9	34.190	31.352	34.190	2.838	34.190
	5	12.9	34.190	31.352	34.190	2.838	34.190

Appendix 5.3

Vehicle Registration Data

ARIZONA DEPARTMENT OF TRANSPORTATION
MOTOR VEHICLE DIVISION
VEHICLE REGISTRATION REPORT

CTY	YEAR	VEH. YEAR SUBTOTAL	LIGHT DUTY VEH. GAS	LIGHT DUTY VEH. DIESEL	LIGHT DUTY TRUCK GAS TK1	LIGHT DUTY TRUCK GAS TK2	LIGHT DUTY TRUCK DIESEL	HEAVY DUTY VEH. GAS	HEAVY DUTY VEH. DIESEL	BUS	MOTOR-CYCLES	ALTERNATE FUELS	ELECTRIC
MAR	2002	154,688	118,528	550	23,403	2,656	1,873	897	1,739	285	4,181	51	525
MAR	2001	219,424	157,596	704	41,009	4,430	2,912	1,618	2,500	398	5,401	1,991	865
MAR	2000	220,921	158,207	920	35,077	4,101	2,604	4,987	3,873	388	4,676	2,378	3,710
MAR	1999	186,382	139,607	613	27,222	3,562	3,137	2,900	3,484	366	4,076	301	1,114
MAR	1998	161,213	119,108	533	28,187	3,049	815	2,683	2,241	347	2,984	462	804
MAR	1997	159,422	114,701	400	29,582	3,044	1,899	4,041	2,371	297	2,278	85	724
MAR	1996	134,920	100,834	340	23,035	2,714	1,206	1,531	2,272	194	2,036	79	679
MAR	1995	141,098	104,948	302	24,453	2,863	983	2,538	2,521	253	1,609	65	563
MAR	1994	123,265	88,597	252	23,877	2,777	613	2,057	2,987	217	1,329	80	479
MAR	1993	103,522	78,587	197	16,850	2,090	708	1,999	1,144	217	1,234	24	472
MAR	1992	81,364	63,821	226	12,557	1,464	426	567	794	159	849	28	473
MAR	1991	76,462	60,462	222	11,386	1,250	332	477	835	290	604	14	590
MAR	1990	71,905	54,194	159	9,997	1,174	258	427	4,279	203	612	11	591
MAR	1989	70,968	51,532	170	11,739	1,493	208	968	3,705	177	596	18	362
MAR	1988	57,426	42,265	178	8,830	1,227	139	1,998	1,691	169	573	14	342
MAR	1987	47,580	36,597	309	7,512	646	171	396	702	132	640	10	465
MAR	1986	44,981	30,961	274	9,832	928	297	497	662	131	1,036	9	354
MAR	1985	36,356	25,657	410	6,891	793	238	435	569	117	865	17	364
MAR	1984	26,570	18,511	406	5,130	548	258	261	379	97	636	12	332
MAR	1983	16,068	10,546	478	3,200	284	188	131	179	134	684	10	234
MAR	1982	12,257	7,016	434	2,601	331	203	159	168	102	846	6	391
MAR	1981	10,401	5,716	283	2,622	376	94	151	189	53	578	3	336
MAR	1980	8,027	4,424	221	1,714	280	52	190	172	61	508	8	397
MAR	1979	11,507	6,794	179	2,728	497	47	410	156	96	334	8	258
MAR	1978	10,261	5,935	102	2,799	527	30	183	112	71	337	12	153
MAR	1977	80,890	49,945	250	23,480	2,675	148	1,100	276	441	1,816	21	738
TOT	2002	2,267,878	1,655,089	9,112	395,713	45,779	19,839	33,601	40,000	5,395	41,318	5,717	16,315

Appendix 5.4

Minimum and Maximum Temperature Calculations

For the analysis of peak season ozone precursor emissions, the same methodology was used as for previous ozone precursor periodic inventories, using an amalgam of the top ten ozone concentration days in the late 1980s. A memo showing the calculation of the maximum and minimum daily temperature used for the peak ozone season inventory follows.

For the analysis of annual average ozone precursor emissions, each month was analyzed separately with unique temperature data for each month. Average monthly minimum and maximum temperatures for each month of 2002 were obtained from the NOAA Local Climatological Data (LCD) reports for Sky Harbor Airport. Specifically, the average maximum and minimum temperatures for each month, as reported in the LCD reports were averaged by MAG to obtain annual average daily maximum and minimum temperatures, as shown in the table below. A portion of the LCD report for January 2002 also follows.

Month	Daily Max	Daily Min	Number of Days
January	67.1	44.8	31
February	74.8	47.8	28
March	78.1	52.3	31
April	89.2	64.1	30
May	95.2	68.2	31
June	107.3	79.5	30
July	107.2	84.8	31
August	106.2	83.9	31
September	101.4	78.2	30
October	86.2	64.0	31
November	78.5	55.3	30
December	65.0	45.4	31
Annual Average	**88.1**	**64.1**	

ENVIRONMENTAL QUALITY & COMMUNITY SERVICES AGENCY
DIVISION OF AIR POLLUTION CONTROL
2406 South 24th Street, Suite E-214
Phoenix, Arizona 85034

(602) 506-6700
(602) 506-6862 (FAX)

April 21, 1992

Cari Anderson
Maricopa Association of Governments
Transportation & Planning Office
2612 S. 46th St.
Phoenix, AZ 85034

Dear Cari:

Following EPA's interim guidance on temperature determinations, I have calculated the average minimum and maximum temperatures for ozone and carbon monoxide SIP emission inventory calculations. I have also calculated the ambient temperature for ozone should you have to use this factor.

The attached tables show the calculations. Please call if you have any questions.

Sincerely,

Jo Crumbaker, Manager
Planning and Analysis

cc: Gary Neuroth, ADEQ

JC:gl/Anderson.ltr

TABLE 1
CARBON MONOXIDE
SEASON: NOVEMBER - JANUARY
(88-89, 89-90, 90-91)

	DATE	SITE	MAX. CONC.	MAX. TEMP.	MIN. TEMP.
1.	1-01-89	W. Phx	15.3	65	35
2.	1-17-89	W. Phx	12.6	69	40
3.	11-24-88	W. Phx	12.4	63	29
4.	12-14-89	WISR	12.2	68	37
5.	1-12-89	W. Phx	11.9	75	40
6.	11-17-90	WISR	11.6	86	63
7.	1-19-89	W. Phx	11.5	77	44
8.	12-09-89	WISR	11.2	75	47
*	1-01-89	C. Phx	11.2		
9.	11-23-88	W. Phx	11.0	77	49
10.	12-01-88	C. Phx	11.0	77	47
*	12-14-89	W. Phx	11.0		
			Average	73.1 73°F	45.1 45°F

* Value not included in ranking because the associated date was identified with a previous max value.

JC/dg/Table1.CM

TABLE 2

OZONE

SEASON: JULY - SEPTEMBER

	DATE	SITE	MAX. CONC.	MAX. TEMP.	MIN. TEMP.
1.	7-11-90	VEI	.141	107	83
2.	9-06-90	Papago	.141	95	72
*	9-06-90	VEI	.14		
3.	9-09-88	Glendale	.140	108	80
4.	9-13-90	Papago	.138	98	71
*	9-13-90	VEI	.13		
5.	9-08-90	VEI	.13	103	78
6.	9-10-90	Papago	.130	98	78
*	9-10-90	VEI	.13		
*	9-10-90	W. Phx	.127		
*	9-10-90	S. Phx	.126		
*	9-08-90	Papago	.126		
*	9-08-90	Glendale	.126		
*	9-9-88	C. Phx	.125		
7.	7-02-89	VEI	.124	112	83
8.	7-28-90	VEI	.124	111	85
9.	8-4-90	LKPL	.124	109	6
10.	9-11-90	LKPL	.124	98	80
			Average:	103.9°F 104°F	79.7°F 80°

* Value not included in the ranking because the associated date was identified with a previous max value.

Ambient temp = [(2/3) X (Avg. Max. Temp. - Avg. min. Temp)]+avg. min. temp.)
= 2/3 X (104-80) + 80
= 96°F

JC/dg/Table2.OZ

SEP 1988
PHOENIX, AZ
NAT'L WEA SER FCST OFC.
2633 E. BUCKEYE RD.

ISSN 0198-0238

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

SKY HARBOR INTL AIRPORT

LATITUDE 33° 26'N LONGITUDE 112° 01'W ELEVATION (GROUND) 1110 FEET TIME ZONE MOUNTAIN 2315

DATE	TEMPERATURE °F					DEGREE DAYS BASE 65°F		WEATHER TYPES	SNOW, ICE PELLETS OR ICE ON GROUND AT 0500	PRECIPITATION		AVERAGE STATION PRESSURE	WIND (m.p.h.)						SUNSHINE		SKY COVER (TENTHS)	
	MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	HEATING (SEASON BEGINS WITH JULY)	COOLING (SEASON BEGINS WITH JAN)	1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	INCHES	WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	ELEV. 1107 FEET ABOVE M.S.L. (INCHES)	RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	PEAK GUST SPEED	PEAK GUST DIRECTION	FASTEST 1-MIN SPEED	FASTEST 1-MIN DIRECTION	MINUTES	PERCENT OF TOTAL POSSIBLE	SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	105	83	94	6	61	0	29		0	0.00	0.0	28.570	11	4.7	6.3	22	SE	15	14	695	90		2
02	104	84	94	6	60	0	29		0	0.00	0.0	28.660	08	8.2	9.2	20	E	14	11	771	100		0
03	105	85	95*	8	53	0	30		0	0.00	0.0	28.690	08	11.8	12.4	28	SE	17	07	708	92		2
04	101	87	94	7	49	0	29		0	0.00	0.0	28.720	09	11.8	12.8	28	E	21	11	383	50		7
05	100	83	92	5	43	0	27		0	0.00	0.0	28.680	10	10.1	12.0	25	SE	17	05	650	85		4
06	103	76	90	3	45	0	25		0	0.00	0.0	28.650	09	4.8	6.7	18	SE	13	07	742	100		0
07	104	78	91	4	45	0	26		0	0.00	0.0	28.630	13	2.2	6.3	14	NW	12	08	745	98		1
08	104	79	92	5	52	0	27		0	0.00	0.0	28.630	24	1.0	5.6	14	W	10	25	730	94		1
09	108*	80	94	8	53	0	29		0	0.00	0.0	28.580	13	0.5	4.8	14	W	9	27	756	100		0
10	106	82	94	8	52	0	29		0	0.00	0.0	28.530	29	1.3	5.1	17	NW	13	30	550	73		4
11	103	81	92	6	53	0	27		0	0.00	0.0	28.535	18	1.2	7.3	21	SW	14	22	451	60		5
12	98	78	88	-2	45	0	23		0	0.00	0.0	28.520	20	3.3	8.5	20	W	16	27	750	100		1
13	97	71	84	-2	38	0	19		0	0.00	0.0	28.710	21	0.7	6.3	15	NE	9	25	748	100		0
14	96	71	84	-1	38	0	19		0	0.00	0.0	28.705	24	1.2	5.5	18	SW	12	24	746	100		0
15	101	72	87	2	39	0	22		0	0.00	0.0	28.670	11	3.6	5.2	14	E	9	10	744	100		0
16	104	73	89	4	43	0	24		0	0.00	0.0	28.630	09	1.8	5.3	14	E	9	10	742	100		0
17	102	73	88	3	44	0	23		0	0.00	0.0	28.545	25	0.6	5.3	14	NW	9	27	740	100		0
18	99	73	86	2	43	0	21		0	0.00	0.0	28.590	12	0.7	6.2	15	SW	12	22	738	100		0
19	100	72	86	2	42	0	21		0	0.00	0.0	28.620	11	3.4	7.9	15	E	12	09	735	100		0
20	100	73	87	3	47	0	22		0	0.00	0.0	28.550	17	8.9	12.7	30	S	21	20	734	100	1	1
21	87	72	80	-3	53	0	15		0	0.00	0.0	28.700	27	6.0	9.6	23	W	17	25	718	98		1
22	86	64*	75*	-8	41	0	10		0	0.00	0.0	28.785	27	3.3	5.4	18	W	13	27	729	100		0
23	92	66	79	-4	40	0	14		0	0.00	0.0	28.770	10	3.8	5.7	21	NE	10	07	727	100		0
24	96	67	82	0	41	0	17		0	0.00	0.0	28.780	09	2.1	5.7	13	NW	9	31	726	100		0
25	98	70	84	2	49	0	19		0	0.00	0.0	28.810	08	3.2	5.3	15	NE	12	09	723	100		0
26	99	74	87	5	49	0	22		0	0.00	0.0	28.820	13	0.4	4.1	15	W	10	30	706	98		1
27	99	73	86	5	45	0	21		0	0.00	0.0	28.750	26	1.4	5.1	18	W	13	26	719	100		0
28	100	68	84	3	40	0	19		0	0.00	0.0	28.720	24	1.8	5.7	15	W	14	26	667	93		4
29	98	72	85	4	27	0	20		0	0.00	0.0	28.730	09	2.1	6.1	16	NE	10	10	690	97		3
30	99	70	85	5	30	0	20		0	0.00	0.0	28.710	11	0.8	4.4	13	W	10	27	700	98		3

SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS	TOTAL	TOTAL	FOR THE MONTH:								TOTAL	% POSS	SUM
2994	2250				0	678		0.00	0.0	28.670	11	2.0	5.9	30	S	21	20	20983	94	40
AVG.	AVG.	AVG.	DEP.	AVG.	DEP.	DEP.	PRECIPITATION	DEP.						DATE: 20		DATE: 20		PASSIBLE	AVG.	AVG.
99.8	75.0	87.4	2.8	45.3	0	90	≥ .01 INCH 0	-0.64										22284	94	1.3

NUMBER OF DAYS		SEASON TO DATE	
MAXIMUM TEMP.	MINIMUM TEMP.	TOTAL	TOTAL
≥ 90°	≤ 32°	DEP.	DEP.
28	0	0	899
≤ 32°	≤ 0°		
0	0		

SNOW, ICE PELLETS		SEASON TO DATE
≥ 1.0 INCH	0	TOTAL
THUNDERSTORMS	0	4339
HEAVY FOG	0	
CLEAR 25	PARTLY CLOUDY 5	CLOUDY 0

GREATEST IN 24 HOURS AND DATES		
PRECIPITATION	SNOW, ICE PELLETS	
0.00	0.0	

GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
0

PHOENIX, AZ SEP 1988

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER

Kenneth D Hadeen

DIRECTOR
NATIONAL CLIMATIC DATA CENTER

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE

NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

JUL 1989
PHOENIX, AZ
NATL WEA SER FCST OFC
2633 S. BUCKEYE RD.

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

SKY HARBOR INTL AIRPORT

LATITUDE 33° 26 'N LONGITUDE 112° 01 'W ELEVATION (GROUND) 1110 FEET TIME ZONE MOUNTAIN 23183

DATE	TEMPERATURE °F MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F HEATING (SEASON) BEGINS WITH JUL	COOLING (SEASON) BEGINS WITH JAN	WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW, ICE PELLETS OR ICE ON GROUND AT 0500 INCHES	PRECIPITATION WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV. 1107 FEET ABOVE M.S.L.	RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	PEAK GUST SPEED	PEAK GUST DIRECTION	FASTEST 1-MIN SPEED	FASTEST 1-MIN DIRECTION	SUNSHINE MINUTES	SUNSHINE PERCENT OF POSSIBLE	SKY COVER (TENTHS) SUNRISE TO SUNSET	SKY COVER (TENTHS) MIDNIGHT TO MIDNIGHT
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	112	81	97	6	41	0	32		0	0.00	0.0	28.630	30	2.4	5.9	22	NW	12	27	560	100	1	3
02	112	83	98	7	45	0	33		0	0.00	0.0	28.660	29	2.7	4.7	18	NW	13	27	560	100	1	1
03	115	82	99	8	37	0	34		0	0.00	0.0	28.640	24	2.0	5.7	21	W	12	25	559	100	1	1
04	118x	83	101	10	38	0	36		0	0.00	0.0	28.620	24	2.1	6.6	18	SW	14	26	559	100	1	3
05	114	87	101	10	47	0	36		0	0.00	0.0	28.650	26	3.6	8.4	18	W	17	25	356	100	1	0
06	113	88	101	9	53	0	36		0	0.00	0.0	28.680	28	4.1	6.6	17	SW	12	25	335	94	5	2
07	113	91	102	10	54	0	37		0	0.00	0.0	28.730	30	3.9	6.9	17	NW	13	33	357	100	2	2
08	111	90	101	9	55	0	36		0	T	0.0	28.670	29	3.8	8.0	26	E	16	28	538	82	8	8
09	107	84	96	4	56	0	31		0	0.00	0.0	28.630	23	2.2	9.0	25	W	16	27	320	96	4	4
10	105	83	94	2	51	0	29	3	0	T	0.0	28.680	13	4.4	8.4	31	SE	16	14	617	72	7	7
11	100	79	90	-2	60	0	25		0	0.03	0.0	28.780	06	1.5	6.2	17	W	12	29	751	89	5	5
12	109	83	96	4	54	0	31		0	0.00	0.0	28.770	27	1.4	5.5	17	W	13	27	353	100	0	0
13	114	83	99	8	49	0	34		0	0.00	0.0	28.670	25	4.6	5.7	21	W	13	28	851	100	0	0
14	115 *	87	101	8	49	0	36		0	0.00	0.0	28.610	25	4.8	7.9	24	W	15	25	351	100	2	2
15	109	87	98	5	61	0	33		0	0.00	0.0	28.710	28	7.2	9.0	36	W	14	27	525	97	2	6
16	107	88	98	5	58	0	33		0	T	0.0	28.755	29	3.6	5.9	17	W	10	28	755	89	6	6
17	110	88	99	6	56	0	34		0	0.00	0.0	28.700	28	4.1	6.2	20	W	15	27	948	100	2	2
18	115	88	102	9	50	0	37		0	0.00	0.0	28.640	26	5.1	6.4	17	W	15	27	846	100	2	2
19	116	90	103	10	55	0	38		0	0.00	0.0	28.660	13	6.4	10.0	36	NE	23	06	845	100	4	4
20	113	93	103x	10	57	0	38		0	0.00	0.0	28.655	14	2.0	8.7	23	E	14	09	753	91	7	7
21	109	79	94	1	61	0	29	3	0	T	0.0	28.650	26	2.4	9.6	37	SW	21	22	735	87	7	7
22	104	80	92	-1	66	0	27		0	0.03	0.0	28.710	26	3.7	7.4	18	W	14	27	744	91	7	7
23	109	86	98	5	62	0	33		0	T	0.0	28.700	23	4.1	7.2	24	SW	16	24	727	86	6	6
24	111	88	100	7	61	0	35		0	0.00	0.0	28.620	10	1.2	7.2	17	W	14	27	734	87	3	3
25	110	89	100	7	59	0	35		0	T	0.0	28.620	10	7.3	11.3	33	NE	26	06	781	93	3	4
26	108	86	97	4	60	0	32		0	0.00	0.0	28.710	10	6.0	9.1	24	SE	17	14	756	90	5	4
27	105	76	91	-1	61	0	26	3	0	0.03	0.0	28.760	11	4.7	8.9	33	N	17	02	710	85	5	7
28	100	76x	88x	-4	66	0	23		0	0.03	0.0	28.730	10	2.4	5.8	22	NE	14	08	625	75	5	6
29	104	83	94	2	64	0	29		0	0.00	0.0	28.680	35	2.3	6.8	18	W	12	27	803	97	5	6
30	108	86	97	5	62	0	32	3	0	0.01	0.0	28.640	18	1.3	6.1	20	NE	12	06	819	99	2	4
31	108	88	98	6	64	0	33	3	0	0.03	0.0	28.540	11	4.1	7.3	36	W	18	25	648	78	6	6
SUM	3404	2635				0	1013	NUMBER OF DAYS		TOTAL 0.13	TOTAL 0.0	28.680	24	1.0	7.4	37	SW	26	06	TOTAL 24399	% POSSIBLE 82	SUN 12	SUN 1129
AVG.	109.8	85.0	97.4	5.1	55.2	0	167	PRECIPITATION		DEP						DATE:21		DATE: 25				AVG	AVG
								≥ .01 INCH	5	-0.61										25257	93	3.9	4.2

NUMBER OF DAYS MAXIMUM TEMP.	MINIMUM TEMP.	SEASON TO DATE TOTAL	TOTAL	SNOW, ICE PELLETS		GREATEST IN 24 HOURS AND DATES PRECIPITATION	SNOW, ICE PELLETS	GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
≥ 90°	≤ 32°	0	3118	≥ 1.0 INCH	0			
DEP	DEP			THUNDERSTORMS	5			
31	0	0	1038	HEAVY FOG	0	0.06	0.0	0
	≤ 0°			CLEAR 15	PARTLY CLOUDY 15	CLOUDY 0		

x EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
- ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

JUL 1989
PHOENIX, AZ

JUL 1990
PHOENIX, AZ
NAT'L WEA SER FCT OFC NOAA
2611 E. BUCKEYE RD

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

SKY HARBOR INTL AIRPORT

LATITUDE 33° 26 'N LONGITUDE 112° 01 'W ELEVATION (GROUND) 1110 FEET TIME ZONE MOUNTAIN 2300

PHOENIX, AZ

DATE	TEMPERATURE °F MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS (ICE ON GROUND AT 0500) INCHES	PRECIPITATION WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE (IN INCHES ELEV. 1107 FEET ABOVE M.S.L.)	WIND (M.P.H.) RESULTANT DIR	RESULTANT SPEED	AVERAGE SPEED	PEAK GUST SPEED	PEAK GUST DIRECTION	FASTEST 1-MIN SPEED	FASTEST 1-MIN DIRECTION	SUNSHINE MINUTES	SUNSHINE PERCENT OF POSSIBLE	SKY COVER (TENTHS) SUNRISE TO SUNSET	SKY COVER (TENTHS) MIDNIGHT TO MIDNIGHT	DATE
01	115*	90	103*	12	61	0	38	1	0	0.00	0.0	28.600	28	2.0	5.5	32	NE	21	06	758	84	-	6	01
02	106	84	95	4	64	0	30	3	0	0.03	0.0	28.615	21	2.6	8.4	23	E	18	11	775	84	-	7	02
03	105	81	93	2	64	0	28		0	T	0.0	28.640	23	1.1	5.6	26	W	12	27	783	91	-	3	03
04	107	87	97-	6	59	0	32		0	0.00	0.0	28.650	26	7.9	8.5	27	SW	13	26	844	98	-	3	04
05	100	87	94	2	59	0	29		0	0.00	0.0	28.640	09	4.8	5.5	13	E	9	12	559	77	-	8	05
06	98	84	91	-1	56	0	26		0	0.01	0.0	28.650	12	4.4	7.5	27	E	13	11	522	61	-	9	06
07	100	79	90	-2	63	0	25		0	0.03	0.0	28.640	15	3.0	8.1	39	S	25	17	744	87	-	2	07
08	100	78	89	-3	69	0	24		0	T	0.0	28.690	13	5.3	6.4	22	SE	16	15	797	93	-	5	08
09	104	80	92	0	66	0	27		0	0.00	0.0	28.750	15	2.5	5.3	17	W	13	26	740	87	-	5	09
10	106	79	93-	1	67	0	28	3	0	0.27	0.0	28.740	08	1.9	8.6	32	NE	24	06	623	80	-	7	10
11	106	80	93	1	67	0	28	3	0	T	0.0	28.720	25	1.4	5.6	13	N	10	08	703	82	-	7	11
12	112	87	100	8	63	0	35		0	T	0.0	28.740	13	4.7	7.7	26	SE	14	16	700	82	-	8	12
13	110	86	98	5	61	0	33		0	0.00	0.0	28.770	15	2.6	8.0	14	SE	10	35	683	80	-	7	13
14	94	81	88	-5	65	0	23		0	T	0.0	28.680	26	6.1	8.4	17	W	14	28	588	69	-	9	14
15	91	74	83*	-10	69	0	18	3	0	0.01	0.0	28.660	20	3.0	6.3	15	SE	13	17	60	7	-	9	15
16	100	82	91-	-2	69	0	26		0	T	0.0	28.720	17	3.3	6.5	20	E	12	10	430	51	-	5	16
17	104	81	93	0	67	0	28		0	0.00	0.0	28.720	07	0.6	6.2	14	W	9	08	848	100	-	2	17
18	110	87	99	6	65	0	34		0	0.00	0.0	28.630	17	1.7	5.8	15	SW	10	24	846	100	-	0	18
19	112	89	100	7	64	0	35		0	0.00	0.0	28.590	23	2.9	8.9	25	SW	13	27	845	100	-	0	19
20	106	88	97	4	68	0	32		0	0.00	0.0	28.660	24	4.5	9.3	18	W	15	25	815	97	-	3	20
21	105	80	93	0	66	0	28	3	0	0.31	0.0	28.690	27	4.7	9.2	36	W	28	01	827	98	-	1	21
22	107	80	94-	1	64	0	29		0	0.00	0.0	28.670	29	2.1	5.9	23	NW	14	36	788	93	-	3	22
23	104	82	93	0	60	0	28	3	0	0.00	0.0	28.660	14	5.5	6.3	29	E	29	11	817	97	-	4	23
24	97	72*	85	-9	65	0	20	3	0	0.39	0.0	28.660	12	3.9	8.3	43	N	26	15	687	82	-	4	24
25	102	83	93	0	67	0	28		0	0.00	0.0	28.680	20	2.2	7.5	14	SE	10	25	813	97	3	3	25
26	104	84	94	1	61	0	29		0	0.00	0.0	28.720	27	1.5	6.0	18	NW	9	28	837	100	-	0	26
27	107	84	96	4	53	0	31		0	0.00	0.0	28.695	26	2.2	5.1	14	W	9	30	835	100	-	0	27
28	108	81	95-	3	51	0	30		0	0.00	0.0	28.670	27	2.2	5.8	17	W	12	27	833	100	-	0	28
29	111	81	96	4	51	0	31		0	0.00	0.0	28.670	25	2.0	5.6	18	W	12	26	833	100	-	0	29
30	107	87	97	5	55	0	32		0	T	0.0	28.720	12	6.0	9.3	39	E	26	08	814	98	3	2	30
31	106	84	95	3	58	0	30	3	0	T	0.0	28.700	15	3.8	8.5	29	S	21	18	829	100	3	2	31
	SUM	SUM				TOTAL	TOTAL			TOTAL	TOTAL	FOR THE MONTH:								TOTAL	%	SUM	SUM	
	3244	2561				0	895	NUMBER OF DAYS		1.05	0.0	28.680	18	1.5	7.3	43	N	29	11	32675	POSS	11	1132	
	AVG	AVG.	AVG.	DEP	AVG.	DEP	DEP.	PRECIPITATION		DEP								DATE: 24		DATE: 23	POSSIBLE	AVG	AVG.	
	104.5	82.6	93.6	1.3	62.9	0	49	≥ .01 INCH	7	0.31											26367	86	1	5	1 4 3

NUMBER OF DAYS				SEASON TO DATE TOTAL	SEASON TO DATE TOTAL
MAXIMUM TEMP.		MINIMUM TEMP.		0	2793
≥ 90°	≤ 32°	≤ 32°	≤ 0°	DEP.	DEP.
31	0	0	0	0	713

SNOW, ICE PELLETS	
≥ 1.0 INCH	0
THUNDERSTORMS	9
HEAVY FOG	3
CLEAR 15	PARTLY CLOUDY 12 CLOUDY 4

GREATEST IN 24 HOURS AND DATES			
PRECIPITATION		SNOW, ICE PELLETS	
0.39	24	0.0	

GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
0	

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER

Kenneth D Hadeen

DIRECTOR
NATIONAL CLIMATIC DATA CENTER

noaa

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

AUG 1990
PHOENIX, AZ
NATL WEA SER FCI DEC NOAA
2633 E. BUCKEYE RD.

ISSN 0198-0238

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

SKY HARBOR INTL AIRPORT

LATITUDE 33° 26'N LONGITUDE 112° 01'W ELEVATION (GROUND) 1110 FEET TIME ZONE MOUNTAIN 2353

PHOENIX, AZ

DAY	TEMPERATURE °F MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 0900 (INCHES)	PRECIPITATION WATER EQUIVALENT (INCHES)	PRECIPITATION SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE (IN INCHES ELEV 1107 FEET ABOVE M.S.L.)	WIND (M.P.H.) RESULTANT DIR	RESULTANT SPEED	AVERAGE SPEED	PEAK GUST SPEED	PEAK GUST DIRECTION	FASTEST 1-MIN SPEED	FASTEST 1-MIN DIRECTION	SUNSHINE MINUTES	SUNSHINE PERCENT OF TOTAL POSSIBLE	SKY COVER (TENTHS) SUNRISE TO SUNSET	SKY COVER (TENTHS) MIDNIGHT TO MIDNIGHT
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	104	79	92	0	61	0	27		0	T	0.0	28.69	14	4.0	9.5	35	SE	24	14	782	95	2	5
02	102	76	89	-3	63	0	24		0	0.00	0.0	28.74	21	0.5	6.8	15	N	12	14	771	93	2	2
03	105	75	90	-2	62	0	25	3	0	0.33	0.0	28.74	24	1.7	6.1	26	W	18	15	790	96	2	2
04	102	79	91	-1	63	0	26		0	0.00	0.0	28.74	12	2.8	4.8	15	NE	12	05	806	98	2	2
05	108	85	97	6	59	0	32	3	0	T	0.0	28.75	10	6.7	8.2	22	SE	13	06	777	95	2	2
06	105	87	96	5	62	0	31	3	0	0.01	0.0	28.80	11	7.0	8.1	22	E	14	07	442	79	3	3
07	102	81	92	1	62	0	27		0	0.00	0.0	28.79	12	5.5	6.6	18	S	12	16	614	100	3	3
08	108	85	97	6	60	0	32		0	0.00	0.0	28.73	12	4.4	6.6	15	S	12	20	817	100	1	1
09	110	86	98	7	57	0	33		0	0.00	0.0	28.71	13	6.0	7.4	20	SE	14	14	815	100	1	1
10	111*	88	100*	9	56	0	35		0	0.00	0.0	28.72	13	1.1	7.0	16	W	13	25	794	98	1	2
11	105	75	90	-1	56	0	25	3	0	0.38	0.0	28.75	28	5.1	6.7	38	NW	17	32	693	85	7	7
12	98	76	87	-3	64	0	22	3	0	0.05	0.0	28.75	11	2.5	6.6	31	NE	23	06	701	87	9	9
13	94	78	86	-4	64	0	21		0	T	0.0	28.71	09	3.0	6.2	15	E	10	09	523	65	9	9
14	78	71	75*	-15	70	0	10		0	1.20	0.0	28.72	10	4.8	5.6	14	E	10	09	11	1	10	10
15	88	70*	79	-11	69	0	14	3	0	0.73	0.0	28.74	11	3.5	4.9	15	W	8	11	598	74	5	7
16	97	77	87	-3	68	0	22		0	0.00	0.0	28.72	10	2.3	4.3	10	S	7	12	755	94	3	3
17	100	79	90	0	65	0	25		0	0.00	0.0	28.69	19	0.4	4.2	12	SW	8	30	778	97	1	1
18	103	81	92	2	55	0	27		0	0.00	0.0	28.69	10	4.4	5.8	13	SE	9	13	781	98	1	1
19	102	79	91	2	52	0	26		0	0.00	0.0	28.67	15	4.4	8.2	17	S	14	20	764	96	3	3
20	102	82	92	3	47	0	27		0	0.00	0.0	28.71	15	4.5	7.5	18	S	12	18	748	94	2	2
21	102	76	89	0	49	0	24		0	0.00	0.0	28.78	07	1.9	5.4	12	SW	9	06	794	100	0	0
22	104	77	91	2	50	0	26		0	0.00	0.0	28.71	12	1.1	5.4	13	NW	9	30	792	100	0	0
23	105	77	91	2	49	0	26		0	0.00	0.0	28.62	11	4.1	5.9	15	S	9	16	790	100	0	0
24	106	77	92	3	45	0	27		0	0.00	0.0	28.66	12	3.6	7.3	17	S	12	13	788	100	1	1
25	102	75	89	0	44	0	24		0	0.00	0.0	28.72	15	2.3	5.8	18	E	10	15	796	100	1	1
26	102	77	90	1	48	0	25		0	0.00	0.0	28.77	07	3.0	5.4	13	SE	10	09	767	98	2	2
27	102	82	92	4	55	0	27		0	0.00	0.0	28.81	27	6.1	7.0	16	W	9	32	712	91	4	4
28	105	82	94	6	66	0	29		0	0.00	0.0	28.75	26	3.6	6.6	14	W	12	24	781	100	1	1
29	108	86	97	9	63	0	32		0	0.00	0.0	28.70	25	1.7	5.8	24	SE	16	15	778	100	2	2
30	106	85	96	8	61	0	31		0	0.00	0.0	28.68	16	2.1	6.1	18	E	13	09	776	100	5	5
31	96	81	89	1	63	0	24		0	T	0.0	28.70	10	5.0	4.9	16	E	12	09	343	44	7	7
SUM	3163	2464				0	806	NUMBER OF DAYS		2.70	0.0	FOR THE MONTH: 28.725	13	2.2	6.4	38	NW	24	14	22282		55	198
AVG.	102.0	79.5	90.9	0.9	58.8	0	34	PRECIPITATION		DEP.						RATE:	11	DATE:	1	POSSIBLE	24864	AVG	AVG
								≥ .01 INCH	5	1.68											90	1.8	6.4

NUMBER OF DAYS				SEASON TO DATE		SNOW, ICE PELLETS		GREATEST IN 24 HOURS AND DATES		GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
MAXIMUM TEMP		MINIMUM TEMP		TOTAL	TOTAL	≥ 1.0 INCH	0			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	DEP	DEP	THUNDERSTORMS	6	PRECIPITATION	SNOW, ICE PELLETS	
29	0	0	0	-0	747	HEAVY FOG	0	1.90 14-15	0.0	0
						CLEAR 23	PARTLY CLOUDY 4	CLOUDY 4		

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
- ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

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Kenneth D Hadeen
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noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION · NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE · NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

SEP 1990
PHOENIX, AZ
NATL WEA SER FCST OFC NOAA
2633 E. BUCKEYE RD

ISSN 0198-0475

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

SKY HARBOR INTL AIRPORT

LATITUDE 33° 26'N LONGITUDE 112° 01'W ELEVATION (GROUND) 1110 FEET TIME ZONE MOUNTAIN 2393

DAY	TEMPERATURE °F MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F HEATING SEASON BEGINS WITH JUL	COOLING SEASON BEGINS WITH JAN	WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 0500 INCHES	PRECIPITATION WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV. 1107 FEET ABOVE M.S.L.	WIND M.P.H. RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	PEAK GUST SPEED	PEAK GUST DIRECTION	FASTEST 1-MIN SPEED	FASTEST 1-MIN DIRECTION	SUNSHINE MINUTES	SUNSHINE PERCENT OF TOTAL POSSIBLE SUNRISE TO SUNSET	SUNSHINE MIDNIGHT TO MIDNIGHT	SKY COVER TENTHS
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	96	83	90	2	65	0	25		0	T	0.0	28.720	08	4.7	6.8	15	E	13	09	272	35	3	7
02	102	74	88	0	68	0	23		0	0.22	0.0	28.720	20	1.3	4.3	16	SE	9	10	244	47	5	
03	104	75	90	3	69	0	25	3	0	0.03	0.0	28.710	13	1.6	8.0	37	NE	23	05	559	71		
04	100	76	88	1	66	0	23		0	0.00	0.0	28.770	25	2.6	5.0	18	W	13	27	404	79	6	
05	94	74	84	-3	70	0	19	3	0	0.06	0.0	28.820	27	4.5	6.5	13	NW	10	24	555	73		
06	100	79	90	3	68	0	25		0	0.00	0.0	28.730	28	2.7	5.0	14	NW	9	25	763	100	0	
07	105	83	94	7	62	0	29		0	0.00	0.0	28.700	24	1.6	3.5	12	E	8	25	751	100	1	
08	108	84	96	9	63	0	31		0	0.00	0.0	28.660	14	1.1	4.4	12	SW	9	23	758	100	1	
09	110	86	98	12	63	0	33		0	0.00	0.0	28.640	13	1.4	5.4	10	W	8	26	757	100	2	
10	111	84	98	12	61	0	33		0	0.00	0.0	28.630	26	1.5	3.8	9	W	7	26	755	100	*	
11	112*	85	99*	13	56	0	34		0	0.00	0.0	28.630	22	1.2	4.4	10	W	8	26	715	95	1	
12	105	83	94	8	61	0	29		0	0.00	0.0	28.650	24	2.1	5.1	13	W	12	26	751	100	3	
13	105	83	94	8	52	0	29		0	0.00	0.0	28.640	26	2.0	4.0	10	W	9	25	749	100	3	
14	100	70	85	0	64	0	20	3	0	0.30	0.0	28.710	24	3.0	7.8	48	NE	35	05	674	90	3	
15	88	69	79	-6	68	0	14	3	0	0.06	0.0	28.720	36	0.8	4.6	16	NW	8	36	435	53	3	
16	95	73	84	-1	65	0	19		0	0.00	0.0	28.620	15	1.9	4.3	12	W	7	08	711	96	1	
17	98	77	88	3	62	0	23		0	0.00	0.0	28.650	11	4.3	5.7	18	SE	14	14	590	80	5	
18	98	77	88	4	62	0	23		0	0.00	0.0	28.670	10	5.1	6.8	15	E	12	10	428	58	5	
19	97	72	85	1	55	0	20		0	0.00	0.0	28.630	10	3.6	6.9	12	W	10	10	736	100	1	
20	93	67*	80	-4	61	0	15	3	0	0.44	0.0	28.630	06	2.1	5.5	32	SW	13	23	540	74	6	
21	95	72	84	1	63	0	19		0	T	0.0	28.750	14	1.6	4.8	16	W	12	25	651	90	4	
22	95	71	83	0	62	0	18		0	0.00	0.0	28.810	15	1.3	3.5	14	SE	8	15	605	83	6	
23	97	77	87	4	63	0	22		0	0.00	0.0	28.800	10	6.5	6.8	17	E	14	11	648	89	4	
24	96	76	86	4	60	0	21		0	0.00	0.0	28.785	09	4.5	5.6	14	E	12	07	714	98	3	
25	100	76	88	6	57	0	23		0	0.00	0.0	28.770	17	1.4	3.7	12	SE	7	11	680	94	2	
26	99	75	87	5	51	0	22		0	0.00	0.0	28.730	12	1.0	3.6	10	S	7	09	692	96	5	
27	99	72	86	5	48	0	21		0	0.00	0.0	28.635	19	1.5	4.6	12	W	9	27	720	100	4	
28	94	71	83	2	46	0	18		0	0.00	0.0	28.630	12	1.9	5.8	12	W	9	28	718	100	0	
29	93	69	81	0	43	0	16		0	0.00	0.0	28.685	11	3.0	4.0	14	SW	8	09	677	95	1	
30	82	70	76*	-4	51	0	11		0	0.00	0.0	28.790	10	6.5	7.4	24	NE	17	06	197	28	7	

	SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS	TOTAL	TOTAL	FOR THE MONTH:								TOTAL		
	2971	2282				0	683		1.11	0.0	28.700	13	1.2	5.2	48	NE	35	05	19169		
	AVG.	AVG	AVG	DEP.	AVG.	DEP.	DEP.	PRECIPITATION	DEP						DATE:24		DATE:14		POSSIBLE	AVG.	AVG.
	99.0	76.1	87.6	3.0	60.5	0	95	≥ .01 INCH 6	0.47										22284	85	3.3

NUMBER OF DAYS				SEASON TO DATE TOTAL	SEASON TO DATE TOTAL	SNOW, ICE PELLETS ≥ 1.0 INCH 0	GREATEST IN 24 HOURS AND DATES		GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
MAXIMUM TEMP		MINIMUM TEMP		0	4282	THUNDERSTORMS 5	PRECIPITATION	SNOW, ICE PELLETS	
≥ 90°	≤ 32°	≤ 32°	≤ 0°	DEP	DEP.	HEAVY FOG 0	0.44 : 20	0.0	0
29	0	0	0	0	842	CLEAR 16 PARTLY CLOUDY 12 CLOUDY 2			

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
- ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

TORNADO OBSERVED DAY 3.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. COLS 16 & 17: PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED. ONE OF TWO WIND SPEEDS IS GIVEN UNDER COLS 18 & 19: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). ERRORS WILL BE CORRECTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER

Kenneth D. Hadeen
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

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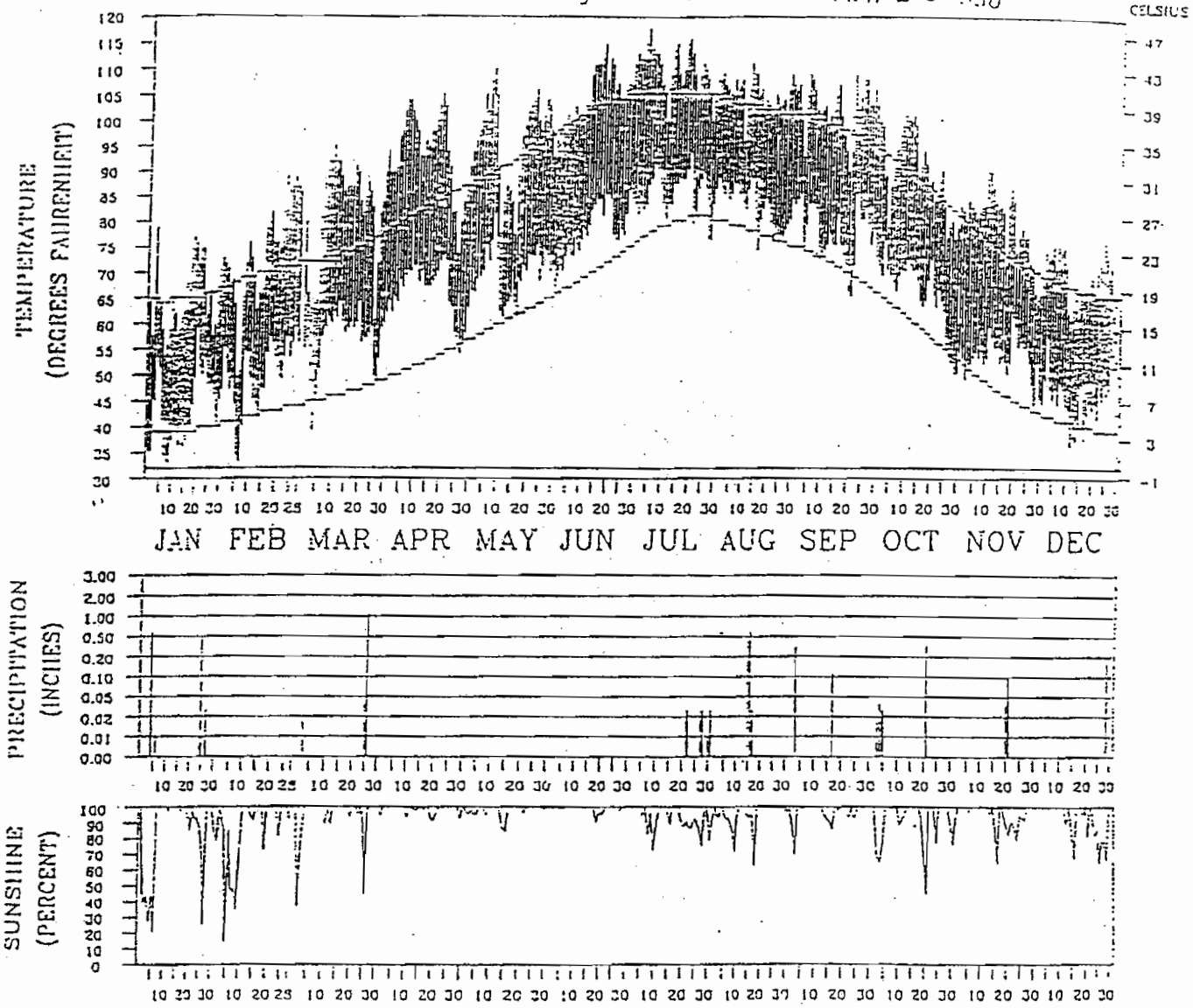
SEP 1990
PHOENIX, AZ

1989 LOCAL CLIMATOLOGICAL DATA
ANNUAL SUMMARY WITH COMPARATIVE DATA

PHOENIX,
ARIZONA

RECEIVED
MAY 2 3 1990

Daily Data



TEMPERATURE DEPICTS NORMAL MAXIMUM, NORMAL MINIMUM AND ACTUAL DAILY HIGH AND LOW VALUES (FAHRENHEIT)
PRECIPITATION IS MEASURED IN INCHES. SCALE IS NON-LINEAR
SUNSHINE IS PERCENT OF THE POSSIBLE SUNSHINE

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

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JANUARY 2002
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

PHOENIX, AZ
SKY HARBOR INTL AIRPORT (PHX)
Lat: 33°26' N Long:111°59' W Elev (Ground): 1103 Feet
Time Zone: MOUNTAIN WBAN: 23183 ISSN #:0198−0475

DATE	TEMPERATURE °F						DEG DAYS BASE 65°		WEATHER	SNOW/ICE ON GND(IN)		PRECIPITATION (INCHES)		PRESSURE (INCHES OF HG)		WIND SPEED = MPH DIR = TENS OF DEGREES							DATE
										0500 LST	1100 LST	2400 LST	2400 LST						MAXIMUM 5−SEC		MAXIMUM 2−MIN		
	MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	HEATING	COOLING		DEPTH	WATER EQUIV	SNOW−FALL	WATER EQUIV	AVERAGE STATION	AVERAGE SEA LEVEL	RESULTANT SPEED	RES DIR	AVERAGE SPEED	SPEED	DIR	SPEED	DIR	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	67	44	56	3	38	47	9	0					0.00	28.91	30.08	1.8	10	4.1	16	05	14	06	01
02	65	50	58	5	29	45	7	0					0.00	28.95	30.11	9.4	07	9.6	22	06	18	06	02
03	66	47	57	4	32	46	8	0					0.00	28.89	30.05	1.6	07	4.7	17	08	15	08	03
04	67	44	56	3	35	46	9	0					0.00	28.94	30.10	1.4	24	5.2	17	26	15	26	04
05	65	41	53	0	26	42	12	0					0.00	29.14	30.32	0.8	22	3.1	15	07	10	06	05
06	67	41	54	1	25	41	11	0					0.00	29.12	30.29	1.0	12	3.2	9	30	9	10	06
07	72	44	58	5	32	45	7	0					0.00	29.06	30.23	2.1	09	3.4	9	30	9	08	07
08	81*	47	64	11	37	50	1	0					0.00	28.90	30.05	2.1	10	2.7	10	09	9	08	08
09	72	53	63	10	38	50	2	0					0.00	28.79	29.94	3.8	11	5.5	13	14	10	10	09
10	74	55	65*	12	40	51	0	0	RA				T	28.85	30.00	1.6	06	6.1	37*	05	31*	05	10
11	76	50	63	10	32	48	2	0					0.00	29.03	30.19	4.3	06	6.3	23	05	20	05	11
12	74	47	61	8	32	47	4	0					0.00	28.98	30.14	2.1	11	3.2	13	12	13	07	12
13	71	44	58	5	31	45	7	0					0.00	28.78	29.94	2.9	10	4.6	12	10	9	09	13
14	73	45	59	5	29	45	6	0					0.00	28.76	29.92	3.6	11	5.1	14	08	13	09	14
15	69	49	59	5	31	45	6	0					0.00	28.74	29.90	3.7	09	5.3	13	08	12	08	15
16	64	53	59	5	42	50	6	0					0.00	28.82	29.98	1.5	28	4.6	18	30	16	31	16
17	62	45	54	0	29	42	11	0					0.00	28.91	30.07	2.1	25	3.5	10	01	8	22	17
18	63	39	51	-3	25	40	14	0	HZ				0.00	28.95	30.12	1.7	14	4.3	15	27	13	28	18
19	62	39	51	-3	16	37	14	0					0.00	28.90	30.07	2.4	09	3.5	16	08	15	07	19
20	61	36	49	-5	17	37	16	0					0.00	28.90	30.08	0.9	10	3.4	10	32	8	26	20
21	67	38	53	-1	18	38	12	0					0.00	28.86	30.03	2.2	10	4.7	14	09	14	09	21
22	67	40	54	-1	21	40	11	0					0.00	28.73	29.90	3.3	09	5.8	16	10	14	09	22
23	61	49	55	-1	22	41	10	0					0.00	28.79	29.95	5.5	27	9.1	24	28	21	26	23
24	64	38	51	-5	9	36	14	0					0.00	29.10	30.28	2.3	35	5.9	20	02	16	07	24
25	72	41	57	1	17	41	8	0					0.00	28.99	30.16	4.9	09	5.8	23	07	21	06	25
26	75	43	59	3	24	44	6	0					0.00	28.83	29.98	3.8	11	4.7	13	17	10	18	26
27	68	47	58	2	31	46	7	0					0.00	28.77	29.92	3.1	09	4.5	16	36	12	09	27
28	65	52	59	3	32	46	6	0					0.00	28.76	29.91	0.4	28	5.3	18	29	16	29	28
29	60	50	55	-1	28	43	10	0					0.00	28.74	29.90	5.0	27	6.2	18	27	16	27	29
30	54	42	48	-8	31	40	17	0	TSRA RA				0.05	28.79	29.96	6.5	29	9.2	25	29	22	28	30
31	55	36*	46*	-10	26	38	19	0					0.00	29.08	30.27	2.4	09	4.3	16	09	12	09	31
	67.1	44.8	56.0		28.2	43.6	8.8	0.0	< MONTHLY AVERAGES	TOTALS−>			0.05	28.90	30.06	1.3	09	5.1	<− MONTHLY AVERAGES				
	2.1	1.4	1.8		<−−−−−−−−−−−−−DEPARTURE FROM NORMAL−−−−−−−−−−−−−>								-.78	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING:	272	−32	681	−56
COOLING:	0	−2	0	−2

GREATEST 24−HR PRECIPITATION: 0.05 DATE :30
GREATEST 24−HR SNOWFALL: DATE :
GREATEST SNOW DEPTH: DATE :

	SEA LEVEL PRESSURE	DATE	TIME
MAXIMUM	30.40	05	0956
MINIMUM	29.82	22	1656

NUMBER OF DAYS WITH →

MAXIMUM TEMP ≥ 90:	0	MINIMUM TEMP ≤ 32 :	0
MAXIMUM TEMP ≤ 32 :	0	MINIMUM TEMP ≤ 0 :	0
THUNDERSTORMS :	1	HEAVY FOG :	0

PRECIPITATION ≥ 0.01 INCH :	1
PRECIPITATION ≥ 0.10 INCH :	0
SNOWFALL ≥ 1.0 INCH :	

Appendix 5.5

VMT Reasonableness Calculations

Vehicle miles traveled (VMT) per gallon of gasoline consumed was calculated to check the reasonableness of the VMT numbers used in compiling the onroad portion of the 2002 Periodic Inventory. The following calculations were made to arrive at the VMT per gallon of gasoline consumed in the Maricopa County nonattainment area in 2002. The answer of 18.16 miles per gallon (mpg) falls within the acceptable range listed in the Appendix B Level II Quality Review Checklist of the Quality Review Guidelines for 1990 Base Year Emission Inventories, July 1992 of 14.6 and 24.4 mpg.

The Arizona Department of Transportation estimated that 1.459×10^9 gallons of gasoline were sold in Maricopa County in 2002. Annual Average Daily VMT (AADVMT) of the county is previously estimated in this report as 73.579×10^6 VMT (See Table 5-1(b), page 6).

Annual VMT = AADVMT × 365 days/year = 265.11×10^8 VMT.

VMT per gallon of gasoline consumed = 26.511×10^9 VMT / 1.459×10^9 gallons of gasoline = 18.40 miles per gallon.

The estimate miles per gallon consumed in the 1999 periodic inventory was 15.84 miles per gallon. Both estimates are well within the acceptable range listed in the quality review checklist.

Appendix 5.6

FORTRAN Source Code for Emission Factor Weighting Program

```
      Program NEIProgram
* This program reads in the monthly MOBILE6 output files, both I/M
* and non-I/M and averages all of the results together into
* an annual average set of emission factors.
*
* There will be 24 runs, two for each month.
*
      character*15 filename(12,2)
      character*130 line1
      character*3 month(12),IM(2),poll(3),scen(16)
      real*8 ef(12,2,3,16,10),efmerg(3,16,10)

      data ef / 11520*0.0 /
      data efmerg / 480*0.0 /

      data filename /'IMJAN02.TXT',
     +              'IMFEB02.TXT',
     +              'IMMAR02.TXT',
     +              'IMAPR02.TXT',
     +              'IMMAY02.TXT',
     +              'IMJUN02.TXT',
     +              'IMJUL02.TXT',
     +              'IMAUG02.TXT',
     +              'IMSEP02.TXT',
     +              'IMOCT02.TXT',
     +              'IMNOV02.TXT',
     +              'IMDEC02.TXT',
     +              'NIMJAN02.TXT',
     +              'NIMFEB02.TXT',
     +              'NIMMAR02.TXT',
     +              'NIMAPR02.TXT',
     +              'NIMMAY02.TXT',
     +              'NIMJUN02.TXT',
     +              'NIMJUL02.TXT',
     +              'NIMAUG02.TXT',
     +              'NIMSEP02.TXT',
     +              'NIMOCT02.TXT',
     +              'NIMNOV02.TXT',
     +              'NIMDEC02.TXT' /
      data month /'Jan','Feb','Mar','Apr','May','Jun',
     +           'Jul','Aug','Sep','Oct','Nov','Dec'/
      data IM /'IM ','NIM'/
      data poll /'VOC','CO ','NOx'/
      data scen /'F-1','F-2','F-3','F-4','F-5',
     +           'A-1','A-2','A-3','A-4','A-5',
     +           'C-1','C-2','C-3','C-4','C-5','L-A'/

      ipoll=0
      iscen=1
      do 100 i12=1,12
        do 110 i2=1,2
  open(unit=20,file=filename(i12,i2),status='old')
          do 120 i10000=1,10000
            read(20,99,end=121) line1
            if(line1(6:14).eq.'Composite') then
c             write(*,*) line1
              ipoll=ipoll+1
```

```
          if(ipoll.gt.3) then
       ipoll=1
            iscen=iscen+1
          endif
          if(iscen.gt.16) iscen=1
          read(line1,97,err=120)
     +     ef(i12,i2,ipoll,iscen,1),
     +     ef(i12,i2,ipoll,iscen,2),
     +     ef(i12,i2,ipoll,iscen,3),
     +     ef(i12,i2,ipoll,iscen,4),
     +     ef(i12,i2,ipoll,iscen,5),
     +     ef(i12,i2,ipoll,iscen,6),
     +     ef(i12,i2,ipoll,iscen,7),
     +     ef(i12,i2,ipoll,iscen,8),
     +     ef(i12,i2,ipoll,iscen,9),
     +     ef(i12,i2,ipoll,iscen,10)
        endif
120     continue
121     close(20)
110   continue
100  continue
      do 210 it3=1,3
       do 220 it4=1,16
        do 230 it5=1,10
         efmerg(it3,it4,it5) =  (
     +   ef(1,1,it3,it4,it5)*0.98*31./365.*.917 +
     +   ef(2,1,it3,it4,it5)*1.03*28./365.*.917 +
     +   ef(3,1,it3,it4,it5)*1.03*31./365.*.917 +
     +   ef(4,1,it3,it4,it5)*1.03*30./365.*.917 +
     +   ef(5,1,it3,it4,it5)*0.99*31./365.*.917 +
     +   ef(6,1,it3,it4,it5)*0.98*30./365.*.917 +
     +   ef(7,1,it3,it4,it5)*0.94*31./365.*.917 +
     +   ef(8,1,it3,it4,it5)*0.96*31./365.*.917 +
     +   ef(9,1,it3,it4,it5)*0.99*30./365.*.917 +
     +   ef(10,1,it3,it4,it5)*1.02*31./365.*.917 +
     +   ef(11,1,it3,it4,it5)*1.02*30./365.*.917 +
     +   ef(12,1,it3,it4,it5)*1.04*31./365.*.917 +
     +   ef(1,1,it3,it4,it5)*0.98*31./365.*.083 +
     +   ef(2,1,it3,it4,it5)*1.03*28./365.*.083 +
     +   ef(3,1,it3,it4,it5)*1.03*31./365.*.083 +
     +   ef(4,1,it3,it4,it5)*1.03*30./365.*.083 +
     +   ef(5,1,it3,it4,it5)*0.99*31./365.*.083 +
     +   ef(6,1,it3,it4,it5)*0.98*30./365.*.083 +
     +   ef(7,1,it3,it4,it5)*0.94*31./365.*.083 +
     +   ef(8,1,it3,it4,it5)*0.96*31./365.*.083 +
     +   ef(9,1,it3,it4,it5)*0.99*30./365.*.083 +
     +   ef(10,1,it3,it4,it5)*1.02*31./365.*.083 +
     +   ef(11,1,it3,it4,it5)*1.02*30./365.*.083 +
     +   ef(12,1,it3,it4,it5)*1.04*31./365.*.083)

230     continue
220    continue
210   continue
     do 300 iscen=1,16
      write(*,*) '  '
      do 310 ipoll=1,3
        write(*,96) (efmerg(ipoll,iscen,it5),it5=1,10)
```

```
     +            , poll(ipoll), scen(iscen)
310    continue
300   continue
97    format(20x,f11.0,4(f10.0),f9.0,4(f10.0))
98    format(f11.4,4(f10.4),f9.4,4(f10.4),4(a5))
96    format(f11.4,4(f10.4),f9.4,4(f10.4),2(a5))
99    format(a130)
      stop
      end
```

Appendix 5.7

Monthly Gasoline Data

Gasoline quality data for each month of the year was obtained from the Arizona Department of Weights and Measures. The fuel quality for each month is shown below. Oxygenate data for the months January through March were not provided, so the similar carbon monoxide season months November and December were averaged and this oxygenate settings were used for January through March.

Month	RVP	Sulfur content	MTBE Market Share	Ethanol Market Share	MTBE %Weight	Ethanol % Weight
January	9.0	26.2	0%	100%	0	3.1
February	8.9	33.9	0%	100%	0	3.1
March	8.9	39.6	0%	100%	0	3.1
April	7.5	50.2	100%	0%	1.5	0
May	7.0	42.1	100%	0%	1.7	0
June	6.6	69.1	100%	0%	1.8	0
July	6.6	88.9	100%	0%	1.8	0
August	6.5	71.5	100%	0%	1.9	0
September	6.6	67.3	100%	0%	2.0	0
October	8.0	64.3	40%	60%	1.4	3.2
November	8.4	48.9	0%	100%	0	3.0
December	8.7	42.0	0%	100%	0	3.2
Annual Average*	7.8	52.5	50%	50%	1.9	3.1

* Note that the annual average may not equal the average of the twelve constituent months because the annual average weights were calculated as the average of the 793 gasoline samples collected in 2002 rather than an averaging of the average values for each of the twelve months. Additionally, the MTBE % by weight reflects the percent by weight in samples with MTBE present. Similarly, the ethanol percent by weight reflects the percent by weight in samples with ethanol present. As an example, the fuel samples for November and December would not effect the MTBE percent by weight because the fuel samples for that month did not include MTBE. The MTBE percent by weight only reflects the averages of the samples that contained MTBE.

EIGHT-HOUR OZONE PLAN
FOR THE MARICOPA NONATTAINMENT AREA

APPENDIX A

EXHIBIT 2

TECHNICAL SUPPORT DOCUMENT FOR OZONE MODELING IN SUPPORT OF THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

TECHNICAL SUPPORT DOCUMENT

FOR

OZONE MODELING IN SUPPORT OF THE EIGHT-HOUR OZONE PLAN FOR THE MARICOPA NONATTAINMENT AREA

JUNE 2007

Maricopa Association of Governments
302 North 1st Avenue, Suite 300
Phoenix, Arizona 85003

MAG Contact Person:
Taejoo Shin, (602) 254-6300

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I. INTRODUCTION

The Maricopa Eight-hour Ozone Nonattainment Area is currently classified as a Basic nonattainment area, by operation of law, effective June 15, 2004. The area is required to meet the NAAQS as expeditiously as practicable, but no later than the deadlines set forth in the Clean Air Act Amendments (CAAA). The attainment date specified by the CAAA for Basic Eight-hour Ozone Nonattainment areas is June 15, 2009.

As the designated Regional Air Quality Planning Agency, the Maricopa Association of Governments (MAG) conducts the modeling for emissions and air quality concentrations and prepares the air quality plans including attainment demonstrations. This Technical Support Document summarizes the analyses of the ground level eight-hour ozone concentrations for an area encompassing the Maricopa Eight-hour Ozone Nonattainment Area (MNA).

The air quality analyses in support of the Eight-hour Ozone Attainment Plan were conducted based on the computer simulations using the Comprehensive Air Quality Model with eXtensions Version 4.40 (CAMx). The CAMx modeling analyses included: (1) preparation of a modeling protocol, (2) preparation of modeling emission inventories, (3) preparation of meteorological and air quality inputs for CAMx, (4) application of CAMx and diagnostic analysis of the model inputs, (5) evaluation of model performance, and (6) an attainment demonstration of the eight-hour ozone standard. The modeling analysis and attainment demonstration have focused on the June 3-7, 2002 episode. Two other episodes (July 8-14, 2002 and August 5-11, 2001) for which supplementary meteorological and air quality data were available, were also simulated, but the June 2002 episode proved to be the superior validation, as described later. The ozone season of 2008 was determined to be appropriate for demonstrating the attainment of the eight-hour ozone standard.

I-1. Background

In accordance with the 1990 Clean Air Act Amendments (CAAA), the Maricopa County Nonattainment Area was initially classified as Moderate for one-hour ozone pollution. Since the area did not achieve the National Ambient Air Quality Standards (NAAQS) for one-hour ozone by the required deadline of November 19, 1996, the one-hour ozone nonattainment area was subsequently reclassified to Serious, effective February 13, 1998. The deadline for Serious areas to attain the one-hour ozone standard was November 19, 1999. There have been no exceedances of the one-hour ozone standard in the nonattainment area since 1996.

The Maricopa Association of Governments (MAG) prepared the One-hour Ozone Redesignation Request and Maintenance Plan which was submitted to EPA in 2004 [1]. EPA subsequently redesignated the Maricopa County one-hour ozone nonattainment area to attainment, effective June 14, 2005; EPA revoked the one-hour ozone standard on June 15, 2005.

On April 30, 2004, EPA published the final rule designating eight-hour ozone nonattainment areas, effective June 15, 2004. A 5,000 square mile area located mainly in Maricopa County and Apache Junction in Pinal County was designated as a nonattainment area for eight-hour ozone. The Maricopa Eight-hour Ozone Nonattainment Area is classified as "Basic" under Part D, Subpart I, of the Clean Air Act, with an attainment date of June 15, 2009.

As the designated Regional Air Quality Planning Agency, MAG conducts modeling of emissions and pollutant concentrations and prepares the air quality plans necessary for attainment and maintenance demonstrations in the Maricopa nonattainment area. This technical support document is developed to detail and formalize procedures for conducting all phases of the modeling for the eight-hour ozone attainment demonstration.

The primary requirement of the ozone attainment plan is a demonstration that the eight-hour ozone standard can be attained by June 15, 2009. EPA requires that all control measures necessary to demonstrate attainment be implemented prior to the start of the ozone season preceding the attainment year [2]. To satisfy this requirement, MAG modeled attainment of the eight-hour ozone standard during the 2008 ozone season.

A secondary objective of the modeling was to evaluate the complex chemical relationships between precursor emissions of volatile organic compounds and nitrogen oxides and the formation of ozone. This evaluation has concluded that additional reductions in NOx emissions do not contribute to attainment of the eight-hour ozone standard in 2008.

I-2. Overview of Study

The main objective of the modeling analysis is to estimate the effects of growth and emission reduction strategies on the future eight-hour ozone air quality in the nonattainment area. The results of the modeling analysis are intended to provide a quantitative assessment of the potential for compliance with the federal ozone standard and, thus, the basis for the development of the Attainment Plan.

A protocol document was developed to detail the technical approach used to demonstrate attainment of the ambient air quality standards for ozone in the Maricopa County area. The Protocol contains the information recommended in the EPA Guidelines [3]. The modeling work documented in the Technical Support Document (this document) follows the modeling details outlined in the Protocol.

The Comprehensive Air Quality Model with eXtensions Version 4.40 (CAMx) was employed to simulate the eight-hour ozone concentrations in the study area. The meteorological input fields for CAMx were generated using the Pennsylvania State University/National Center for Atmosphere Research (PSU/NCAR) Fifth Generation Mesoscale Model (MM5). The CAMx Emissions Preprocessor System (EPS3.0) [4] was used to process the emissions inventories. The onroad mobile emissions were generated by the EPA MOBILE6.2 model [5] and M6Link. M6Link is a MAG software program applied at the transportation link level to generate gridded mobile source emissions for input to

CAMx. The EPA NONROAD 2005 model [6] was used to generate nonroad emissions for the eight-hour ozone modeling.

Because CAMx accounts for spatial and temporal variations, it is well suited for evaluating the effects of emission control strategies on urban air quality. An evaluation of the performance of CAMx in modeling eight-hour ozone in the Maricopa nonattainment area was accomplished by replicating three different ozone episodes within the EPA prescribed statistical criteria. The June 3-7, 2002, July 8-14, 2002, and August 5-11, 2001 episodes were selected according to the procedures described in the Protocol document,provided in Appendix I.

Once the model results had been evaluated and the model had performed within the prescribed criteria, the emissions inventory was modified to represent ozone emissions in the attainment year of 2008, with committed control measures. The model was then exercised using the 2008 emission inventories. The resulting ozone concentrations were used to evaluate attainment of the eight-hour ozone standard.

The CAMx modeling analysis consisted of the following tasks:

(1) Preparation of a modeling protocol (including selection of the modeling domain and simulation periods)

(2) Preparation of day-specific CAMx modeling emission inventories

(3) Preparation of meteorological and air quality inputs for CAMx

(4) Application of CAMx and diagnostic analysis of the model inputs

(5) Evaluation of model performance

(6) Preparation of future year CAMx modeling emission inventories

(7) Completion of the attainment demonstration

(8) Completion of the Technical Support Document (this document)

Unless otherwise noted, all of the hour-long periods of time mentioned in this document are referred to by the beginning hour of the one hour period (e.g. "@ 1200 LST" means hour beginning at 1200 LST).

I-3. Data Access Procedure

All of the modeling data files are saved in a DVD data disk. A summary of the computer files used for the air quality modeling in support of the Eight-hour Ozone Attainment Plan is contained in Appendix I-ii. The file and model descriptions are grouped by computer program or model and are presented in logical order from emission rate estimates through the final output from UAM. As a result, the file summary also provides a sequential outline of the overall air quality modeling chain.

A comprehensive list of the names of the DVD files follows the job file lists and description. The comprehensive file list is not generally presented in the order in which the named files were employed. Rather, the comprehensive list is ordered alphabetically by subdirectory name.

For clarity, the job file lists indicate the names of the job control files which were used to run each program. Each job control file is the executable file which was used to run the particular air quality model or program for a particular day or scenario. Note that some air quality models were not run by job file (i.e. MOBILE6) and, therefore, no job files are listed. Also, some air quality models have very simple job files (i.e. M6Link) whose purpose is calling a larger control file. Since these job files are very simple, only a sample job file was provided. These sample job files may be changed easily to call a different control file. All input and output files are organized on a data media by program or model in separate subdirectories.

Files have been placed in the DVD directory structure by model or program. It is important to note that the directory structure on the DVD is not identical to the directory structure on the MAG computers. As a result, job files, while calling the correctly named input and output files, may not search for those files in the correct directories as they appear on the DVD data disk. Editing or moving files may be necessary to reproduce MAG runs using job files found on the DVD disk.

I-4. Structure of the Document

Section II of this Technical Support Document describes the modeling domain and episode selection. Section III details the input preparation for running CAMx for the historical ozone episodes. Section IV illustrates the base case simulation results and performance evaluation along with diagnostic and sensitivity analyses. Section V presents the modeling details for attainment demonstration.

Each appendix is numbered so as to be consistent with the section that refers to that appendix.

REFERENCES

1. Maricopa Association of Governments (March 2004) "One-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area".

2. Tesche, T.W., Georgopoulos, P., Lurmann, F.L., and Roth, P.M. (1990) "Improvement of Procedures for Evaluating Photochemical Models, Draft Final Report". California Air Resources Board, Sacramento, CA.

3. U.S. Environmental Protection Agency (October 2005b) "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS". EPA-454/R-05-002. Emissions, Monitoring, and Analysis Division, Office of Air Quality Planning and Standards.

4. ENVIRON (August 2005), User's Guide Emission Preprocessor Systems 3.0, 2005

5. US EPA, 2003. User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010, August 2003.

6. http://www.epa.gov/otag/nonrdmdl.htm#model

II. DOMAIN AND DATA BASE ISSUES

II-1. Modeling Domain

Selection of the modeling domain took into account the distribution of major emissions sources, the locations of the meteorological and air quality monitoring sites, and the prevailing winds associated with ozone episodes. The nested UTM grid system being used for both MM5 and CAMx was suggested by ENVIRON [1]. An evaluation of 36-hour back-trajectory air flow patterns concluded that a simpler two-grid (12/4 km) configuration would be sufficient for the CAMx air quality simulations to capture transport characteristics for the selected ozone episodes [2]. The MM5 meteorological model utilized a full 36/12/4 km nested grid system covering CAMx domains for each grid resolution. A map of the CAMx/MM5 modeling domains for this application is presented in Figure II-1. The shaded area represents the EPA-designated nonattainment area for eight-hour ozone. The inner CAMx modeling domain consists of 50 grid cells in the west-east direction and 29 grid cells in the south-north direction, with a horizontal grid spacing of four kilometers. The origin, which is the southwest corner of the domain, is at 297 km easting and 3652 km northing in UTM zone 12. The inner modeling domain has an area of 200 km by 116 km, or approximately 9,000 square miles.

II-2. Horizontal Grid Resolution

The horizontal grid resolutions applied to the CAMx/MM5 modeling domains are 4 km by 4 km, 12 km by 12 km, and 36 km by 36 km. A regional domain (36 km grid) was eliminated from the CAMx modeling domains as a result of the evaluation of 36-hour back-trajectory mentioned above. The 4 km grid spacing should allow sufficient resolution of the major emissions sources in the Maricopa Eight-hour Ozone Nonattainment Area (MNA).

II-3. Number of Vertical Layers

The numbers of layers in the vertical direction used in the CAMx simulations were twenty (fifteen layers within the PBL and five layers above the PBL) and twenty-three (fifteen layers within the PBL and eight layers above the PBL) for 12 km and 4 km grids, respectively. The top of the modeling domain is set at about 15,000 meters. This vertical structure is consistent with the MM5 meteorological modeling being performed by ENVIRON for the Western Regional Air Partnership (WRAP) and exceeds the minimum standards recommended by EPA guidance [3].

II-4. Aerometric Data Bases

Meteorological and air quality data used for the CAMx modeling applications were collected from all available valid monitoring sites in or around the MNA. The Arizona Department of Environmental Quality (ADEQ) and the Maricopa County Air Quality Department (MCAQD) maintain networks collecting both air quality and meteorological data.

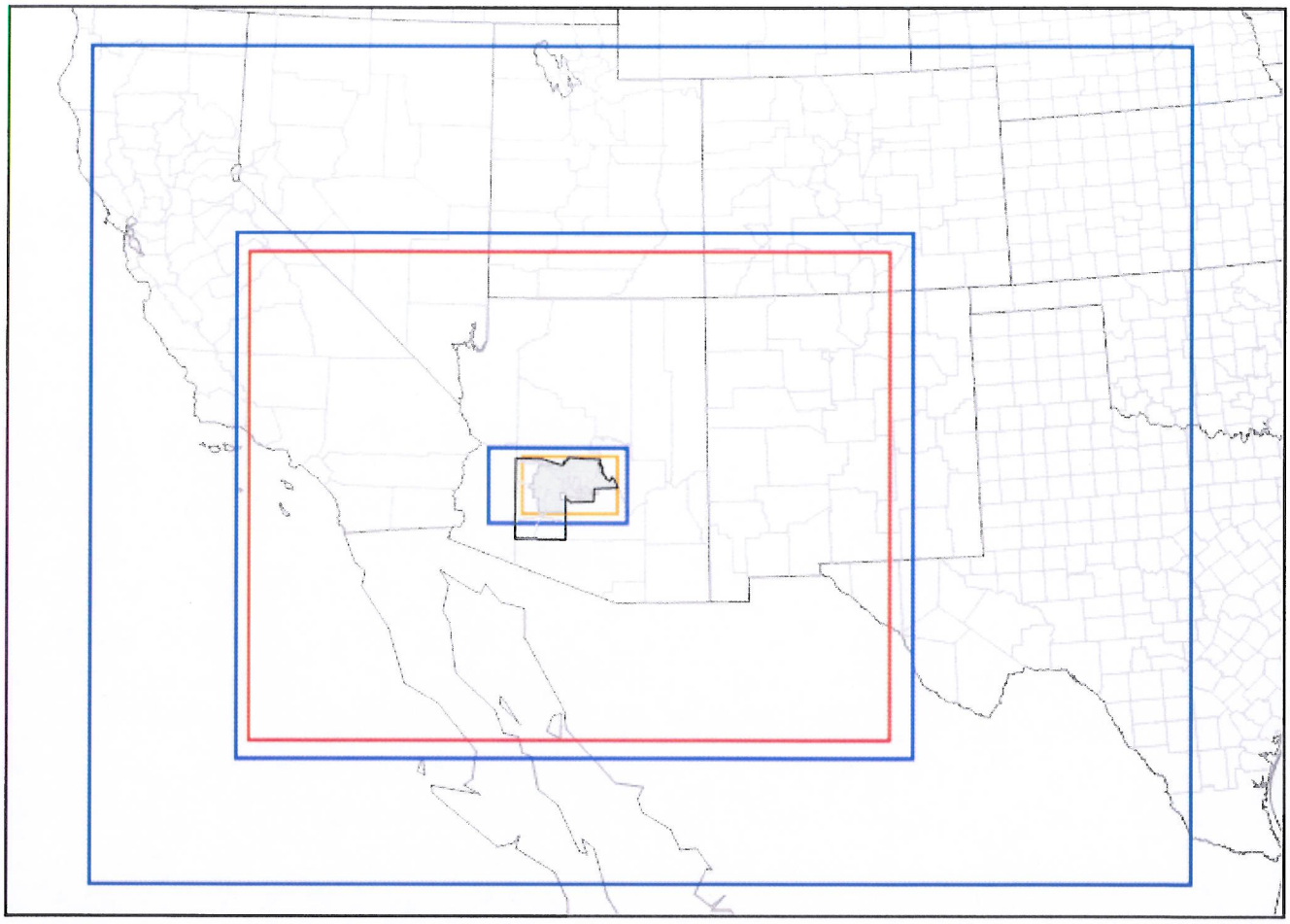

Figure II-1. The eight-hour ozone modeling domain (red: 12 km and yellow: 4 km) overlapping with meteorological modeling domain (blue: 36 / 12 / 4 km).

The location of the ozone monitoring sites located in the inner CAMx modeling domain is listed in Table II-1 and illustrated in Figure II-2. Additional meteorological data were collected from other monitoring networks including the AriZona METeorological network (AZMET), the National Weather Service (NWS), and the Forecast Systems Laboratory (FSL). Two networks (AZMET and NWS) provide surface observations and the FSL provides upper air data. Table II-2 identifies the meteorological stations for these three networks. The upper air stations in Flagstaff, Tucson, and Yuma are located in the outer (12 km) ozone modeling domain.

The air quality data generally served two purposes. First, air quality data were used to specify initial and boundary concentrations, where available. Second, ambient measurements were used to assess the ability of the model to replicate historical episodes, that is, to evaluate model performance for the base years. These topics are addressed in the relevant sections of the Technical Support Document.

II-5. Ozone Episode Selection

Elevated eight-hour concentrations that occurred during the ozone seasons of 2000 through 2004 were considered in the selection of episodes for this modeling analysis. The ozone episodes were initialized with a ranking of ozone readings greater than or equal to 80 ppb, a cutoff number representing 94% of the concentration level of the ozone standard (85 ppb).

The historical patterns of ozone episodes and the fundamental meteorological regimes conducive to ozone formation in the area were taken into account in evaluating and justifying selection of the episodes for the Attainment Plan. The episodes selected represent different meteorological regimes observed to correspond to eight-hour ozone greater than or equal to 80 ppb. Wind flow patterns (e.g., well defined transport winds vs. light and variable winds) were the primary consideration for distinguishing among meteorological regimes. Region-wide temperature observations (e.g., high temperatures vs. less extreme temperatures) were also considered as a factor in selecting a set of modeling episodes. High ozone days were partitioned into major meteorological regimes. The detailed procedures used in selecting the ozone episodes are documented in "*Modeling Protocol in Support of an Eight-Hour Ozone Attainment Demonstration for the Maricopa Nonattainment Area,*" January 31, 2006, provided in Appendix I. The review concluded that three modeling episodes, August 5-11, 2001, June 3-7, 2002, and July 8-14, 2002, should be used in the present eight-hour ozone attainment demonstration. Three additional days were added to the beginning of each episode as model ramp-up periods to reduce air quality model sensitivity to initial conditions.

The July 2002 episode, which recorded the highest eight-hour ozone concentration of 107 ppb, represents the worst case conditions in this area. The June 2002 episode was selected, because it had the greatest number of sites with the 4th highest eight-hour ozone occurring during the episode. The August 2001 episode was selected to evaluate the mixture of the local ozone production and transported ozone. These three regimes were modeled to provide confirmation of the ability of CAMx to represent the physical and chemical processes associated with diverse ozone episodes in the MNA.

Table II-1. Ozone monitoring sites

Abbr.	Name	AIRS Code	Operator	Location	Data Availability	O_3	CO	NO	NO_2	WS/WD
AJ*	Apache Junction	04-021-3001	PCAQD	305 E Superstition Blvd	2002-2004	√				
BP†*	Blue Point	04-013-9702	MCAQD	Usery Pass & Bush Highway	2000-2004	√				√
BE	Buckeye	04-013-4011	MCAQD	26453 W MC85	Since 8/1/2004	√	√		√	√
CC*	Cave Creek	04-013-4008	MCAQD	37019 N Lavon Ln	Since 8/1/2001	√				√
CP†*	Central Phoenix	04-013-3002	MCAQD	1845 E Roosevelt	2000-2004	√	√		√	√
DY	Dysart	04-013-4010	MCAQD	16825 N Dysart	Since 7/21/2003	√	√			√
EM	Emergency Management	04-013-3004	MCAQD	52nd St & McDowell Rd	Till 5/31/2001	√				
FF†*	Falcon Field	04-013-1010	MCAQD	4530 E Mckellips	2000-2004	√				√
FH†*	Fountain Hills	04-013-9704	MCAQD	16426 E Palisades	2000-2004	√				√
GL†*	Glendale	04-013-2001	MCAQD	6000 W Olive	2000-2004	√	√			√
HM†*	Humboldt Mountain	04-013-9508	ADEQ	7 Springs Rd	2000-2004	√				
LP*	Lake Pleasant	04-013-9805	MCAQD	41402 N 87th Ave	Till 7/31/2001	√				√
MRCP**	Maricopa	04-021-3010	PCAQD	44625 W Garvey Rd	Since 7/1/2002	√				
MV*	Maryvale	04-013-3006	MCAQD	6180 W Encanto	2000-2003	√	√			
ME*	Mesa	04-013-1003	MCAQD	370 S Brooks	2000-2002	√	√			√
MORD*	Mount Ord	04-013-9701	ADEQ	Mountain Ord Summit	5/19/2000-2001	√				√
NP†*	North Phoenix	04-013-1004	MCAQD	610 E Butler	2000-2004	√	√			√
PALV†*	Palo Verde	04-013-9993	ADEQ	36248 W Elliot Rd	2000-2004	√		√	√	
PP†*	Pinnacle Peak	04-013-2005	MCAQD	25000 Windy Walk Way	2000-2004	√	√			√
QC**	Queen Creek	04-021-3009	PCAQD	301 E Combs Rd	Since 7/1/2002	√				
QV**	Queen Valley	04-021-8001	ADEQ	10 S Queen Ann	Since 5/23/2001	√		√	√	
RV†*	Rio Verde	04-013-9706	MCAQD	N Forest Rd & Del Ray Ave	2000-2004	√				
SAC**	Sacaton	04-021-7001	Tribal	35 Pima St	Since 7/1/2002	√				
SP†*	South Phoenix	04-013-4003	MCAQD	33 W Tamarisk Ave	2000-2004	√	√			√
SS†*	South Scottsdale	04-013-3003	MCAQD	2857 N Miller Road	2000-2004	√	√		√	√
SUPR†*	Super Site	04-013-9997	ADEQ	4530 N 17th Ave	2000-2004	√	√	√	√	√
SU	Surprise	04-013-4007	MCAQD	18600 N Reems Rd	2001-7/14/2003	√	√			
TEMP*	Tempe	04-013-4005	MCAQD	1525 S College Ave	Since 7/1/2000	√	√		√	√
TNM**	Tonto National Monument	04-007-0010	ADEQ	South of SR88	Since 5/24/2002	√		√	√	
WC	West Chandler (old)	04-013-3009	MCAQD	163 S Price Rd	Till 5/31/2000	√	√			√
WC*	West Chandler	04-013-4004	MCAQD	Ellis St & Frye Rd	Since 8/1/2000	√	√			√
WP†*	West Phoenix	04-013-0019	MCAQD	3847 W Earll Rd	2000-2004	√	√		√	√

† Monitoring sites having a complete data record.

* Monitoring sites having eight-hour ozone exceedance at least once during the period (2000-2004) that affected selection of episodes to be modeled.

** Monitoring sites inside of the inner model domain but outside of the Eight-hour Ozone Nonattainment Area. Data from these sites will be used for model performance evaluation.

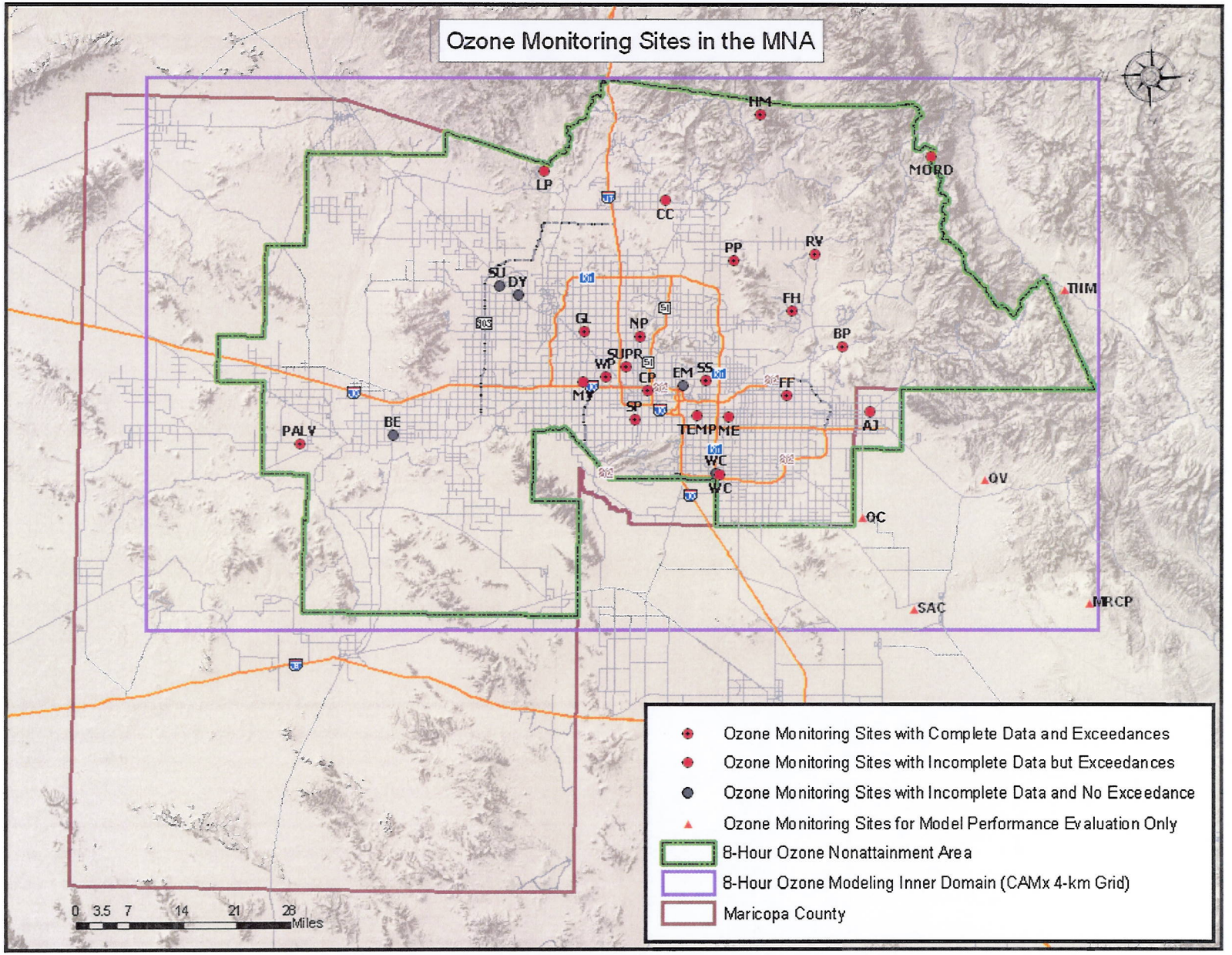

Figure II-2. Ozone monitoring sites in the MNA.

Table II-2. Meteorological monitoring stations

NWS (33 sites)

Site	Abbr.	Lat	Long	UTM (Zone 12)		Elev. (m)	Address	County
				Northing (m)	Easting (m)			
Casa Grande Municipal Airport	KCGZ	32.95000	-113.76389	3646004.74	428339.63	446	510 E. FLORENCE BLVD, Casa Grande	Pinal
Chandler Municipal Airport	KCHD	33.26917	-113.93306	3681421.13	424459.38	379	2380 S. STINSON WAY, Chandler	Maricopa
Davis-Monthan Air Force Base	KDMA	32.16667	-111.44806	3558916.01	511000.13	824	DAVIS-MONTHAN AFB, Tucson	Pima
Douglas Bisbee International Airport	KDUG	31.46917	-112.42222	3482443.65	632656.74	1266	1415 MELODY LANE, BLDG C, Douglas Bisbee	Cochise
Phoenix Deer Valley Municipal Airport	KDVT	33.69028	-110.72083	3728325.15	401239.94	450	702 W DEER VALLEY DR, Phoenix	Maricopa
Tucson NEXRAD	KEMX	31.88300	-110.00556	3527531.19	536222.38	1586	Tucson	Pima
Mesa/Falcon Field	KFFZ	33.46667	-109.37917	3703264.45	431857.54	424	4800 FALCON DR, Mesa	Maricopa
Flagstaff	KFGZ	36.21700	-111.67222	4008326.71	426567.23	2192	Flagstaff	Coconino
Libby AAF Fort Huachuca	KFHU	31.60000	-111.81700	3496292.91	563243.03	1438	401 GIULIO CESARE AVE, Sierra Vista	Cochise
Flagstaff Pulliam Airport	KFLG	35.14028	-112.15472	3888806.53	438763.21	2137	6200 S. PULLIAM DR, 204, Flagstaff	Coconino
Flagstaff NEXRAD	KFSX	34.56700	-114.55944	3825044.89	481654.04	2260	Flagstaff	Coconino
Gila Bend U.S. Army Airfield	KGBN	32.43333	-112.68333	3589715.73	341743.08	262	Gila Bend	Maricopa
Grand Canyon National Park Airport	KGCN	35.94611	-110.61700	3978587.39	395854.86	2014	Grand Canyon	Coconino
Glendale Municipal Airport	KGEU	33.52722	-112.38333	3710488.09	379721.07	325	6801 N. GLEN HARBOR BLVD 201, Glendale	Maricopa
Goodyear Municipal	KGYR	33.41667	-110.84583	3698335.76	371380.94	295	1658 SO LITCHFIELD RD, Goodyear	Maricopa
Laughlin/Bullhead International Airport	KIFP	35.15750	-110.33333	3893236.68	722300.40	212	2550 LAUGHLIN VIEW DR, Bullhead City	Mohave
Kingman Airport	KIGM	35.25778	-109.60361	3905575.22	233156.32	1050	7000 FLIGHTLINE DR, Kingman	Mohave
Winslow Municipal Airport	KINW	35.02806	-110.95528	3876190.43	525466.06	1505	21 WILLIAMSON AVE, Winslow	Navajo
Mesa Williams Gateway Airport	KIWA	33.31660	-109.63556	3686574.65	439496.98	421	6001 SOSSAMAN RD, Mesa	Maricopa
Williams AFB/Chandler	KIWA	33.31667	-111.76667	3686574.65	439496.98	421	6001 SOSSAMAN RD, Mesa	Maricopa
Luke Air Force Base/Phoenix	KLUF	33.53333	-111.81111	3711271.17	371553.24	332	LUKE AFB, Glendale	Maricopa
Yuma Marine Corps Air Station	KNYL	32.62361	-109.06667	3612935.22	240675.79	64	Yuma	Yuma
Nogales International Airport	KOLS	31.42083	-111.73333	3476252.27	514652.98	1198	Nogales	Santa Cruz
Page Municipal Airport	KPGA	36.92056	-112.06556	4086153.63	460091.83	1314	697 VISTA AVENUE, Page	Coconino
Phoenix Sky Harbor International Airport	KPHX	33.43417	-111.65000	3699914.60	402291.25	345	3400 SKY HARBOR BLVD, Phoenix	Maricopa
Prescott Love Field	KPRC	34.64917	-111.65000	3835058.29	369663.82	1537	6546 CRYSTAL LANE, Prescott	Yavapai
Wind Rock Airport	KRQE	35.65000	-112.29528	3946850.91	675023.86	2055	Window Rock	Apache
Safford Municipal Airport	KSAD	32.85722	-111.91056	3636283.38	627670.20	968	4550 E AVIATION WAY, Safford	Graham
Scottsdale Airport	KSDL	33.62278	-114.60000	3720703.49	415540.50	460	15000 N AIRPORT DR, Scottsdale	Maricopa
St. Johns Industrial Airpark	KSJN	34.51833	-111.20000	3820822.44	648772.04	1747	St. Johns	Apache
Show Low Regional Airport	KSOW	34.26528	-110.88333	3792017.67	591549.62	1955	3150 AIRPORT LOOP, Show Low	Navajo
Tucson International Airport	KTUS	32.13139	-112.05111	3555000.31	504218.01	805	Tucson	Pima
Yuma International Airport	KYUM	32.65000	-112.38333	3615031.47	725106.73	65	2191 E 32ND ST, Yuma	Yuma

Table II-2. Meteorological monitoring stations (Concluded)

AZMET (23 sites)

Site	Abbr.	Lat	Long	UTM (Zone 12)		Elev. (m)	Address	County
				Northing (m)	Easting (m)			
Aguila	AGUI	33.946667	-113.188889	3758401	297716	655	0.6 Miles NW of Aguila City Limits	Maricopa
Bonita	BONI	32.463611	-109.929444	3592330	600610	1346	18 Miles N on Rex Allen Dr from Willcox at I-10	Graham
Buckeye	BCK1	33.400000	-112.683333	3696899	343454	304	3.5 km S of Exit 109 from I-10	Maricopa
Coolidge	COOL	32.980000	-111.604722	3649232	443496	422	0.8 km SW of the Curry Rd & Bechtel	Pinal
Eloy	ELOY	32.773889	-111.556944	3626358	447840	461	0.8 km E of 11 Miles Corner Rd on Arica Rd	Pinal
Harquahala	HARQ	33.483333	-113.116667	3706876	303337	350	1.8 km N of the Intersection of Courthouse Rd & 491st Ave	Maricopa
Laveen	LAVE	33.376389	-112.150000	3693605	393027	315	3921 W Baseline Rd	Maricopa
Litchfield	LITC	33.467222	-112.398056	3703959	370087	309	1 Mile N of McDowell Rd on Cotton Ln	Maricopa
Marana	MARA	32.461111	-111.233333	3591572	478071	601	1 Mile W of I-10 on Trico-Marana Rd	Pima
Maricopa	MARI	33.068611	-111.971667	3659313	409299	361	NW corner of field #5 S of Irrigation Lab Building	Pinal
Mohave	MOHA	34.967222	-114.605833	3872026	718581	146	14.2 Miles S of Bullhead City on AZ Route 95	Mohave
Paloma	PALO	32.926667	-112.895556	3644751	322765	219	9 Miles W of Gila Bend on I-8 to Paloma Exit	Maricopa
Parker	PARK	33.882778	-114.447778	3752091	736045	94	8 Miles S of Poston & 0.4 Miles E on Nez Rd	La Paz
Phx. Encanto	ENCA	33.479167	-112.096389	3704947	398135	335	SE of Thomas Rd & 19th Ave (Encanto Golf Course)	Maricopa
Phx. Greenway	PGRN	33.621389	-112.108333	3720728	397193	401	SE of Greenway & 23rd Ave (Cave Creek Golf Course)	Maricopa
Queen Creek	QUEE	33.258333	-111.641667	3680110	440233	430	0.1 km E of Queen Creek Rd & Ellsworth Rd	Maricopa
Roll	ROLL	32.744444	-113.961111	3626837	222539	91	County 4th St & Ave 39 E	Yuma
Safford	SAFF	32.813333	-109.678333	3631367	623729	901	0.8 km SE of Lone Star Rd & Mountain Rd	Graham
Tucson	TUCS	32.280278	-110.945833	3571504	505101	713	1 km NW of Campbell Ave & Roger Rd	Pima
Waddell	WADD	33.618056	-112.459722	3720763	364592	407	2 Miles W of Cotton Ln & 0.4 Miles S of Greenway Rd	Maricopa
Yuma Mesa	YMES	32.611944	-114.633889	3610740	722021	58	0.32 km W of Ave A on 15th St	Yuma
Yuma North Gila	YUMA	32.735278	-114.529444	3624641	731506	44	2.1 km W on 7th Ave from Gila Center	Yuma
Yuma Valley	YVAL	32.712500	-114.705000	3621744	715106	32	5 Miles W of Yuma on 8th St	Yuma

FSL (4 sites)

Site	Abbr.	Lat	Long	UTM (Zone 12)		Elev. (m)	Address	County
				Northing (m)	Easting (m)			
Flagstaff/Bellemt	FGZ	35.23	-111.82	3898858	425383	2179	123 miles North from Central Phoenix	Coconino
Tucson	TUS	32.12	-110.93	3553739	506603	788	113 miles South from Central Phoenix	Pima
Yuma/US Army	YUM	32.87	-114.33	3640036	749823	131	138 miles West from Central Phoenix	Yuma
Yuma/US Army	1Y7	32.87	-114.40	3639872	743271	98	142 miles West from Central Phoenix	Yuma

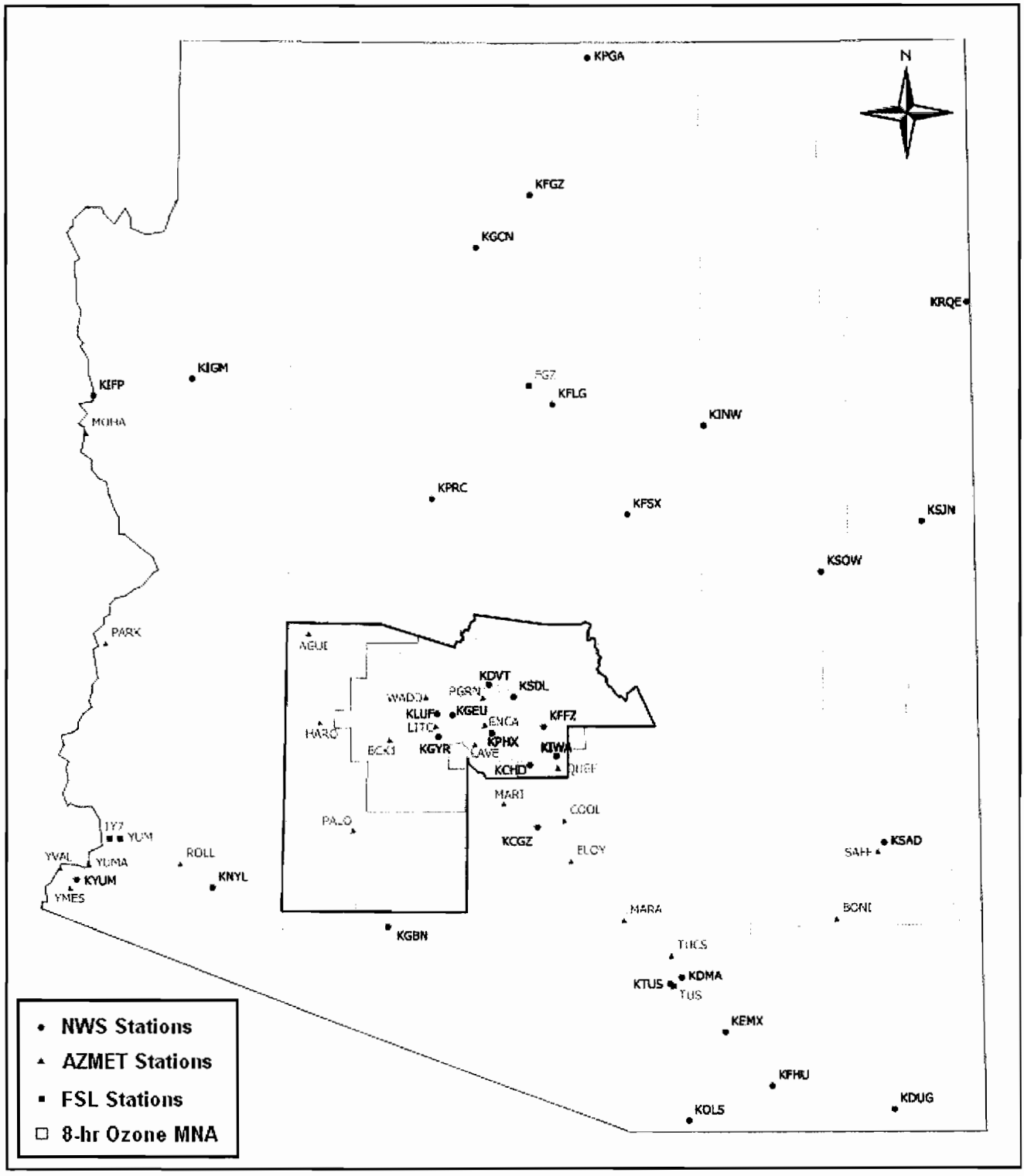

Figure II-3. Meteorological monitoring stations

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2. Jung, I. (August 2005) "Addendum to Review of 2000-2004 Ozone Episodes in the Maricopa County 8-hour Ozone Nonattainment Area". Maricopa Association of Governments Office memo (August 24, 2005).

3. U.S. Environmental Protection Agency (October 2005) "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS". EPA-454/R-05-002. Emissions, Monitoring, and Analysis Division, Office of Air Quality Planning and Standards.

III. BASE CASE CAMx INPUT PREPARATION

The Maricopa Association of Governments (MAG), in coordination with the Arizona Department of Environmental Quality (ADEQ), the Arizona Department of Transportation (ADOT), and the Maricopa County Air Quality Department (MCAQD), has elected to apply the EPA-recommended Comprehensive Air Quality Model with eXtensions (CAMx), a three-dimensional photochemical grid model, to the Maricopa eight-hour ozone nonattainment area (MNA) for the attainment demonstration. The inner ozone modeling domain (4 km) is larger than the MNA , and consists of both urbanized and undeveloped portions of Maricopa County, as well as portions of Gila, Pinal, and Yavapai counties.

CAMx Version 4.40 was applied in this analysis. The CAMx inputs include: day-specific emission inventories for carbon monoxide (CO), oxides of nitrogen (NOx), and volatile organic compounds (VOCs); meteorological data for the modeled episode; air quality concentrations for the modeled episode; and other data, such as gridded land use information for the modeling domain and chemistry parameters. The inputs were prepared in accordance with the general guidelines established by the U.S. EPA for the regulatory application of eight-hour ozone models [1] as outlined in the CAMx modeling protocol which is included in Appendix I-i.

III-1. Emission Inventory

The emission inventory consists of emissions from various sources including stationary point, area, onroad mobile, nonroad mobile, and biogenic sources. The emissions from point and area source categories were developed based on the 2002 periodic inventory for ozone precursors developed by MCESD [2]. The 2002 inventory was updated by MAG to reflect the latest socioeconomic, traffic and land use data available. This periodic inventory was factored down to represent the episode days in 2001. Growth factors were applied to project the 2002 inventories to 2008. The Emissions Preprocessor System (EPS3.0) [3] was used to process the emission inventory. The emissions were temporally adjusted and spatially allocated to the grid cells using EPS3.0.

The MEGAN model was used to process the biogenic emission inventory. The onroad mobile emissions were generated by the EPA MOBILE6.2 model and M6Link. M6Link is a MAG software program applied at the transportation link level to generate gridded mobile source emissions. All emissions by source type were merged by EPS3.0 to provide input to CAMx. The development of the benefit of the committed attainment measure in 2008 is documented in Section V-2.

CAMx emission input files were developed for August 2-11, 2001, and May 31-June 7, 2002 and July 5-14, 2002. The 2001 and 2002 inventories reflect control measures and conditions in effect at that time. Control measures in effect at the time are those listed in Table III-1. Episode-specific conditions assumed in the analysis include data such as solar angle and hourly temperatures.

Table III-1. Base case measures assumed in the 2001 and 2002 model validation for the eight-hour ozone attainment plan.

Measures Assumed in the 2001 and 2002 Modeling Base Cases
1. Inspection/Maintenance (I/M) idle test was required for all gasoline vehicles
2. I/M waiver rates of 1.3% assumed for pre-1981 model year vehicles and 1.0%, for 1981 and newer vehicles
3. Oxygenate content and Reid Vapor Pressure (RVP) were based on actual fuel properties from surveys
4. Vehicles participating in I/M test - 89.6%; not-participating - 10.4%
5. Efficiency of 80.77% for Stage II Vapor Recovery System
6. Expansion of Area A (S.B. 1427)

It is important to note that the methodology for quantifying the emission reduction credit for the Expansion of Area A (H.B. 2538) measure in this Ozone Attainment Plan does not take into account the portion of Area A located in Pinal or Yavapai Counties. Under A.R.S. 49-406 (A), MAG has statutory authority to conduct nonattainment area planning within Maricopa County. However, MAG does not have air quality planning authority for either Pinal or Yavapai Counties.

Under A.R.S. 49-406 (K), the Arizona Department of Environmental Quality has air quality planning authority to adopt SIP measures in those portions of Area A in Pinal and Yavapai Counties where MAG does not have authority . For ozone, the committed measures include the Vehicle Emissions Inspection Program, Clean Burning Gasoline Program, Stage II Vapor Recovery Program, Trip Reduction Program, Voluntary Vehicle Repair and Retrofit Program, and Traffic Light Synchronization. MAG anticipates that ADEQ will also provide notice and public hearing on this plan, perhaps jointly with MAG, prior to ADEQ's adoption of the plan under A.R.S section 49-404 and ADEQ's subsequent submittal of the plan to EPA for approval.

III-1-1. Onroad Mobile Source Emissions

The first step in developing onroad mobile emissions is to estimate emission factors. A very large array of mobile emission factors is required by the M6Link model to produce a complete motor vehicle emissions inventory. These factors, in units of grams per mile, are multiplied by vehicle miles traveled (VMT) in each grid cell of the modeling domain to produce the onroad mobile source emissions estimates. These factors are unique by vehicle type, vehicle age, hour of the day, and facility type the vehicle is driving on. Emission factors are also influenced by several other parameters, including fuel formulations, specific scenario conditions (e.g. speeds, temperatures, etc.), and vehicle fleet characteristics.

MOBILE6.2

MOBILE6.2 [4] is a model developed by EPA for the purpose of estimating motor vehicle emission factors. The inputs to MOBILE6.2 used in the attainment plan are generally consistent with the ozone season periodic inventory for 2002, although changes have been made when better information become available or were necessary due to the use of the latest MOBILE6.2 model. For example, the MOBILE6.2 model accepts data on the sulfur content of gasoline, whereas the MOBILE5a model did not use such data.

There are a variety of inputs used by the MOBILE6.2 model. Two sets of control measures were applied to the MOBILE6.2 inputs depending upon the location: Area A and outside Area A. To reflect all vehicles operating in the Area A requires the weighting oftwo runs: an Inspection and Maintenance (I/M) run and a non-I/M run. The results from these runs are weighted appropriately to reflect the estimated proportions of I/M and non-I/M vehicles within the Area A. Fuel emission control measures including stage II refueling program were assumed in Area A. The program started in 1994 and phased in over one year with

80.77 percent efficiency for the LDGVs, LDGTs and HDGVs. However, emission control measures assumed in Area A were not applied to outside Area A. 2007 Heavy Duty Diesel Vehicle emission reduction rule was removed from both Area A and outside Area A.

Additionally, the MOBILE6.2 model was run separately for each of the five area types defined in the modeling area: central business district, urban, urban fringe, suburban, and rural. These area types were modeled separately in order to take into account different speed patterns on roadways in the different area types.

Additionally, local data such as details of the inspection and maintenance program, local fleet vehicle registration data, fractions of the vehicle fleet that are diesel powered, episode specific temperatures, and gasoline properties are included in the data input to MOBILE6.

Emission factors from the MOBILE6.2 model are unique to each hour of the day and reflect a unique temperature for the modeling domain for the given hour and episode. The output from the MOBILE6.2 model includes emission factors by vehicle class, vehicle age, facility type, and hour. These emission factors are utilized by the M6Link program in estimating onroad motor vehicle emissions for the MAG region.

M6Link

The M6Link system is a series of two FORTRAN-based programs that integrates travel demand modeling output and emission factors from MOBILE6.2 to produce estimates of total onroad vehicle emissions. The vehicle travel component of M6Link reads in the output from the travel demand models that are processed through GIS software. The output from the travel demand models reflect four times of day; a.m. peak, midday, p.m. peak, and nighttime. The outputs also reflect four vehicle classes; light duty commercial vehicles, medium duty commercial vehicles, heavy duty commercial vehicles, and all other vehicles. Other attributes of the data produced by the MAG travel demand models include the coordinates of each modeled roadway link and individualized traffic estimates and travel times for that link, the facility type of the link, and the area type. The output from the travel demand model is unique to the year modeled. That is, a different transportation modeling network is produced for the 2001 and 2002 model years.

The vehicle travel component of M6Link reads in data produced from the travel demand models and produces vehicle miles traveled (VMT) estimates that have been changed from being link-specific to grid cell specific. The estimates have also been converted from reflecting a total for the four time periods of the day to hourly estimates.

All VMT estimates output by the MAG travel demand models are generated for an average weekday. To take into account traffic volumes for a specific episode day, adjustment factors are used to convert the "typical" weekday traffic volumes into volumes for the specific ozone episode days modeled in this analysis. For example, the average annual daily traffic volume factor 0.8959 for June is multiplied by day of the week factor 1.0774 for

Monday and then divided by month of the year factor 1.0100 to yield an adjustment factor of 0.9557 for a Monday in June. These adjustment factors are based on the latest MAG congestion study [5].

Vehicle speeds on roadways in the modeling area are incorporated into the air quality modeling. The data output by the travel demand models includes roadway link length and average travel time for a vehicle on the link. Link-specific vehicle speeds are calculated as the length of the link divided by the time a vehicle spends on a roadway link. Speed estimates are developed for each of the four time periods of the day modeled. The link-specific roadway speeds are aggregated by the first portion of the M6Link program into speed bins for freeways and arterials for each hour of the day. These speed bin files, which are developed for each of the five area types modeled, are appropriate for input to the MOBILE6.2 model. Through this aspect of the modeling chain, the levels of traffic congestion and roadway capacity are incorporated in the development of locally-specific emission factors.

The highway network VMT data, created with the EMME/2 transportation model, that is read in by M6Link, re-emerges from M6Link in the form of a VMT table. This VMT table includes the estimated VMT for each grid cell, for each hour, and for each combination of area type, facility type, and vehicle class. This file includes individual VMT estimates for approximately two million area type/hour/vehicle class/grid cell/facility type combinations. Each of these VMT estimates is combined with an emissions factor (in grams per VMT) in the second portion of M6Link.

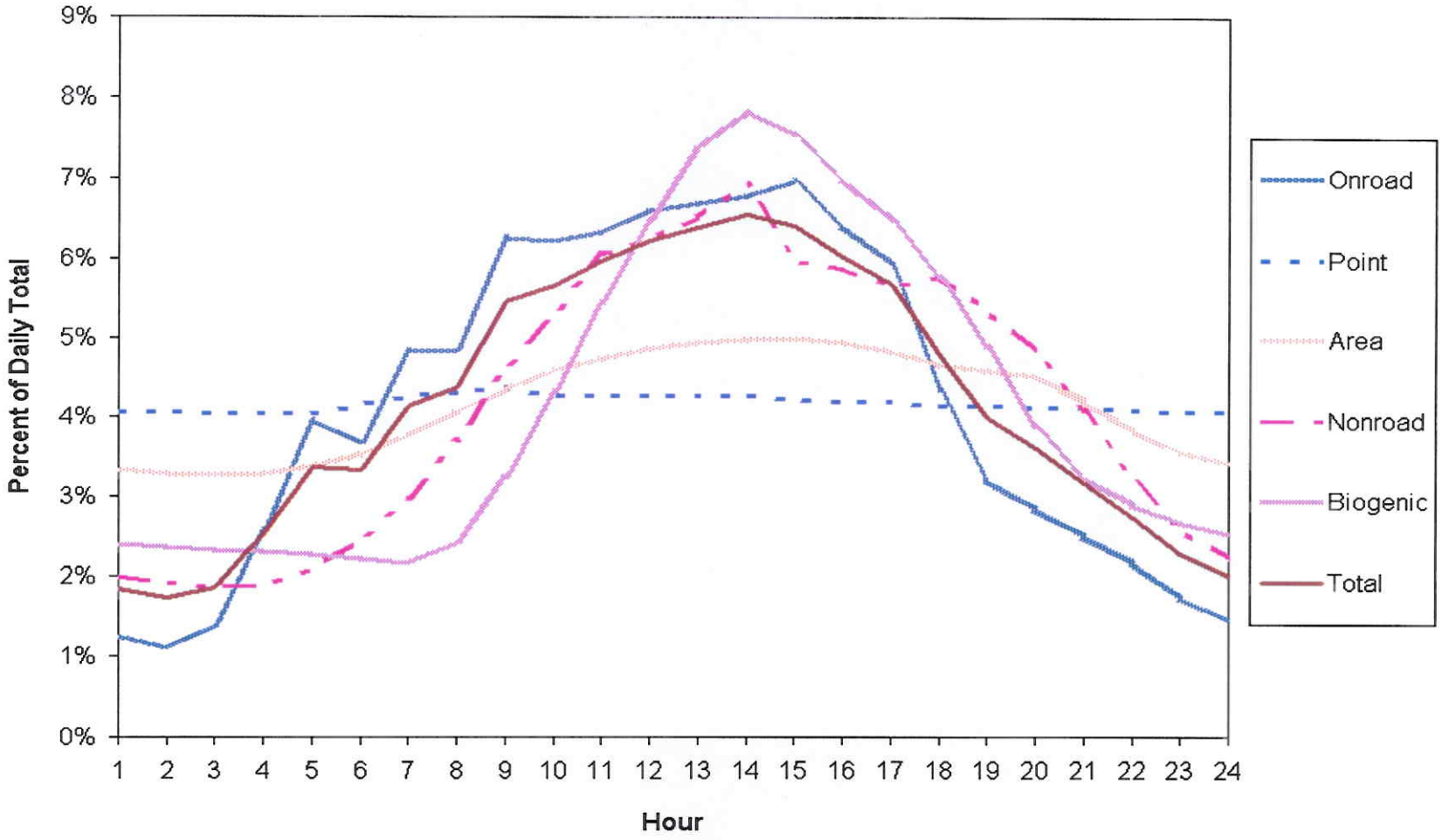
There are several inputs required by the second portion of M6Link to calculate emissions. In addition to the very detailed outputs of the vehicle travel component of M6Link, other inputs include the emission factor outputs from MOBILE6.2 in database format, a job file that includes information such as the year that is being modeled and the names of the MOBILE6.2 files to use, and a file that assists in converting the 28 vehicle classes considered by the MOBILE6.2 model into the four classes included in the travel demand models.

Like the vehicle travel component of M6Link, the emissions component of M6Link performs several tasks. The MOBILE6.2 outputs that reflect the I/M scenario and the outputs that reflect the non-I/M scenario reside in different electronic files. The program reads in the I/M and non-I/M emission factor for each scenario and weights them internally to produce a single emission factor for each area type/vehicle type/facility type/hour combination. The program also combines the emission factors from the 28 vehicle classes produced by MOBILE6.2 into the four vehicle classes produced by the travel demand models.

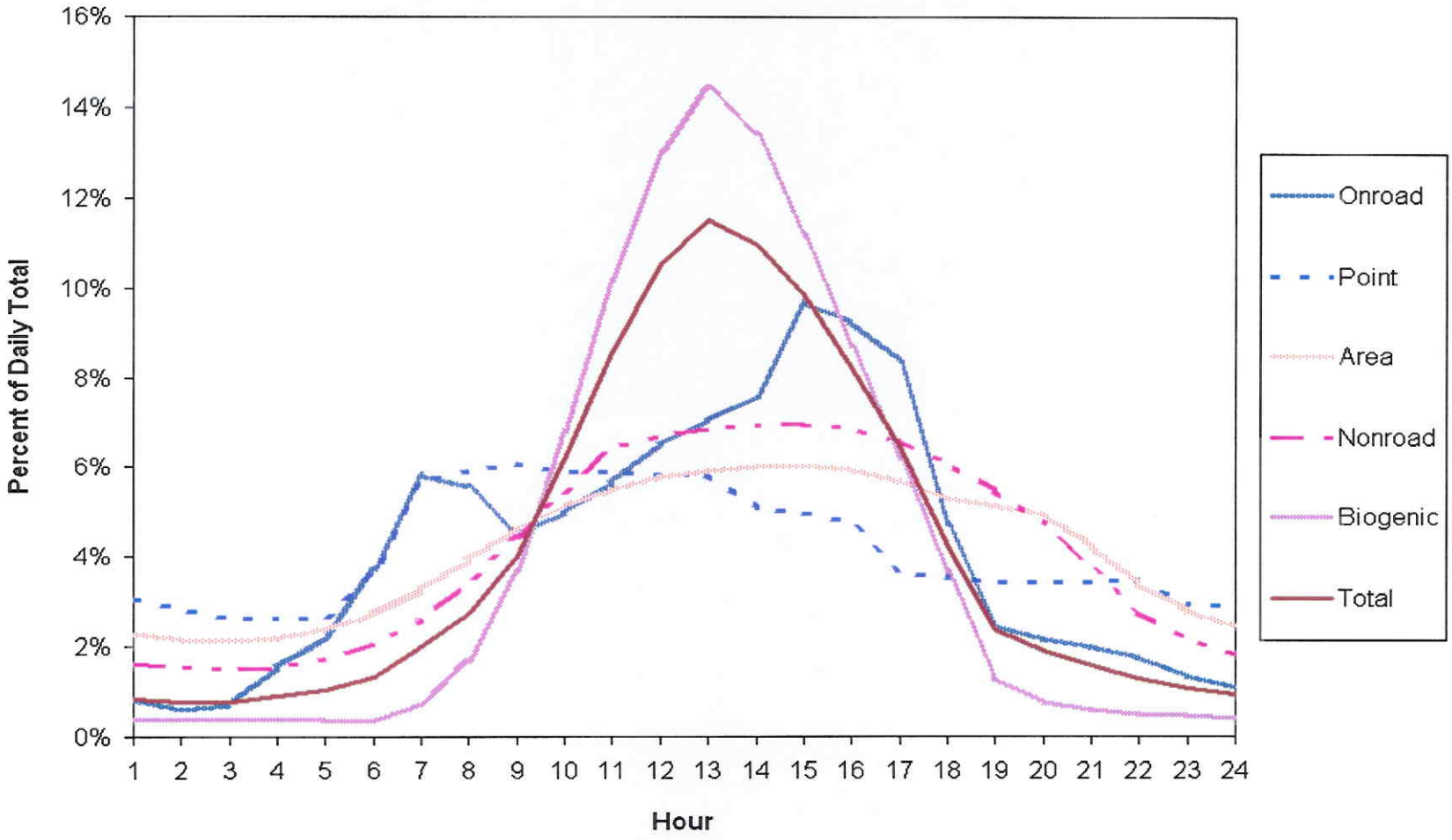
Additionally, while the MOBILE6.2 model produces estimates of cold start, hot soak, diurnal, and resting emission factors independent of facility type, these emissions are generally more likely to occur on roadways such as arterials and local streets. It is unlikely that vehicles would produce cold start emissions while on a freeway since it would generally take several minutes to reach a freeway from where the vehicle had been at rest

(such as a home or workplace). As such, the emission types listed above have been applied to all roadway types except for freeways and freeway ramps to effect a more realistic spatial allocation of these emissions. Using the emission factors output by MOBILE6, M6Link calculates and spatially allocates the onroad mobile emissions in the modeling domain. The hourly emissions from M6Link are processed through MEDEXPLORA and utility programs to provide CAMx-ready input files.

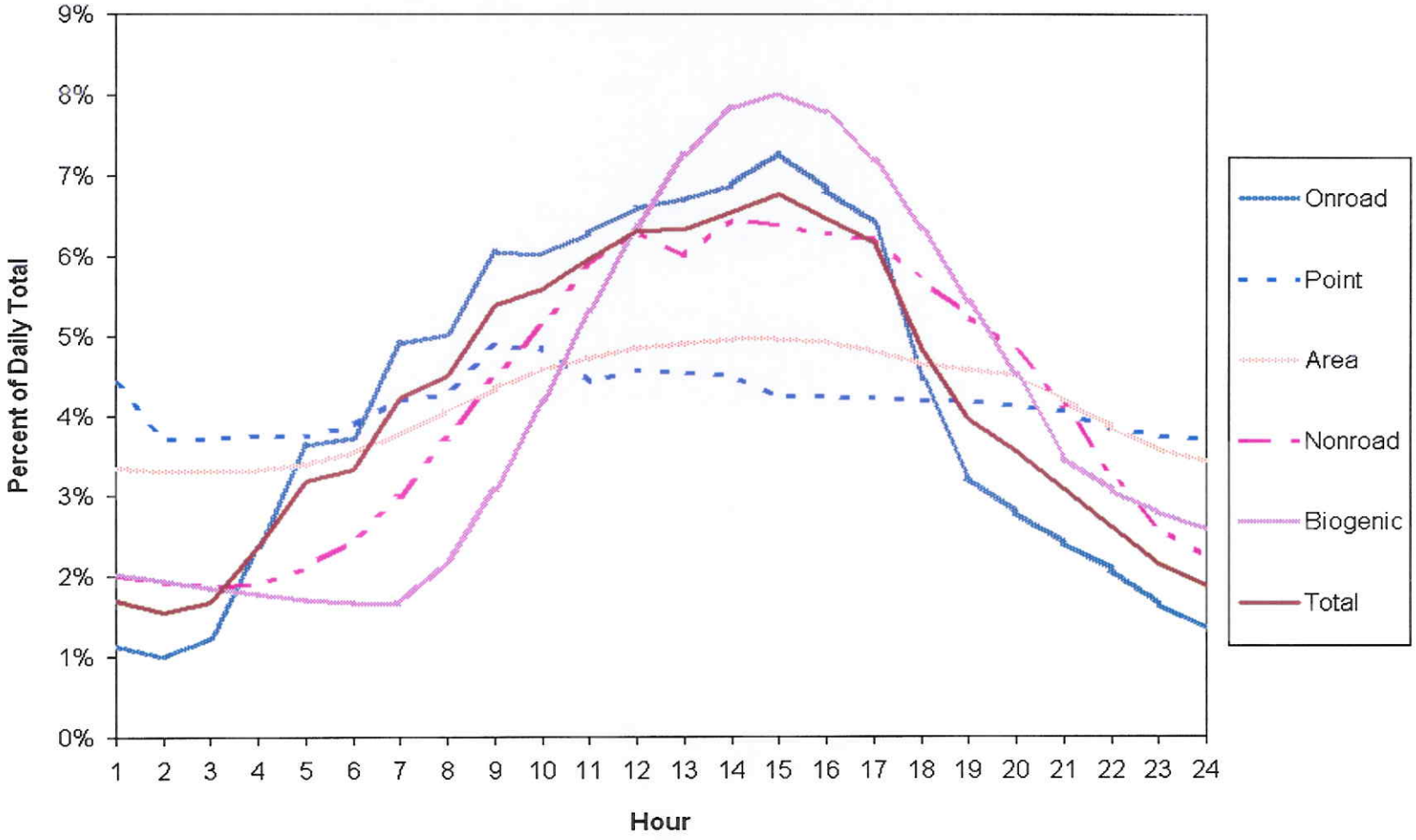
The temporal distribution of the emissions by source category for VOCs and NOx for the 2001 and 2002 episode days with the highest simulated eight-hour ozone concentrations are shown in Figures III-1A through III-1F. The spatial allocation of the onroad mobile source VOCs and NOx emissions for these 2001 and 2002 episode days are shown in Figures III-2A through 2F. The maximum emission density from onroad vehicles modeled for August 10, 2001, June 6, 2002, and July 9, 2002 occurs at grid cell (27,14) for NOx and grid cell (27,15) for VOCs.



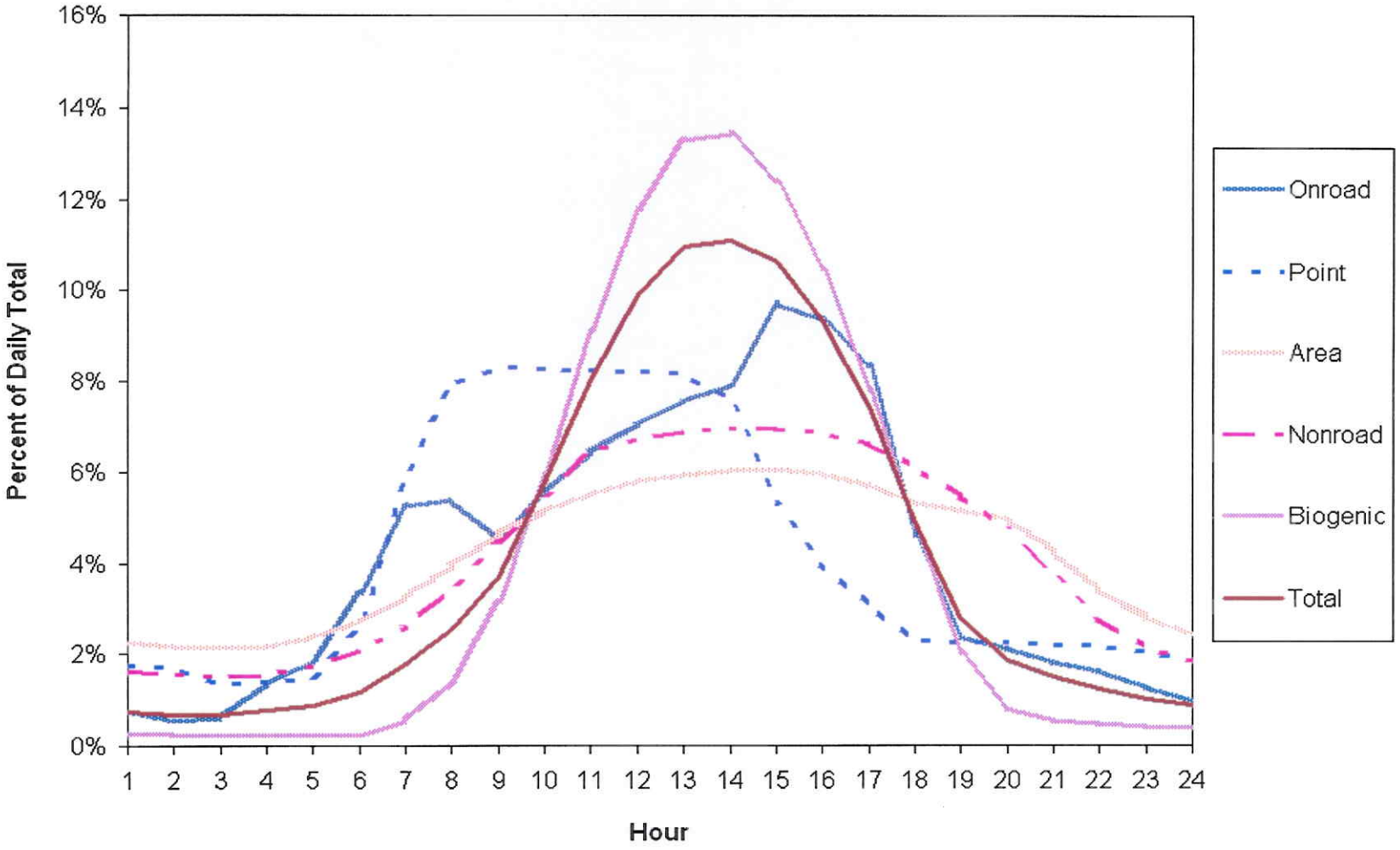
III-1A. Temporal Distribution of NOx Emission Sources (Modeling Domain), August 10, 2001



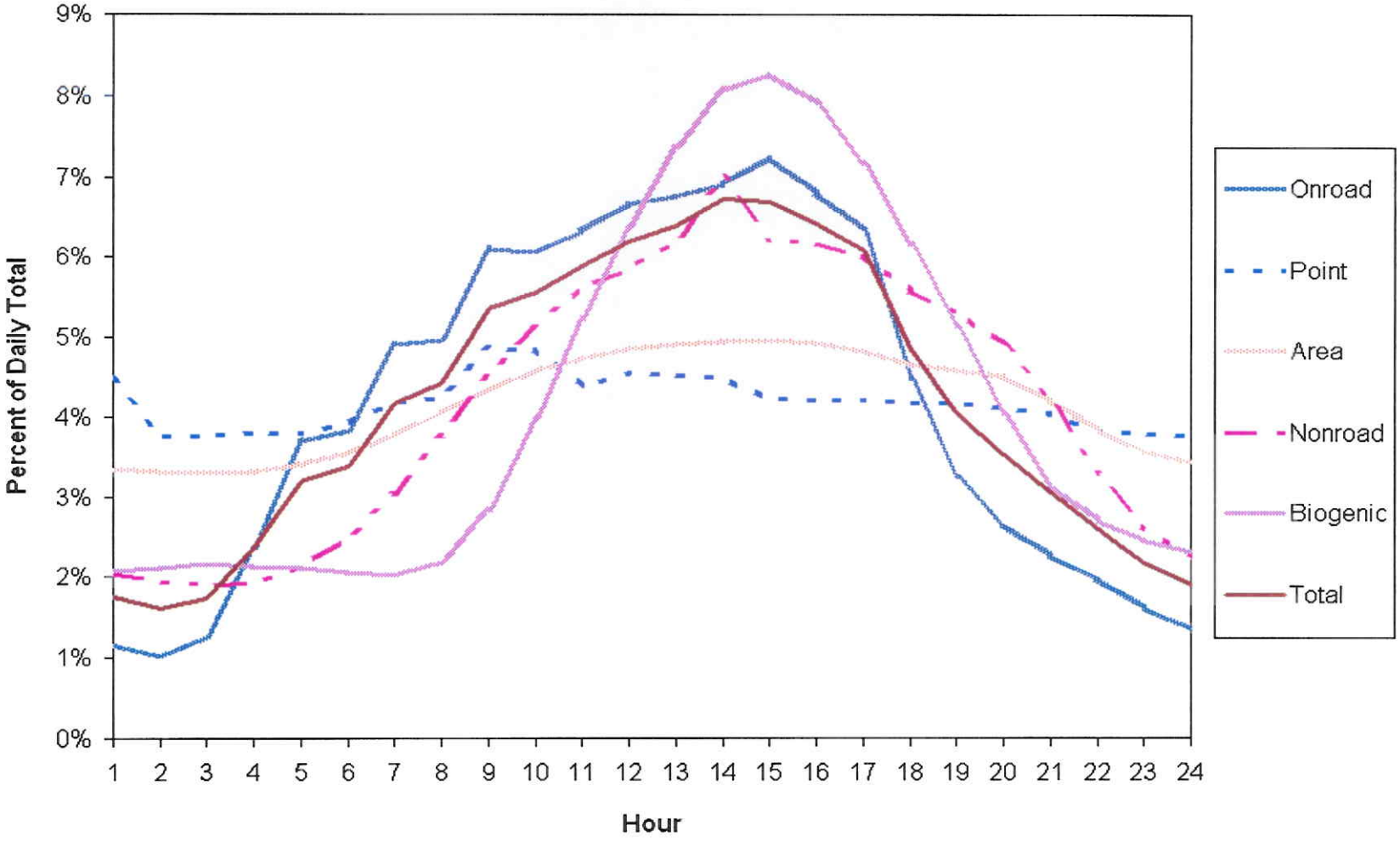
III-1B. Temporal Distribution of VOC Emission Sources (Modeling Domain), August 10, 2001



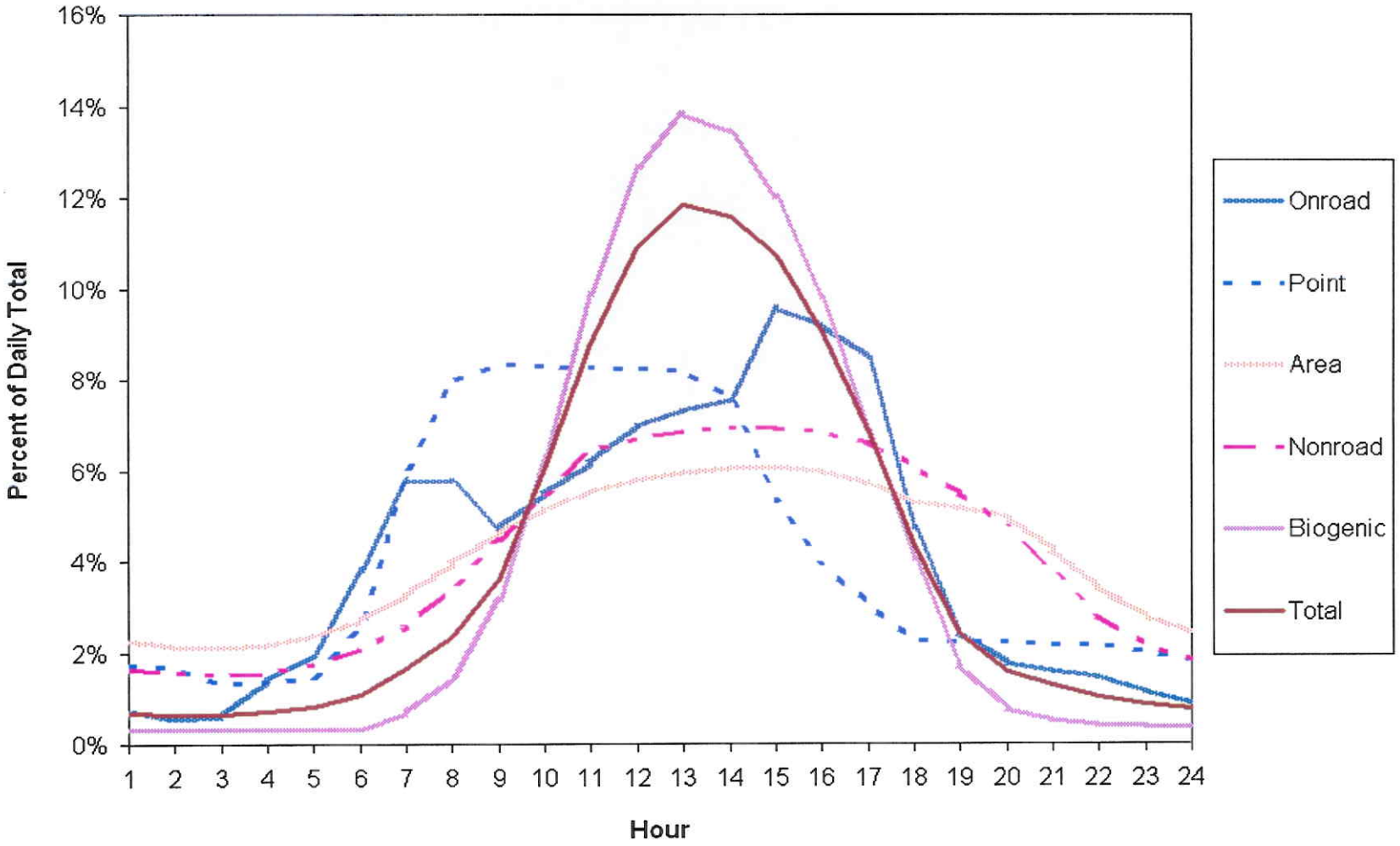
III-1C. Temporal Distribution of NOx Emission Sources (Modeling Domain), June 06, 2002



III-1D. Temporal Distribution of VOC Emission Sources (Modeling Domain), June 06, 2002



III-1E. Temporal Distribution of NOx Emission Sources (Modeling Domain), July 09, 2002



III-1F. Temporal Distribution of VOC Emission Sources (Modeling Domain), July 09, 2002

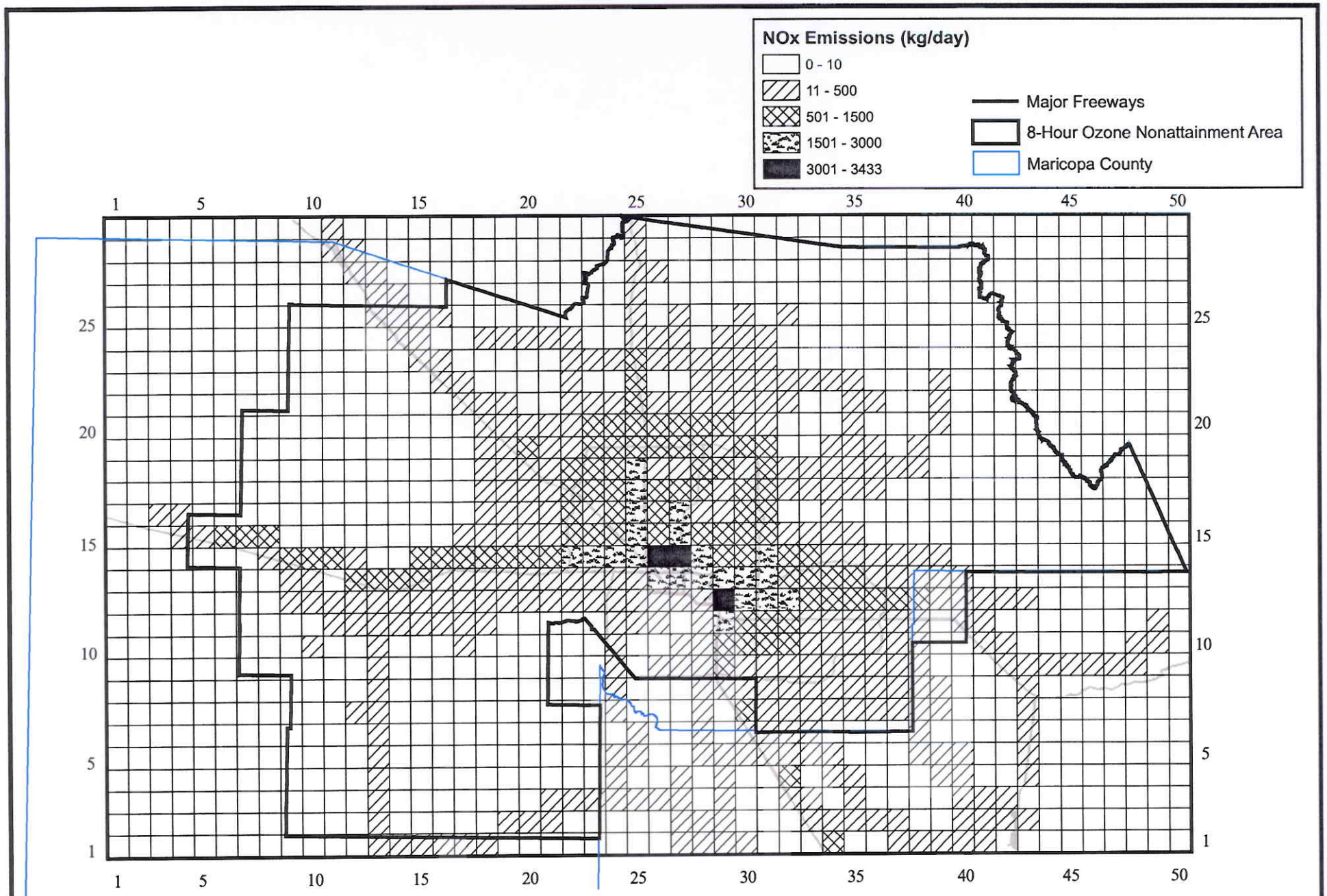


FIGURE III-2A. Onroad Mobile Source NOx Emissions for August 10, 2001 - Base Case
Total emissions = 167,094 kg/day
Total emissions in 8-hour ozone nonattainment area = 159,744 kg/day
Maximum = 3,433 kg/day at Cell (27,14)

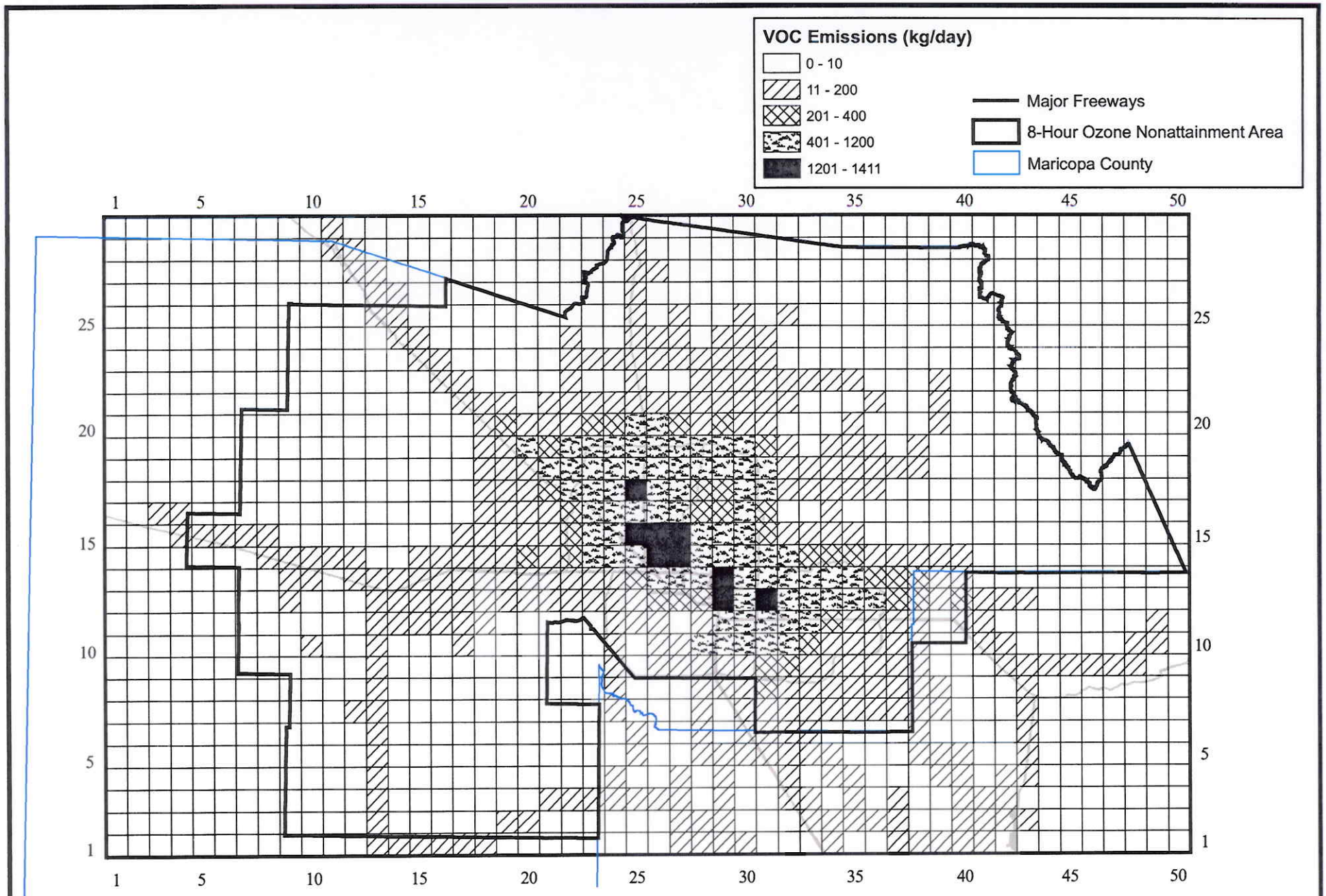


FIGURE III-2B. Onroad Mobile Source VOC Emissions for August 10, 2001 - Base Case
Total emissions = 90,430 kg/day
Total emissions in 8-hour ozone nonattainment area = 86,474 kg/day
Maximum = 1,411 kg/day at Cell (27,15)

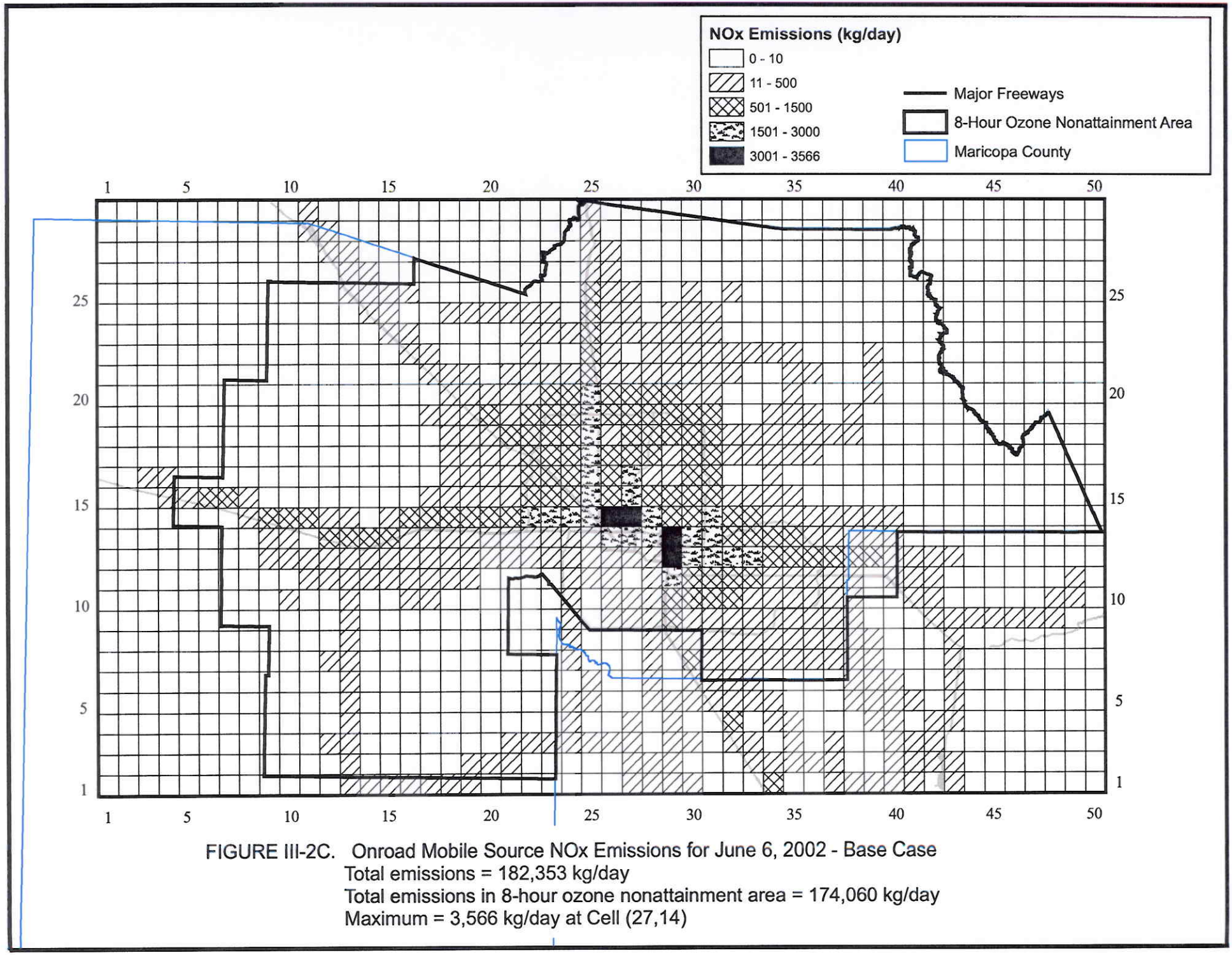


FIGURE III-2C. Onroad Mobile Source NOx Emissions for June 6, 2002 - Base Case
Total emissions = 182,353 kg/day
Total emissions in 8-hour ozone nonattainment area = 174,060 kg/day
Maximum = 3,566 kg/day at Cell (27,14)

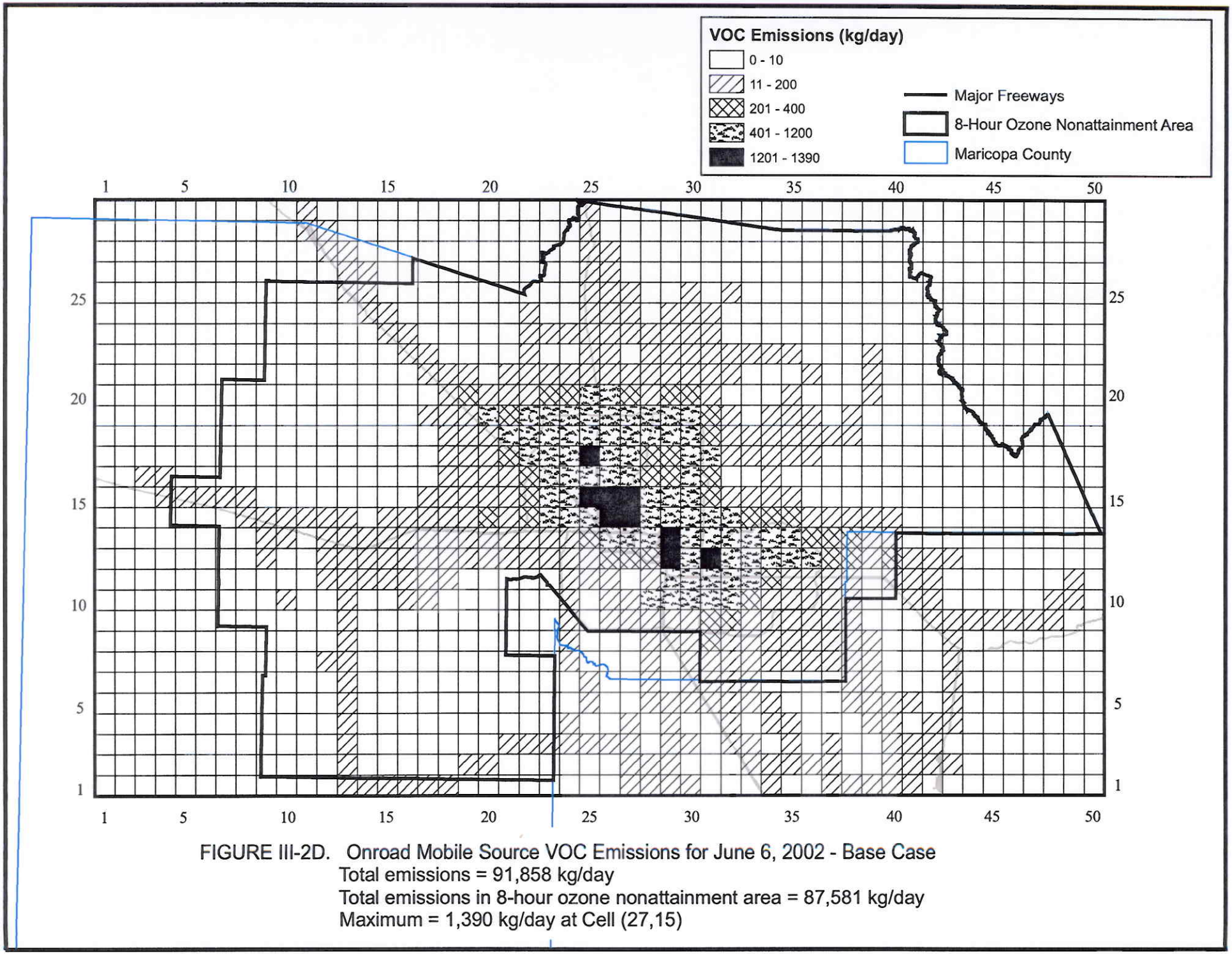


FIGURE III-2D. Onroad Mobile Source VOC Emissions for June 6, 2002 - Base Case
Total emissions = 91,858 kg/day
Total emissions in 8-hour ozone nonattainment area = 87,581 kg/day
Maximum = 1,390 kg/day at Cell (27,15)

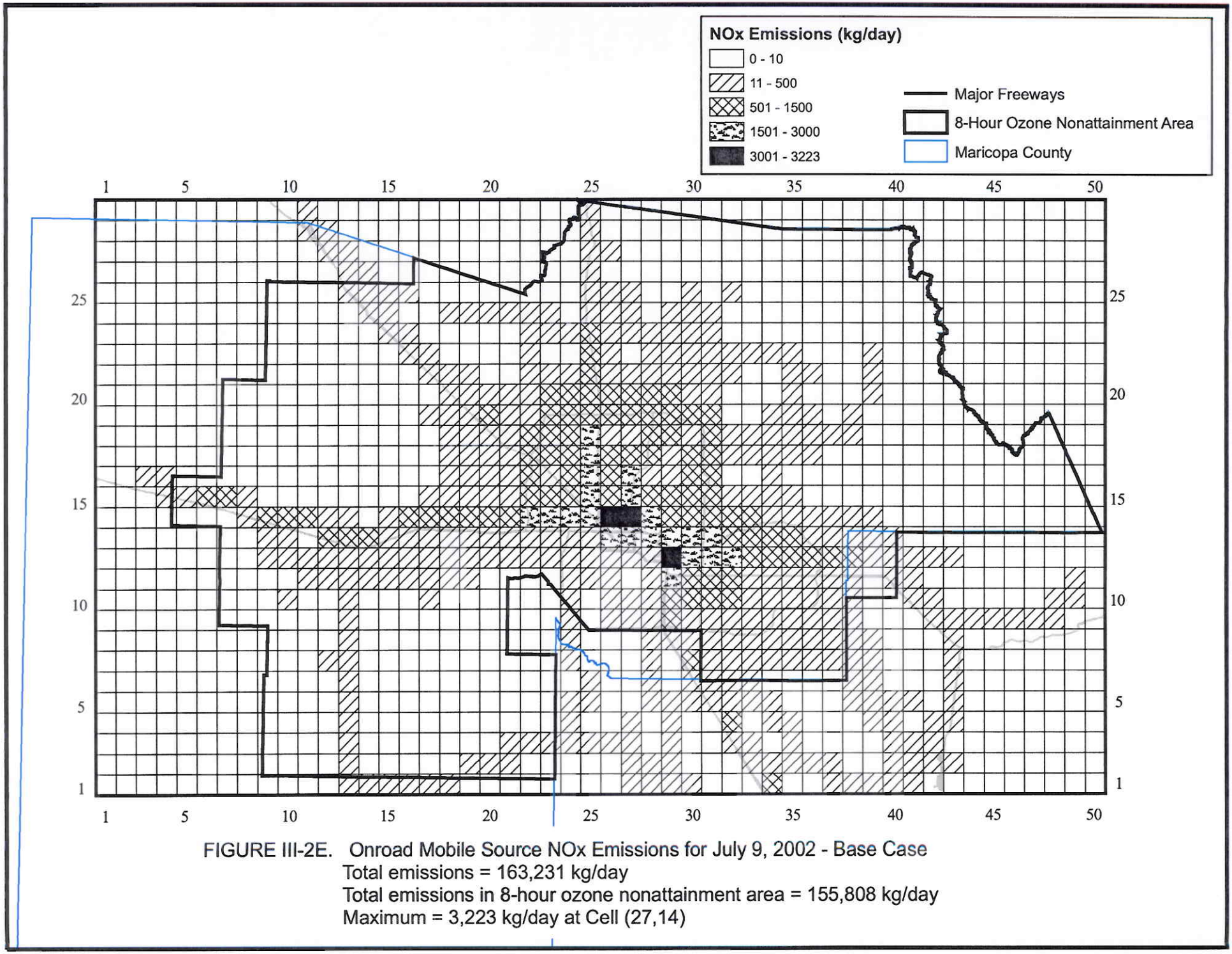


FIGURE III-2E. Onroad Mobile Source NOx Emissions for July 9, 2002 - Base Case
Total emissions = 163,231 kg/day
Total emissions in 8-hour ozone nonattainment area = 155,808 kg/day
Maximum = 3,223 kg/day at Cell (27,14)

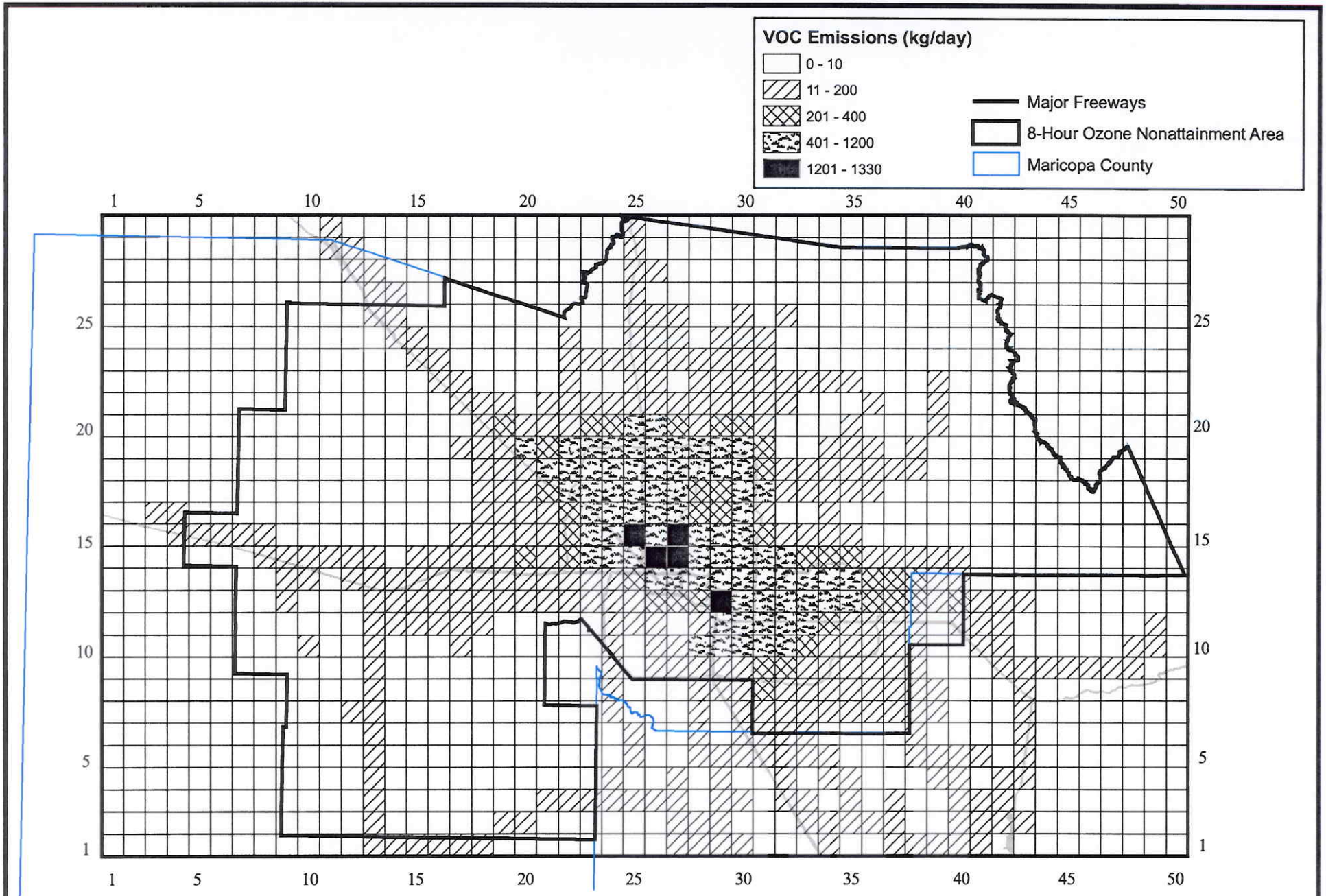


FIGURE III-2F. Onroad Mobile Source VOC Emissions for July 9, 2002 - Base Case
Total emissions = 88,128 kg/day
Total emissions in 8-hour ozone nonattainment area = 84,036 kg/day
Maximum = 1,330 kg/day at Cell (27,15)

III-1-2. Biogenics Source Emissions

Biogenic emissions estimates for the modeling domain were prepared using the MEGAN Biogenic Emissions Inventory System [6,7]. MEGAN is an acronym of Model of Emissions of Gases and Aerosols from Nature, which is a biogenic emissions model designed to generate hourly gridded VOC, NOx, and CO emissions. MAG contracted with ENVIRON International Corporation and Dr. Guenther in 2005 to develop a more reliable and accurate biogenic emission model and update and/or supplement desert plant emission rates within Maricopa County. ENVIRON and Dr. Guenther provided MAG with MEGAN as a next generation state-of-art biogenic emission model. The emission factors used in MEGAN were developed based on the results of a field study to identify prevalent plant species in Maricopa County, including their locations and biomass density [8].

MEGAN requires gridded meteorological data generated by the Penn State/NCAR Mesoscale Meteorological Model 5 (MM5) as inputs. The MM5 gridded meteorological data need to be formatted for MEGAN ASCII input format. Gridded solar radiation, temperature, wind speed, humidity, and soil moisture data can be typically obtained by the MM5 runs. The MEGAN2DVP program, included in the MEGAN package, extracts monthly leaf area index (LAI), plant function type (PFT), gridded emission factors, and light dependence factors (LDF) from MEGAN data portal files which are needed to run MEGAN along with the MM5 generated meteorological data.

The MEGAN program creates an EPS3.0 ready hourly gridded emissions file. The program calculates the vegetation emissions for chemical species defined in Carbon Bond IV chemical mechanism. Since gridded hourly emissions files generated by MEGAN are based on the ASCII file format, emissions need to be converted to a EPS3.0 binary emission file format. ENVIRON developed a utility program for the conversion based on FORTRAN programming language. The utility program converts ASCII biogenic emissions to binary file which is merged with anthropogenic emissions using the EPS3.0 MRGUAM module. Tables III-2, III-3, III-4 summarize the biogenic emissions by species for the 2001 and 2002 episode days.

Table III-2. Summary of the August 2001 biogenic emissions for the modeling domain

Date	Daily Emission (metric tons/day)	
	NOx	VOC
August 2	9.5	394.1
August 3	9.2	324.5
August 4	8.9	271.5
August 5	9.8	437.3
August 6	10.9	513.7
August 7	10.0	362.3
August 8	9.4	390.7
August 9	8.3	271.5
August 10	9.6	398.4
August 11	10.3	440.6

Table III-3. Summary of the June 2002 biogenic emissions for the modeling domain

Date	Daily Emission (metric tons/day)	
	NOx	VOC
May 31	8.4	451.4
June 1	7.8	407.4
June 2	6.8	332.3
June 3	6.2	286.5
June 4	6.5	303.7
June 5	7.4	374.5
June 6	8.6	451.3
June 7	8.1	435.7

Table III-4. Summary of the July 2002 biogenic emissions for the modeling domain

Date	Daily Emission (metric tons/day)	
	NOx	VOC
July 5	10.0	566.0
July 6	10.6	610.9
July 7	10.9	628.1
July 8	11.9	651.1
July 9	11.9	639.9
July 10	10.5	522.2
July 11	11.2	549.4
July 12	11.5	541.9
July 13	11.4	589.9
July 14	8.9	388.0

III-1-3. Nonroad Mobile Source Emissions

Nonroad mobile sources are defined as those sources that move or are moved within a 12-month period and are not licensed or certified as highway vehicles. Nonroad emissions result from the burning of fuel by a diverse collection of vehicles and equipment. Nonroad mobile sources are vehicles and engines that fall under the following categories:

- Agricultural equipment, such as tractors;
- Airport ground support equipment, such as baggage tugs, and terminal tractors;
- Commercial equipment, such as generators and pumps;
- Industrial equipment, such as forklifts and sweepers;
- Construction and mining equipment, such as graders, back hoes and trenchers;
- Lawn and garden equipment, such as leaf blowers and lawn mowers;
- Logging equipment, such as shredders and large chain saws;
- Pleasure craft, such as power boats and personal watercraft;
- Railway maintenance equipment, such as rail straighteners;
- Recreational equipment, such as all-terrain vehicles and off-road motorcycles;
- Underground mining and oil field equipment, such as mechanical drilling engine
- Aircraft, such as jet and piston engines; and
- Locomotives, such as switching and line haul trains.

EPA's NONROAD2002 model(Core Version 2.1d March, 2002) was used to estimate emissions for all nonroad mobile source categories except aircraft and locomotives. Aircraft emissions was calculated using the airport emissions model developed under Phase II of the MAG Aviation Air Quality Study. Refer to section III-1-4 for additional details. Locomotive emissions was obtained from the Maricopa County Air Quality Department and are shown in table III-6. Nonroad emissions were calculated for the following periods - August 2001, May 2002, and Summer 2002. The fuel types include gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG).

Temperature and fuel-related inputs required for the operation of the NONROAD2002 model were obtained from the Maricopa County Air Quality Department [2]. The inputs are listed below:

- Fuel volatility (Reid Vapor Pressure [RVP]), psi: 9.0 in winter, 8.1 in spring, 7.8 summer and fall.
- Gasoline oxygen content (weight %): 3.36 from October through February, 0.0 otherwise.
- Gasoline sulfur content (ppm): 179 in fall and winter, 115 in spring and summer.
- Diesel sulfur content (ppm): 310 all seasons.
- Temperatures (minimum/average/maximum °F): 39/55/65 winter, 53/72/83 Spring,78/94/104 summer, 57/78/87 fall.

Arizona-specific estimates developed for the Western Regional Air Partnership (WRAP)

were applied in the NONROAD2002 model to produce 2001 and 2002 nonroad emissions. Table V-9 provides the growth factors for 2002 relative to 1996 by nonroad category.

Equipment population numbers and activity levels for commercial lawn and garden equipment were adjusted based on survey results of the commercial lawn and garden industry performed by ENVIRON as part of the CTOC (Cap and Trade Oversight Committee) work. Survey results show that for most categories of lawn and garden equipment, the equipment populations for Maricopa County are significantly lower than EPA default values, while the average annual hours of operation for most equipment types are slightly higher than EPA's values. Temporal allocations for nonroad equipment categories modeled in the NONROAD2002 model come from EPA recommendations on weekday and weekend day activity levels for each nonroad equipment category[9].

Locomotive Emissions

Locomotive emissions were obtained from MCAQD (Maricopa County Air Quality Department). MCAQD provided the methodology for calculating the locomotive emissions. Annual emissions from locomotives were calculated based on diesel fuel usage provided by Burlington Northern/Santa Fe Railway (BNSF) and Union Pacific Railway (UP). Railway operations from these companies fall into two categories: Class I haul lines and Class II yard/switching operations. No Class II or Class III haul lines operated in Maricopa County in 2002. Annual emissions from Class I haul operations and Class II yard/switching operations were calculated by multiplying diesel fuel usage by EPA emission factors for VOC, NOx, and CO [10]. The annual emissions are divided by four to obtain the 2002 summer season locomotive emissions shown in Table III-5.

Table III-5. Summer 2002 emissions (tons/season) from locomotives in Maricopa County

Locomotive Type	VOC	NOx	CO
Haul Line (Class I)	27.58	745.88	83.34
Yard/Switching Operations (Class II)	6.64	115.2	13.82

Aviation Emissions

The airport emissions model was developed under Phase II of the MAG Aviation Air Quality Study. The aviation emission estimates were obtained from the MAG Aviation Emissions Preprocessor, described in the report by Lee Engineering (November 1996) [11] Airport activity levels were based on surveys conducted at each airport which included questions about aircraft activity, ground service vehicle use, fuel use, and coating operations. The activity data for the preprocessor were collected through airport surveys conducted in 2000. Emission factors for estimating aircraft emissions were calculated using the FAA Aircraft Engine Emissions Database (FAEED) and were supplemented with

emission factors not included in the FAEED database, based upon EPA guidance [12]. The preprocessor also adjusts emission estimates based upon episode-specific mixing heights obtained from ENVIRON and includes an algorithm which improves estimates of time-in-mode during busy periods.

The MAG Aviation Emissions Preprocessor was initially designed to model aviation-related emissions for a 1995 time frame. In order to develop emission estimates for the years modeled in this analysis (2001 and 2002), total operations were assumed to be the same for the years 2000, 2001 and 2002 [13]. The same assumption was used for ground service equipment activity levels for the years 2000, 2001 and 2002. A more comprehensive description of the growth factors used can be found in Section VI-3-4.

Thirteen airports are located within the ozone modeling domain: Chandler, Deer Valley, Glendale Municipal, Goodyear, Luke, Memorial, Mesa Falcon Field, Pleasant Valley, Scottsdale Municipal, Sky Harbor International, Sky Ranch, Stellar Airpark, and Williams Gateway. Emission totals from aviation-related sources at these airports are estimated using the MAG Aviation Emissions Preprocessor (Lee Engineering, 1996) [11]. The aviation-related sources include both emissions from aircraft, which are estimated on an hourly basis, and ground service vehicles, which are estimated on a daily basis. There are only VOC emissions from refueling or fuel storage activities in the preprocessor output. The hourly emissions from aircraft and daily emissions from ground service vehicles are assigned to links for further processing in the EPS3.0 LBASE program. Tables III-6 A, B and C provide a summary of the aviation-related emissions by airport for the ozone modeling domain.

Table III-6A. June 06, 2002 summary of the Aviation-related Emissions (metric Tons/day) by Airport for the Ozone Modeling Domain.

Airport	Aircraft		GSE		Refueling	Fuel Storage	Total	
	VOC	NOx	VOC	NOx	VOC	VOC	VOC	NOx
Buckeye	0.0236	0.0040	0.0001	0.0000	0.0001	0.0020	0.0257	0.0040
Chandler	0.0653	0.0111	0.0006	0.0072	0.0006	0.0095	0.0791	0.0183
Estrella	0.0043	0.0007	0.0000	0.0000	0.0000	0.0000	0.0043	0.0007
Glendale	0.0296	0.0050	0.0004	0.0058	0.0004	0.0061	0.0400	0.0108
Memorial	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0006	0.0001
Mesa Falcon Field	0.0720	0.0122	0.0011	0.0115	0.0011	0.0168	0.0982	0.0237
Deer Valley	0.0971	0.0165	0.0006	0.0006	0.0006	0.0086	0.1069	0.0171
Goodyear	0.0373	0.0063	0.0015	0.0311	0.0015	0.0220	0.0750	0.0374
Sky Harbor	0.5777	4.7918	0.4202	1.1815	0.4202	6.3432	7.6785	5.9733
Pleasant Valley	0.0134	0.0023	0.0000	0.0000	0.0000	0.0000	0.0134	0.0023
Scottsdale	0.0538	0.0091	0.0057	0.0139	0.0057	0.0859	0.1494	0.0230
Sky Ranch Carefree	0.0012	0.0002	0.0001	0.0000	0.0001	0.0009	0.0022	0.0002
Stellar Airpark	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0012	0.0002
Williams Gateway	0.0409	0.0070	0.0032	0.0427	0.0032	0.0486	0.1009	0.0497

Table III-6B. July 09,2002 summary of the Aviation-related Emissions (metric Tons/day) by Airport for the Ozone Modeling Domain.

Airport	Aircraft		GSE		Refueling	Fuel Storage	Total	
	VOC	NOx	VOC	NOx	VOC	VOC	VOC	NOx
Buckeye	0.0236	0.0040	0.0001	0.0000	0.0001	0.0020	0.0257	0.0060
Chandler	0.0653	0.0111	0.0006	0.0072	0.0006	0.0095	0.0791	0.0278
Estrella	0.0043	0.0007	0.0000	0.0000	0.0000	0.0000	0.0043	0.0007
Glendale	0.0296	0.0050	0.0004	0.0058	0.0004	0.0061	0.0400	0.0169
Memorial	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0006	0.0001
Mesa Falcon Field	0.0720	0.0122	0.0011	0.0115	0.0011	0.0168	0.0982	0.0405
Deer Valley	0.0971	0.0165	0.0006	0.0006	0.0006	0.0086	0.1069	0.0257
Goodyear	0.0373	0.0063	0.0015	0.0311	0.0015	0.0220	0.0750	0.0594
Sky Harbor	0.5777	4.7918	0.4202	1.1815	0.4202	6.3432	7.6627	11.2431
Pleasant Valley	0.0134	0.0023	0.0000	0.0000	0.0000	0.0000	0.0134	0.0023
Scottsdale	0.0538	0.0091	0.0057	0.0139	0.0057	0.0859	0.1494	0.1089
Sky Ranch Carefree	0.0012	0.0002	0.0001	0.0000	0.0001	0.0009	0.0022	0.0011
Stellar Airpark	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0012	0.0002
Williams Gateway	0.0409	0.0070	0.0032	0.0427	0.0032	0.0486	0.1009	0.0983

Table III-6C. August 10,2001 summary of the Aviation-related Emissions (metric Tons/day) by Airport for the Ozone Modeling Domain.

Airport	Aircraft		GSE		Refueling	Fuel Storage	Total	
	VOC	NOx	VOC	NOx	VOC	VOC	VOC	NOx
Buckeye	0.0236	0.0040	0.0001	0.0000	0.0001	0.0020	0.0257	0.0040
Chandler	0.0653	0.0111	0.0006	0.0072	0.0006	0.0095	0.0791	0.0183
Estrella	0.0043	0.0007	0.0000	0.0000	0.0000	0.0000	0.0043	0.0007
Glendale	0.0296	0.0050	0.0004	0.0058	0.0004	0.0061	0.0400	0.0108
Memorial	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0006	0.0001
Mesa Falcon Field	0.0720	0.0122	0.0011	0.0115	0.0011	0.0168	0.0982	0.0237
Deer Valley	0.0971	0.0165	0.0006	0.0006	0.0006	0.0086	0.1069	0.0171
Goodyear	0.0373	0.0063	0.0015	0.0311	0.0015	0.0220	0.0750	0.0374
Sky Harbor	0.5777	4.7918	0.4202	1.1815	0.4202	6.3432	7.6876	6.2513
Pleasant Valley	0.0134	0.0023	0.0000	0.0000	0.0000	0.0000	0.0134	0.0023
Scottsdale	0.0538	0.0091	0.0057	0.0139	0.0057	0.0859	0.1494	0.0230
Sky Ranch Carefree	0.0012	0.0002	0.0001	0.0000	0.0001	0.0009	0.0022	0.0002
Stellar Airpark	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0012	0.0002
Williams Gateway	0.0409	0.0070	0.0032	0.0427	0.0032	0.0486	0.1009	0.0497

Summary

Table III-7 summarizes 2002 summer emissions of VOC, NOx, and CO from nonroad mobile sources in Maricopa County.

Table III-7. 2002 summer emissions from nonroad mobile sources in Maricopa County (tons/season)

Equipment Category	VOC	NOx	CO
Agricultural Equipment	18.87	124.28	146.36
Commercial Equipment	687.36	303.32	13139.14
Construction and Mining Equipment	817.77	4094.95	6900.89
Industrial Equipment	220.29	824.37	3671.90
Lawn and Garden Equipment (Res)	1644.01	67.96	15540.55
Lawn and Garden Equipment (Com)	760.10	128.49	13157.22
Pleasure Craft	382.45	24.49	892.60
Railroad Equipment	0.59	2.08	7.10
Recreational Equipment	277.22	15.42	3483.34
Locomotives	31.59	617.47	88.14
GSE	39.88	119.07	1516.58
Aircraft	89.89	447.07	1634.84
Total	**4970.02**	**6768.97**	**60178.66**

III-1-4. EPS3.0 Source Emissions (Point, Area and Nonroad Sources)

EPS3.0 source emissions (also known as "background emissions" hereafter) are defined as all emissions except those from onroad mobile and biogenics sources. That is, the EPS3.0 source emissions include point, nonroad mobile, and area sources such as industrial boilers. For this modeling analysis, the nonroad mobile source category includes aviation and locomotive emissions, in addition to gasoline and diesel-powered equipment, ranging from lawn and garden to construction equipment. Nonroad emissions are described separately in Section III-1-3.

The CAMx Emissions Preprocessor System (EPS3.0) [3] is an EPA model available for developing background emission estimates. EPS3.0 provides a series of modules into which locally derived or default data are input with the final result being emission factor files appropriate for use in the CAMx model. This section will discuss how the EPS3.0

system itself process background emissions.

EPS3.0

The CAMx Emissions Preprocessor System (EPS3.0) was used to process the emissions inventories for point, area, and nonroad mobile sources.

EPS3.0 consists of a set of FORTRAN programs that are executed sequentially to prepare the gridded emission inventory for use by the CAMx. EPS3.0 is used to process the point, area, and nonroad mobile sources emissions and to merge those emissions with onroad mobile and biogenic emissions prepared separately. The modules in the EPS3.0 programs are as follows:

PREPNT:	Prepares annual or seasonal point source inventory for further processing; identifies which sources are to be treated as elevated by the CAMx.
PREAM:	Prepares annual or seasonal county-level area and mobile source emissions for further processing.
LBASE:	Prepares link-based mobile source emission estimates for further processing and disaggregates total emissions into individual components. This module is used only for processing aviation emissions; the onroad mobile processing is done by M6Link.
CNTLEM:	Adjusts emission levels to reflect the effects of anticipated growth or implementation of proposed controls.
CHMSPL:	Assigns input hydrocarbon emissions to chemical species expected by the chemical mechanism.
TMPRL:	Temporally adjusts emissions from annual, seasonal, or typical season day to episodic levels.
GRDEM:	Spatially allocates emissions based on source location, link location, or gridded spatial surrogate indicators; converts to a CAMx-ready inventory of low-level emissions.
PSTPNT:	Reformat elevated point sources to be CAMx-ready.
MRGUAM:	Merges several files for area, mobile, low-level point source, nonroad, aviation and biogenics emissions into one CAMx-ready emissions file.
RPRTEM:	Summarizes emission totals for the modeling domain by category.
PIGEMS:	Produces an elevated emissions file to be read and used by the CAMx photochemical model. It also provides a sophisticated methodology for flagging sources for the Plume in Grid (PiG) treatment within CAMx.

Temporal Allocation of Background Emissions

EPS3.0 is used to temporally allocate the power plant point source emission data based on the operating schedule provided by the Maricopa County Air Quality Department (MCAQD). All other point sources are resolved temporally based on profiles for seasonal activity, activity provided by day of week, and diurnal patterns of activity. EPS3.0 uses monthly and day-of-week adjustment factors to convert the point source emissions to episode day values (e.g. a Thursday in July 2002 or a Monday in August 2001) . For point source emissions estimates, this information was determined from annual emission inventory reports. These emission inventory reports request seasonal throughput percentages, operating hours per day, days per week in operation, and specific hours of operation.

Nonroad and area source emissions were input to EPS3.0 as ozone seasonal totals. To convert these values to average June, July, and August daily values, EPS3.0 applies an adjustment factor representing the ratio of June, July, and August emissions to ozone seasonal emissions for each source type. A day-of-week factor is necessary to convert average day emissions to a specific day of the week. Area source seasonal data were obtained from the natural gas suppliers for fuel combustion, area source emission inventory reports for incineration, and limits of permits for open burning. Hourly data for area sources provided by MCAQD were taken from Table 6-11 of the EPA guidance for emission inventories [14]

A few diurnal profiles were based on data obtained from sources other than MCAQD. The diurnal allocation of aircraft emissions was provided by the MAG Aviation Emission Preprocessor. The temporal distribution of point, area, and nonroad mobile emissions, as well as total emissions, is shown in Figures III-1A through III-1L.

Spatial Allocation of Background Emissions

Point sources are spatially allocated on the basis of the location (UTM coordinates or latitude/longitude) of each source. Area and nonroad mobile source emissions, with the exception of aviation-related emissions, are spatially distributed based on surrogate factors that indicate emission level or activity. For this analysis, projections based on U.S. Bureau of Census population data (2000) and MAG 2004 land use data have been used to determine the spatial allocation factors for all of the area and nonroad mobile sources except for aviation. Appendix II-iii contains detailed information on the development of the spatial surrogates for this application.

Figures III-3 through III-6 illustrate the spatial distribution of the point, area, nonroad, and total background sources in the ozone modeling domain for Thursday, June 6, 2002; Tuesday, July 9, 2002; and Friday, August 10, 2001. The table below provides the maximum NOx and VOC emissions and coordinates of the grid cell location for background, onroad and total emissions.

Figures III-7 through III-10 depict the spatial distribution of total emissions for the ozone precursors (NOx and VOC), including point, area, onroad, and nonroad emissions, for June 6, 2002; July 9, 2002; and August 10, 2001, respectively. Tables III-6A, 6B, and

Table III-8. Grid cell location of maximum NOx and VOC emissions (in kilograms/day)

Source	Pollutant	June 6, 2002	July 9, 2002	August 10, 2001
Background	NOx	4950 (24,13)	4979 (24,13)	9846 (24,13)
	VOC	7377 (28,12)	7373 (28,12)	7396 (28,12)
Onroad	NOx	3566 (27,14)	3223 (27,14)	3433 (27,14)
	VOC	1390 (27,15)	1330 (27,15)	1411 (27,15)
Total	NOx	6803 (28,13)	5801 (28,13)	10,074 (24,13)
	VOC	7803 (28,12)	7812 (28,12)	7810 (28,12)

6C provide a summary of emissions for the same days.

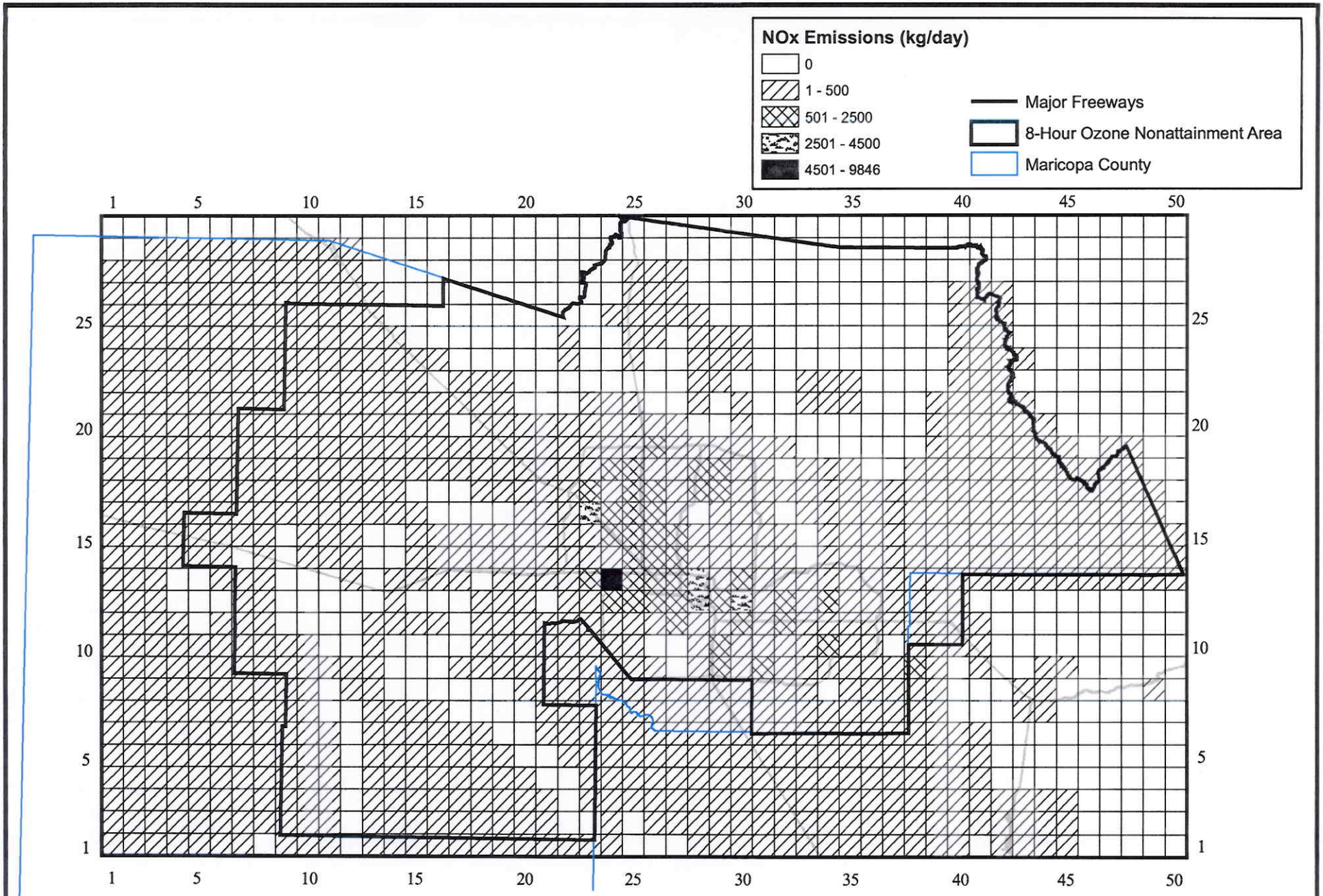


FIGURE III-3A. Background Source NOx Emissions for August 10, 2001 - Base Case
Total emissions = 96,068 kg/day
Total emissions in 8-hour ozone nonattainment area = 93,330 kg/day
Maximum = 9,846 kg/day at Cell (24,13)

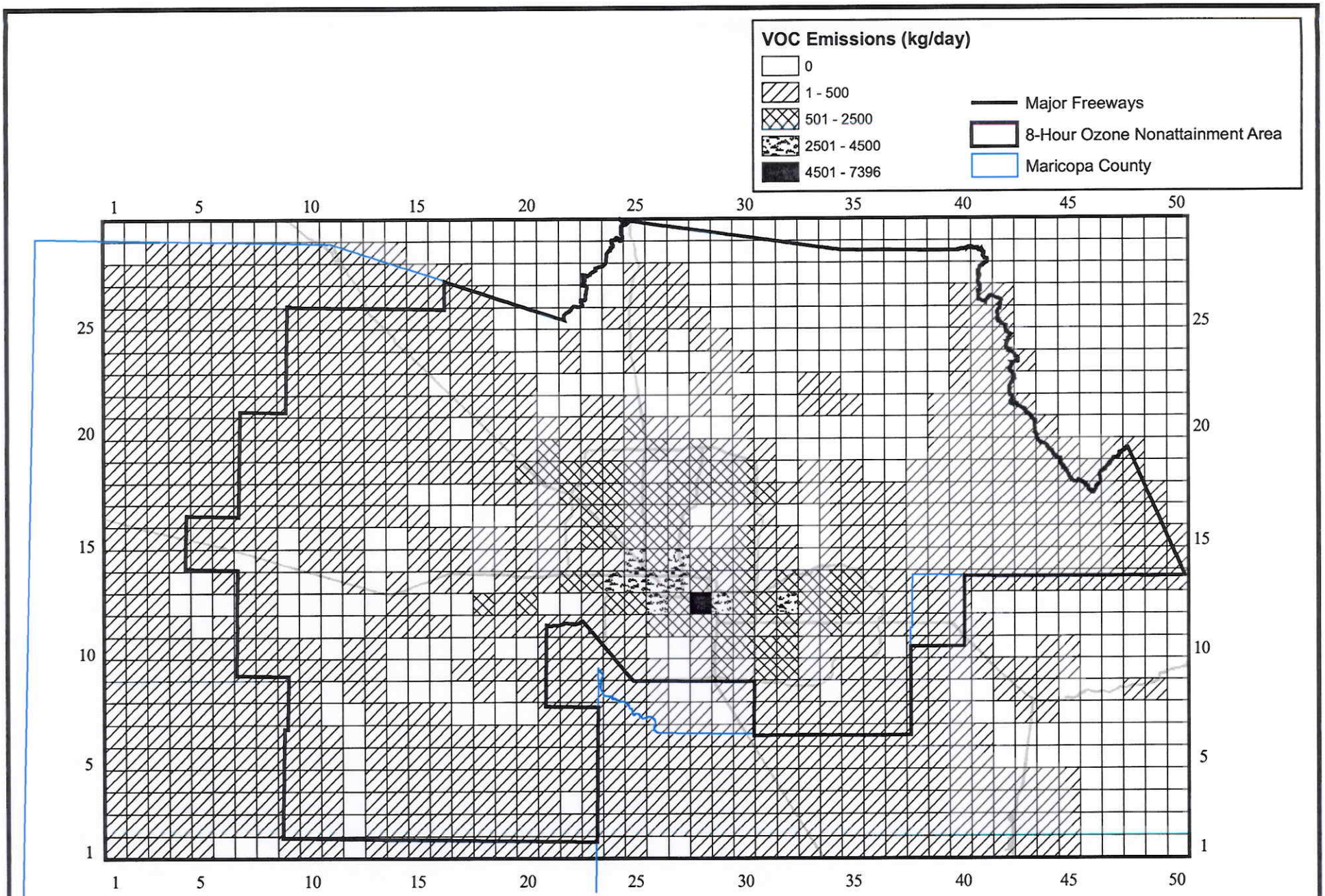


FIGURE III-3B. Background Source VOC Emissions for August 10, 2001 - Base Case
Total emissions = 142,028 kg/day
Total emissions in 8-hour ozone nonattainment area = 137,817 kg/day
Maximum = 7,396 kg/day at Cell (28,12)

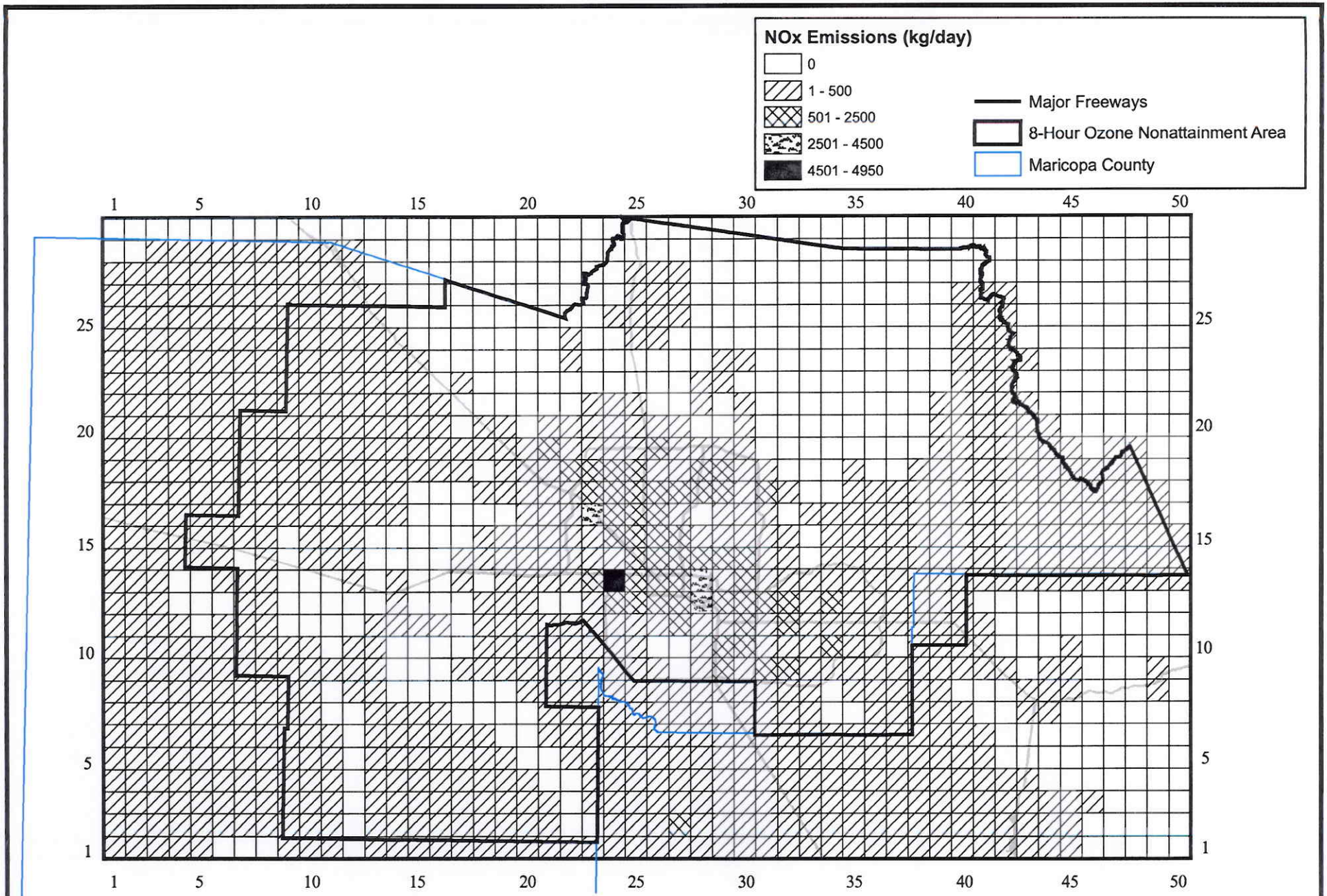


FIGURE III-3C. Background Source NOx Emissions for June 06, 2002 - Base Case
Total emissions = 99,783 kg/day
Total emissions in 8-hour ozone nonattainment area = 93,239 kg/day
Maximum = 4,950 kg/day at Cell (24,13)

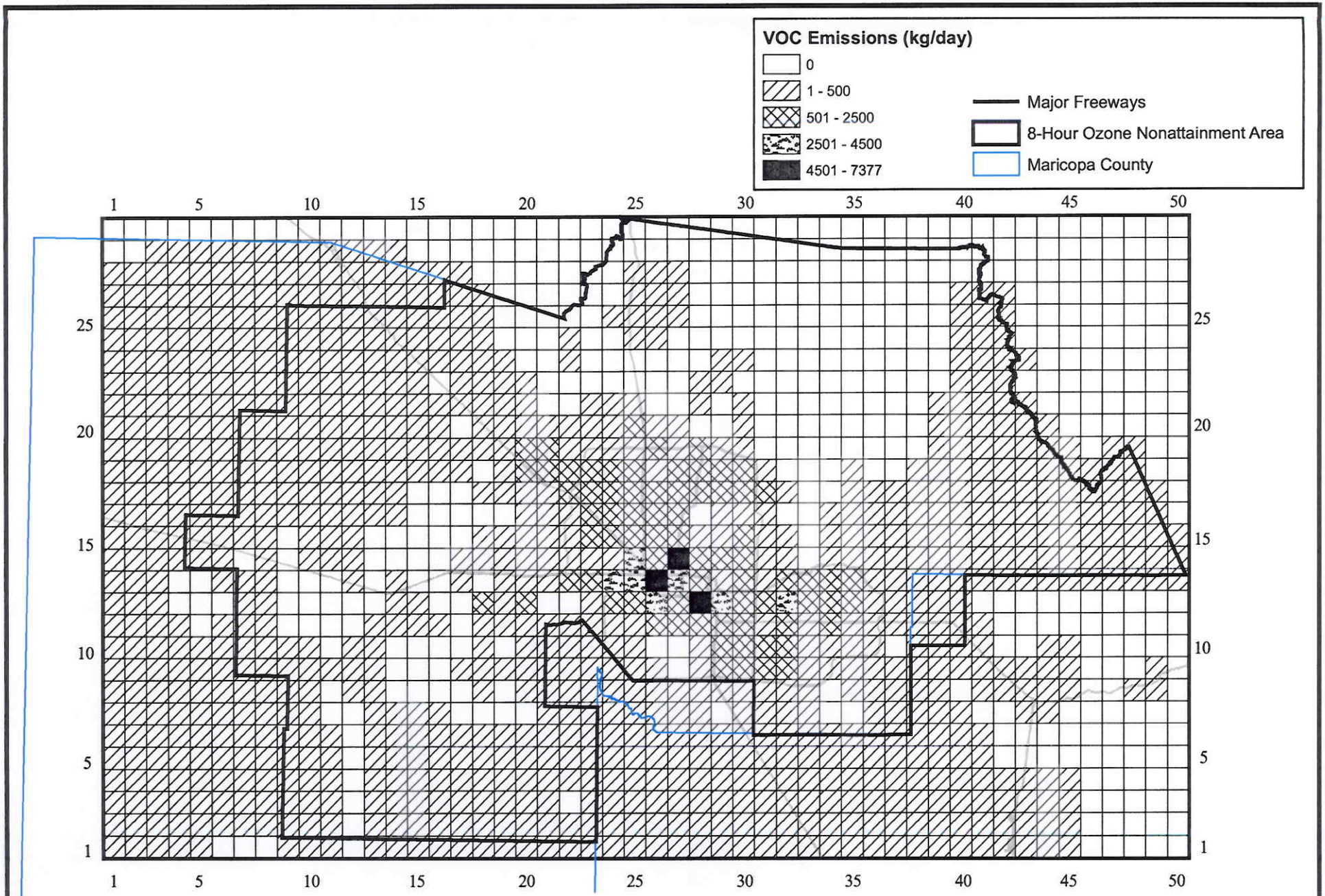


FIGURE III-3D. Background Source VOC Emissions for June 6, 2002 - Base Case
Total emissions = 153,030 kg/day
Total emissions in 8-hour ozone nonattainment area = 146,778 kg/day
Maximum = 7,377 kg/day at Cell (28,12)

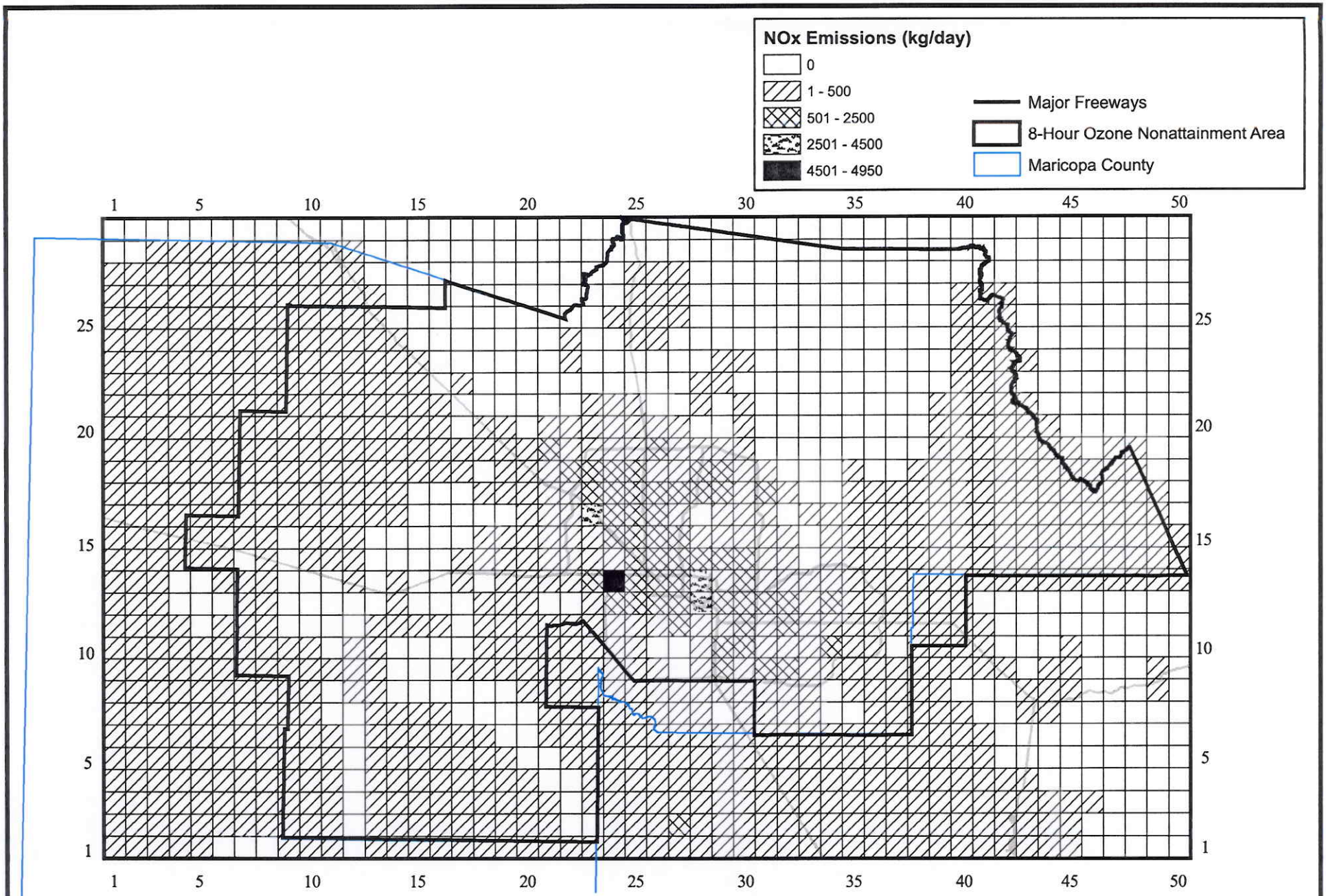


FIGURE III-3E. Background Source NOx Emissions for July 09, 2002 - Base Case
Total emissions = 98,343 kg/day
Total emissions in 8-hour ozone nonattainment area = 91,799 kg/day
Maximum = 4,950 kg/day at Cell (24,13)

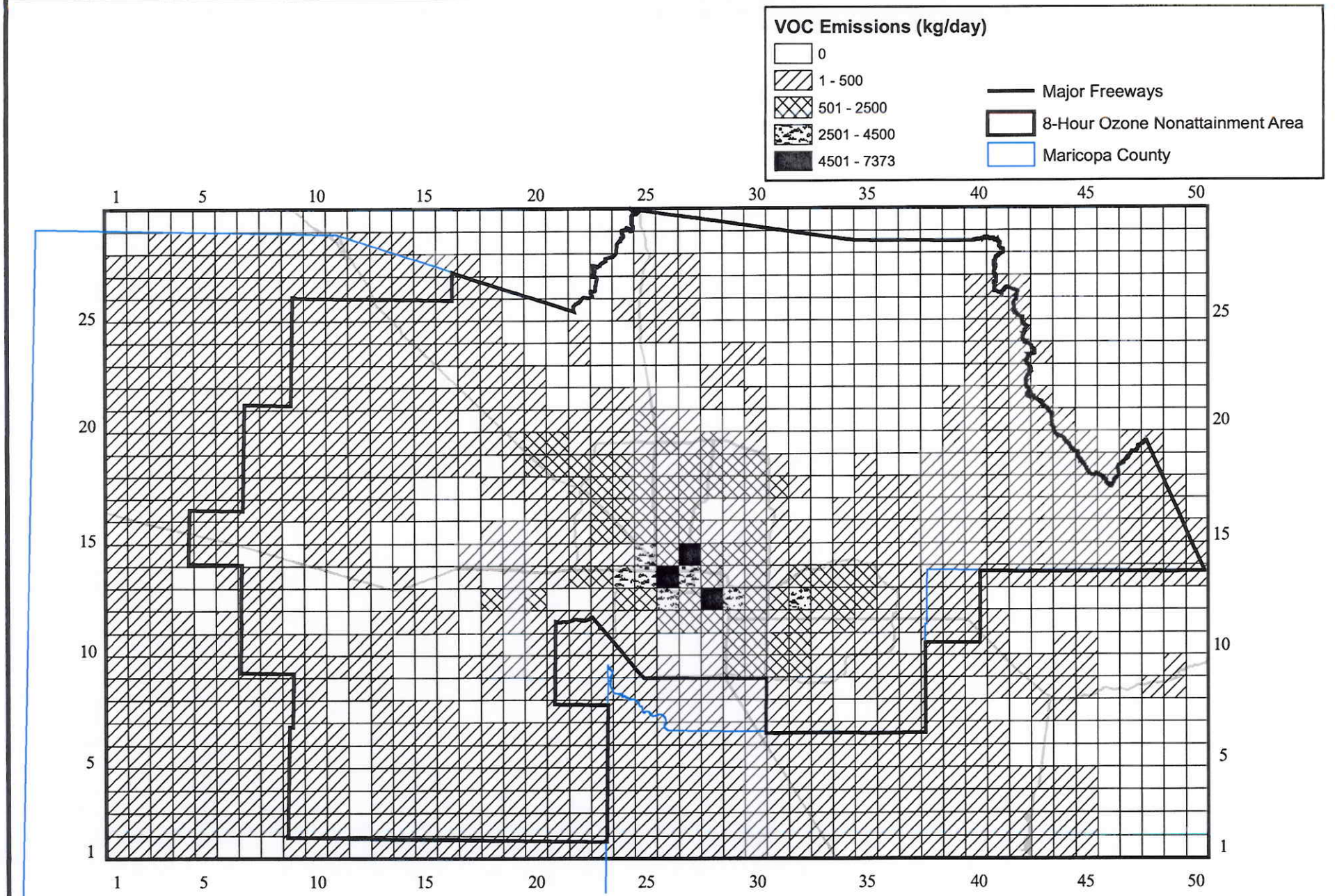


FIGURE III-3F. Background Source VOC Emissions for July 9, 2002 - Base Case
Total emissions = 153,019 kg/day
Total emissions in 8-hour ozone nonattainment area = 146,767 kg/day
Maximum = 7,373 kg/day at Cell (28,12)

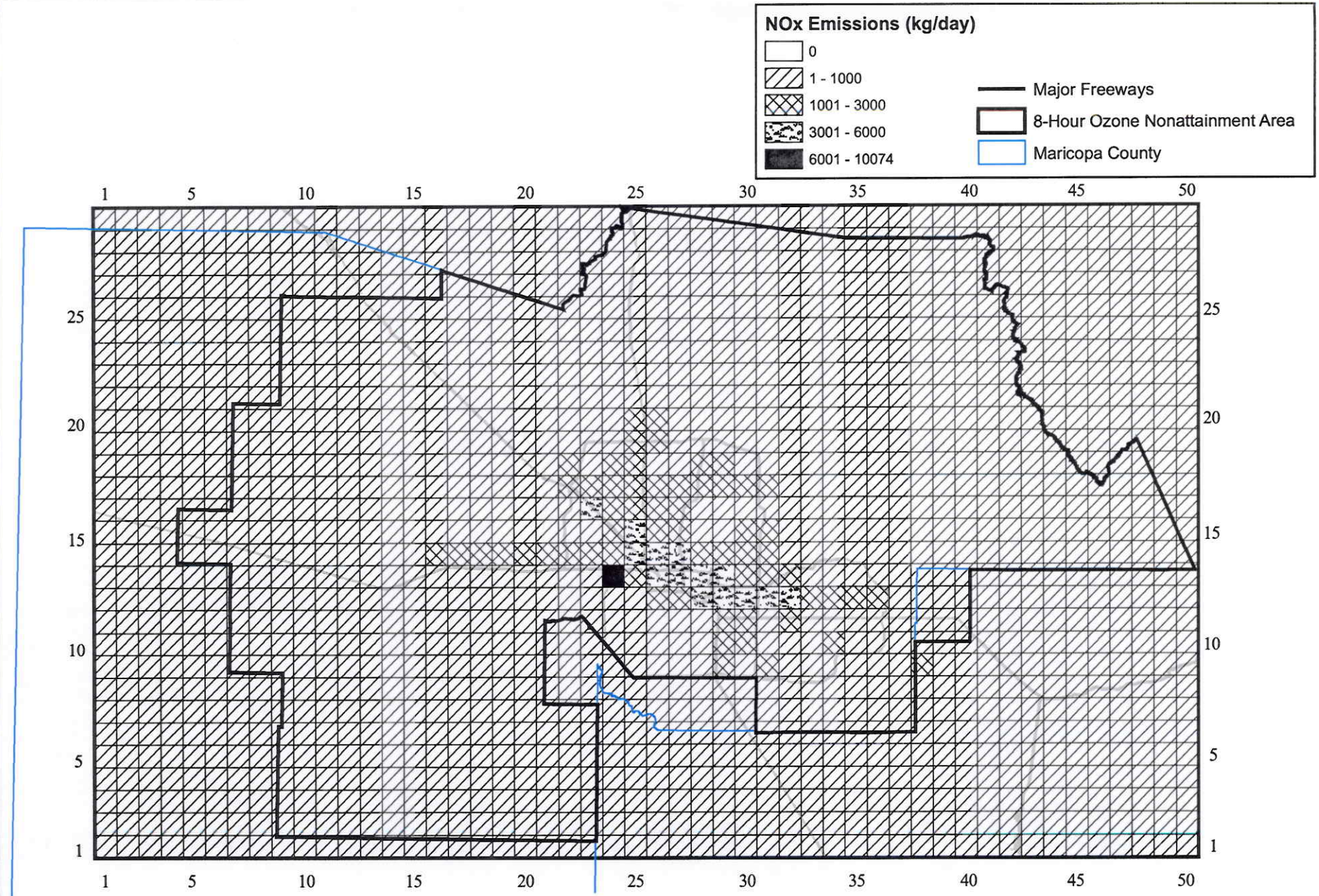


FIGURE III-3G. All Source NOx Emissions for August 10, 2001 - Base Case
Total emissions = 272,729 kg/day
Total emissions in 8-hour ozone nonattainment area = 258,841 kg/day
Maximum = 10,074 kg/day at Cell (24,13)

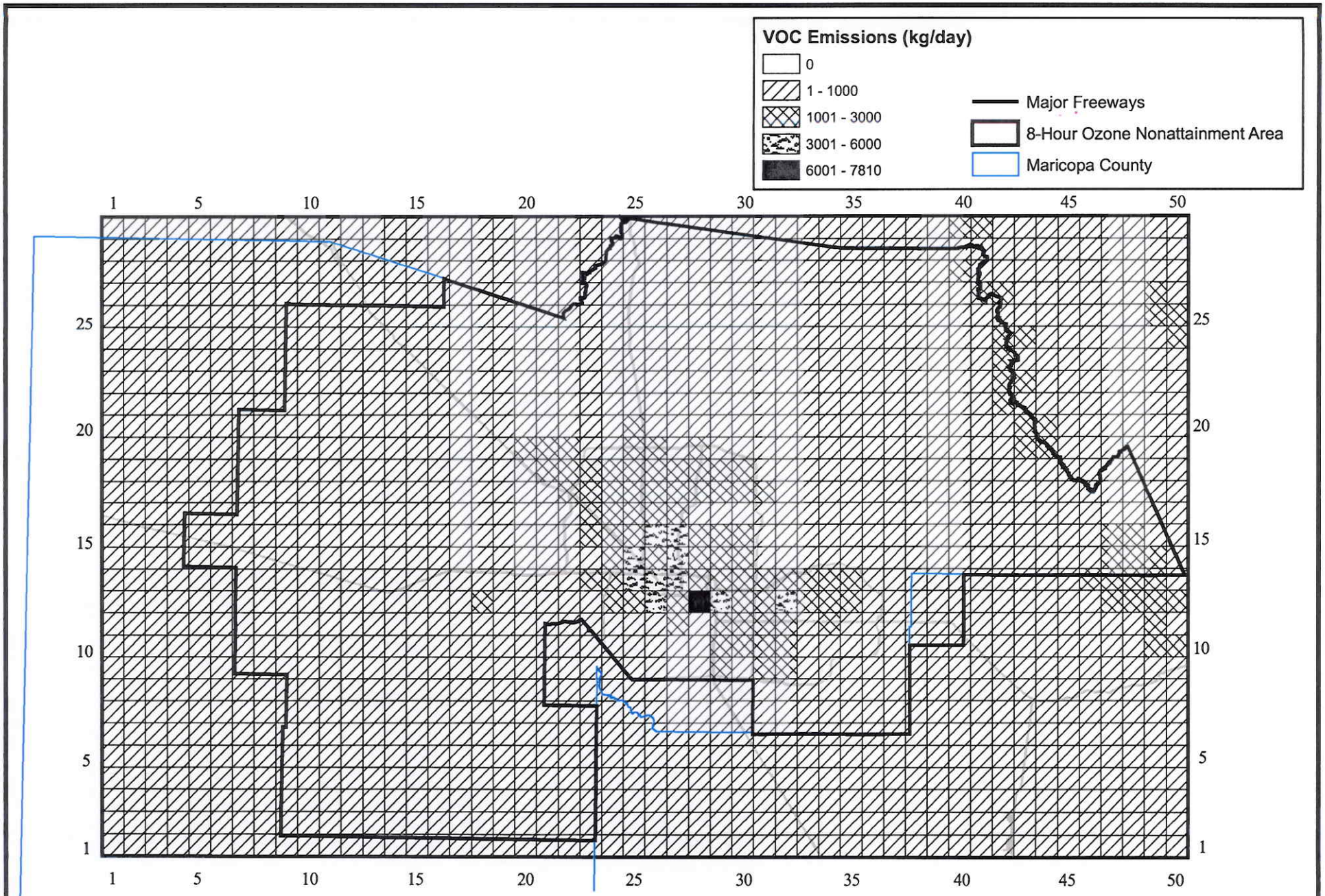


FIGURE III-3H. All Source VOC Emissions for August 10, 2001 - Base Case
Total emissions = 631,154 kg/day
Total emissions in 8-hour ozone nonattainment area = 457,106 kg/day
Maximum = 7,810 kg/day at Cell (28,12)

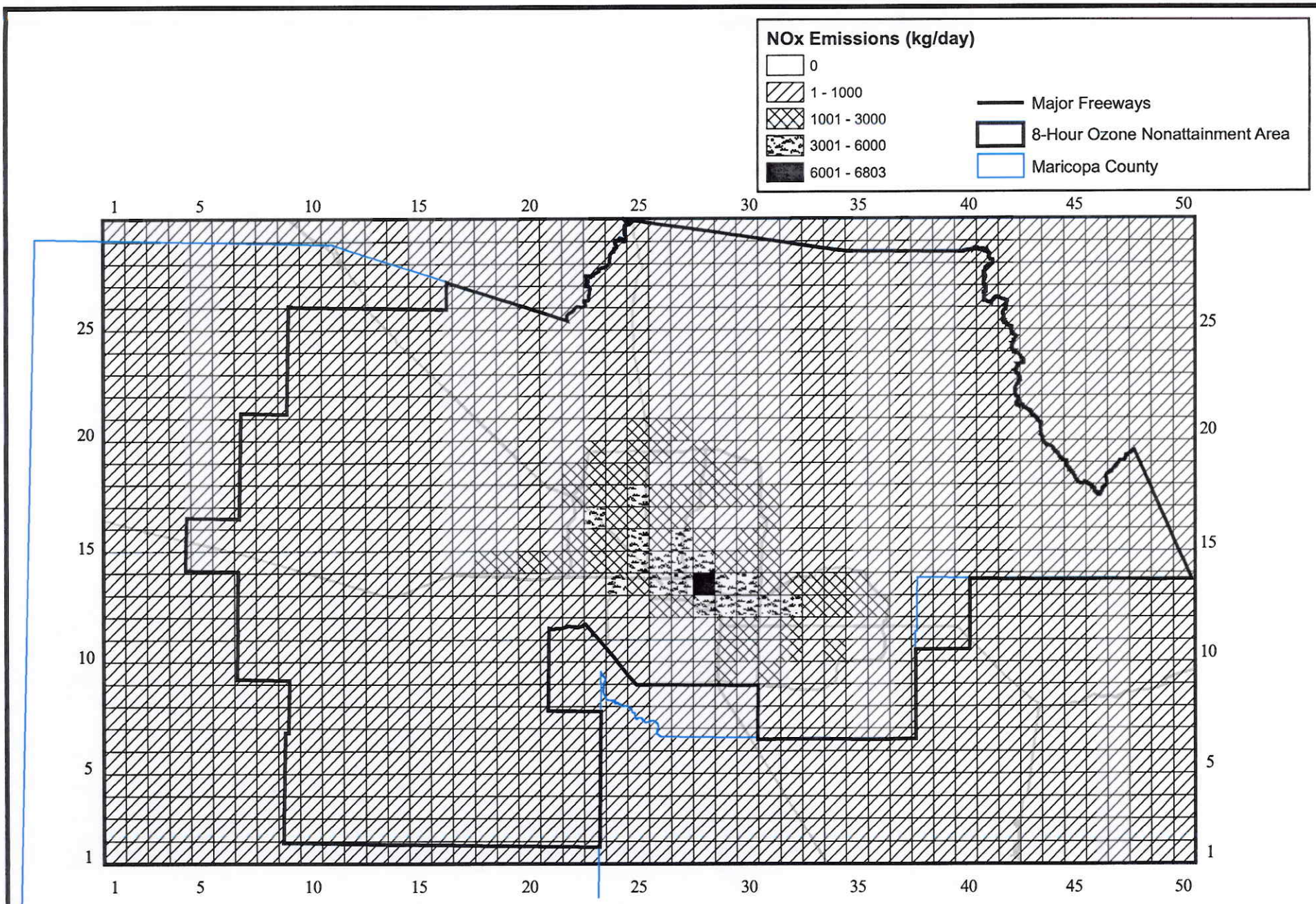


FIGURE III-3I. All Source NOx Emissions for June 6, 2002 - Base Case
Total emissions = 290,655 kg/day
Total emissions in 8-hour ozone nonattainment area = 272,444 kg/day
Maximum = 6,803 kg/day at Cell (28,13)

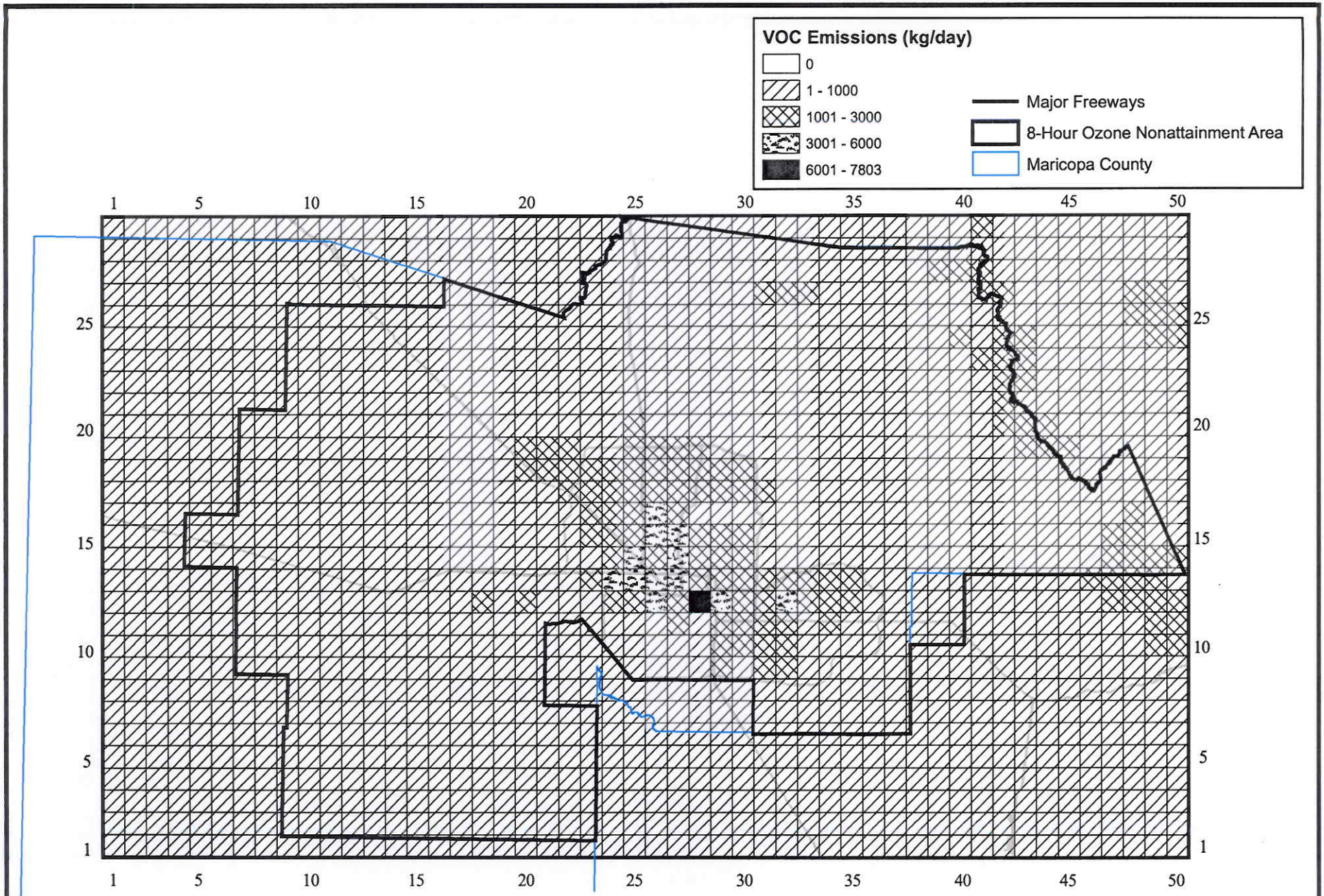


FIGURE III-3J. All Source VOC Emissions for June 6, 2002 - Base Case
Total emissions = 696,307 kg/day
Total emissions in 8-hour ozone nonattainment area = 501,910 kg/day
Maximum = 7,803 kg/day at Cell (28,12)

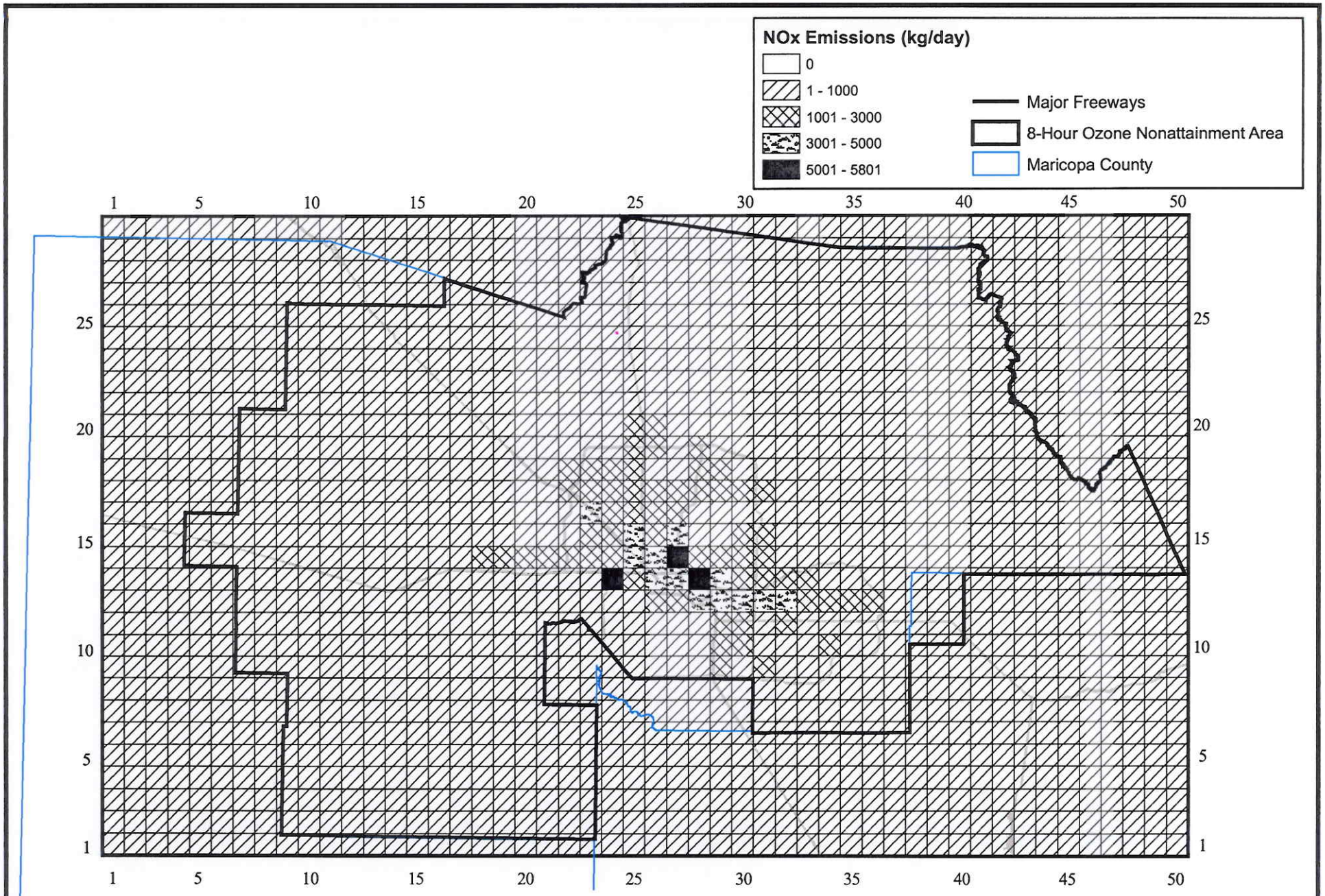


FIGURE III-3K. All Source NOx Emissions for July 09, 2002 - Base Case
Total emissions = 273,407 kg/day
Total emissions in 8-hour ozone nonattainment area = 254,806 kg/day
Maximum = 5,801 kg/day at Cell (28,13)

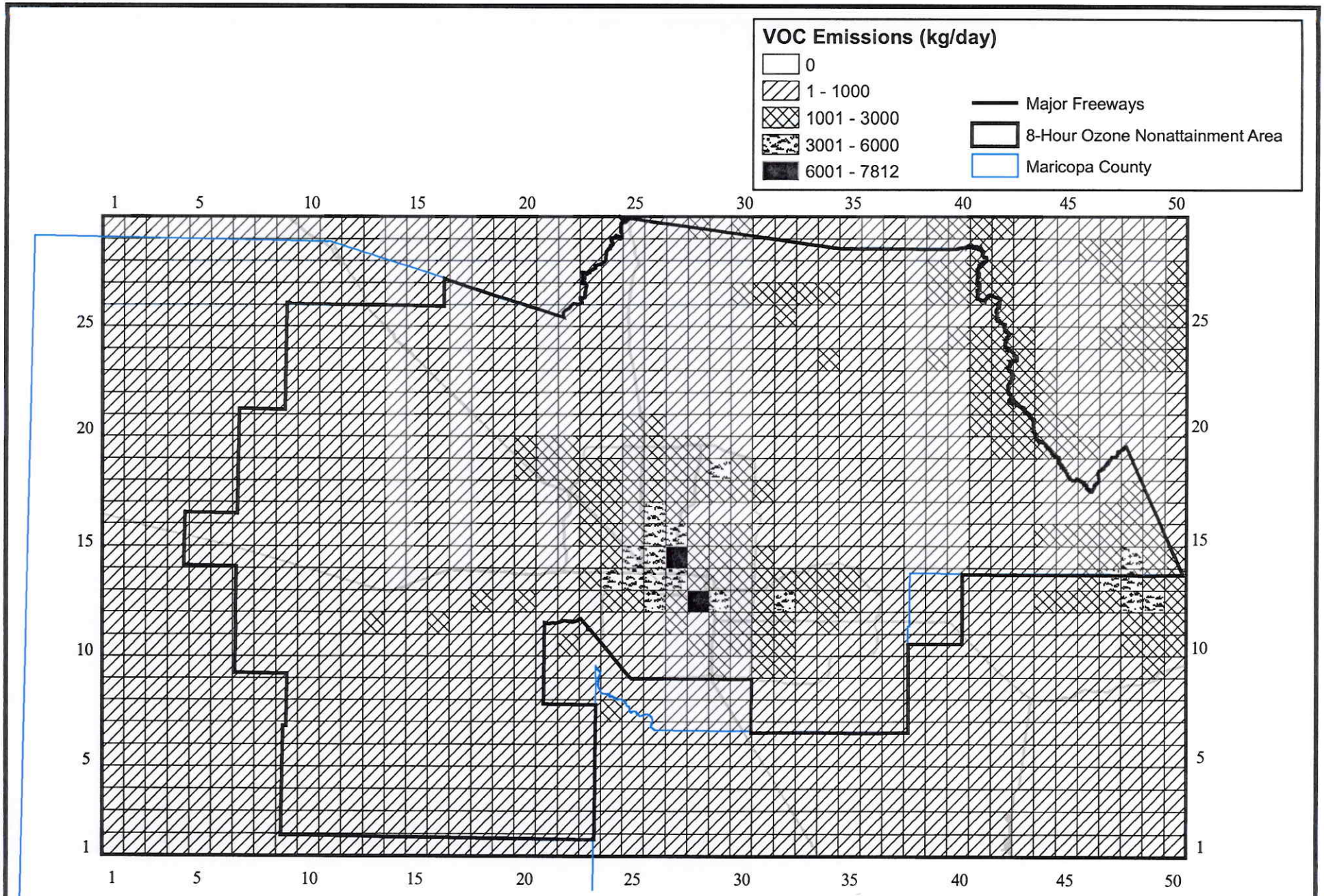
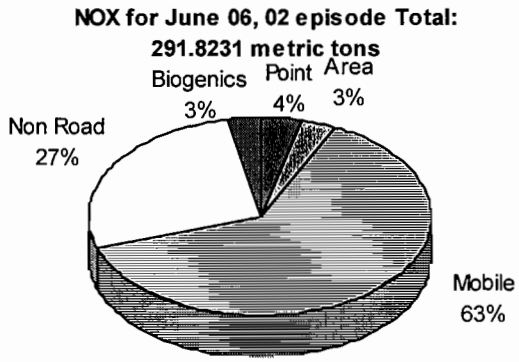


FIGURE III-3L. All Source VOC Emissions for July 9, 2002 - Base Case
Total emissions = 881,274 kg/day
Total emissions in 8-hour ozone nonattainment area = 614,252 kg/day
Maximum = 7,812 kg/day at Cell (28,12)

Table III-9A. Emission totals (metric tons/day) for June 06, 2002 for the ozone modeling domain.

Source	NOx	VOC
Point	11.1	11.7
Area	9.8	90.6
Nonroad Mobile	80.0	50.7
Onroad Mobile	182.4	91.8
Biogenics	8.6	451.3
Total	**291.8**	**696.1**



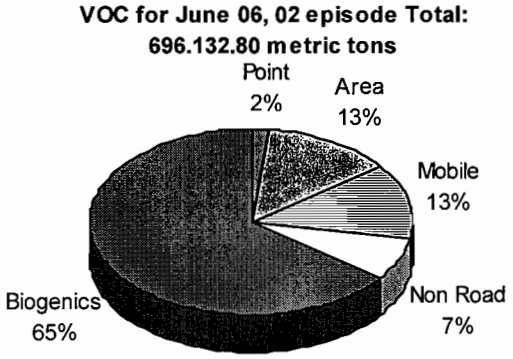
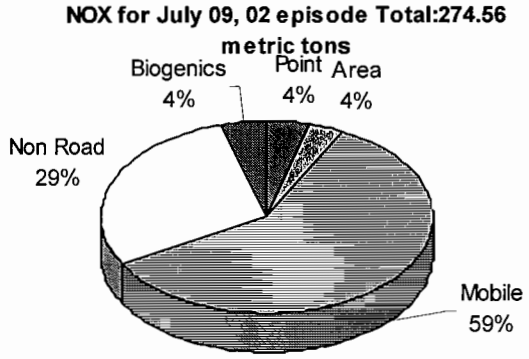


Table III-9B. Emission totals (metric tons/day) for July 09, 2002 for the ozone modeling domain.

Source	NOx	VOC
Point	11.1	11.7
Area	9.8	90.6
Nonroad Mobile	78.5	50.7
Onroad Mobile	163.2	88.1
Biogenics	11.9	639.9
Total	**274.5**	**881.0**



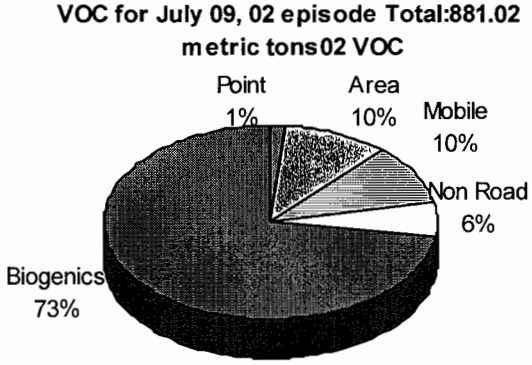
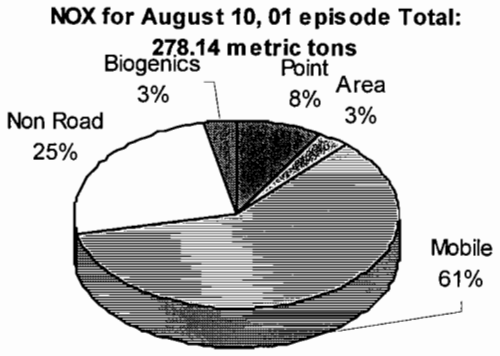
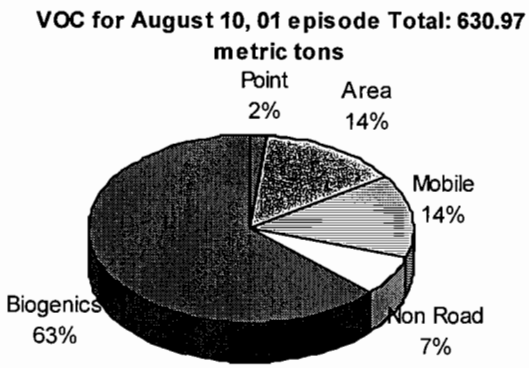


Table III-9C. Emission totals (metric tons/day) for August 10, 2001 for the ozone modeling domain.

Source	NOx	VOC
Point	23.2	10.3
Area	9.4	87.7
Nonroad Mobile	68.9	44.2
Onroad Mobile	167.1	90.4
Biogenics	9.6	398.4
Total	**278.1**	**631.0**





III-2. Meteorological Inputs

Meteorological inputs required by CAMx include three-dimensional gridded fields of layer average height, pressure, wind, temperature, water vapor concentration, cloud, rain, and vertical diffusivity. These meteorological inputs for the three eight-hour ozone episodes were developed using the PSU/NCAR MM5 prognostic meteorological model by ENVIRON. Highlights of MM5 model preparation, configuration, and sensitivity test include:

- *The MM5 model with four-dimensional data assimilation (FDDA) has been applied to the region surrounding the Maricopa County on three nested-grid domains having grid resolutions of 35-, 12-, and 4-km. All grids were configured with 34 layers in the vertical direction, having greater resolution near the surface and in the boundary layers, with deeper layers aloft. The configurations of physics and FDDA options from the WRAP study were first adopted for all three episodes. Data were assimilated into model runs using analysis nudging on all grids and observation nudging on the 12-km and 4-km domains. Observations from DS472 and MAG (including AZMET, NWS, and FSL) datasets were used for observation nudging and model evaluation. Due to the lack of convective activity in the June 2002 episode, MM5 performed quite well in the Maricopa area without the need for additional work.*

- *A series of sensitivity tests over the July 2002 episode was designed to address the overestimate of convective activity and related model performance problems. Results from these runs showed that various FDDA configurations had limited impacts on improving the model performance. By changing the cumulus scheme to a more updated and sophisticated algorithm, and making other adjustments to soil moisture, the wind, temperature and humidity fields over the July 2002 episode finally closed to near the benchmarks suitable for air quality modeling. Similar configurations were applied for the August 2001 episode as well.*

Detailed information for MM5 model preparation, configuration, and sensitivity tests are provided in Appendices III-i and III-ii *"MM5 Meteorological Simulations in Support of Eight-hour Ozone Modeling for the Maricopa Nonattainment Area"* [15,16].

The MM5CAMx pre-processor was used to convert the hourly, three-dimensional, and multi-scale meteorological fields simulated by MM5 into the Fortran binary input files for each meteorological parameter required by CAMx. The Fortran binary input files generated by MM5CAMx from MM5 output files are composed of six different files for a single CAMx grid per episode day. Those six meteorological input files are height/pressure file, wind file, temperature file, water vapor file, cloud/rain file, and vertical diffusivity file. One of the main functions MM5CAMx offers is horizontal interpolation of MM5 data to another projection and /or resolution grid. MM5 data simulated in LCP projection was interpolated to UTM grid system used in the eight-hour ozone modeling domain. MM5CAMx provides three options to calculate vertical diffusivity (Kv) as below:

Kv profile within PBL depth by O'Brien (OB70)

Integration methodology by Byun et al. (CMAQ)

Level 2.5 Turbulent Kinetic Energy approach by Mellor and Yamada (TKE)

As a result of several sensitivity tests on Kv options for each episode, OB70 option was selected to apply to the 4 km domain for the June 2002 and August 2001 episodes and the CMAQ option was chosen for the 12 km domain for all episodes and the 4 km domain for the July 2002 episode. In order to simulate better vertical air movement in the nested domain, ENVIRON recommended three more layers be added right above the PBL. Only the 4 km domain applied the new layer structure (23 layers), while the 12 km domain retained its original layer structure (20 layers). Also the KVPATCH tool was used to limit the PBL height to 2500 m in the 4 km domain for the July 2002 episode using the CMAQ Kv option, because the PBL depth generated in the 4 km domain was too high (more than 3000 m).

III-3. Air Quality Inputs

The air quality inputs required by CAMx include gridded initial concentrations of each of the simulated chemical species (IC), gridded hourly concentrations of each chemical species along the boundaries of the modeling domain (BC), and time/space constant top concentrations for the area above the modeling domain (TC). These inputs were extracted by ENVIRON from existing in-house modeling output, the WRAP (2002), and EPA/CAIR (2001).

III-3-1. Initial and Boundary Conditions

There are two methods to prepare initial and boundary conditions for CAMx modeling. One is using the ICBCPREP preprocessor to set constant values for each species for the entire domain. The other is extracting 3-D gridded emissions from a previous photochemical modeling study. MAG applied the latter approach with assistance from ENVIRON. ENVIRON used the CMAQ ICON/BCON processors (v4.5) to extract initial and boundary condition files for the CAMx 12 km grid from their previous studies. The initial conditions at local midnight (0:00 MST) for each of the three initial modeling days and the hourly boundary conditions (midnight to midnight MST) were converted from the ICON and BCON files, respectively, of the WRAP and EPA/CAIR study. The IC and BC files provided concentrations of the 42 chemical species used in the CAMx CB-IV chemical mechanism at the initial hour of the simulation and for each simulation hour, respectively, over 20 layers. The 42 chemical species contained in the IC and BC files are NO, NO2, O3, PAN, NXOY, OLE, PAR, TOL, XYL, FORM, ALD2, ETH, CRES, MGLY, OPEN, PNA, CO, HONO, H2O2, HNO3, ISOP, ISPD, NTR, SO2, SULF, NH3, OLE2, CG1, CG2, CG3, CG4, CG5, PSO4, PNO3, PNH4, POA, PEC, FPRM, CPRM, NA, PCL, and PH2O. The detailed process for CMAQ ICON/BCON extraction is described in Appendix III-iii *"Development of regional grid initial and boundary conditions for CAMx"* [17].

III-3-2. Top Concentrations

The TOPC file contains pollutant concentrations along the top of the modeling region. Since measured pollutant concentrations at the top of modeling region are not available, top concentrations were provided in the same manner applied to IC/BC preparation by ENVIRON. The chemical species and their concentrations used for the TOPC file for each episode are presented in Table III-10.

III-4. Other Inputs

III-4-1. Chemistry Parameters

Chemistry parameters are chemical species characteristics, reaction properties, and stoichiometric coefficients for the Carbon-Bond IV (CB-IV) Mechanism. The chemistry parameters are included in the CAMx CHEMPARAM file. For the present ozone simulations, 30 chemical species and 117 chemical reactions of CB-IV, as described in the User's Guide [18], were employed.

Table III-10. Chemical species and their concentrations used for the TOPC file for each episode. (Unit: ppmV)

Species	June 2002 Episode	July 2002 Episode	August 2001 Episode
NO	1.34E-12	2.32E-12	3.68E-11
NO2	3.20E-05	1.77E-05	1.52E-05
O3	9.58E-02	8.66E-02	4.32E-02
PAN	1.58E-04	1.69E-04	2.70E-04
NXOY	1.22E-05	3.99E-06	2.12E-06
OLE	1.59E-06	9.27E-06	6.18E-06
PAR	2.08E-03	3.14E-03	4.98E-03
TOL	1.40E-06	6.19E-06	8.96E-06
XYL	2.69E-08	1.59E-07	5.25E-07
FORM	1.14E-04	1.30E-04	1.01E-04
ALD2	2.03E-05	6.05E-05	5.57E-05
ETH	3.30E-06	1.86E-05	1.45E-05
CRES	2.20E-07	8.84E-07	1.74E-06
MGLY	8.02E-07	1.54E-06	9.02E-07
OPEN	2.50E-08	9.60E-08	1.36E-07
PNA	4.84E-05	2.94E-05	1.56E-05
CO	7.79E-02	7.53E-02	8.44E-02
HONO	8.55E-08	3.62E-08	3.49E-08
H2O2	9.70E-04	9.07E-04	1.10E-03
HNO3	2.96E-04	1.95E-04	9.48E-05
ISOP	4.46E-07	2.27E-06	1.55E-06
ISPD	3.75E-06	1.04E-05	1.07E-05
NTR	3.28E-05	9.70E-05	2.96E-04
SO2	1.76E-05	1.07E-05	5.32E-06
SULF	4.36E-10	3.93E-10	1.62E-10
NH3	2.57E-11	2.72E-10	9.54E-09
OLE2	1.18E-08	2.29E-07	1.96E-07
CG1	3.08E-07	9.33E-07	1.37E-06
CG2	7.13E-07	2.01E-06	3.10E-06
CG3	1.39E-20	2.42E-20	1.92E-19
CG4	8.69E-06	2.36E-05	1.40E-05
CG5	2.23E-07	7.04E-07	1.07E-06
PSO4	4.70E-02	6.80E-02	6.34E-02
PNO3	9.74E-02	1.04E-01	7.37E-03
PNH4	2.81E-02	3.39E-02	1.14E-02
POA	3.01E-02	5.16E-02	6.99E-03
PEC	1.04E-02	1.24E-02	2.48E-03
FPRM	4.35E-03	2.21E-02	6.31E-03
CPRM	2.60E-01	1.26E-01	7.34E-03
NA	5.47E-03	1.08E-03	3.28E-17
PCL	8.43E-03	1.66E-03	5.06E-17
PH2O	9.81E-03	1.92E-02	1.98E-02

III-4-2. Albedo/Haze/Ozone Parameters

Since chemistry is invoked in this study, CAMx requires albedo/haze/ozone (AHO) file used to determine the spatial and temporal variation of photolysis rates. Earth Probe Total Ozone Mapping Spectrometer (EP/TOMS) data were prepared as input to the

AHOMAP preprocessor (http://jwocky.gsfc.nasa.gov/eptoms/ep.html) for the master grid only; CAMx internally assigns master cell values to nested grid cells.

III-4-3. Photolysis Rate Parameters

The CAMx photolysis rate file is a lookup table of the primary and secondary photolysis reaction rates in five dimensions, including variations over solar zenith angle, height above ground, ultraviolet (UV) albedo of the ground, atmospheric turbidity, and total ozone column density. This table was generated using the TUV radiative transfer model as a preprocessor and the AHOMAP file as an input.

III-4-4. Surface Roughness and Deposition

The CAMx landuse file contains time-invariant two-dimensional gridded fields of landuse distributions used to define surface resistance for dry deposition calculations and to set default surface roughness lengths. Land use categories for the domain were extracted from the MAG 2004 land use coverage for Maricopa County and converted to roughness length and vegetation factor according to the landuse categories presented in Table 5-5 in the CAMx User's Guide [18].

Drought stress codes impacting dry deposition calculations for non-water landuse categories was applied to the AHO file as an optional field. The AHO file requires a drought stress map of codes composed of drought stress indices, which coincide with the Palmer Drought Index (PDI). To provide the map of codes, first, a historic Palmer drought severity map for each episodic period for the entire US (e.g., Figure III-11) was acquired from the National Climatic Data Center web site (http://www.ncdc.noaa.gov/oa/climate/research/drought/palmer-maps/index.php). Then, as shown in Figure III-12, it was superimposed with the 12 km grids to generate a drought stress map of codes for the AHO file. Finally, a drought stress map of codes was generated manually as shown in Figure III-13. In the map of codes, the PDI values for moderate, severe, and extreme drought areas were set with 2, 3, and 5, respectively (in positive values). The areas outside of the U.S., Mexico and the ocean, were set with the PDI value 0. The map shows most areas in the 12 km domain were in a dry condition (moderate ~ extreme drought). In this case, the drought stress map of codes was only given for the 12 km domain, although the AHO file optionally supports nested grids in addition to the master grid.

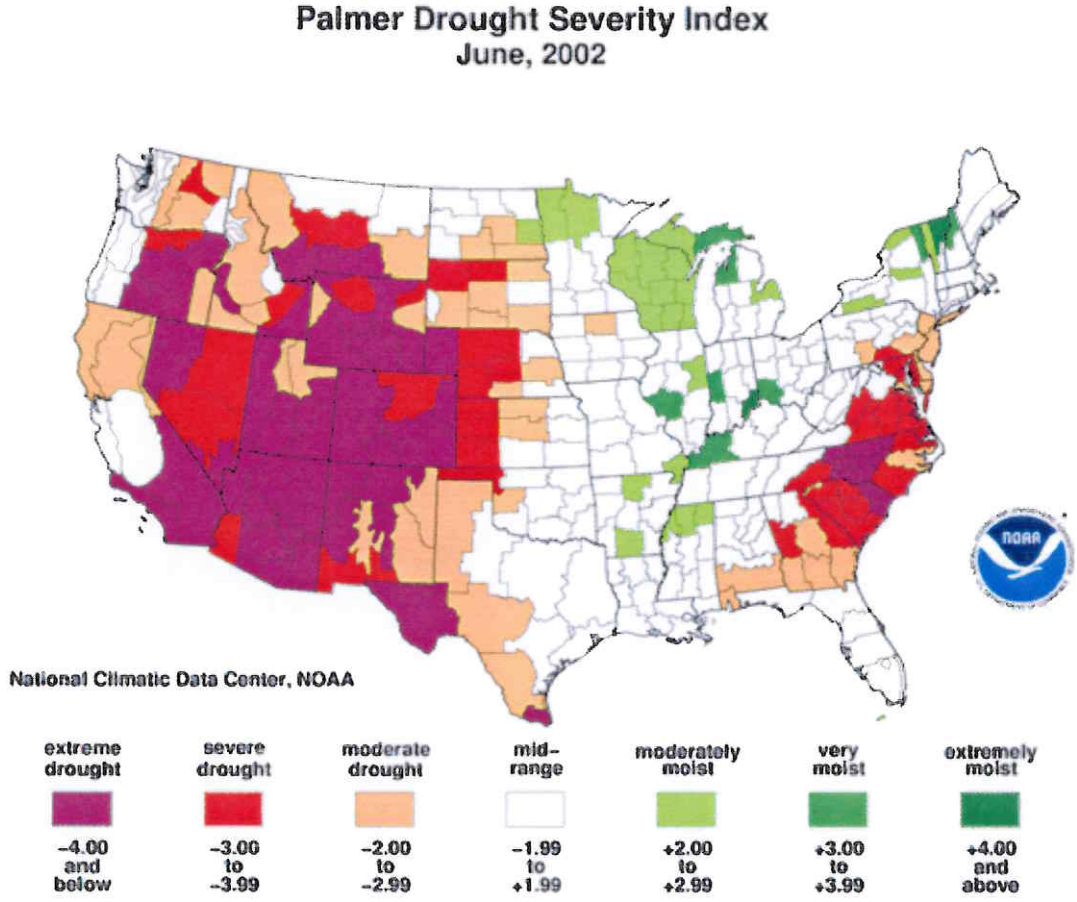


Figure III-4. Palmer drought severity map in June 2002.

* Source: Historic Palmer Drought Indices from National Climatic Data Center (http://www.ncdc.noaa.gov/oa/climate/research/drought/palmer-maps/index.php)

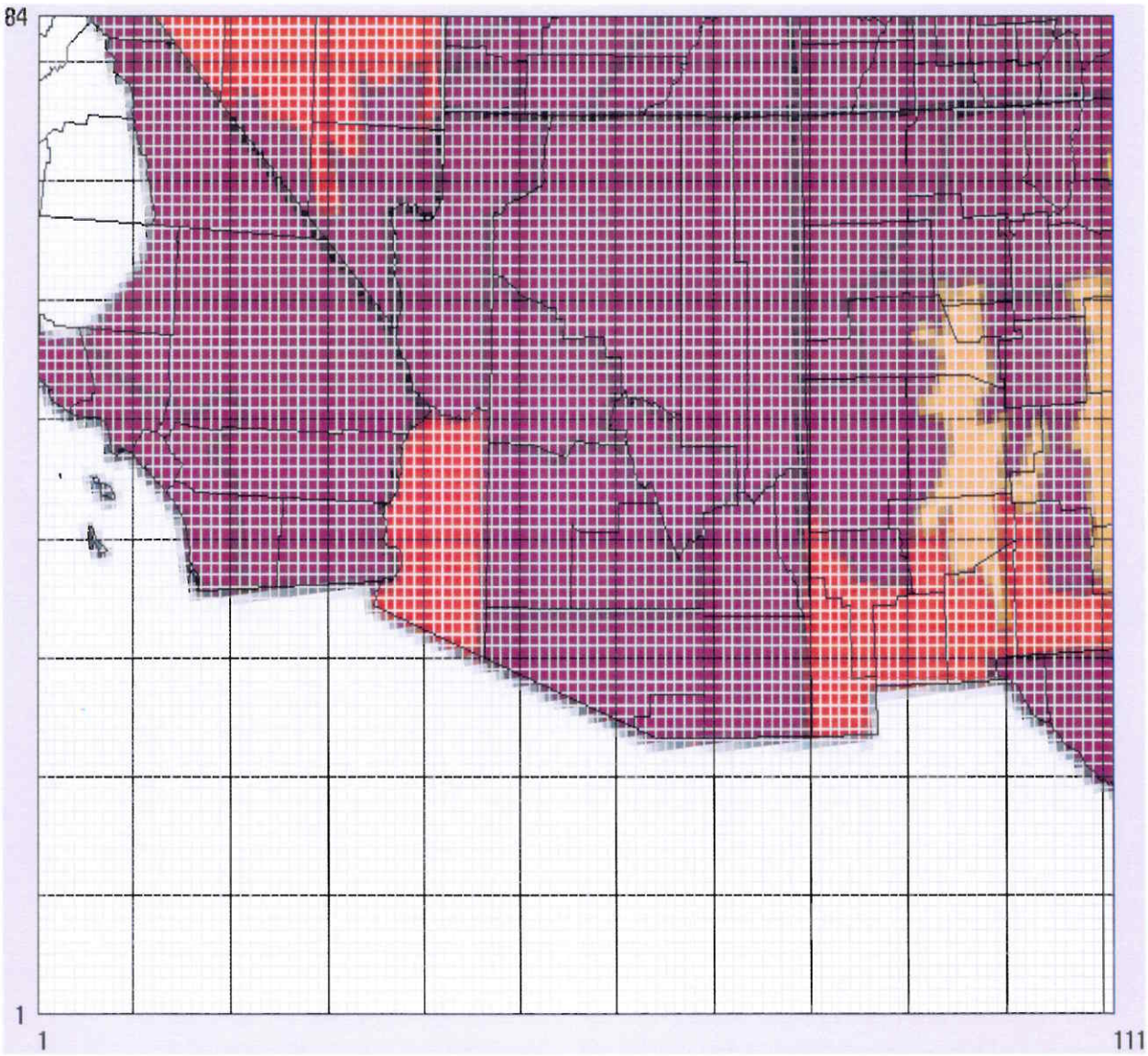


Figure III-5. Gridded 12 km domain mapped with the drought severity map in June 2002.

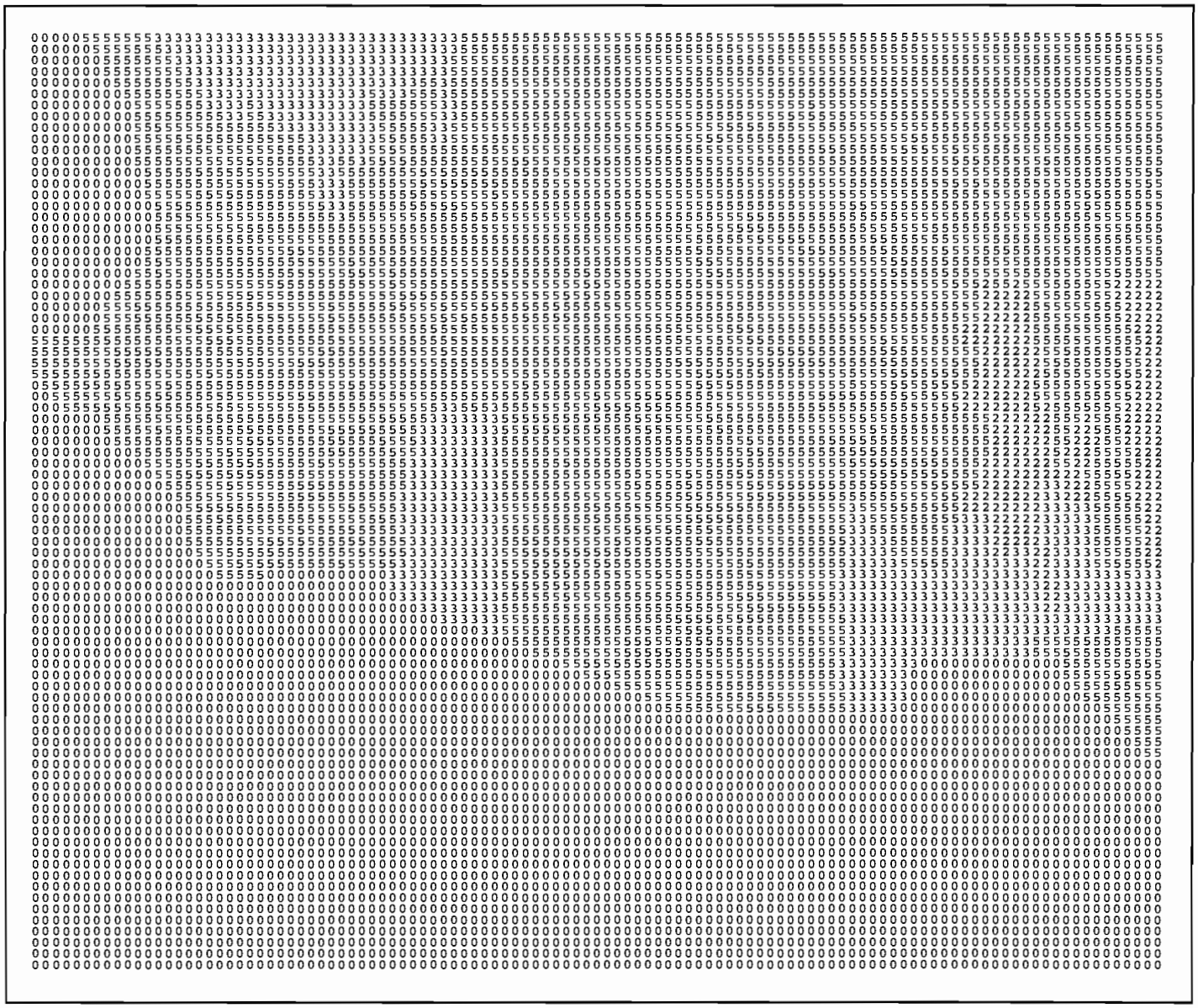


Figure III-6. Drought stress map of codes (12 km domain) added in the AHO file (June 2002).

III-4-5. Simulation Control Parameters

The CAMx run control file contains the simulation control information, including the period of simulation, model options, and information on the integration time steps. For this application, the simulation period for all episodes extended from 0000 LST on the first simulation days to 2400 LST on the second and subsequent simulation days. Three days before the first episode day were added as "spin-up" days, to minimize the effect of assumed initial conditions on the primary episode days.

It should be noted that the modeling performance for the "spin-up" days may or may not meet the EPA standards. The focus in the modeling performance evaluation was given to the primary episode days, which are of primary interest in the CAMx applications.

III-5. Quality Assurance of Input Components

The air quality, emissions, and meteorological data and inputs were plotted and examined to ensure accurate representation of the observed data in the CAMx-ready fields, temporal and spatial consistency, and reasonableness. The hourly VMT patterns for the June and July 2002 and August 2001 modeled episodes were also examined for reasonableness, as shown in Figure III-15.

Plots showing hourly surface temperature, wind fields, and ground level ozone concentrations are presented in Appendices III-iv through III-xii. These modeled meteorological and ozone concentration fields were plotted to ensure reasonable diurnal and nocturnal hourly variation and spatial patterns.

Wind field plots were generated to visually examine the reasonableness of the simulated winds compared with the observations. The surface layer of the MM5 wind fields for selected hours was plotted. Vectors representing the wind observations were plotted over the simulated wind fields to facilitate comparison between the predicted and observed winds. Following application of the postprocessing procedure, the CAMx-ready wind fields were also plotted and examined to ensure that the vertical averaging from the MM5 wind field to the CAMx layers was properly implemented and that the resulting fields were physically reasonable. The sample wind field plots can be found in Appendix III.

The purpose of this testing is to establish that apparently good model results are the result of valid model inputs and assumptions, and not the result of compensating errors in input data. Prior to conducting a base case simulation, individual air quality, meteorological, and emissions fields were reviewed for consistency and obvious omission errors. Both spatial and temporal characteristics of the data were evaluated.

On the basis of these evaluations, it was concluded that the modeling results are the result of valid model inputs and assumptions.

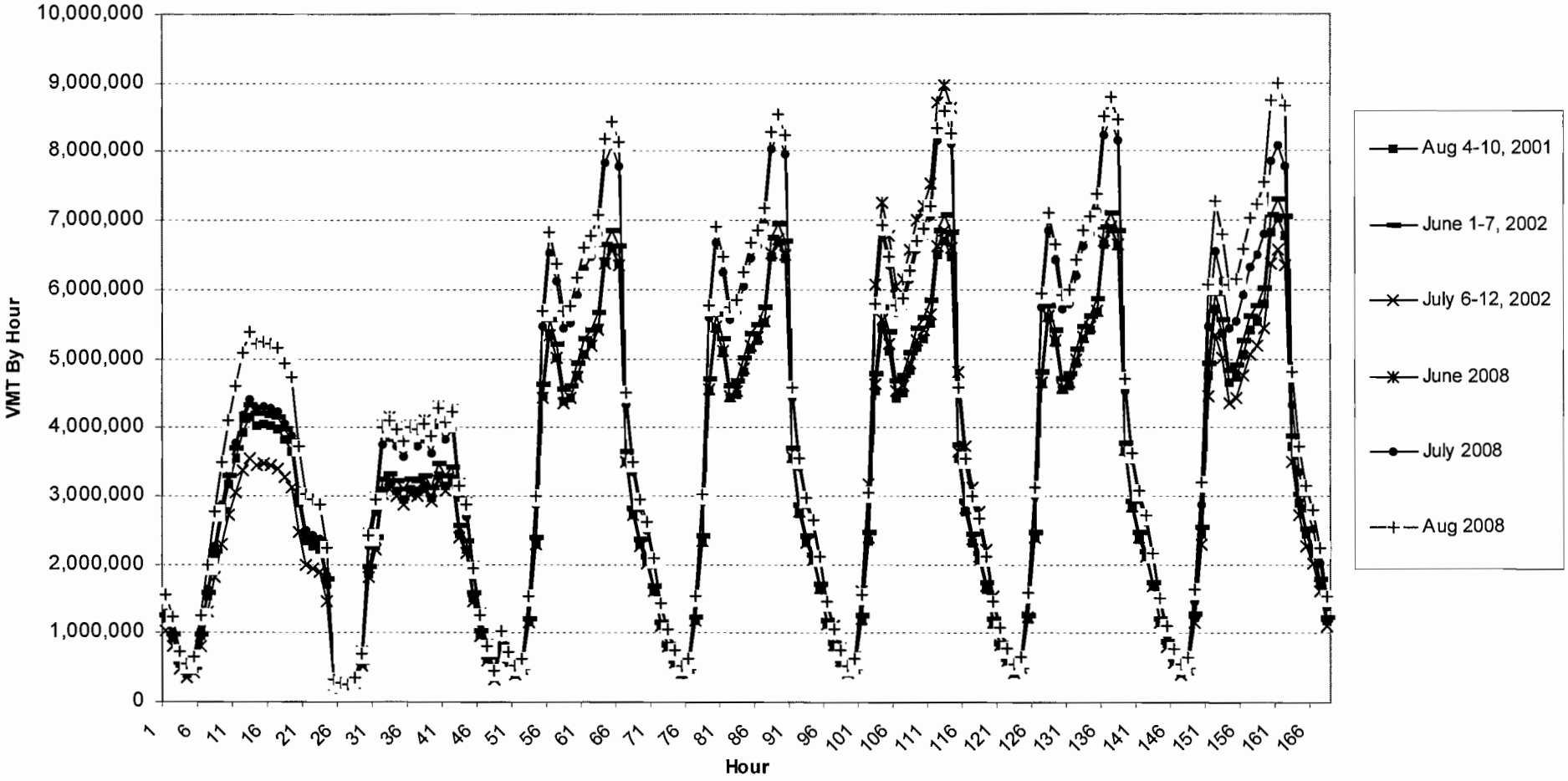


Figure III-7. Onroad Temporal VMT Pattern

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IV. MODEL PERFORMANCE EVALUATION

Before CAMx can be used to assess future attainment of the national eight-hour ozone standard, it must be demonstrated that the model adequately replicates the historical ozone episodes (i.e., an acceptable base case simulation for each episode is achieved). This requires a careful and comprehensive evaluation of model performance. In this section the results of the base case simulations and a detailed summary of model performance are provided for the three modeling episodes.

Traditionally, one-hour ozone modeling applications only focused on the statistical goals, such as bias, error, and accuracy, because of limited resources. However, EPA adjusted their policy for the eight-hour ozone attainment demonstrations to assess overall model performance with additional qualitative procedures, rather than applying rigid criteria for model acceptance or rejection based on three statistical goals. As EPA recommended in their Guidance [1], model performance has been assessed using operational and diagnostic evaluations. An operational evaluation diagnosed the model's ability to replicate observed concentrations and a diagnostic evaluation addressed the model's accuracy in characterizing sensitivity of ozone to emissions changes. MAG performed numerous modeling analyses to increase confidence in the model performance.

IV-1. Operational Evaluation

Generally, operational evaluations are comprised of graphical and statistical measures indicating how well the model replicates historical air quality values. For statistical performance measures, EPA recommends that the following numerical statistics be applied as measures for operational performance evaluation:

(1) Mean Normalized Bias (MNB)

(2) Mean Normalized Gross Error (MNGE)

(3) Average Peak Prediction Bias and Error

These three metrics were calculated for pairs in which the one-hour or eight-hour observed concentrations were greater than 60 ppb and for all pairs with no threshold. In addition to the statistical measures above, further statistical analyses of the model results recommended by EPA [1] were also performed. These additional statistical measures include the paired (time and/or space) peak accuracy estimates (equations (1), (2), and (3)), the mean gross bias (equation (5)), mean gross error (equation (9)), mean bias at all stations (equations (6), (8), and (9)), normalized bias (equations (11), (13), and (14)), and time displacement of the peak. The time displacement of the peak is defined as the average absolute error in the predicted time of the one-hour peak concentration, paired by station. All the other formulations of the above statistical measures are detailed below.

Accuracy of Peak Estimates (%):

$$\textit{Paired Accuracy of the Peak, } A_{ts} = \frac{C_e(\bar{x},\bar{t}) - C_o(\bar{x},\bar{t})}{C_o(\bar{x},\bar{t})} \times 100\% \quad \text{... (1)}$$

$$\textit{Temporally-pared Accuracy of the Peak, } A_t = \frac{C_e(x,t) - C_o(x,t)}{C_o(\bar{x},\bar{t})} \times 100\% \quad \text{... (2)}$$

$$\textit{Spatially-paired Accuracy of the Peak, } A_s = \frac{C_e(\bar{x},t) - C_o(\bar{x},\bar{t})}{C_o(\bar{x},\bar{t})} \times 100\% \quad \text{... (3)}$$

$$\textit{Unpaired Accuracy of the Peak, } A_u = \frac{C_e(x,t) - C_o(\bar{x},\bar{t})}{C_o(\bar{x},\bar{t})} \times 100\% \quad \text{... (4)}$$

Mean Bias:

$$\textit{At All Hours (ppb), } B = \frac{1}{M \times N} \sum_{j=1}^{N} \sum_{i=1}^{M} (C_e(x_i,t_j) - C_o(x_i,t_j)) \quad \text{... (5)}$$

$$\textit{Normalized At All Hours (\%), } B = \frac{1}{M \times N} \sum_{j=1}^{N} \sum_{i=1}^{M} \frac{(C_e(x_i,t_j) - C_o(x_i,t_j))}{C_o(x_i,t_j)} \times 100\% \quad \text{... (6)}$$

$$\textit{Mean Fractional Bias (\%), } B_f = \frac{2}{M \times N} \sum_{j=1}^{N} \sum_{i=1}^{M} \frac{(C_e(x_i,t_j) - C_o(x_i,t_j))}{(C_e(x_i,t_j) + C_o(x_i,t_j))} \times 100\% \quad \text{... (7)}$$

$$\textit{Normalized At Peak Hour (spatially-paired, \%), } B_s = \frac{1}{M} \sum_{i=1}^{M} \frac{(C_e(x_i,t_e) - C_o(x_i,t_o))}{C_o(x_i,t_o)} \times 100\% \quad \text{... (8)}$$

$$\textit{Normalized At Peak Hour (paired, \%), } B_{ts} = \frac{1}{M} \sum_{i=1}^{M} \frac{(C_e(x_i,t_o) - C_o(x_i,t_o))}{C_o(x_i,t_o)} \times 100\% \quad \text{... (9)}$$

Mean Error:

$$\textit{At All Hours (ppb)},\ E = \frac{1}{M \times N} \sum_{j=1}^{N} \sum_{i=1}^{M} |(C_e(x_i,t_j) - C_o(x_i,t_j))| \quad \text{... (10)}$$

$$\textit{Normalized At All Hours (\%)},\ E = \frac{1}{M \times N} \sum_{j=1}^{N} \sum_{i=1}^{M} \frac{|(C_e(x_i,t_j) - C_o(x_i,t_j))|}{C_o(x_i,t_j)} \times 100\% \quad \text{... (11)}$$

$$\textit{Mean Fractional Error (\%)},\ E_f = \frac{2}{M \times N} \sum_{j=1}^{N} \sum_{i=1}^{M} \frac{|(C_e(x_i,t_j) - C_o(x_i,t_j))|}{C_e(x_i,t_j) + C_o(x_i,t_j)} \times 100\% \quad \text{... (12)}$$

$$\textit{Normalized At Peak Hour (spatially-paired, \%)},\ E_s = \frac{1}{M} \sum_{i=1}^{M} \frac{|(C_e(x_i,t_e) - C_o(x_i,t_o))|}{C_o(x_i,t_o)} \times 100\% \quad \text{... (13)}$$

$$\textit{Normalized At Peak Hour (paired, \%)},\ E_{ts} = \frac{1}{M} \sum_{i=1}^{M} \frac{|(C_e(x_i,t_o) - C_o(x_i,t_o))|}{C_o(x_i,t_o)} \times 100\% \quad \text{... (14)}$$

where subscript *o* is for observations; subscript *e* is for estimations; over bar indicates pair in either space or time; *M* is the number of available stations, and *N* is the number of hours.

Along with the statistical measures, three sets of graphical analyses were prepared as part of the performance analysis. The graphical measures included those recommended by EPA Guidance [1]: time series plots, scatter plots, and daily tile/contour plots showing the predicted isopleth, superimposed on the observed daily maximum concentrations.

IV-1-1. Base Case Simulation Results

The modeling performance evaluation described in the following sections is based upon the CAMx results for all three episodes. It should be noted that the first three ramp-up days of each episode were used for initialization but were excluded from the model performance evaluation. In this section, the performance of CAMx was quantified both graphically and statistically for each of the three episodes.

IV-1-1-1. June 2002 Episode

The general pattern of ozone formation over the MNA is that the one-hour ozone concentrations start to build up gradually around 07:00 LST and to deplete rapidly around

19:00 LST. A similar pattern is observed in eight-hour ozone, but the hours are shifted 7 hours earlier, that is 0:00 and 12:00 LST, and ozone depletes gradually. The elevated ozone concentrations are simulated during the afternoon hours between 12:00 and 18:00 LST for one-hour ozone and between 8:00 and 14:00 LST for eight-hour ozone. Tables IV-1 through IV-4 summarize the statistical modeling performance evaluation for one-hour and eight-hour ozone with/without the 60 ppb threshold. These statistics indicate that the model is capable of replicating the location and concentrations of elevated ozone generally within a one hour range of the time the peak actually occurred. Statistics of ozone modeling performance applying the 60 ppb threshold indicate that CAMx replicates the observed ozone concentrations well, satisfying EPA's standard applied for one-hour ozone during the episode days, except on June 3, 2002. On June 3, 2002, the normalized bias of -25.1 percent and the unpaired peak accuracy of -28.6 percent do not satisfy the EPA's standards, which are ±15 and ±20 percent ranges, respectively. During the last three days of this episode, from June 5 through 7, 2002, CAMx did not accurately simulate ozone depletion from late evening through early morning over most of sites in the MNA, especially monitoring sites located in the western (i.e. PALV) and eastern (i.e. AJ, BP, FF, FH, RV, and WC) periphery. Simulated ozone concentrations during these ozone depletion periods are mostly lower than 60 ppb. This causes severe over-prediction of ozone during those three days when there is no threshold value. However, using a threshold of 60 ppb reduces the over-prediction problem. Scatter plots in Figures IV-1(a)~(b) show that the higher observed ozone concentrations have the better correlation with predicted ozone.

The quantile-quantile plots provide several levels of information, such as a scatter diagram, correlation coefficient (r^2), and Q-Q circles. A scatter diagram plots the paired peaks, where each point represents performance in replicating the peak eight-hour ozone at a given site on a given day. The coefficient of determination provides a single metric relating the spread of the data scatter, and measures the fraction of variation simulated by the model. The Q-Q circles are shown as 20 points, defining the 5^{th}-percentiles over the range of paired values. The purpose of the quantile data is to evaluate whether the model forecasts high or low over different portions of the range of data. EPA has established ±20% boundary for this metric.

EPA's most recent eight-hour ozone modeling guidance [1] introduced a new concept that focuses on ozone "near" the monitoring locations. The same definition of "near" is used for these new comparisons as for the attainment test. When using a 4 km grid, "near" the monitor is defined as a block of 7 by 7 grid cells centered on the monitor location. Figure IV-2 shows a quantile-quantile plot of nearest observed and predicted ozone "near" monitor locations in the MNA. This figure includes several performance evaluation methods:

- The scatter plot of observed/predicted pairs shows values centered on the 1:1 line with no clear tendency toward over or under prediction for higher values greater than 80 ppb.

- The observed/predicted values mostly lie within 20% of the 1:1 line, meeting the goal.

- The correlation coefficients (r^2) for the scatter plot of observed/predicted pairs are 0.6821 and 0.65 for one-hour and eight-hour ozone, respectively, which meet the goal of a moderate to large positive correlation.

- The quantile-quantile plot (circles) lies very close to the 1:1 line showing that the observations and predictions have very similar distributions of values for higher quantiles, 25 percentile and above.

As shown in Figures IV-3(a)~(c) and IV-4(a)~(c), the time series show that the model performs well in predicting the timing of the daily peak ozone levels. The magnitude of the diurnal variation at down-wind monitors located on the northern periphery, especially Pinnacle Peak (PP), Cave Creek (CC), and Humboldt Mountain (HM), was noticeably less than monitors in other areas. CAMx was able to simulate this diurnal trend fairly well. The modeled and observed ozone concentrations agree better on June 4 through 6, 2002, when the modeling does not tend to under predict ozone. The largest differences in the time series occur at night, especially on the eastern and western periphery, as mentioned above, during the heart of the episode, which is June 5 and 6, 2002. These differences are not problematic, since it can be difficult to obtain good nighttime model performance. That is because limited atmospheric mixing at night means that monitors can be influenced by localized sources and conditions that are not resolved at a 4 km grid resolution.

The daily one-hour and eight-hour maxima contour plots of predicted ozone across the 4 km domain, with the actual observations as an overlay, for the June 2002 episode are depicted in Figures IV-5(a)~(e) and IV-6(a)~(e), respectively. The contour plots show that the model performs well in predicting the daily peak ozone levels spatially. The model has a tendency to under predict the observed maximum ozone concentrations on June 3, 2002 at all monitors, suggesting the background ozone transported into the MNA may be too low in the model.

The statistical and spatial analyses for the primary episode days indicate that the CAMx replicates the observed ozone concentrations well, except for an under-prediction on the first episode day of June 3, 2002. However, this does not affect the results of the attainment test presented in Section V of this TSD, because none of the monitoring sites in the MNA on June 3, 2002 observed daily maximum eight-hour ozone concentration greater than the threshold value, 70 ppb, used for the attainment test. In other words, if we use a 70 ppb threshold, daily maximum eight-hour ozone concentrations on June 3, 2002 would not be considered in calculating relative reduction factors to show attainment.

Table IV-1. Summary of Statistical Modeling Performance Evaluation for the June 2002 Episode (One-Hour Ozone with a 60 ppb Threshold).

	6/3	6/4	6/5	6/6	6/7
Peak Observed (Site)	HM	HM	FH	FH	FH
(Hour)	23:00	15:00	16:00	15:00	15:00
(Concentration; ppb)	86.8	95.3	101.7	99.1	100.8
Peak Predicted (Cell X, Y)	(22, 25)	(40, 19)	(24, 11)	(30, 21)	(40, 19)
(Hour)	18:00	16:00	16:00	16:00	16:00
(Concentration; ppb)	64.6	96.6	103.4	104.2	107.1
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-25.6	1.4	1.7	5.1	6.2
Peak Bias (unpaired time; ppb)	-21.2	-0.2	3.8	-0.4	-9.3
(unpaired time; %)	-27.8	-0.1	4.8	0.2	-10.2
Peak Error (unpaired time; ppb)	21.2	4.0	6.6	6.0	10.0
(unpaired time; %)	27.8	4.9	7.6	6.9	11.0
Peak Bias (paired time; ppb)	-24.7	-4.2	1.5	-3.0	-13.1
(paired time; %)	-32.5	-5.0	2.3	-3.1	-14.4
Peak Error (paired time; ppb)	24.7	6.0	6.4	7.1	13.4
(paired time; %)	32.5	7.2	7.3	7.9	14.7
Number of Stations	21	21	21	21	21
Number of Valid Peak Pairs	20	21	21	21	21
Average Prediction (ppb)	34.8	53.9	63.7	61.6	52.8
Average Observation (ppb)	48.6	53.7	54.4	52.3	51.9
Difference in Average (ppb)	-13.7	0.3	9.3	9.3	0.9
(%)	-28.3	0.5	17.1	17.8	1.7
Bias (absolute) (ppb)	-20.4	-4.4	3.7	-0.9	-8.5
(normalized) (%) (EPA Goal: < ±15)	-28.9	-5.5	5.1	-0.5	-10.6
(fractional) (%)	-35.6	-6.5	4.2	-1.1	-11.9
Error (absolute) (ppb)	20.4	7.6	7.6	6.9	9.9
(normalized) (%) (EPA Goal: < 35)	28.9	10.0	10.3	8.9	12.6
(fractional) (%)	35.6	10.7	10.1	8.9	13.8
RMS Error (ppb)	22.4	10.5	9.5	8.4	12.3
Number of Total Pairs	504	504	504	504	504
Number of Valid Pairs	151	238	247	245	226
Ratio of Valid to Total Pairs (%)	30.0	47.2	49.0	48.6	44.8

Table IV-2. Summary of Statistical Modeling Performance Evaluation for the June 2002 Episode (One-Hour Ozone without Threshold).

	6/3	6/4	6/5	6/6	6/7
Peak Observed (Site)	HM	HM	FH	FH	FH
(Hour)	23:00	15:00	16:00	15:00	15:00
(Concentration; ppb)	86.8	95.3	101.7	99.1	100.8
Peak Predicted (Cell X, Y)	(22, 25)	(40, 19)	(24, 11)	(30, 21)	(40, 19)
(Hour)	18:00	16:00	16:00	16:00	16:00
(Concentration; ppb)	64.6	96.6	103.4	104.2	107.1
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-25.6	1.4	1.7	5.1	6.2
Peak Bias (unpaired time; ppb)	-20.5	-0.2	3.8	-0.4	-9.3
(unpaired time; %)	-27.0	-0.1	4.8	-0.2	-10.2
Peak Error (unpaired time; ppb)	20.5	4.0	6.6	6.0	10.0
(unpaired time; %)	27.0	4.9	7.6	6.9	11.0
Peak Bias (paired time; ppb)	-23.8	-4.2	1.5	-3.0	-13.1
(paired time; %)	-31.5	-5.0	2.3	-3.1	-14.4
Peak Error (paired time; ppb)	23.8	6.0	6.4	7.1	13.4
(paired time; %)	31.5	7.2	7.3	7.9	14.7
Number of Stations	21	21	21	21	21
Number of Valid Peak Pairs	21	21	21	21	21
Average Prediction (ppb)	34.8	53.9	63.7	61.6	52.8
Average Observation (ppb)	48.6	53.7	54.4	52.3	51.9
Difference in Average (ppb)	-13.7	0.3	9.3	9.3	0.9
(%)	-28.3	0.5	17.1	17.8	1.7
Bias (absolute) (ppb)	-13.7	0.3	9.3	9.3	0.9
(normalized) (%) (EPA Goal: < ±15)	-3.5	19.5	58.1	112.1	47.3
(fractional) (%)	-34.0	0.7	22.7	31.6	11.4
Error (absolute) (ppb)	16.7	9.8	12.3	13.8	11.3
(normalized) (%) (EPA Goal: < 35)	57.6	40.8	65.1	120.2	65.1
(fractional) (%)	50.3	29.1	31.7	41.8	32.8
RMS Error (ppb)	19.8	13.1	16.3	19.0	14.5
Number of Total Pairs	504	504	504	504	504
Number of Valid Pairs	489	498	490	485	499
Ratio of Valid to Total Pairs (%)	97.0	98.8	97.2	96.2	99.0

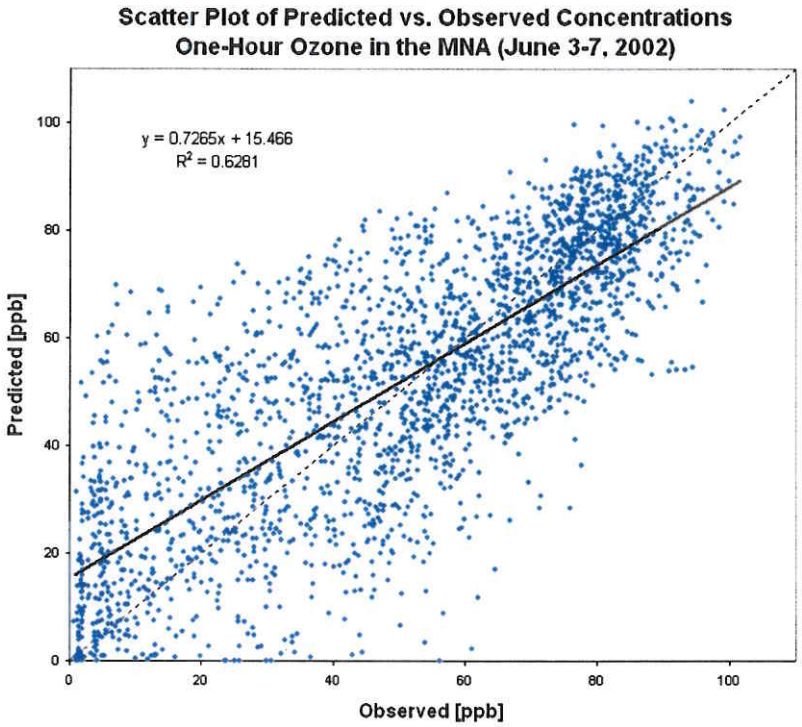
Table IV-3. Summary of Statistical Modeling Performance Evaluation for the June 2002 Episode (Eight-Hour Ozone with a 60 ppb Threshold).

	6/3	6/4	6/5	6/6	6/7
Peak Observed (Site)	HM	HM	HM	FH	CC
(Hour)	23:00	0:00	15:00	10:00	11:00
(Concentration; ppb)	90.5	90.2	91.6	93.0	89.6
Peak Predicted (Cell X, Y)	(42, 21)	(43, 21)	(22, 25)	(27, 21)	(38, 19)
(Hour)	23:00	23:00	11:00	11:00	11:00
(Concentration; ppb)	64.6	91.1	98.7	91.3	87.1
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-28.6	1.0	7.7	-1.8	-2.8
Peak Bias (unpaired time; ppb)	-17.2	-1.6	3.9	-1.1	-7.3
(unpaired time; %)	-24.9	-1.9	5.0	-1.0	-8.8
Peak Error (unpaired time; ppb)	17.2	4.2	5.0	4.8	7.7
(unpaired time; %)	24.9	5.4	6.4	5.8	9.5
Peak Bias (paired time; ppb)	-18.4	-3.8	2.8	-1.8	-7.8
(paired time; %)	-26.6	-4.4	3.7	-1.8	-9.5
Peak Error (paired time; ppb)	18.4	5.6	5.0	5.4	8.0
(paired time; %)	26.6	6.9	6.4	6.5	9.8
Number of Stations	21	21	21	21	21
Number of Valid Peak Pairs	20	21	21	21	21
Average Prediction (ppb)	36.9	56.2	64.2	59.8	57.6
Average Observation (ppb)	48.2	53.7	53.6	52.2	58.4
Difference in Average (ppb)	-11.3	2.5	10.5	7.6	-0.7
(%)	-23.5	4.7	19.6	14.6	-1.3
Bias (absolute) (ppb)	-17.1	-2.6	5.5	-0.4	-6.7
(normalized) (%) (EPA Goal: < ±15)	-25.1	-3.3	7.8	0.2	-8.6
(fractional) (%)	-29.4	-3.9	7.1	-0.3	-9.4
Error (absolute) (ppb)	17.1	5.7	7.0	6.1	7.8
(normalized) (%) (EPA Goal: < 35)	25.1	7.9	9.8	8.0	10.3
(fractional) (%)	29.4	8.2	9.2	8.1	11.1
RMS Error (ppb)	18.5	7.9	8.4	7.8	9.4
Number of Total Pairs	504	504	504	504	357
Number of Valid Pairs	149	231	240	223	191
Ratio of Valid to Total Pairs (%)	29.6	45.8	47.6	44.2	53.5

Table IV-4. Summary of Statistical Modeling Performance Evaluation for the June 2002 Episode (Eight-Hour Ozone without Threshold).

	6/3	6/4	6/5	6/6	6/7
Peak Observed (Site)	HM	HM	HM	FH	CC
(Hour)	23:00	0:00	15:00	10:00	11:00
(Concentration; ppb)	90.5	90.2	91.6	93.0	89.6
Peak Predicted (Cell X, Y)	(42, 21)	(43, 21)	(22, 25)	(27, 21)	(38, 19)
(Hour)	23:00	23:00	11:00	11:00	11:00
(Concentration; ppb)	64.6	91.1	98.7	91.3	87.1
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-28.6	1.0	7.7	-1.8	-2.8
Peak Bias (unpaired time; ppb)	-16.7	-1.6	3.9	-1.1	-7.3
(unpaired time; %)	-24.3	-1.9	5.0	-1.0	-8.8
Peak Error (unpaired time; ppb)	16.7	4.2	5.0	4.8	7.7
(unpaired time; %)	24.3	5.4	6.4	5.8	9.5
Peak Bias (paired time; ppb)	-18.0	-3.8	2.8	-1.8	-7.8
(paired time; %)	-26.4	-4.4	3.7	-1.8	-9.5
Peak Error (paired time; ppb)	18.0	5.6	5.0	5.4	8.0
(paired time; %)	26.4	6.9	6.4	6.5	9.8
Number of Stations	21	21	21	21	21
Number of Valid Peak Pairs	21	21	21	21	21
Average Prediction (ppb)	36.9	56.2	64.2	59.8	57.6
Average Observation (ppb)	48.2	53.7	53.6	52.2	58.4
Difference in Average (ppb)	-11.3	2.5	10.5	7.6	-0.7
(%)	-23.5	4.7	19.6	14.6	-1.3
Bias (absolute) (ppb)	-11.3	2.5	10.5	7.6	-0.7
(normalized) (%) (EPA Goal: < ±15)	-19.0	14.0	43.0	42.7	6.2
(fractional) (%)	-27.2	7.4	25.2	24.2	2.9
Error (absolute) (ppb)	13.3	8.7	11.7	10.7	8.1
(normalized) (%) (EPA Goal: < 35)	31.3	25.8	45.1	46.6	18.6
(fractional) (%)	35.1	20.8	27.6	28.3	16.3
RMS Error (ppb)	15.4	11.3	15.1	14.2	10.2
Number of Total Pairs	504	504	504	504	357
Number of Valid Pairs	498	498	491	491	357
Ratio of Valid to Total Pairs (%)	98.8	98.8	97.4	97.4	100.0

(a)



(b)

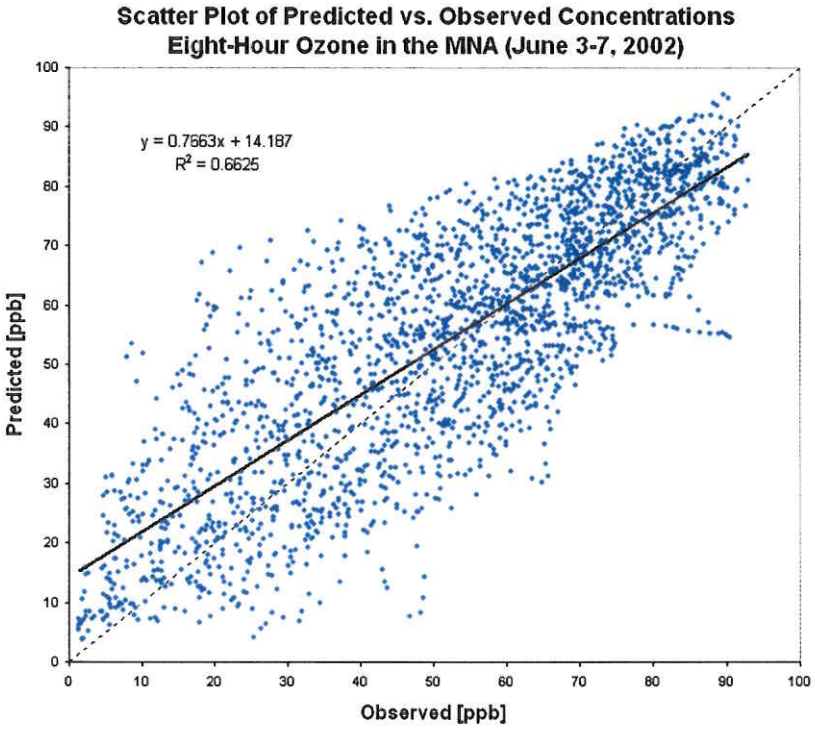
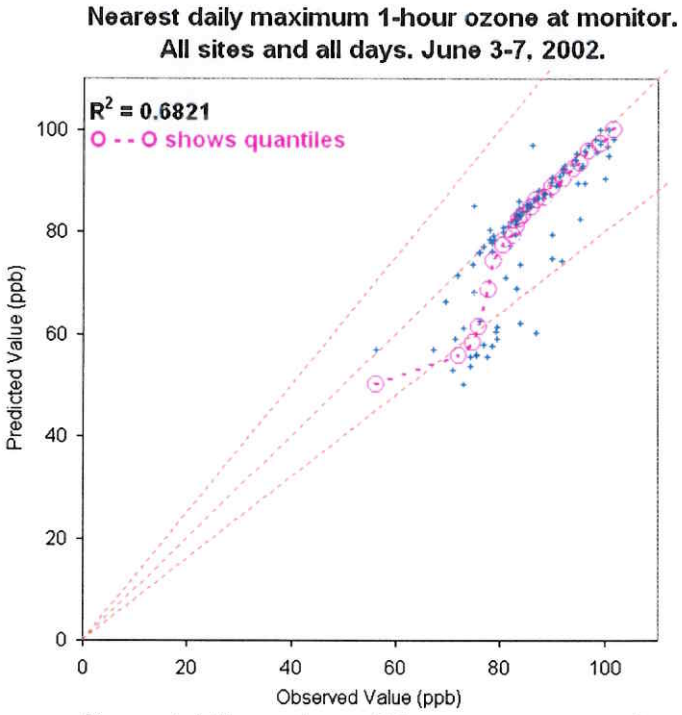


Figure IV-1. Scatter plots of predicted and observed (a) one-hour and (b) eight-hour ozone in the MNA (June 3-7, 2002).

(a)



(b)

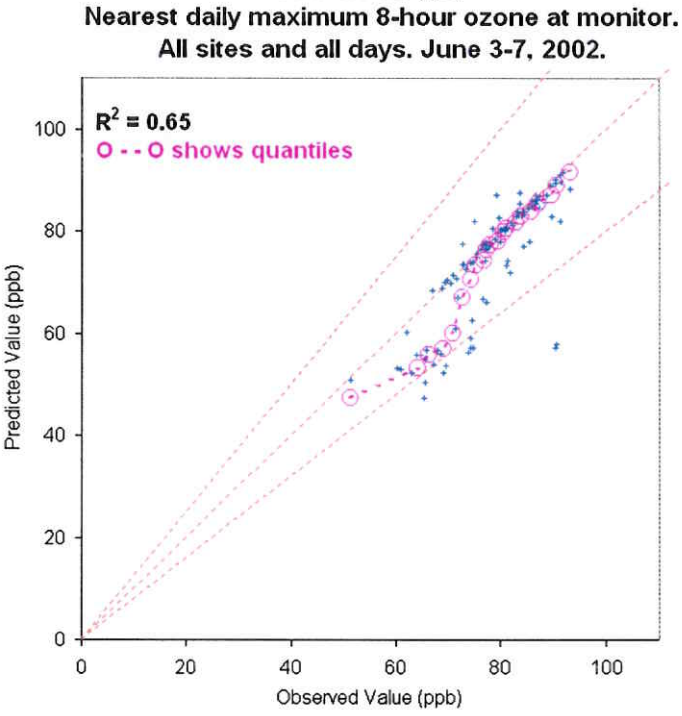


Figure IV-2. Quantile-quantile plot of nearest observed/predicted paired peak (a) one-hour and (b) eight-hour ozone near monitor locations in the MNA for each day of the June 2002 episode. [EPA recommended ±20% envelope is shown as red dotted lines surrounding 1:1 line (middle red dashed line). The r^2 value is the correlation coefficient.]

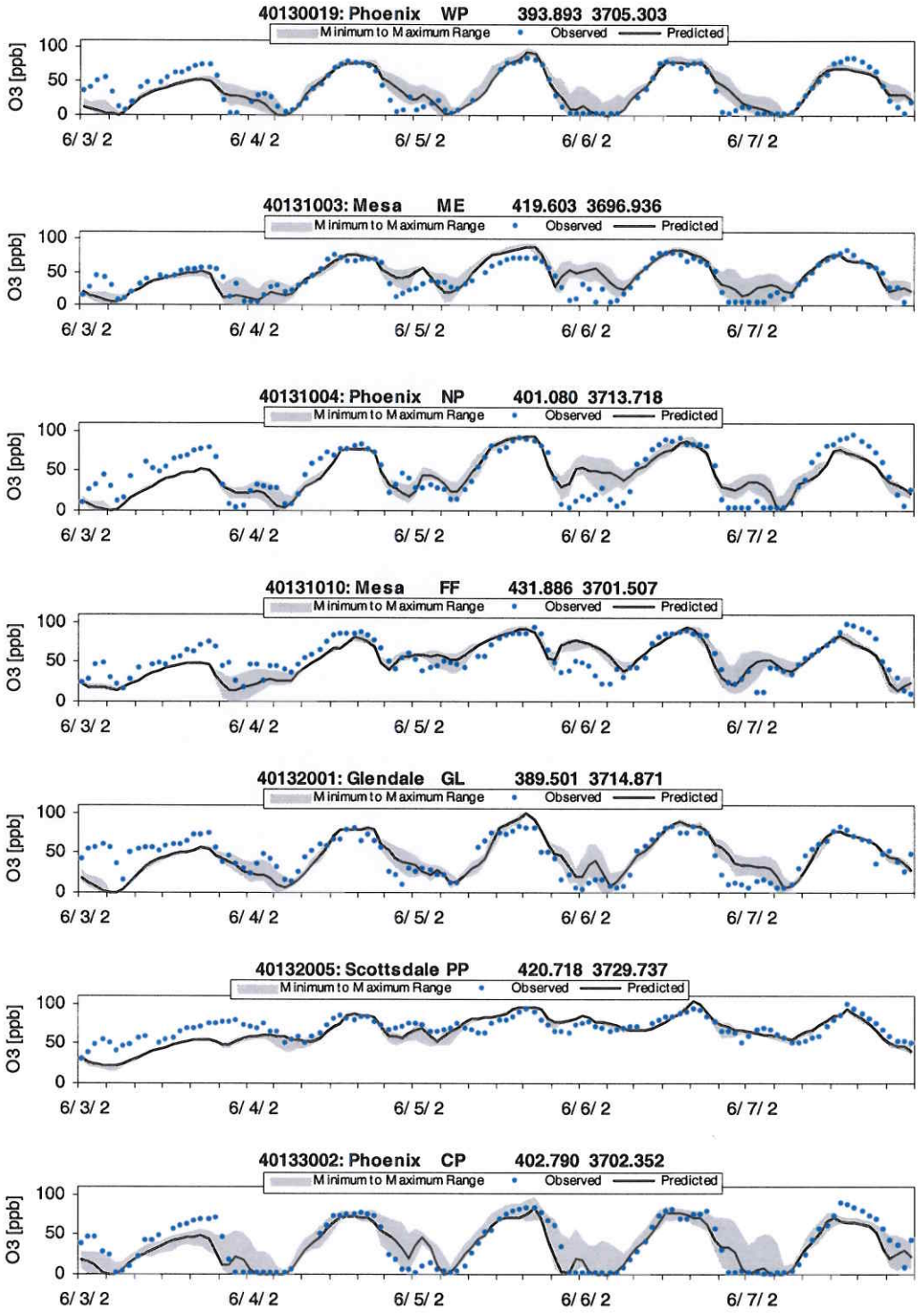


Figure IV-3(a). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the June 2002 episode.

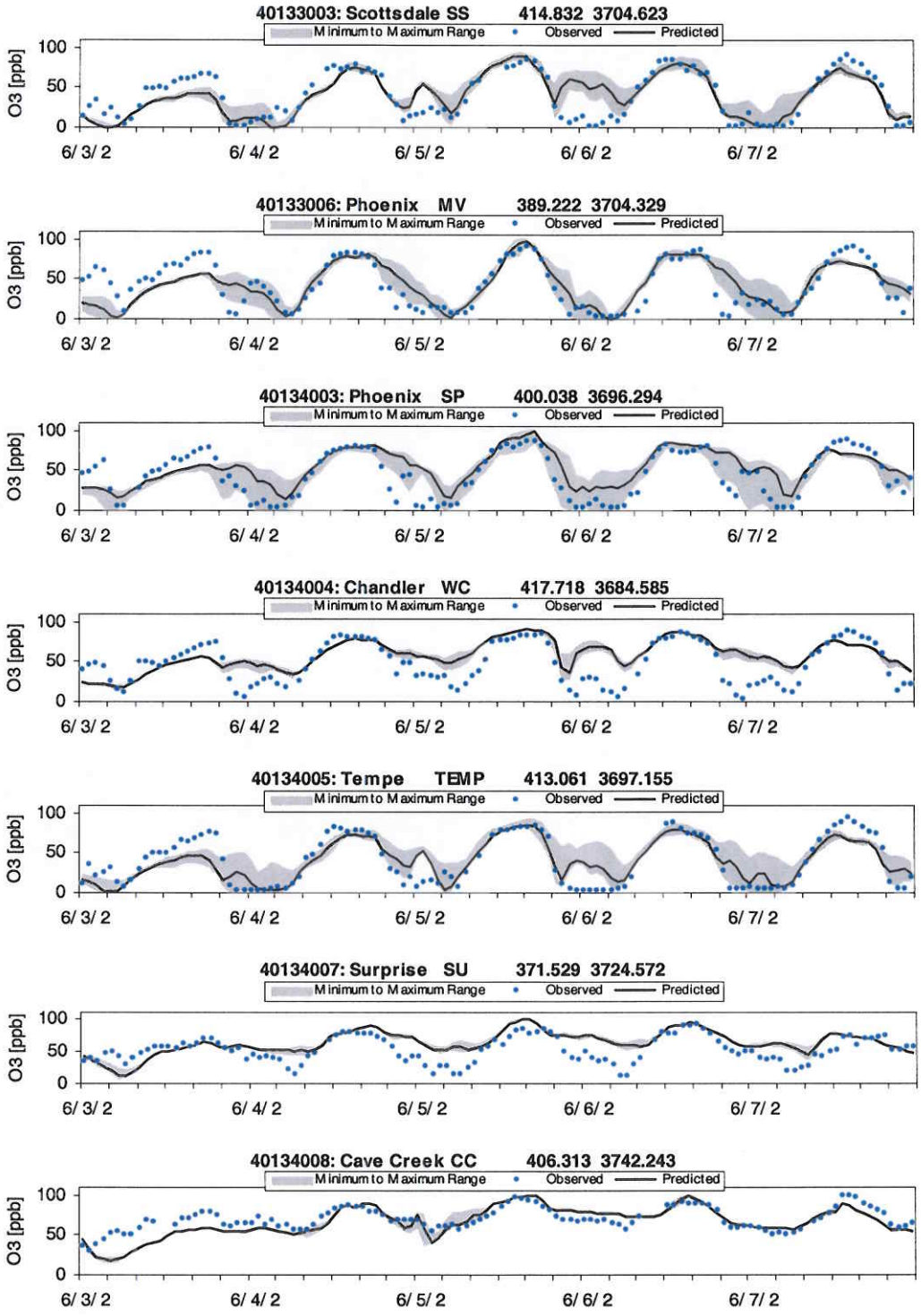


Figure IV-3(b). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the June 2002 episode.

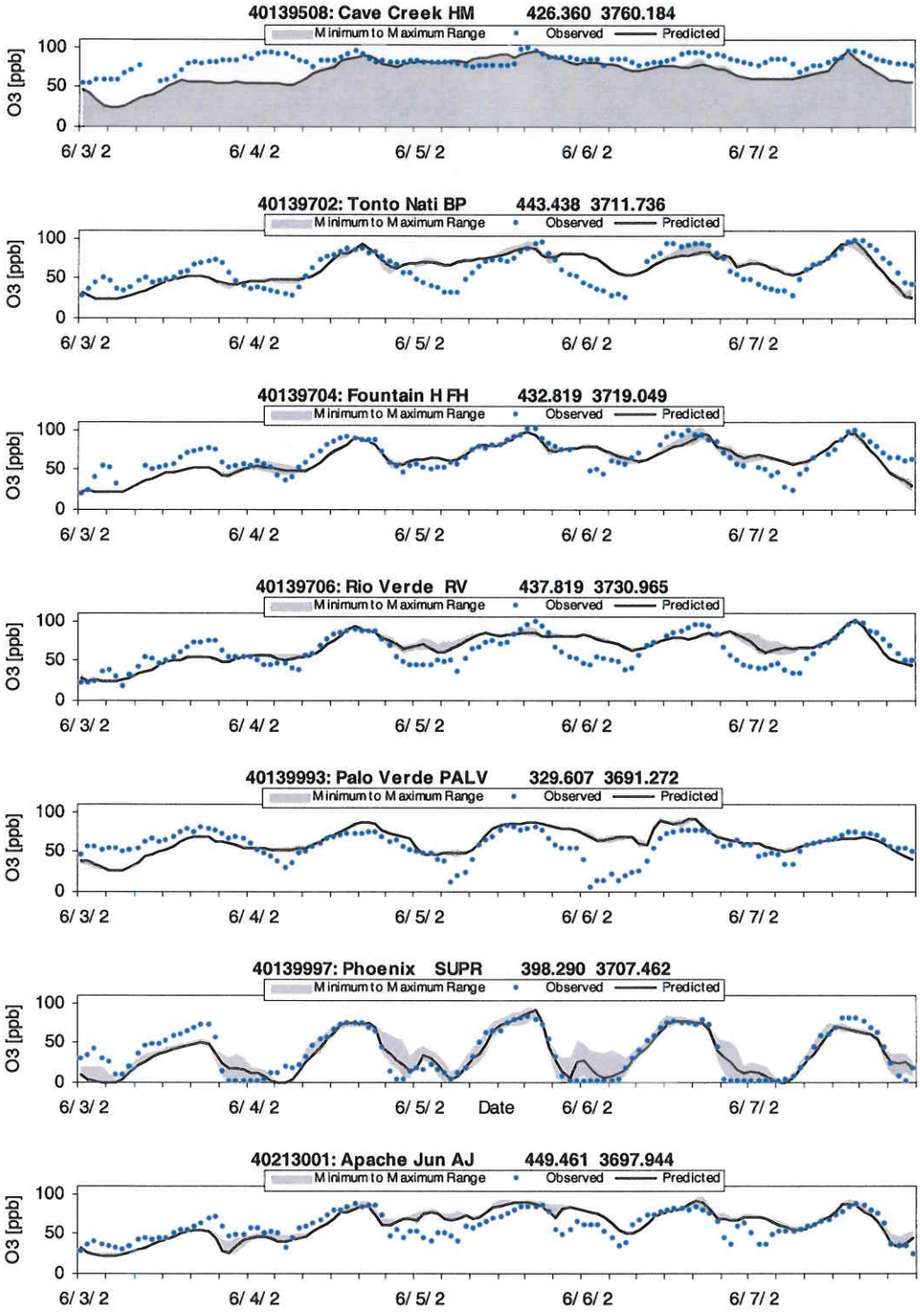


Figure IV-3(c). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the June 2002 episode.

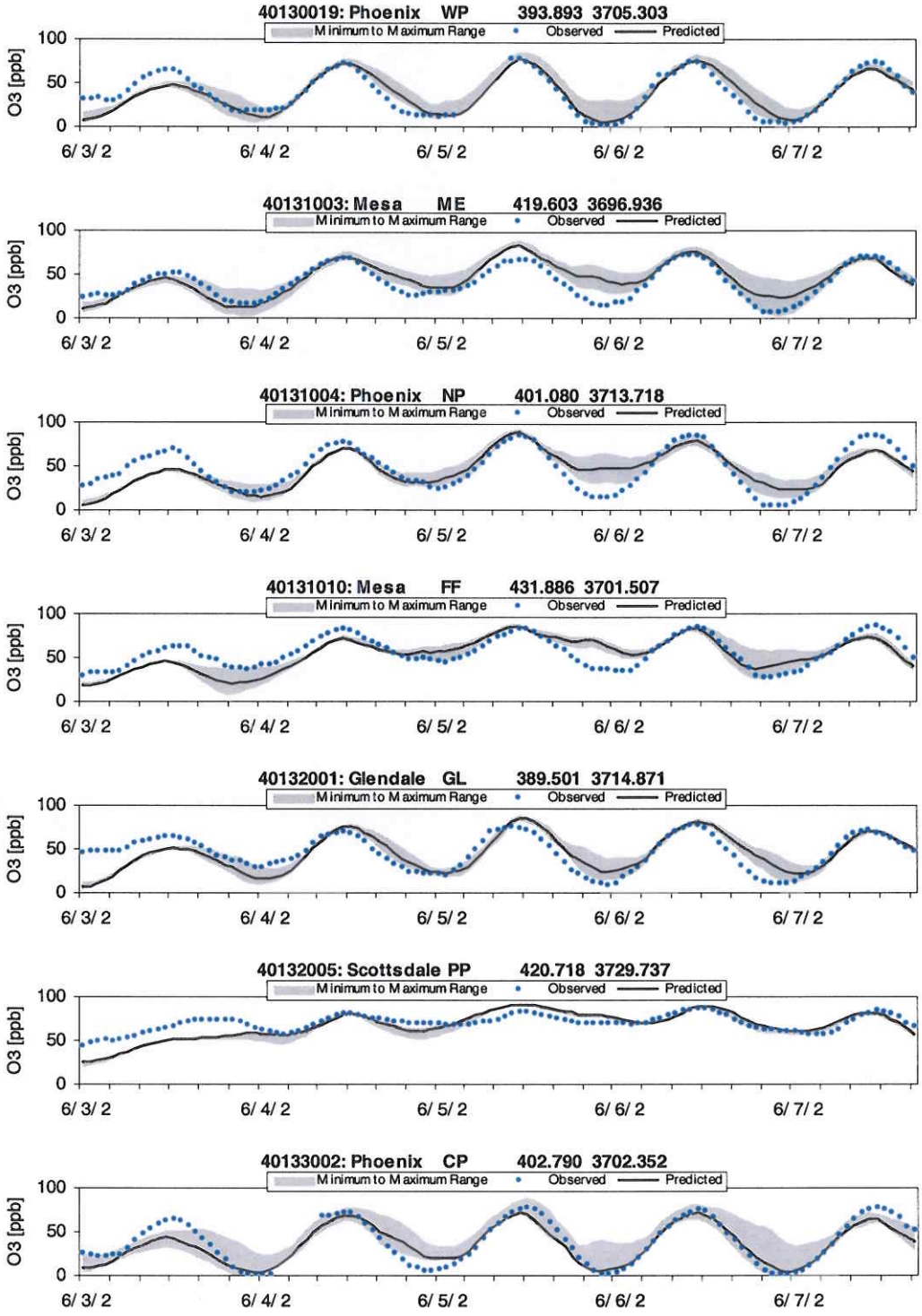


Figure IV-4(a). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the June 2002 episode.

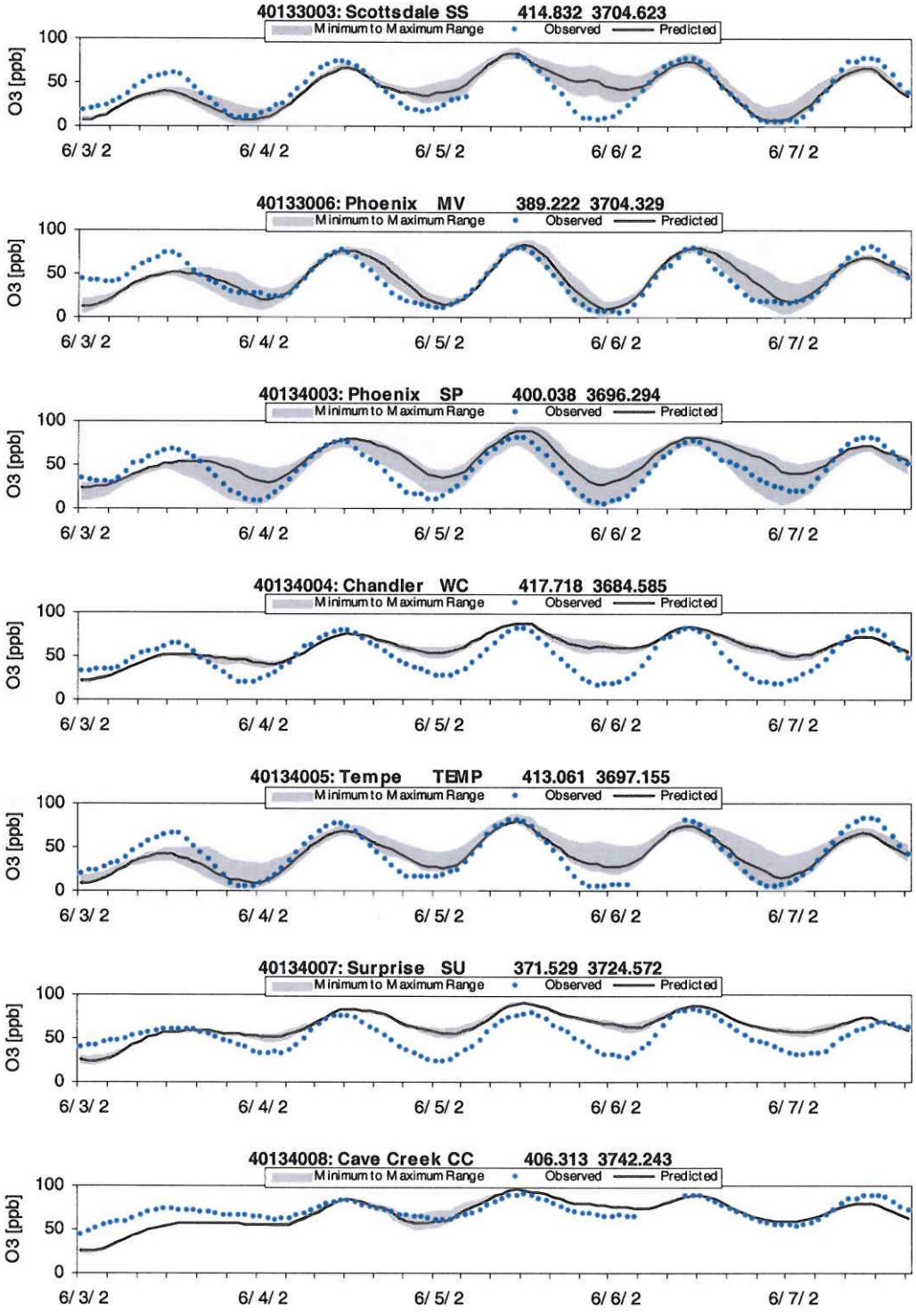


Figure IV-4(b). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the June 2002 episode.

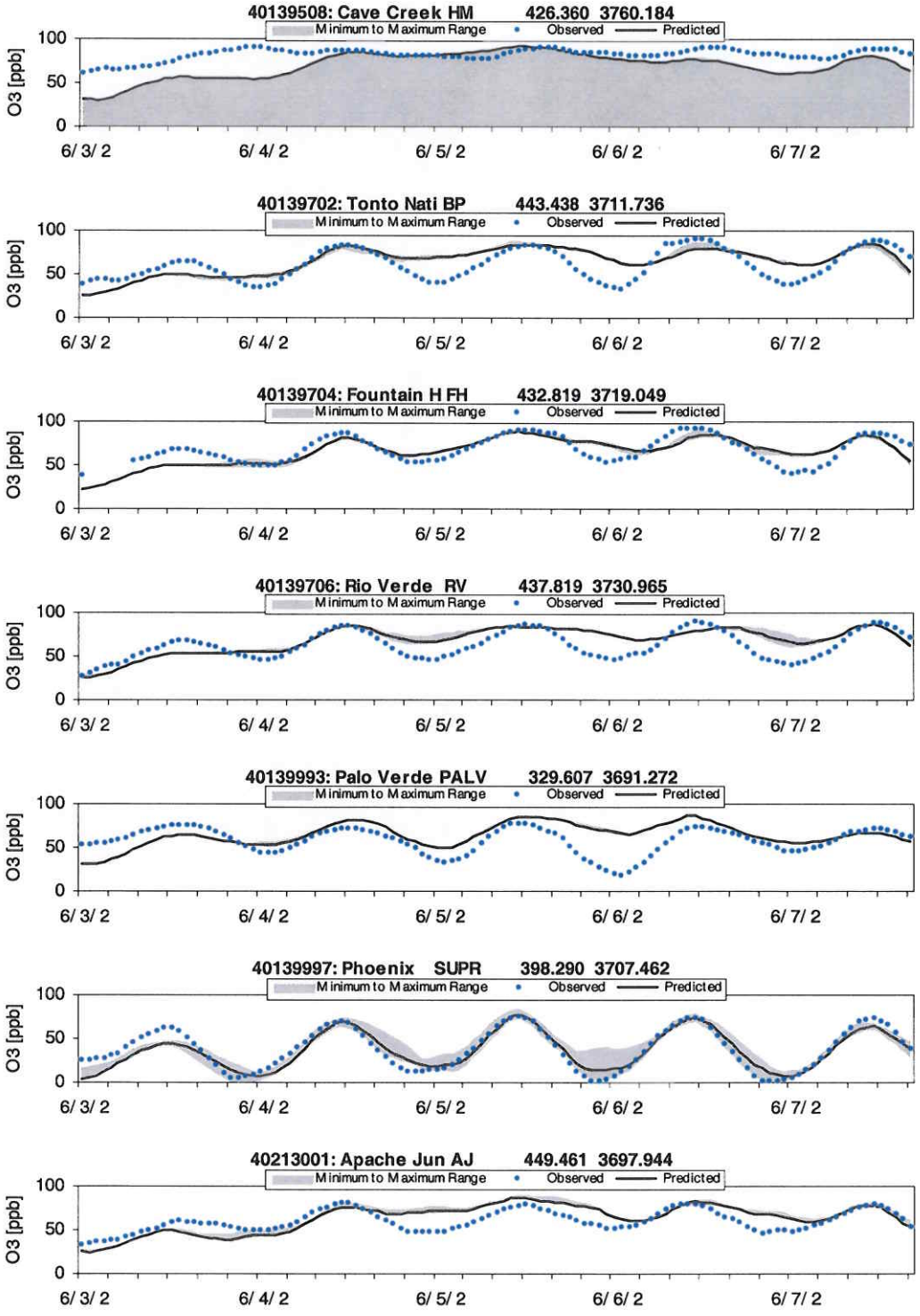


Figure IV-4(c). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the June 2002 episode.

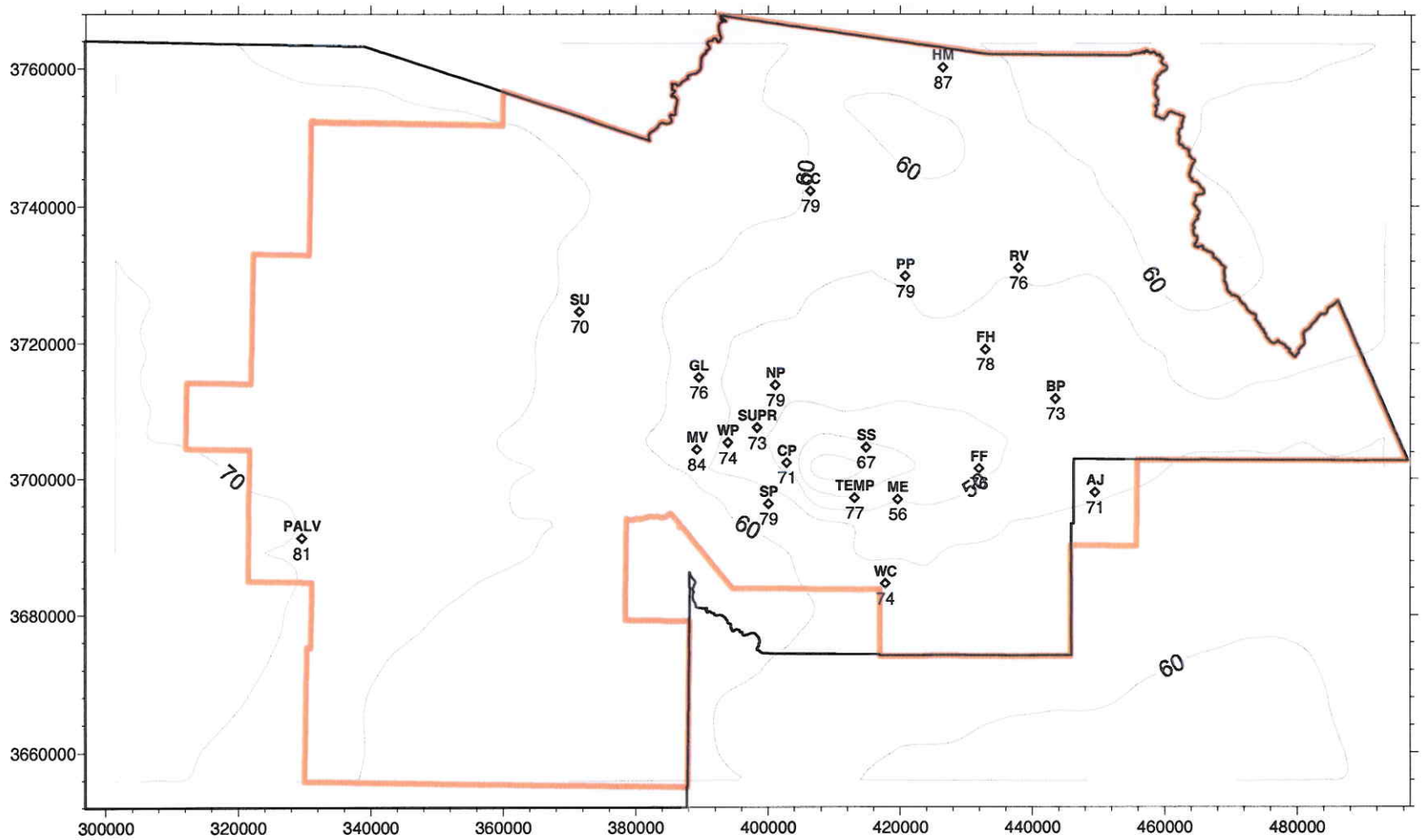


Figure IV-5(a). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 3, 2002.

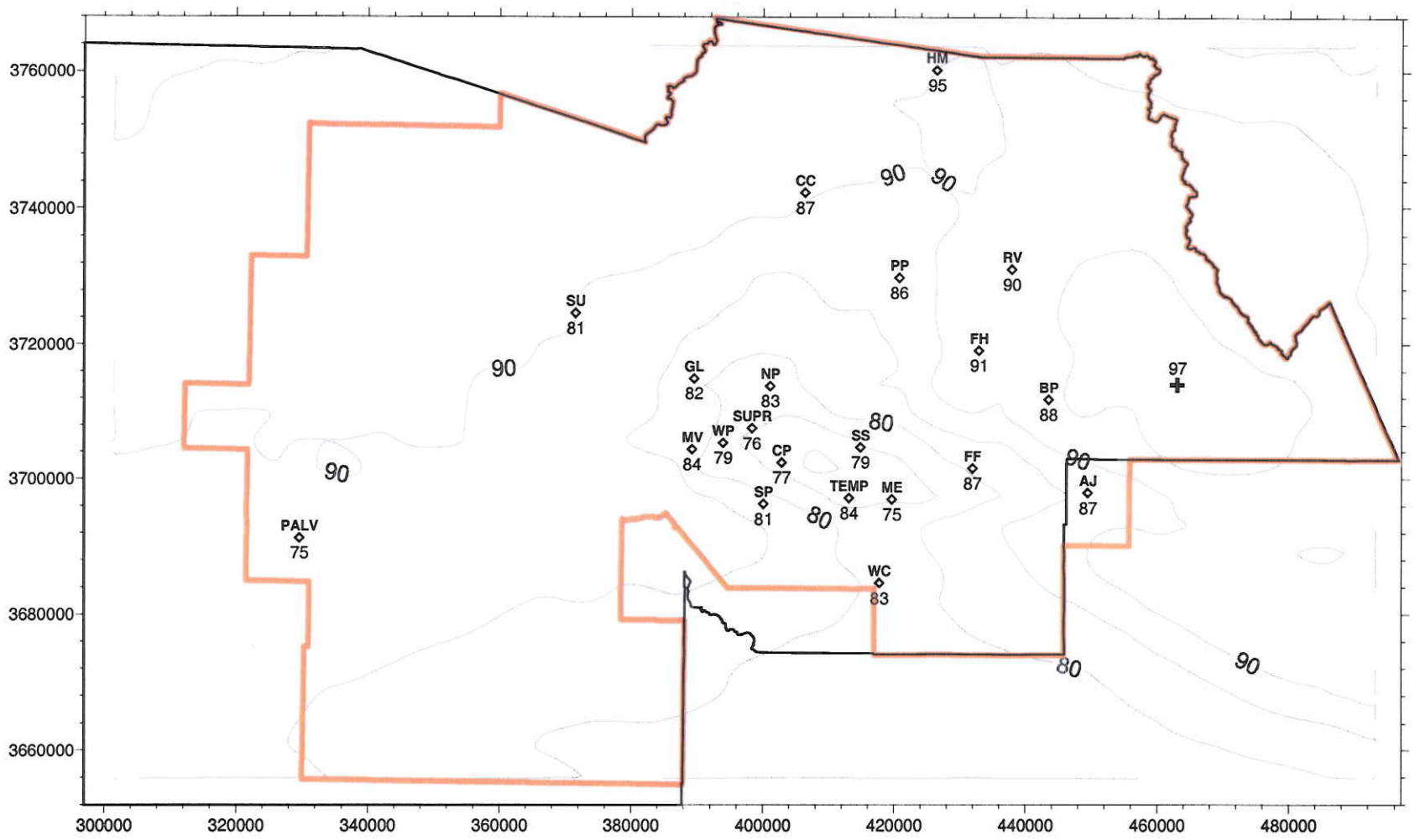


Figure IV-5(b). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 4, 2002.

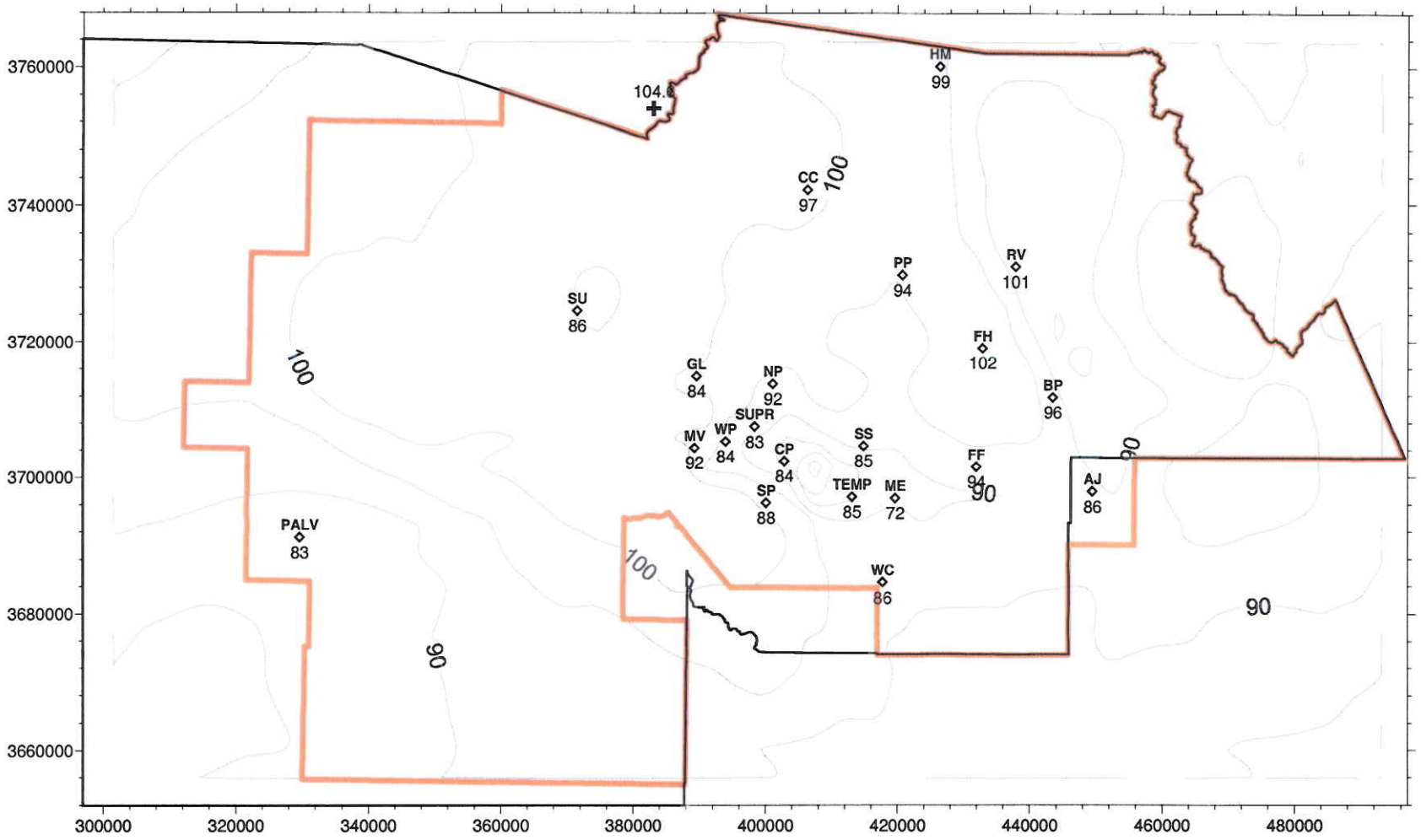


Figure IV-5(c). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 5, 2002.

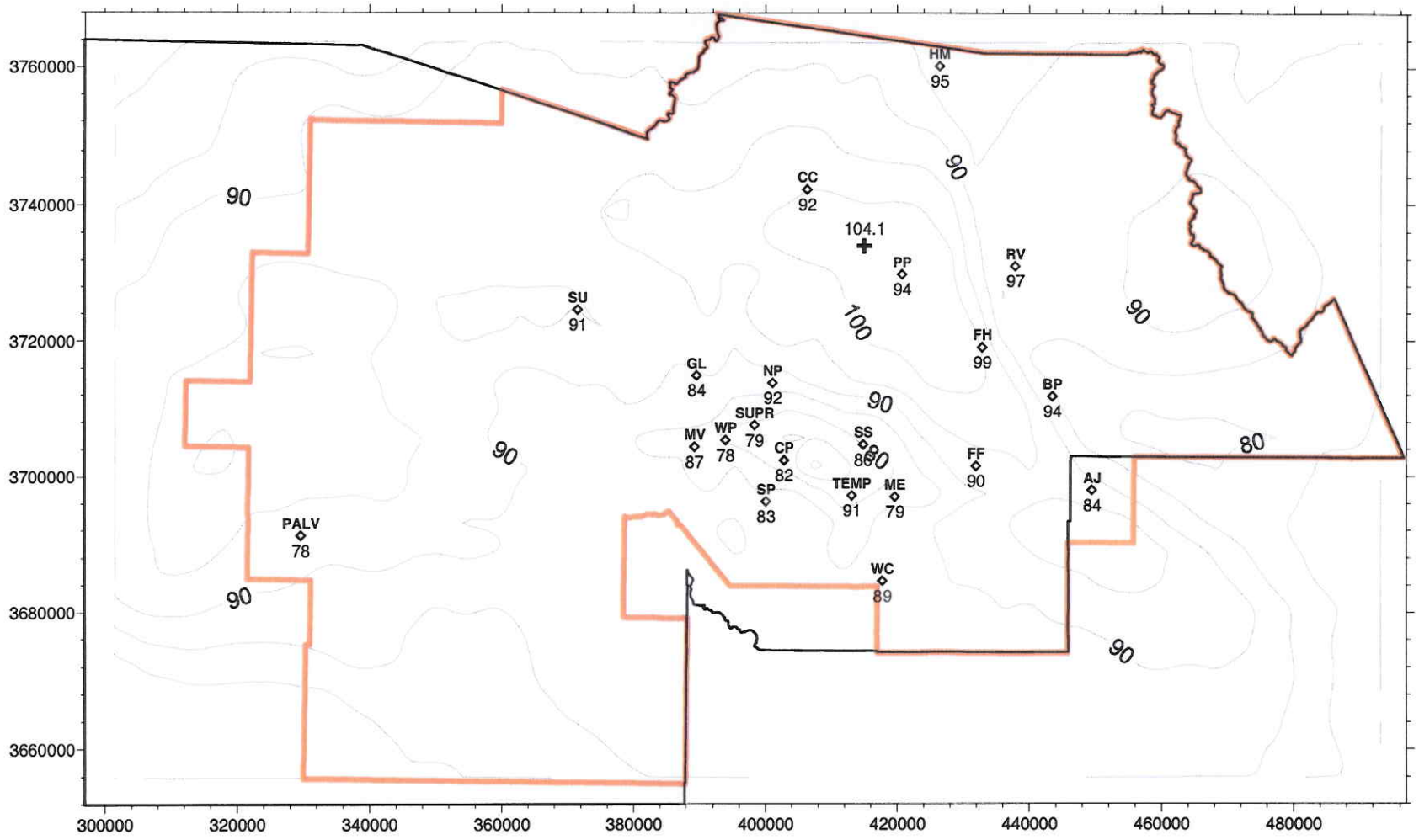


Figure IV-5(d). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 6, 2002.

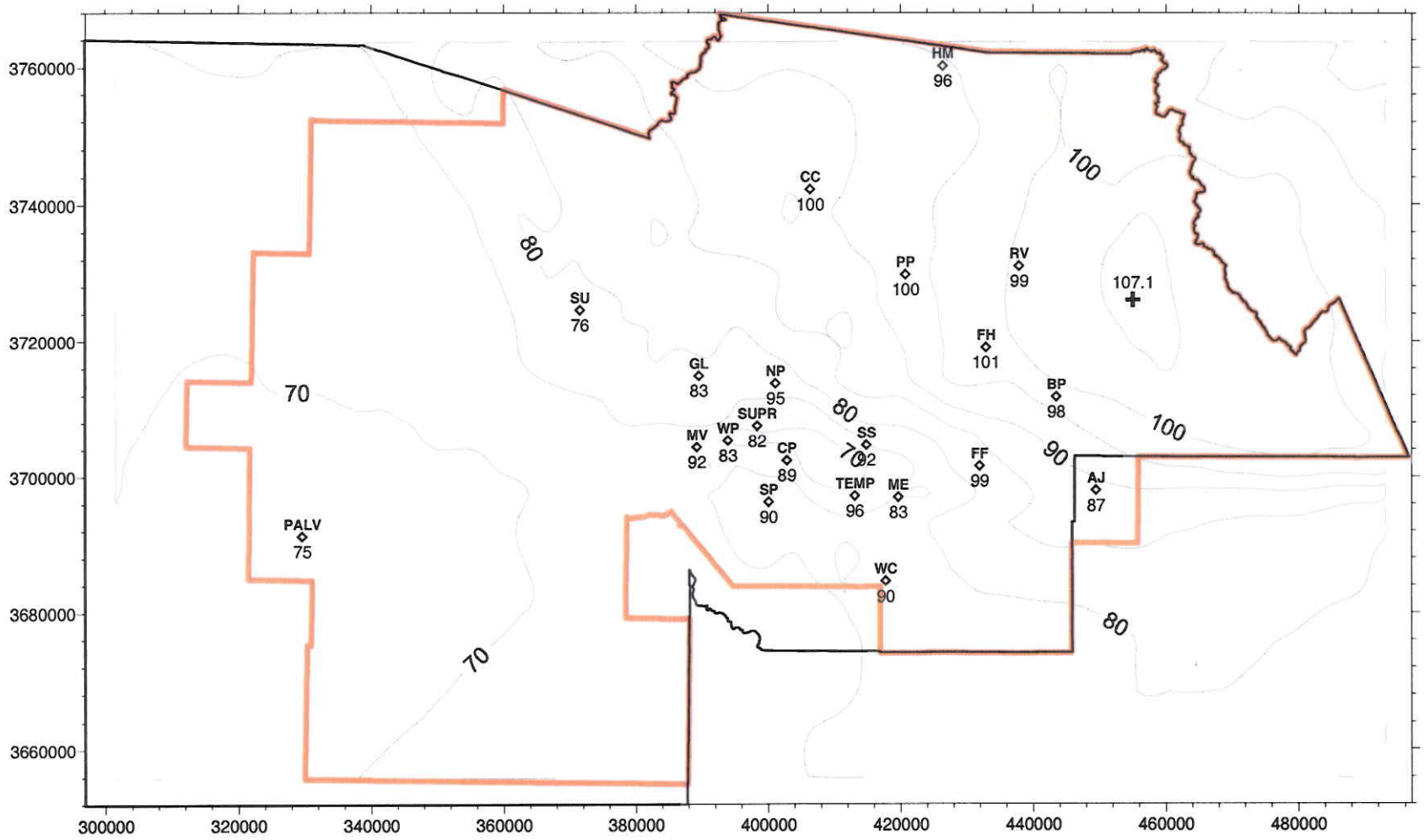


Figure IV-5(e). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 7, 2002.

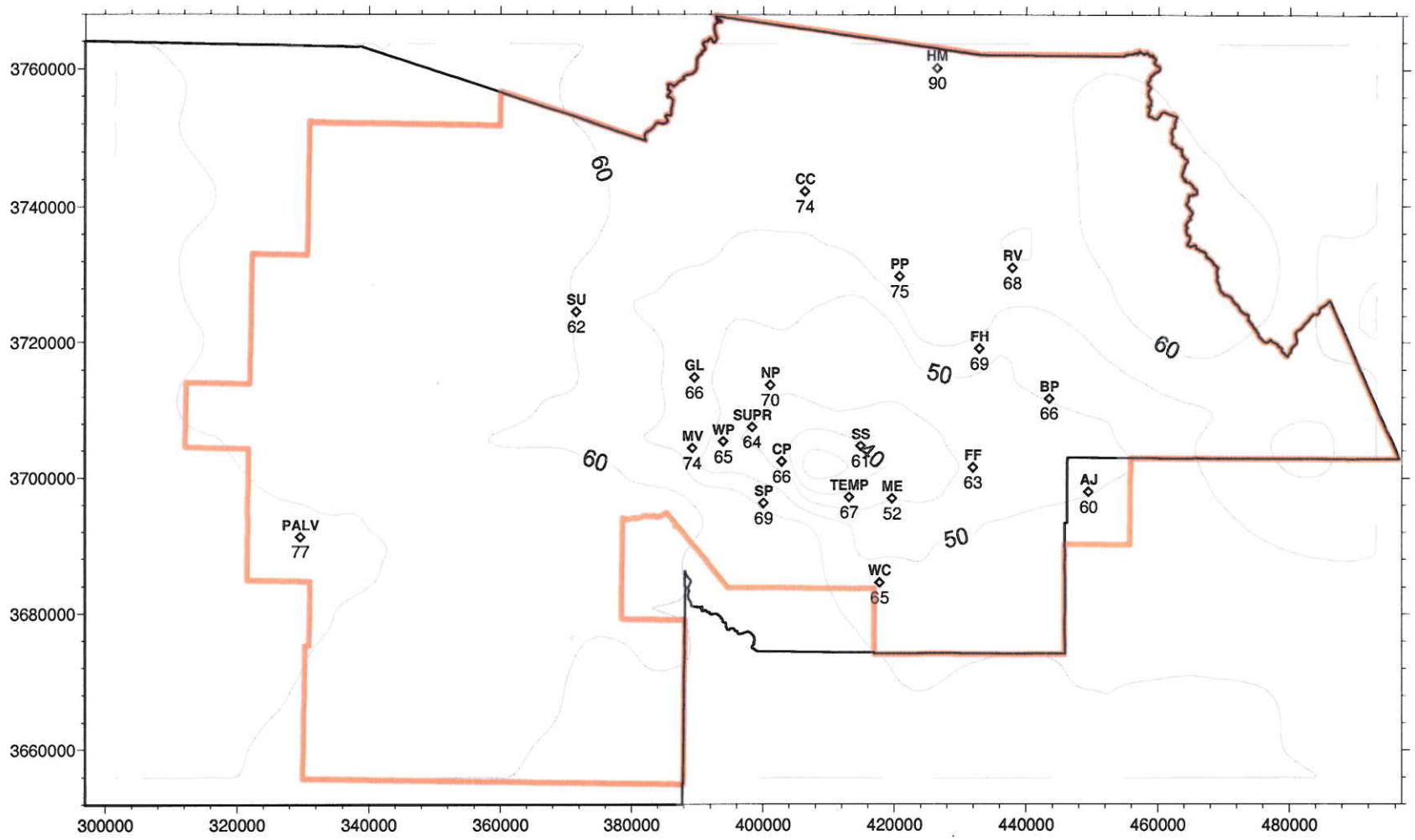


Figure IV-6(a). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 3, 2002.

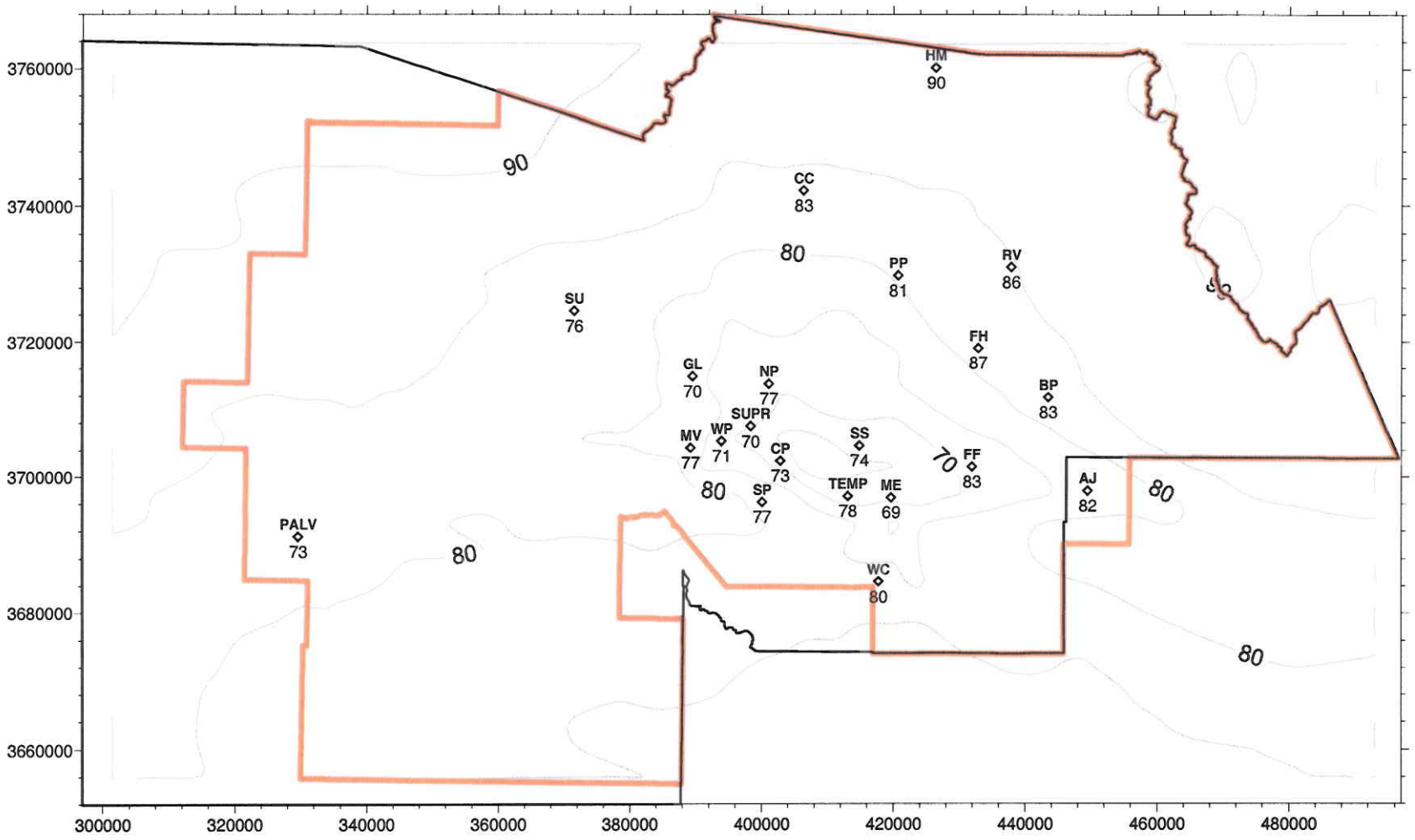


Figure IV-6(b). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 4, 2002.

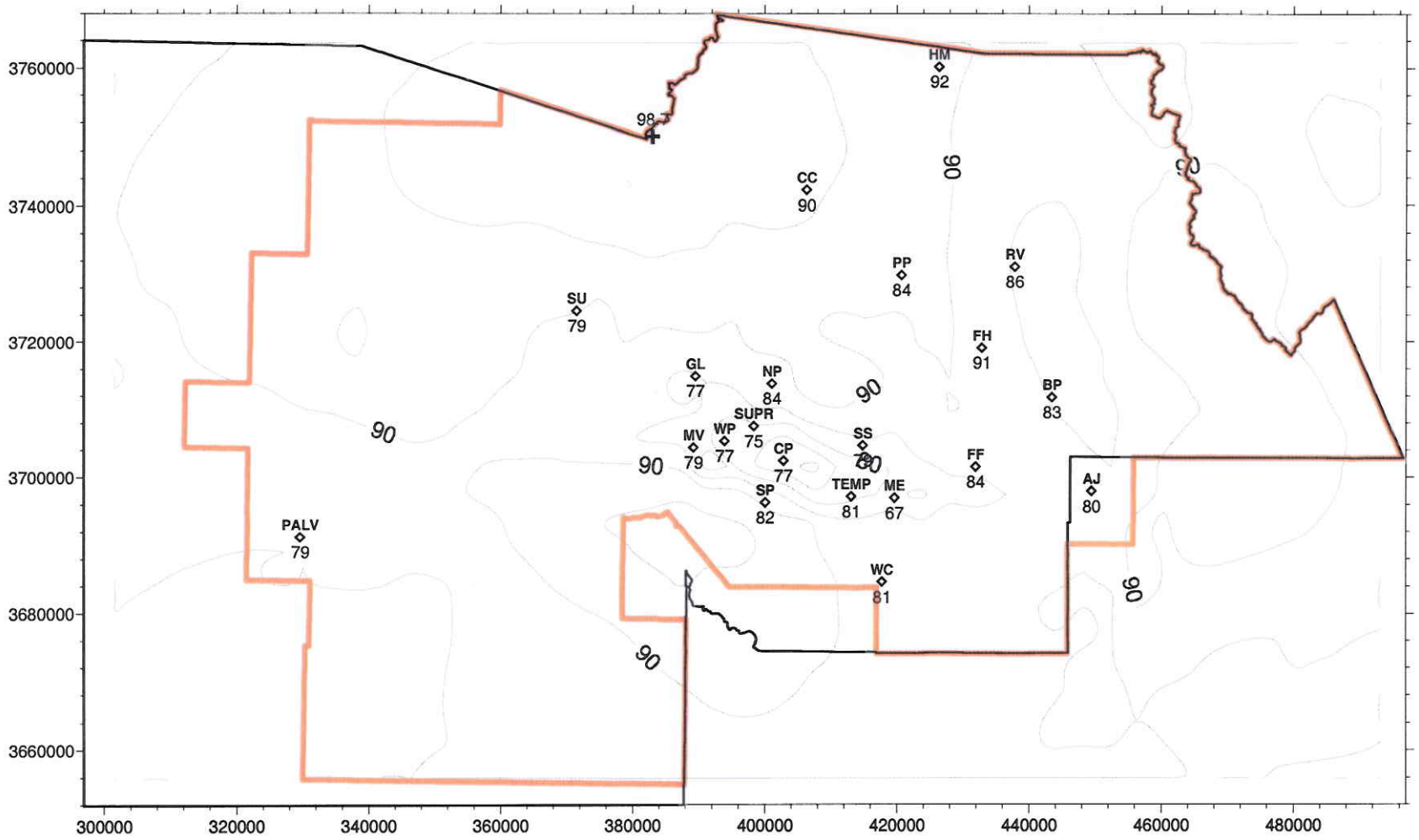


Figure IV-6(c). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 5, 2002.

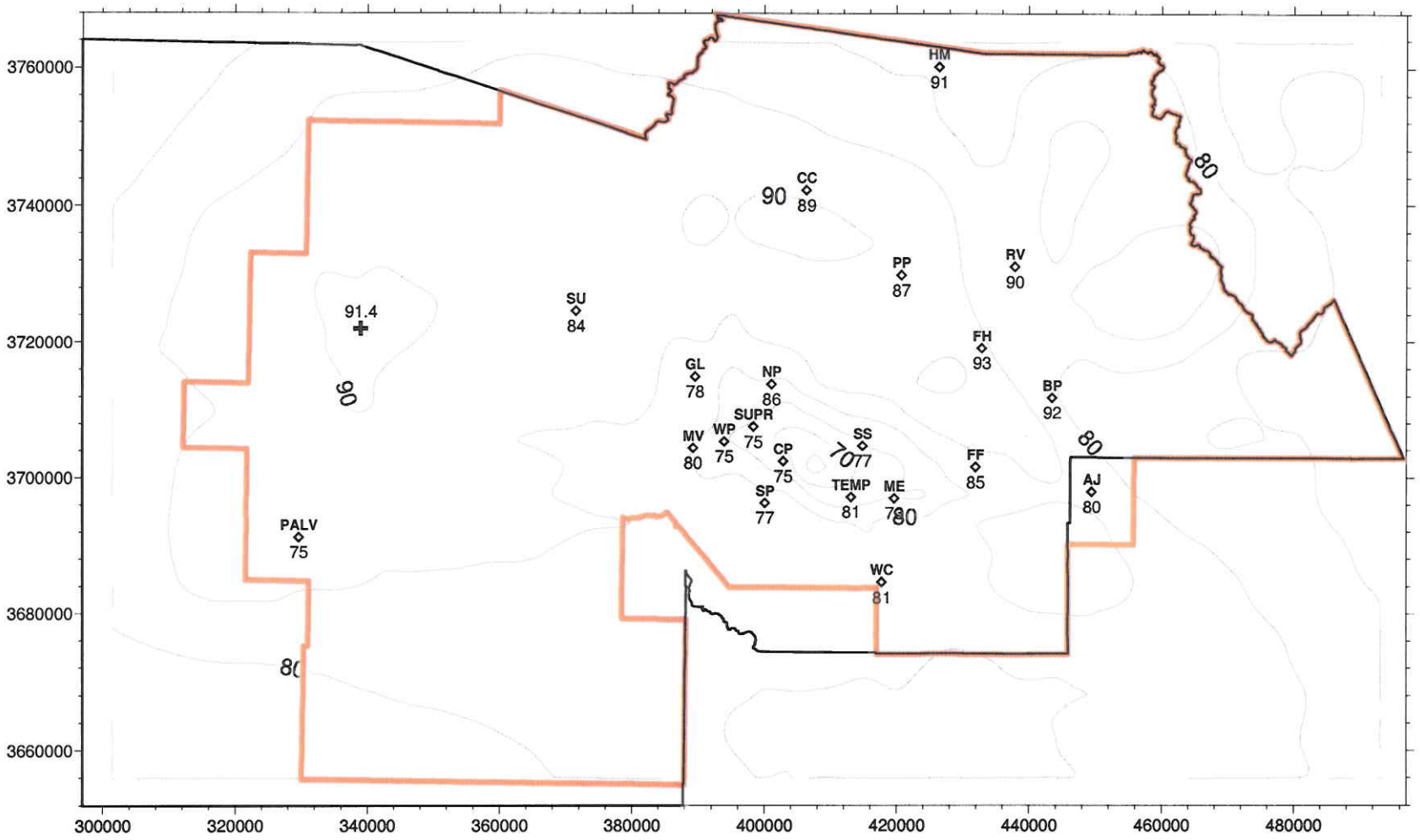


Figure IV-6(d). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 6, 2002.

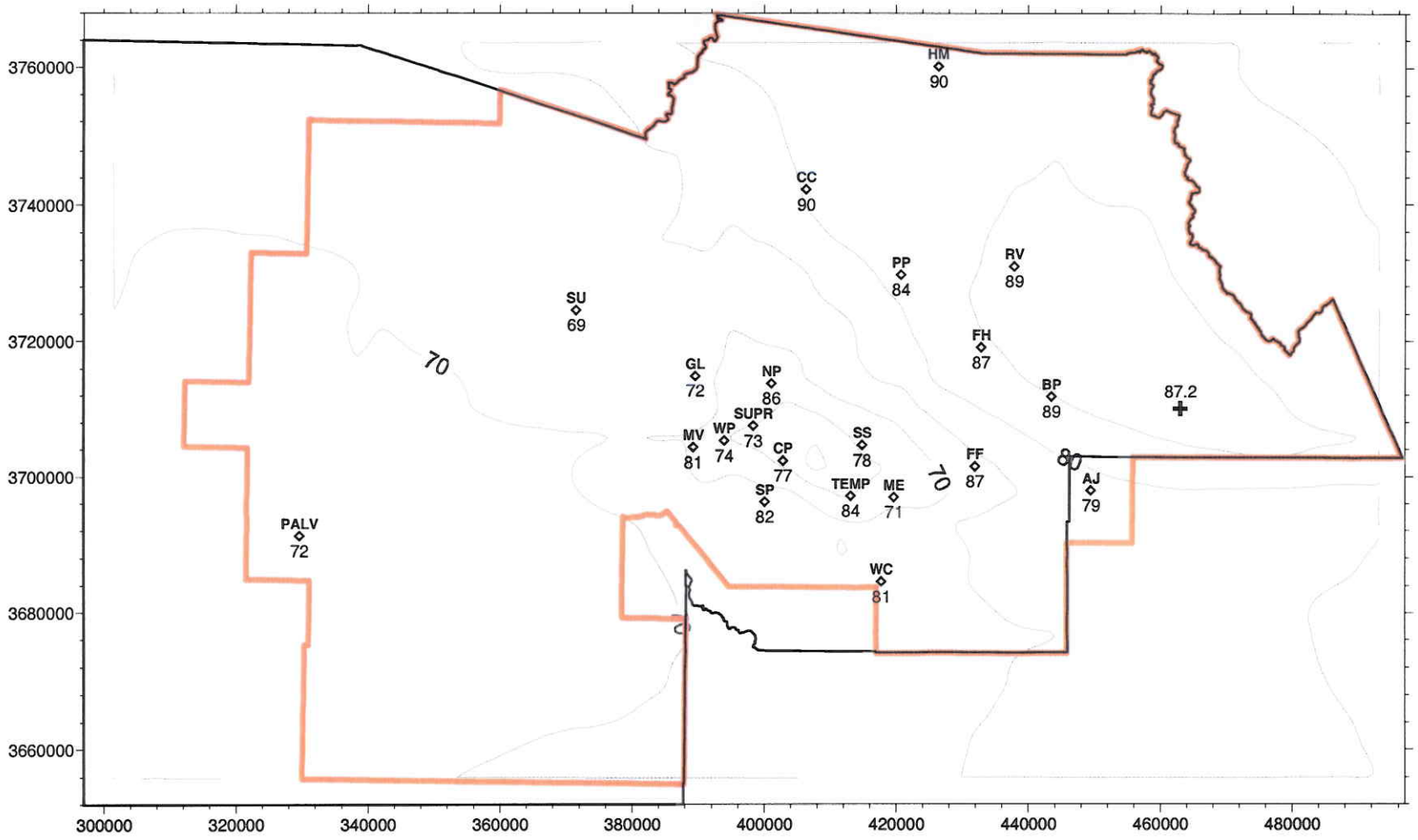


Figure IV-6(e). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on June 7, 2002.

IV-1-1-2. July 2002 Episode

The July 2002 episode is characterized by the highest one-hour ozone observed in the 2000 to 2004 years and occurred in a meteorological regime different from the other episodes.

Unlike the June 2002 episode, the general pattern of ozone formation over the MNA observed in the July 2002 episode is that one-hour ozone concentrations start to build up rapidly around 07:00 LST and to deplete gradually around 16:00 LST. A smoothed eight-hour ozone distinguishes this trend from hourly fluctuation. The elevated ozone concentrations are simulated during the afternoon hours between 12:00 and 18:00 LST for one-hour ozone and between 8:00 and 14:00 LST for eight-hour ozone. Tables IV-5 through IV-8 summarize the statistical modeling performance evaluation for one-hour and eight-hour ozone with/without a 60 ppb threshold. Statistics of ozone modeling performance applying a 60 ppb threshold indicate that CAMx generally under-predicts the observed ozone concentrations. Except for July 8, 2002, the normalized biases during episode days are lower than -15 percent, indicating the model's under-prediction does not meet the EPA's standards. Scatter plots in Figures IV-7(a)~(b) show that the closer to the mid-range of observed ozone concentrations, which are 50~70 ppb, the better the correlation with predicted ozone. Figure IV-8 shows a quantile-quantile plot of the nearest observed and predicted ozone near monitor locations in the MNA. This figure includes several performance evaluation methods:

- The scatter plot of observed/predicted pairs shows values centered on the 1:1 line with clear tendency toward under prediction for the entire ozone range.

- The observed/predicted values mostly lie within 20% of the 1:1 line meeting the goal.

- The correlation coefficients (r^2) for the scatter plot of observed/predicted pairs are 0.3685 and 0.4 for one-hour and eight-hour ozone, respectively, which are moderate.

- The quantile-quantile plot (circles) indicates a consistent under prediction bias with the quantile values remaining parallel to the 1:1 line throughout the distribution. The spread is slightly larger, and the quantile values show worse performance for the highest value.

As shown in Figures IV-9(a)~(c)and IV-10(a)~(c), the time series show that the modeled and observed ozone concentrations do not agree well over the region during episode days. The modeling tends to under predict ozone, although CAMx simulated observed ozone trend exceptionally well on July 8, 2002. Progress of ozone depletion in this episode is slow but ozone generation occurs rapidly. This ozone trend creates a deep ravine having a rapid slope around 6:00 LST which is the reverse of the June 2002 episode. However, CAMx was not able to simulate the trend. Minimum to maximum ranges for the 9 cells

around each monitor are narrower than ones for the June 2002 episode. Most of the sites located in up-wind and urban areas such as WP, NP, GL, PP, CP, SS, ME, MV, SP, WC, TEMP, PALV, and SUPR, have significant under-prediction, especially during the heart of the episode, which is July 11 and 12, 2002. The predicted ozone concentrations at the monitors located in the eastern periphery (AJ, BP, FH, PP, and RV) agree with observed ozone very well, although CAMx still under-predicts the peaks.

In addition, the daily one-hour and eight-hour maxima contour plots of predicted ozone across the 4 km domain, with the actual observations as an overlay for the July 2002 episode, are presented in Figures IV-11(a)~(g) and IV-12(a)~(g), respectively. The contour plots show that the predicted ozone concentrations are spatially shifted in different directions for each episode day compared with the overlaid ozone concentrations observed at each monitor. This suggests the modeled wind speed and wind direction misdirect the ozone plume in the model.

The statistical and spatial analyses for the primary episode days indicate that the CAMx consistently under-predicts the observed ozone concentrations in the July 2002 episode.

Table IV-5. Summary of Statistical Modeling Performance Evaluation for the July 2002 Episode (One-Hour Ozone with a 60 ppb Threshold).

	7/8	7/9	7/10	7/11	7/12	7/13	7/14
Peak Observed (Site)	RV	MV	WC	CP	HM	FF	AJ
(Hour)	16:00	16:00	13:00	16:00	16:00	14:00	14:00
(Concentration; ppb)	82.2	119.2	110.9	123.7	124.7	111.0	93.8
Peak Predicted (Cell X, Y)	(38,17)	(24, 15)	(40, 11)	(27, 21)	(36, 20)	(36, 12)	(39, 16)
(Hour)	17:00	17:00	17:00	15:00	16:00	14:00	14:00
(Concentration; ppb)	92.4	105.6	102.4	112.5	111.2	112.6	78.4
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	12.4	-11.4	-7.6	-9.0	-10.8	1.5	-16.5
Peak Bias (unpaired time; ppb)	-0.8	-20.1	-8.1	-26.2	-22.6	-14.3	-10.1
(unpaired time; %)	-1.1	-22.3	-6.7	-25.4	-22.9	-15.7	-13.8
Peak Error (unpaired time; ppb)	7.2	20.4	17.7	27.5	23.9	16.4	10.3
(unpaired time; %)	10.1	22.7	20.5	26.9	24.3	18.6	14.0
Peak Bias (paired time; ppb)	-4.9	-25.1	-14.9	-37.4	-26.4	-17.9	-13.1
(paired time; %)	-7.1	-28.0	-15.4	-37.1	-26.5	-21.0	-18.2
Peak Error (paired time; ppb)	8.0	25.1	21.1	37.4	27.7	19.5	13.2
(paired time; %)	11.2	28.0	24.4	37.1	27.9	23.2	18.5
Number of Stations	21	21	21	21	21	21	21
Number of Valid Peak Pairs	18	21	20	20	20	19	19
Average Prediction (ppb)	36.3	43.1	41.1	39.4	43.0	45.1	38.8
Average Observation (ppb)	35.3	58.6	55.3	57.6	57.2	54.7	49.2
Difference in Average (ppb)	1.0	-15.6	-14.1	-18.2	-14.3	-9.6	-10.4
(%)	2.8	-26.5	-25.6	-31.7	-24.9	-17.6	-21.2
Bias (absolute) (ppb)	-2.9	-18.4	-15.7	-25.2	-18.1	-15.1	-14.0
(normalized) (%) (EPA Goal: < ±15)	-4.4	-23.8	-20.3	-31.0	-22.4	-21.4	-21.2
(fractional) (%)	-5.4	-28.2	-25.7	-39.8	-26.4	-26.6	-24.5
Error (absolute) (ppb)	7.9	19.4	19.6	26.0	18.7	15.6	14.2
(normalized) (%) (EPA Goal: < 35)	11.6	25.1	26.1	32.2	23.1	22.0	21.6
(fractional) (%)	12.1	29.5	30.8	40.9	27.0	27.2	24.9
RMS Error (ppb)	9.5	21.4	22.7	29.8	21.2	19.0	15.8
Number of Total Pairs	504	504	504	504	504	504	504
Number of Valid Pairs	87	216	207	222	224	184	136
Ratio of Valid to Total Pairs (%)	17.3	42.9	41.1	44.0	44.4	36.5	27.0

Table IV-6. Summary of Statistical Modeling Performance Evaluation for the July 2002 Episode (One-Hour Ozone without Threshold).

	7/8	7/9	7/10	7/11	7/12	7/13	7/14
Peak Observed (Site)	RV	MV	WC	CP	HM	FF	AJ
(Hour)	16:00	16:00	13:00	16:00	16:00	14:00	14:00
(Concentration; ppb)	82.2	119.2	110.9	123.7	124.7	111.0	93.8
Peak Predicted (Cell X, Y)	(38,17)	(24, 15)	(40, 11)	(27, 21)	(36, 20)	(36, 12)	(39, 16)
(Hour)	17:00	17:00	17:00	15:00	16:00	14:00	14:00
(Concentration; ppb)	92.4	105.6	102.4	112.5	111.2	112.6	78.4
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	12.4	-11.4	-7.6	-9.0	-10.8	1.5	-16.5
Peak Bias (unpaired time; ppb)	0.5	-20.1	-8.1	-26.2	-22.6	-13.4	-10.1
(unpaired time; %)	1.3	-22.3	-6.7	-25.4	-22.9	-14.6	-13.8
Peak Error (unpaired time; ppb)	7.7	20.4	17.7	27.5	23.9	15.7	10.3
(unpaired time; %)	11.6	22.7	20.5	26.9	24.3	18.0	14.0
Peak Bias (paired time; ppb)	-3.1	-25.1	-14.9	-37.4	-26.4	-17.8	-13.1
(paired time; %)	-4.1	-28.0	-15.4	-37.1	-26.5	-21.5	-18.2
Peak Error (paired time; ppb)	8.4	25.1	21.1	37.4	27.7	19.3	13.2
(paired time; %)	12.4	28.0	24.4	37.1	27.9	23.6	18.5
Number of Stations	21	21	21	21	21	21	21
Number of Valid Peak Pairs	21	21	20	20	20	20	19
Average Prediction (ppb)	36.3	43.1	41.1	39.4	43.0	45.1	38.8
Average Observation (ppb)	35.3	58.6	55.3	57.6	57.2	54.7	49.2
Difference in Average (ppb)	1.0	-15.6	-14.1	-18.2	-14.3	-9.6	-10.4
(%)	2.8	-26.5	-25.6	-31.7	-24.9	-17.6	-21.2
Bias (absolute) (ppb)	1.0	-15.6	-14.1	-18.2	-14.3	-9.6	-10.4
(normalized) (%) (EPA Goal: < ±15)	42.6	-25.3	-25.8	Inf.	-16.0	-12.9	-15.9
(fractional) (%)	5.3	-35.2	-38.7	-46.3	-34.7	-22.6	-27.0
Error (absolute) (ppb)	7.3	16.9	17.1	20.5	17.1	13.8	14.7
(normalized) (%) (EPA Goal: < 35)	66.7	31.6	33.5	Inf.	41.9	29.3	34.3
(fractional) (%)	39.7	39.2	44.9	53.1	46.8	34.7	39.4
RMS Error (ppb)	9.6	19.6	20.9	24.8	20.2	17.7	17.3
Number of Total Pairs	504	504	504	504	504	504	504
Number of Valid Pairs	484	472	466	473	470	451	447
Ratio of Valid to Total Pairs (%)	96.0	93.7	92.5	93.8	93.3	89.5	88.7

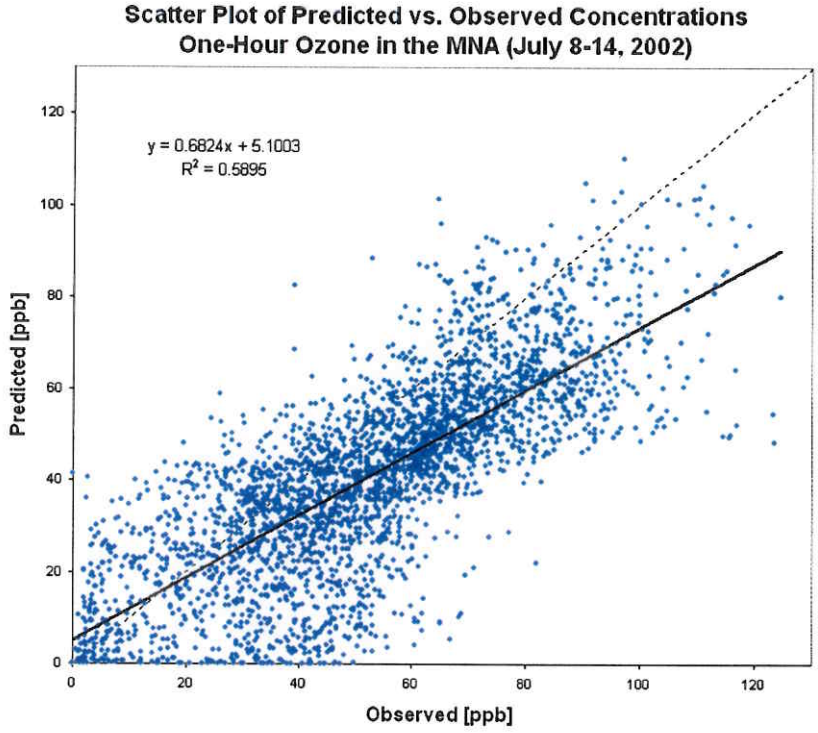
Table IV-7. Summary of Statistical Modeling Performance Evaluation for the July 2002 Episode (Eight-Hour Ozone with a 60 ppb Threshold).

	7/8	7/9	7/10	7/11	7/12	7/13	7/14
Peak Observed (Site)	BP	MV	MV	WP	HM	BP	FF
(Hour)	12:00	11:00	11:00	9:00	12:00	9:00	10:00
(Concentration; ppb)	74.1	107.9	95.0	103.2	103.2	86.8	75.8
Peak Predicted (Cell X, Y)	(36, 16)	(23, 15)	(36, 13)	(27, 21)	(30, 22)	(34, 13)	(43, 15)
(Hour)	12:00	12:00	11:00	11:00	11:00	9:00	10:00
(Concentration; ppb)	75.9	89.6	79.0	82.0	85.7	79.9	69.3
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	2.5	-17.0	-16.9	-20.6	-17.0	-8.0	-8.6
Peak Bias (unpaired time; ppb)	-2.0	-18.7	-12.3	-23.4	-17.8	-11.7	-12.7
(unpaired time; %)	-3.0	-23.0	-14.5	-26.9	-20.8	-15.4	-19.2
Peak Error (unpaired time; ppb)	4.3	18.7	15.2	23.7	17.8	11.7	12.7
(unpaired time; %)	6.3	23.0	18.8	27.3	20.8	15.4	19.2
Peak Bias (paired time; ppb)	-2.6	-19.4	-13.7	-25.1	-18.6	-12.7	-13.9
(paired time; %)	-4.0	-24.0	-16.4	-29.0	-21.8	-16.7	-21.0
Peak Error (paired time; ppb)	4.9	19.4	16.0	25.1	18.6	12.7	13.9
(paired time; %)	7.3	24.0	19.9	29.0	21.8	16.7	21.0
Number of Stations	21	21	21	21	21	21	21
Number of Valid Peak Pairs	10	21	20	20	20	16	15
Average Prediction (ppb)	37.3	43.2	39.2	40.2	43.5	46.5	41.6
Average Observation (ppb)	38.5	58.7	54.6	57.8	58.6	52.3	53.6
Difference in Average (ppb)	-1.1	-15.5	-15.4	-17.6	-15.1	-5.8	-12.0
(%)	-2.9	-26.4	-28.3	-30.5	-25.8	-11.1	-22.4
Bias (absolute) (ppb)	-3.7	-18.8	-16.2	-23.1	-17.9	-11.8	-13.6
(normalized) (%) (EPA Goal: < ±15)	-5.8	-25.7	-22.3	-30.1	-23.4	-16.3	-21.0
(fractional) (%)	-6.6	-30.1	-26.8	-36.8	-27.3	-18.2	-24.1
Error (absolute) (ppb)	5.8	18.9	17.2	23.3	18.0	11.8	13.6
(normalized) (%) (EPA Goal: < 35)	9.0	25.8	23.8	30.4	23.5	16.4	21.0
(fractional) (%)	9.8	30.2	28.2	37.1	27.4	18.2	24.1
RMS Error (ppb)	7.8	20.0	20.1	25.6	19.8	13.1	15.0
Number of Total Pairs	504	504	504	504	504	504	357
Number of Valid Pairs	64	220	195	225	220	141	103
Ratio of Valid to Total Pairs (%)	12.7	43.7	38.7	44.6	43.7	28.0	28.9

Table IV-8. Summary of Statistical Modeling Performance Evaluation for the July 2002 Episode (Eight-Hour Ozone without Threshold).

	7/8	7/9	7/10	7/11	7/12	7/13	7/14
Peak Observed (Site)	BP	MV	MV	WP	HM	BP	FF
(Hour)	12:00	11:00	11:00	9:00	12:00	9:00	10:00
(Concentration; ppb)	74.1	107.9	95.0	103.2	103.2	86.8	75.8
Peak Predicted (Cell X, Y)	(36, 16)	(23, 15)	(36, 13)	(27, 21)	(30, 22)	(34, 13)	(43, 15)
(Hour)	12:00	12:00	11:00	11:00	11:00	9:00	10:00
(Concentration; ppb)	75.9	89.6	79.0	82.0	85.7	79.9	69.3
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	2.5	-17.0	-16.9	-20.6	-17.0	-8.0	-8.6
Peak Bias (unpaired time; ppb)	0.0	-18.7	-12.3	-23.4	-17.8	-8.1	-11.6
(unpaired time; %)	0.6	-23.0	-14.5	-26.9	-20.8	-9.0	-17.9
Peak Error (unpaired time; ppb)	4.4	18.7	15.2	23.7	17.8	11.7	11.6
(unpaired time; %)	7.7	23.0	18.8	27.3	20.8	17.4	17.9
Peak Bias (paired time; ppb)	-0.7	-19.4	-13.7	-25.1	-18.6	-10.2	-13.9
(paired time; %)	-0.7	-24.0	-16.4	-29.0	-21.8	-13.2	-21.6
Peak Error (paired time; ppb)	4.8	19.4	16.0	25.1	18.6	11.7	13.9
(paired time; %)	8.2	24.0	19.9	29.0	21.8	16.3	21.6
Number of Stations	21	21	21	21	21	21	21
Number of Valid Peak Pairs	21	21	20	20	20	20	19
Average Prediction (ppb)	37.3	43.2	39.2	40.2	43.5	46.5	41.6
Average Observation (ppb)	38.5	58.7	54.6	57.8	58.6	52.3	53.6
Difference in Average (ppb)	-1.1	-15.5	-15.4	-17.6	-15.1	-5.8	-12.0
(%)	-2.9	-26.4	-28.3	-30.5	-25.8	-11.1	-22.4
Bias (absolute) (ppb)	-1.1	-15.5	-15.4	-17.6	-15.1	-5.8	-12.0
(normalized) (%) (EPA Goal: < ±15)	2.5	-26.9	-29.7	-29.6	-26.2	-8.2	-21.9
(fractional) (%)	-2.3	-32.6	-41.6	-40.1	-34.4	-11.1	-26.9
Error (absolute) (ppb)	5.4	15.8	16.5	19.0	15.8	8.9	13.1
(normalized) (%) (EPA Goal: < 35)	20.5	27.8	32.1	34.6	28.6	17.7	24.6
(fractional) (%)	19.4	33.5	43.8	43.7	36.3	19.5	29.3
RMS Error (ppb)	6.9	17.3	19.7	21.6	18.5	11.1	15.0
Number of Total Pairs	504	504	504	504	504	504	357
Number of Valid Pairs	491	485	474	474	470	446	321
Ratio of Valid to Total Pairs (%)	97.4	96.2	94.0	94.0	93.3	88.5	89.9

(a)



(b)

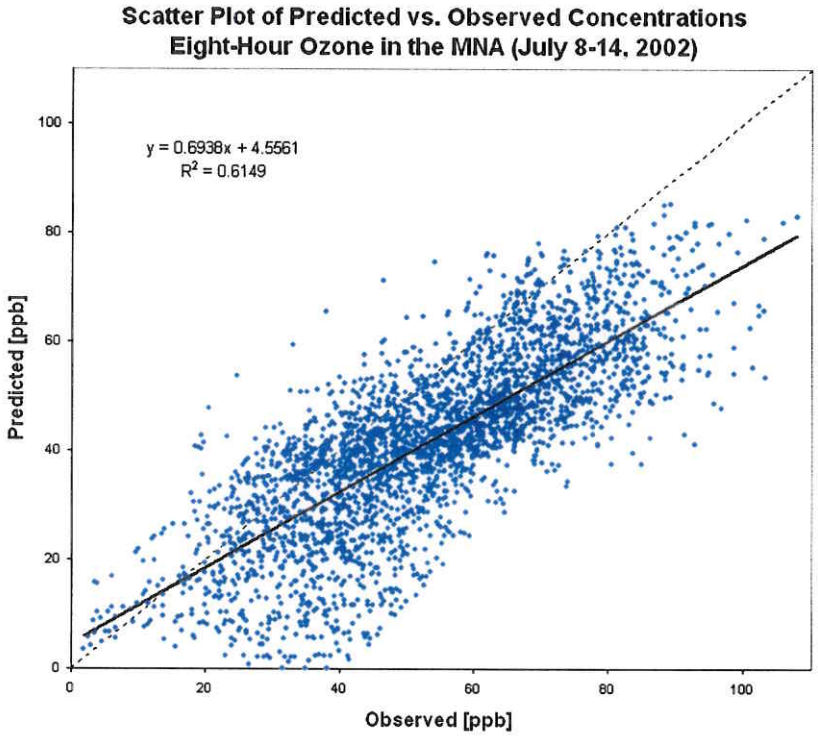
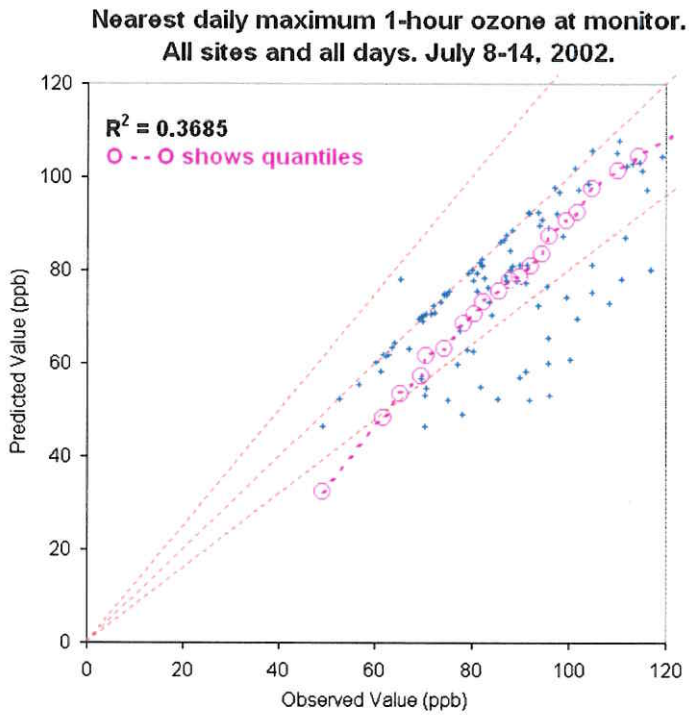


Figure IV-7. Scatter plots of predicted and observed (a) one-hour and (b) eight-hour ozone in the MNA (July 8-14, 2002).

(a)



(b)

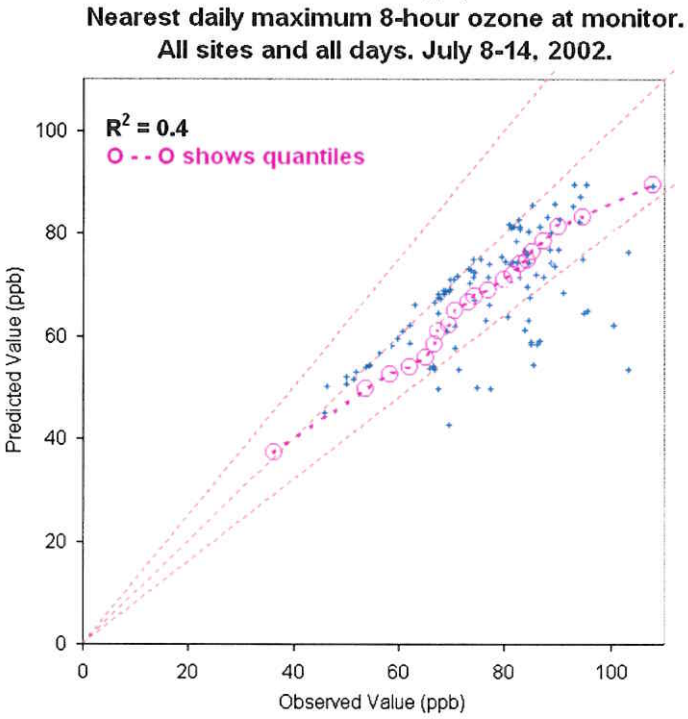


Figure IV-8. Quantile-quantile plot of nearest observed/predicted paired peak (a) one-hour and (b) eight-hour ozone near monitor locations in the MNA for each day of the July 2002 episode. [EPA recommended ±20% envelope is shown as red dotted lines surrounding 1:1 line (middle red dashed line). The r^2 value is the correlation coefficient.]

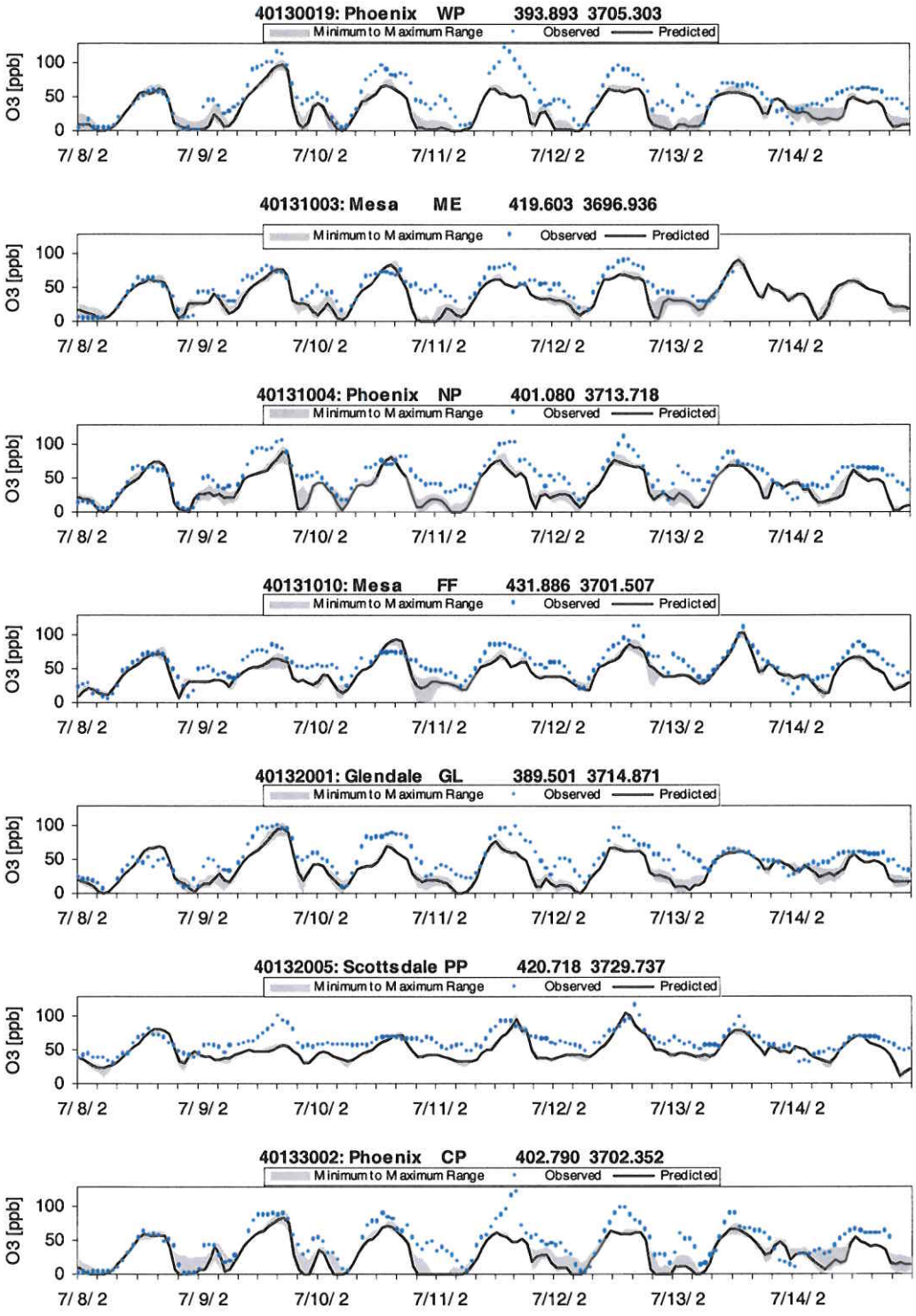


Figure IV-9(a). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the July 2002 episode.

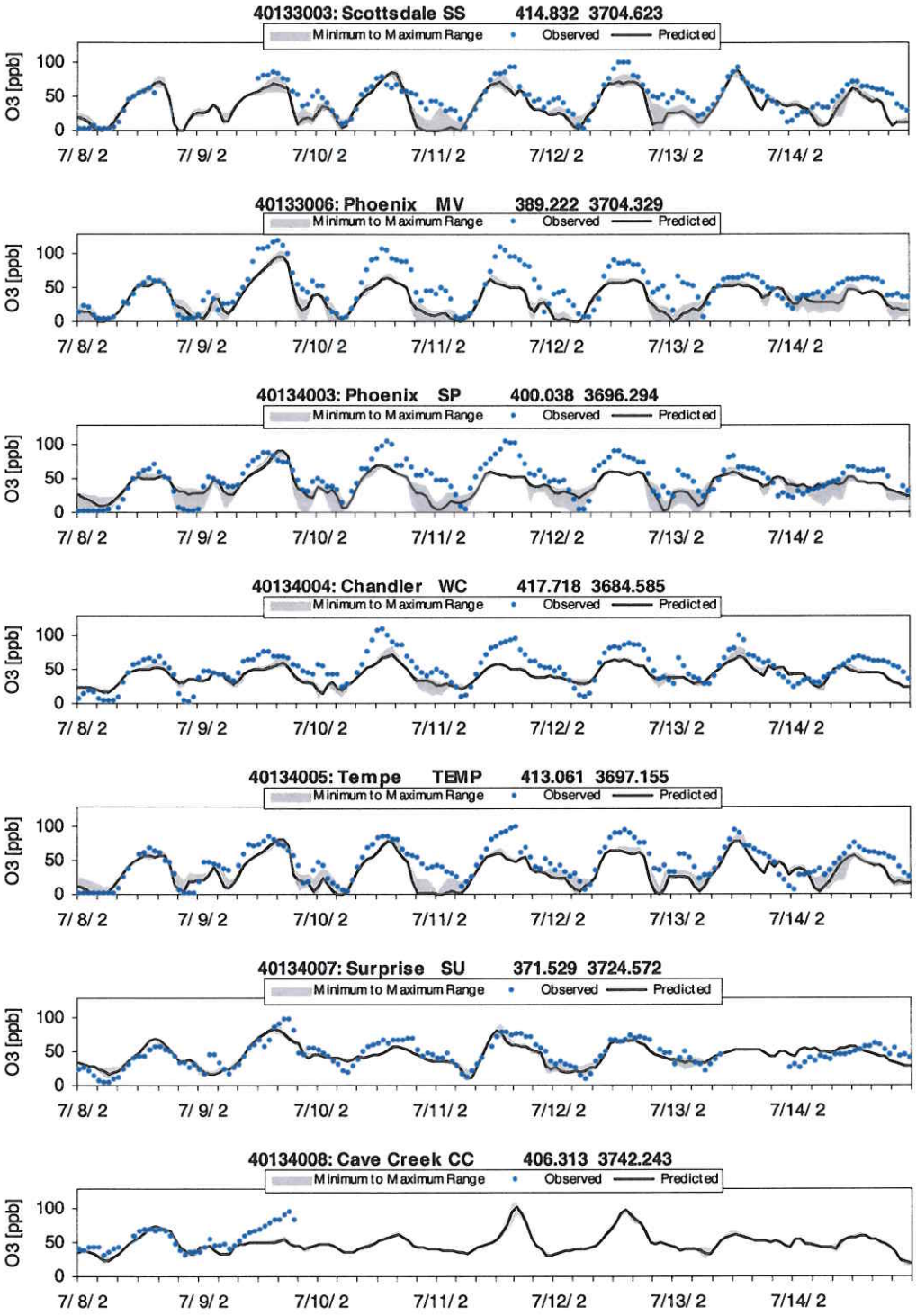


Figure IV-9(b). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the July 2002 episode.

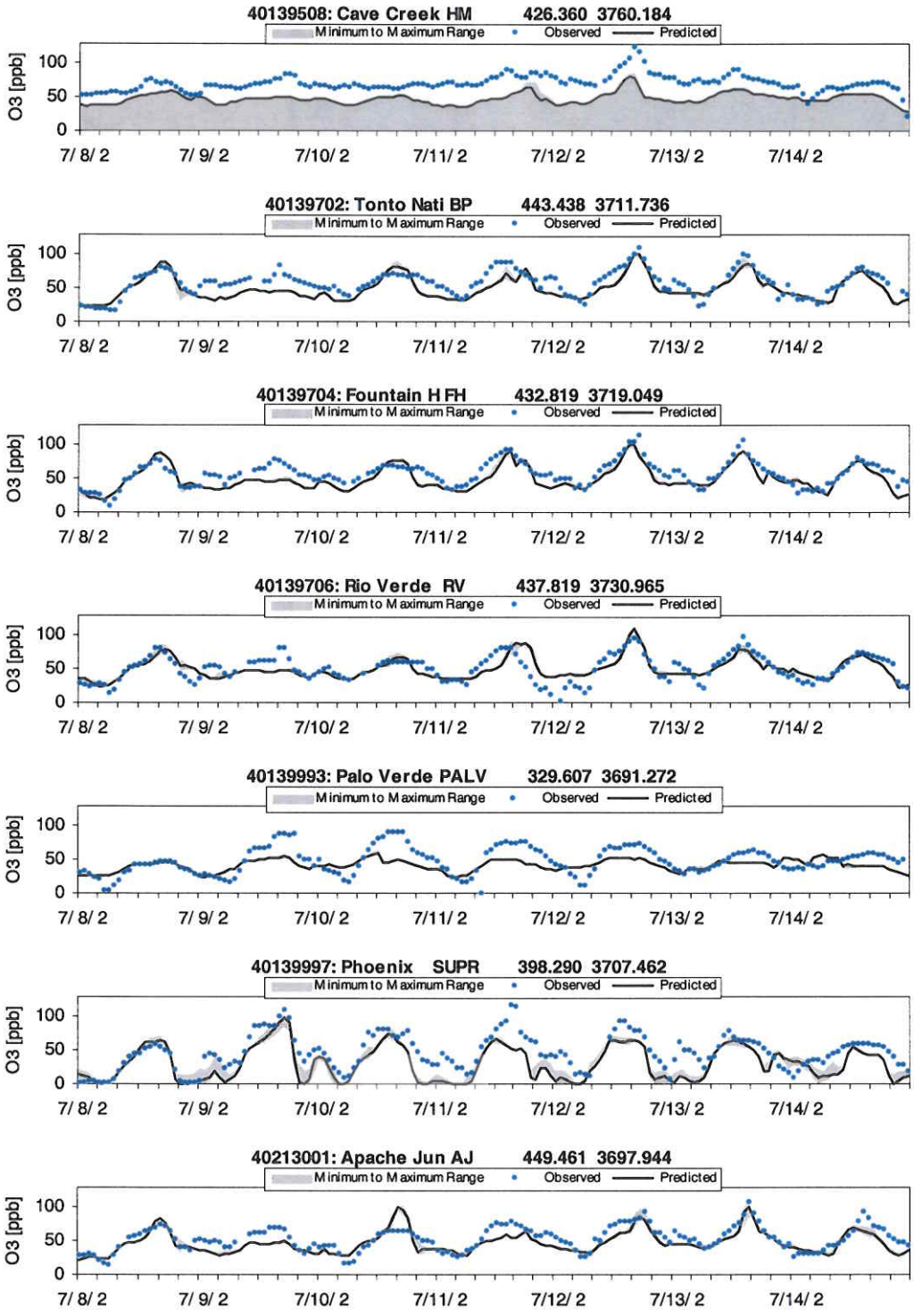


Figure IV-9(c). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the July 2002 episode.

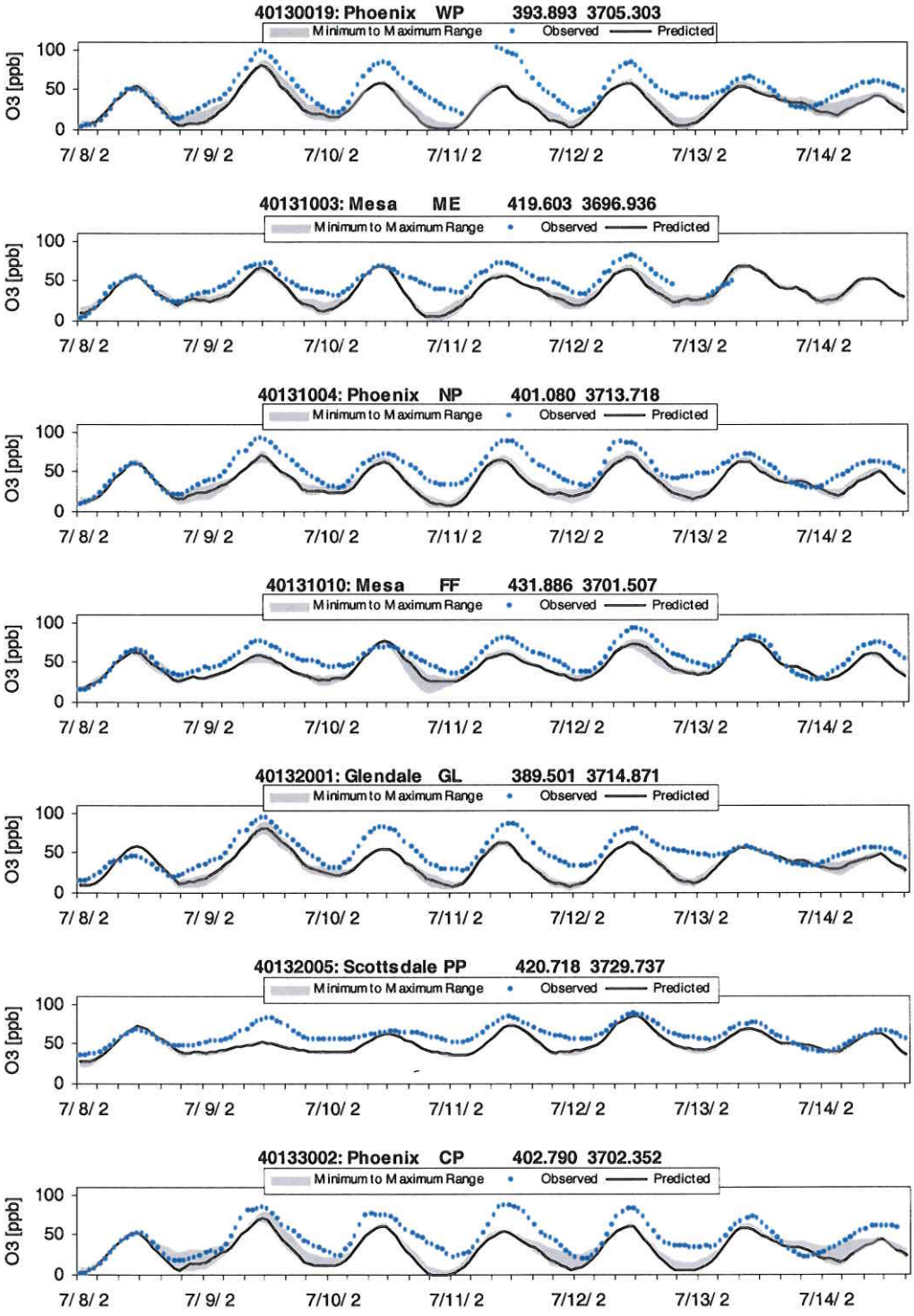


Figure IV-10(a). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the July 2002 episode.

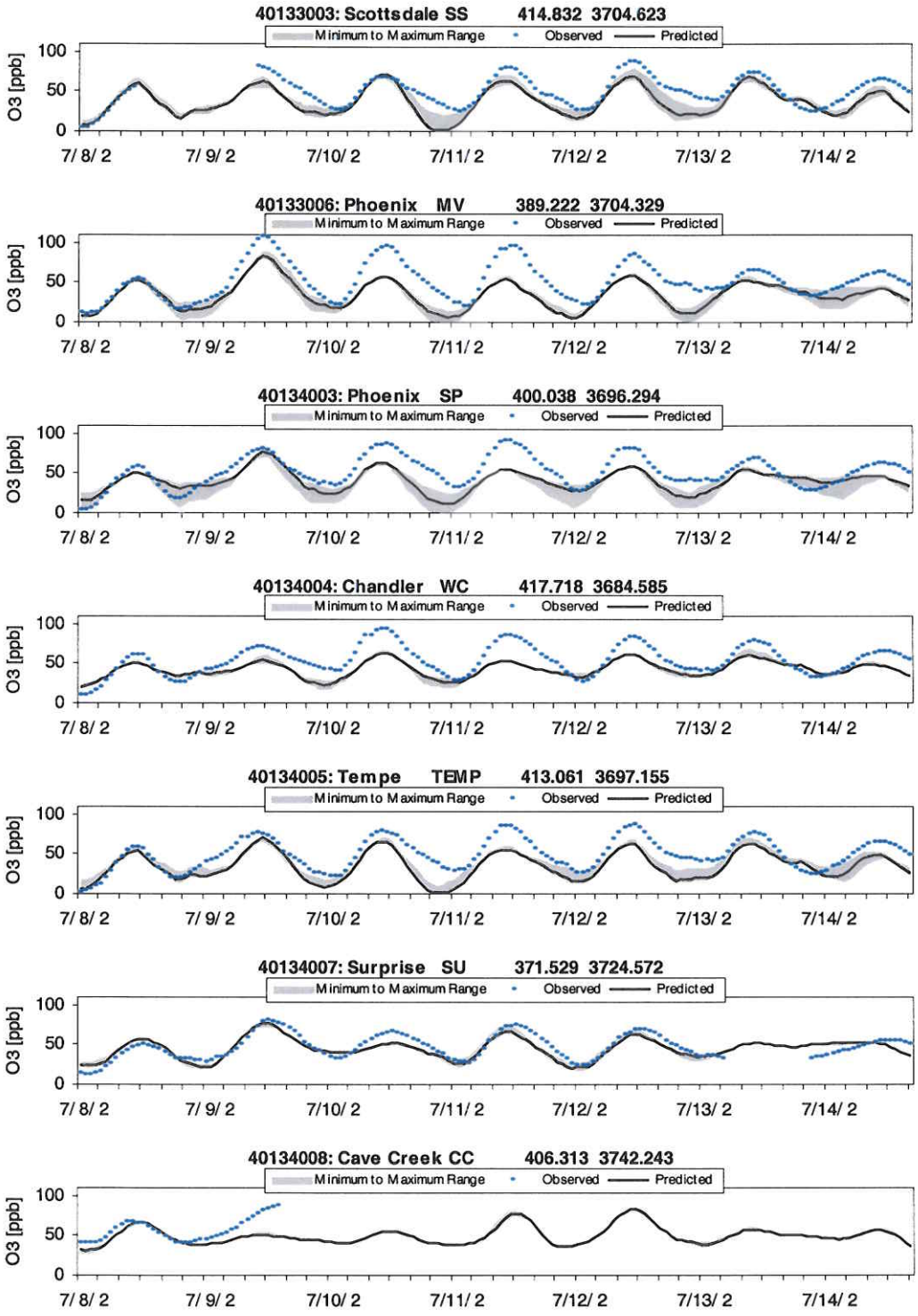


Figure IV-10(b). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the July 2002 episode.

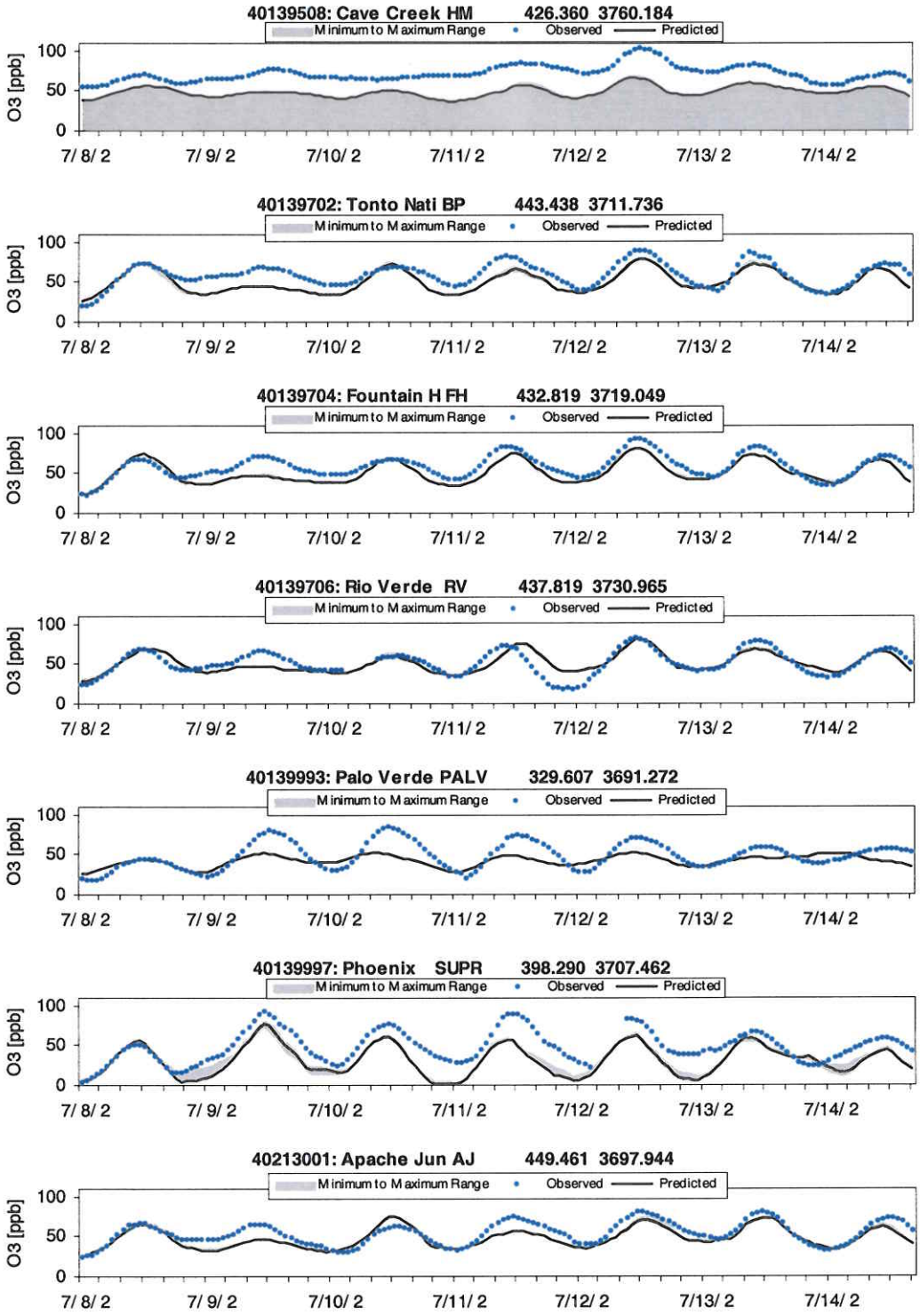


Figure IV-10(c). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the July 2002 episode.

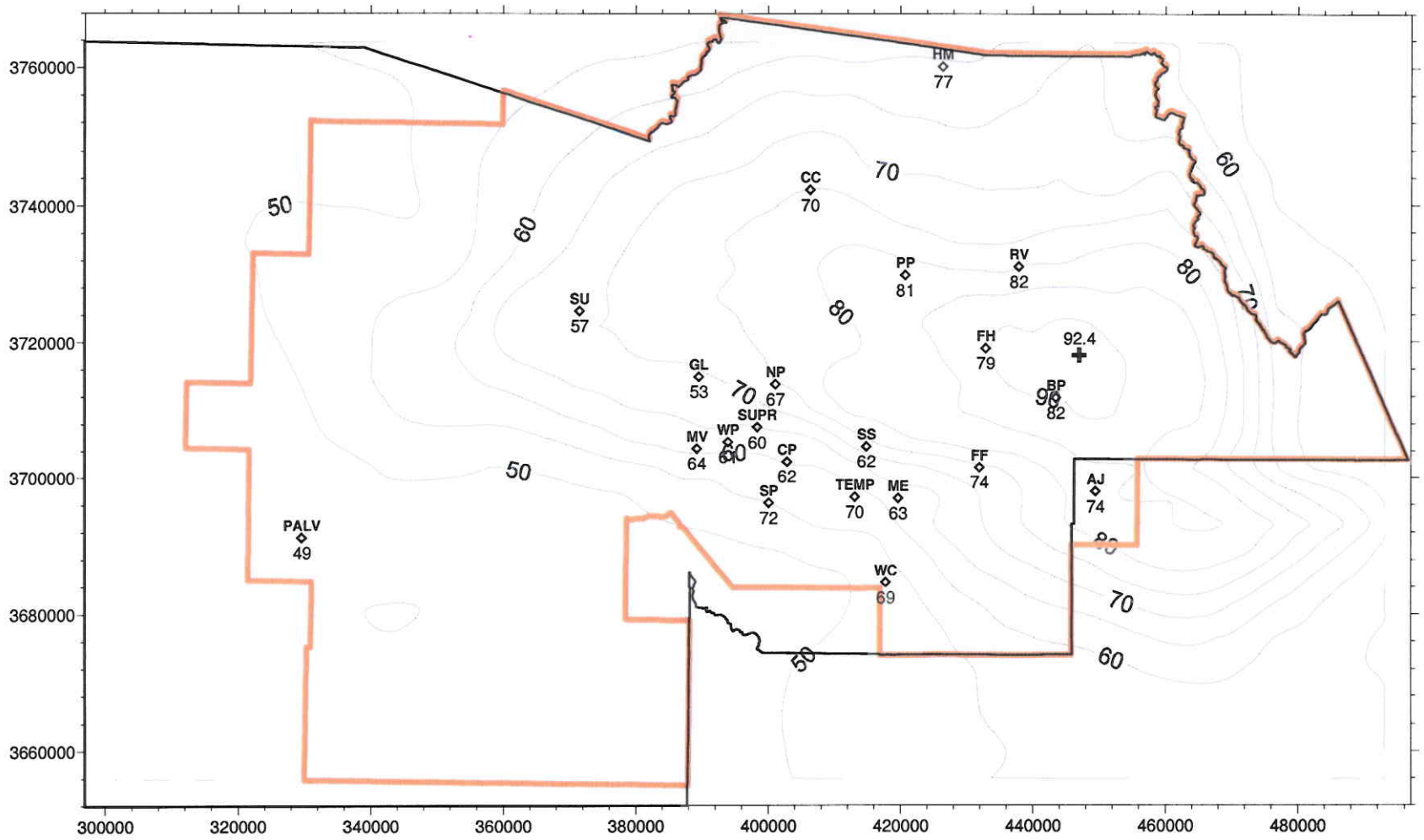


Figure IV-11(a). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 8, 2002.

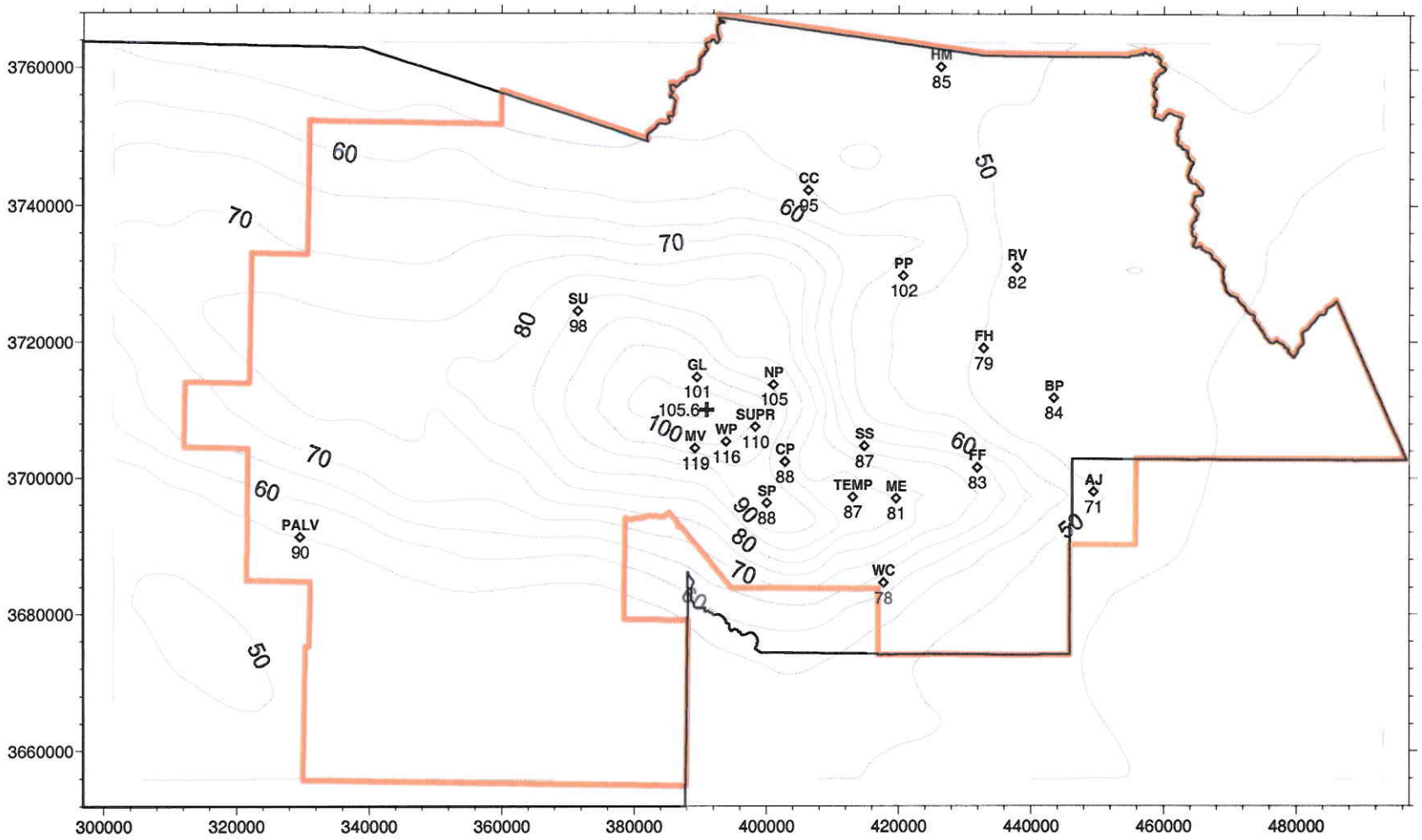


Figure IV-11(b). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 9, 2002.

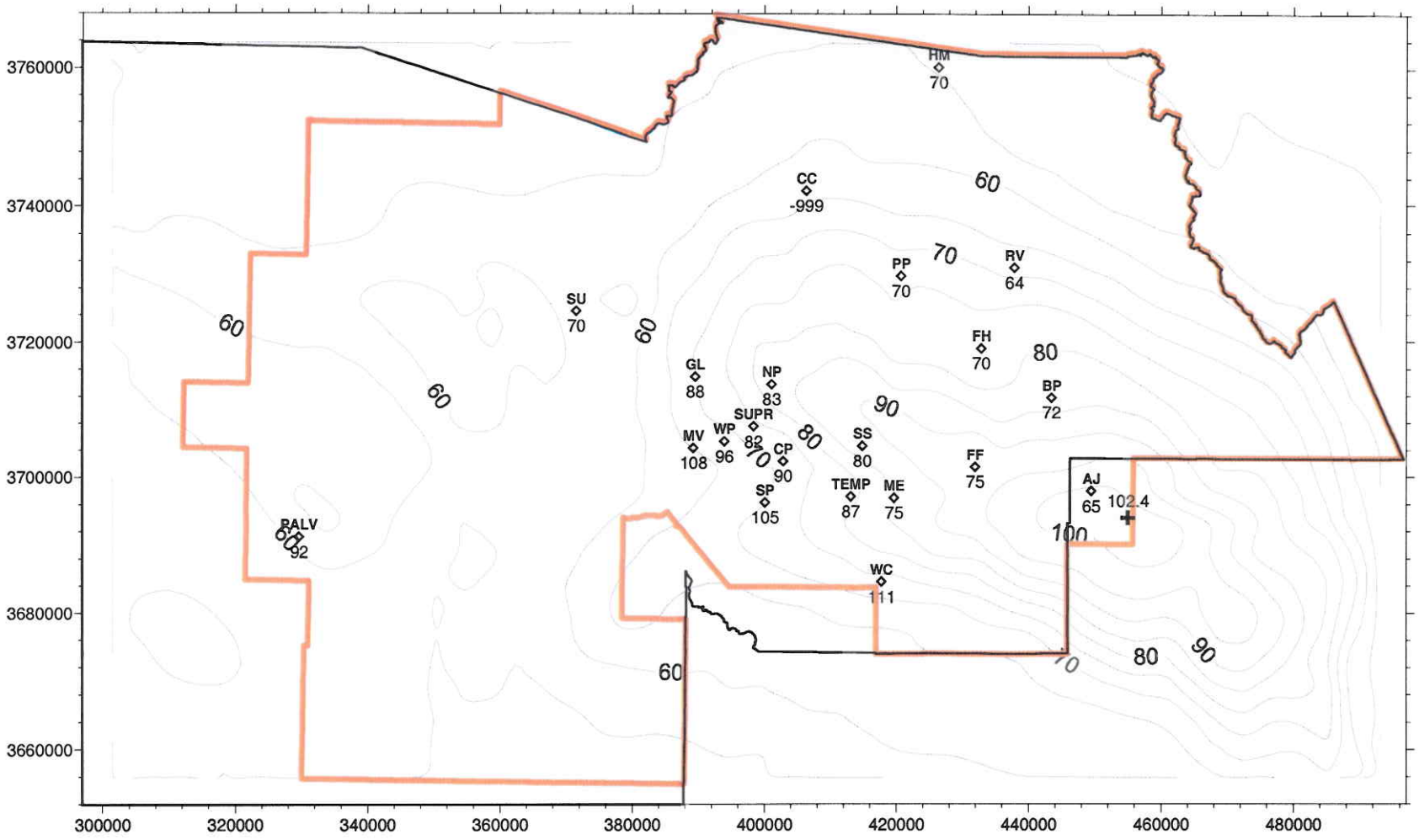


Figure IV-11(c). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 10, 2002.

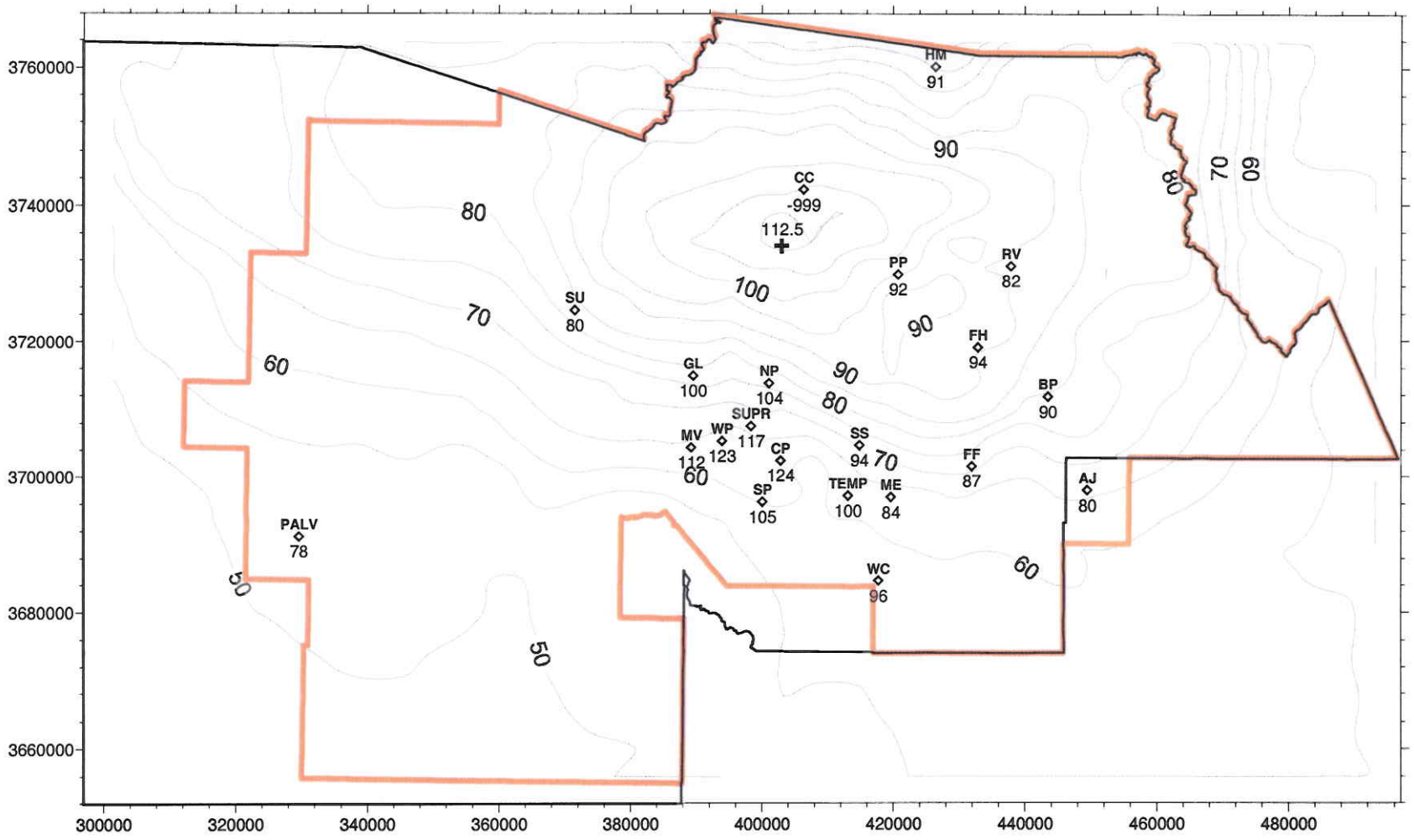


Figure IV-11(d). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 11, 2002.

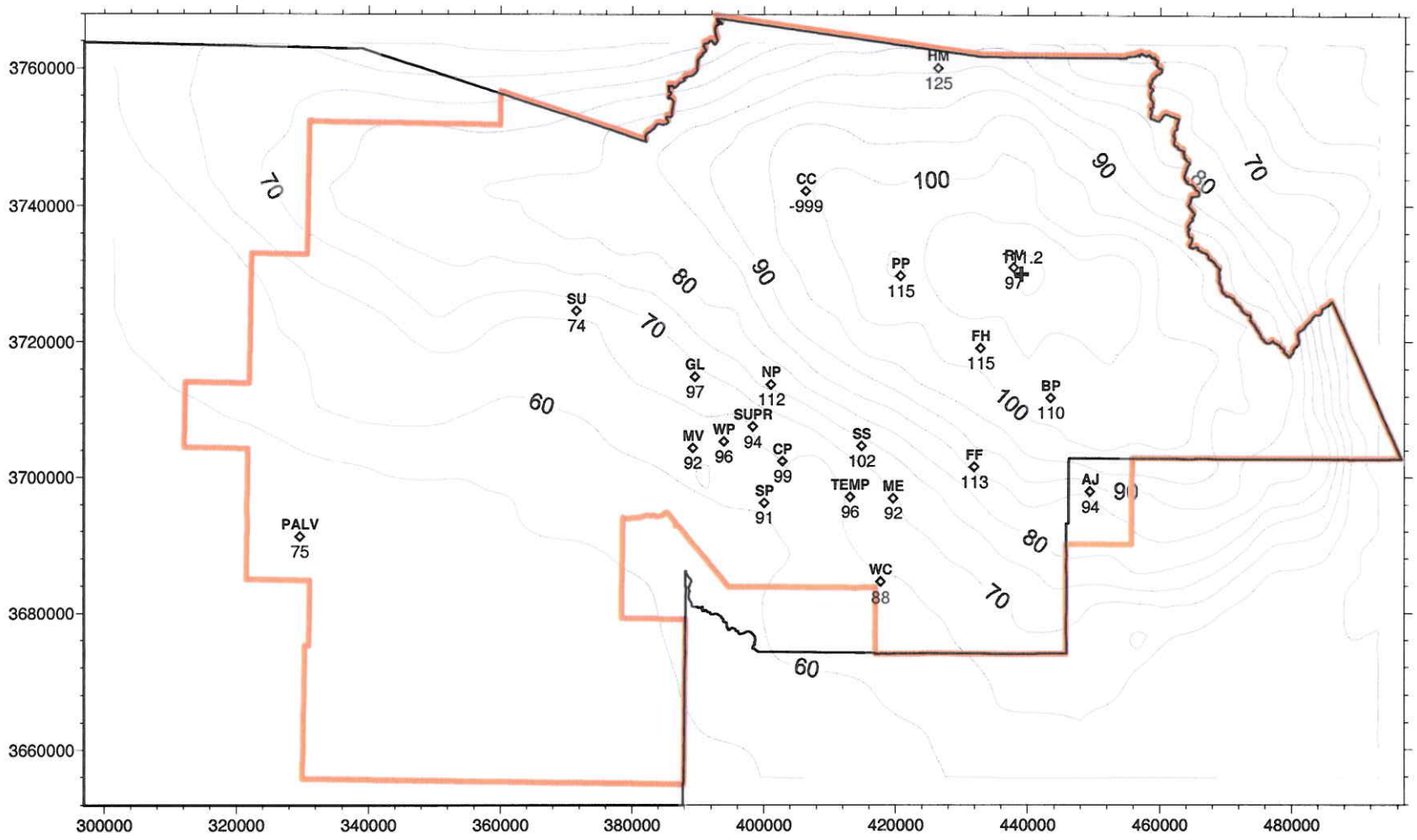


Figure IV-11(e). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 12, 2002.

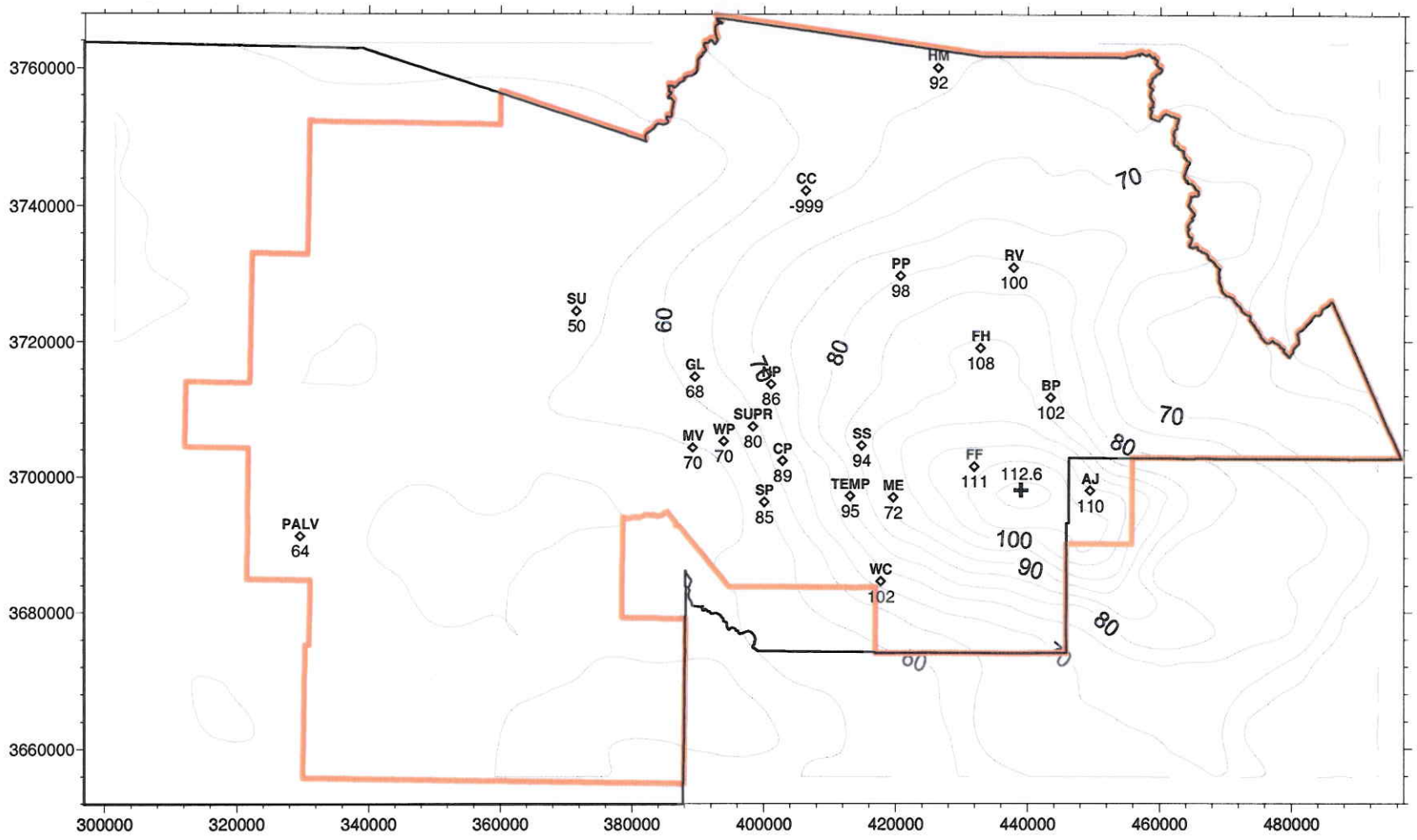


Figure IV-11(f). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 13, 2002.

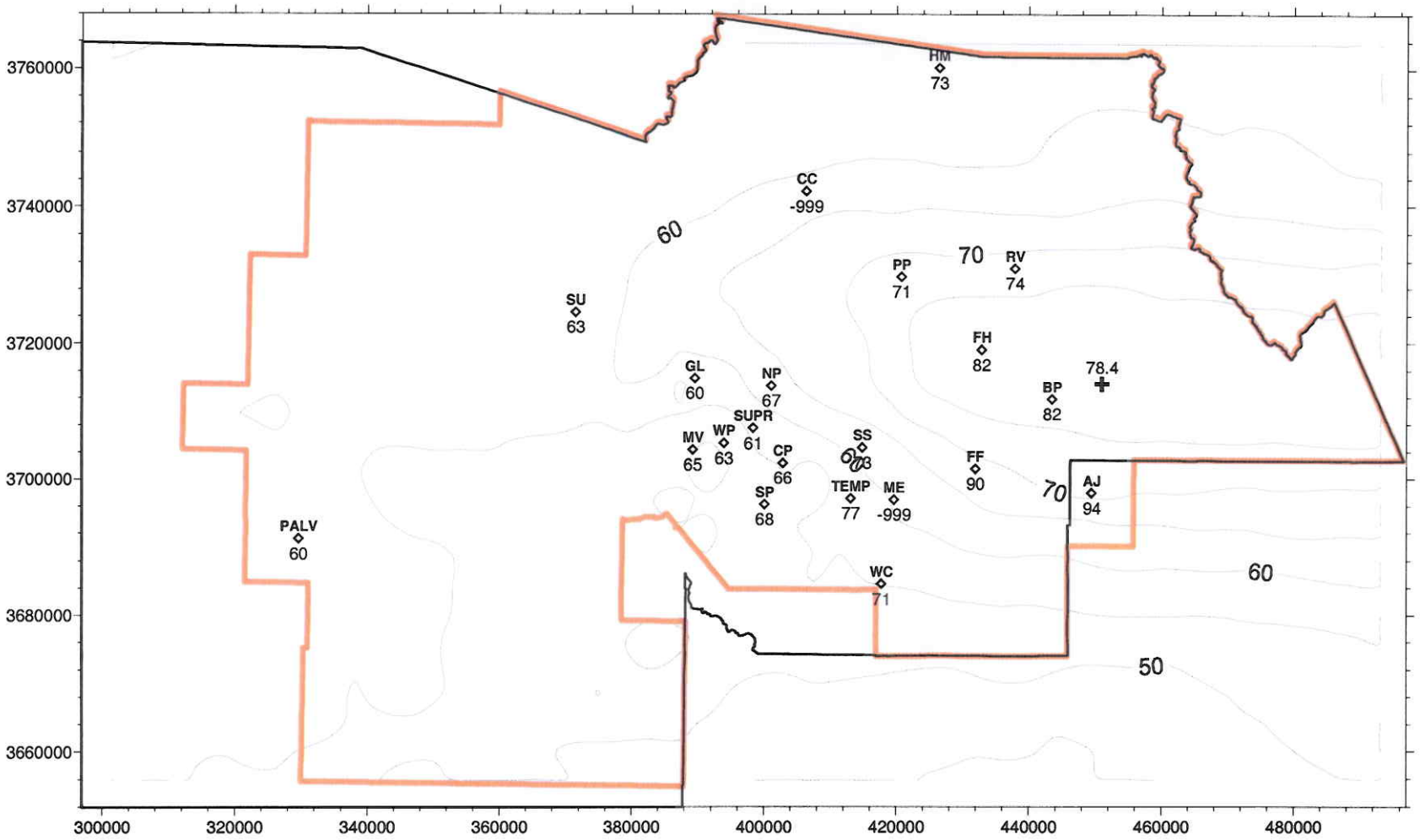


Figure IV-11(g). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 14, 2002.

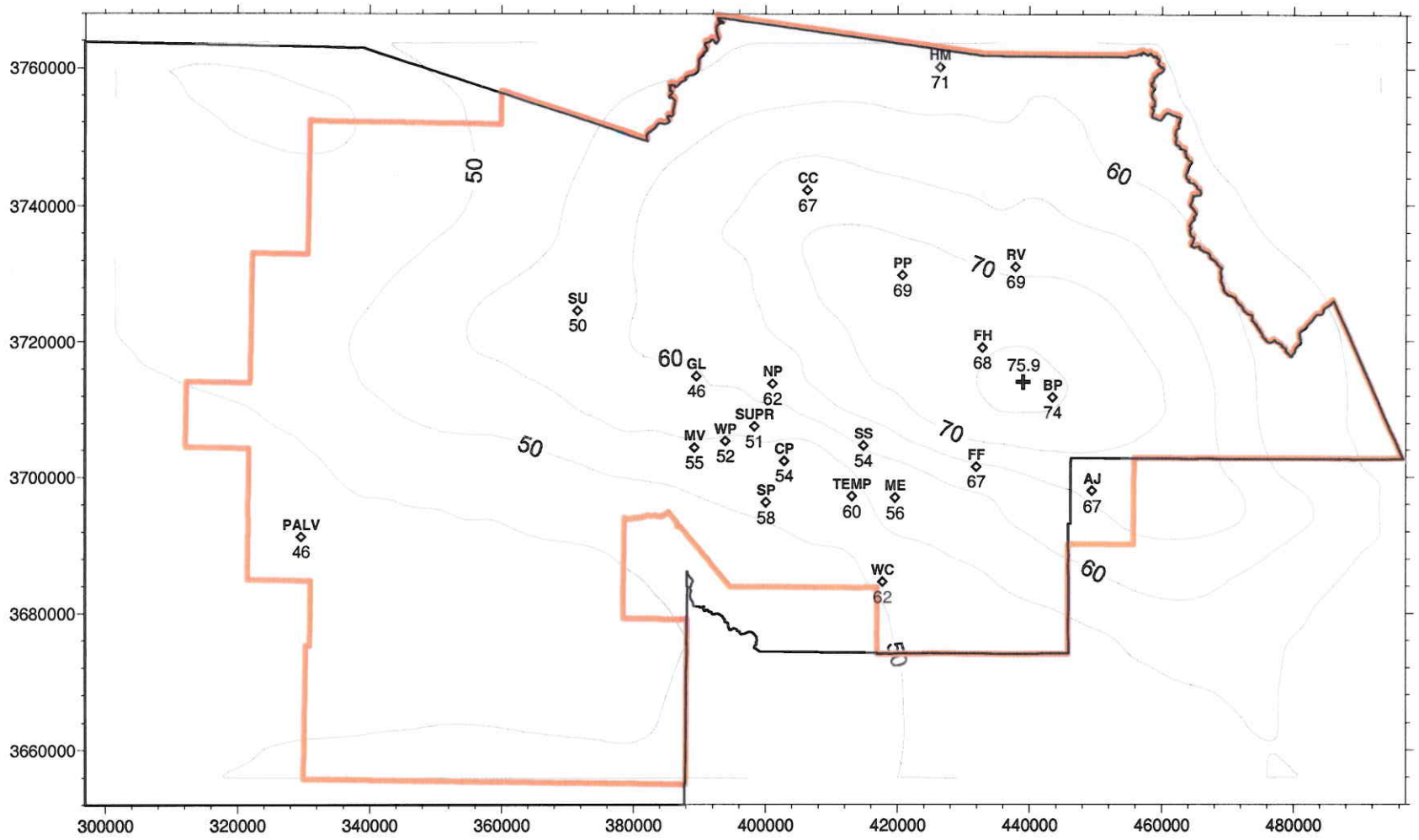


Figure IV-12(a). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 8, 2002.

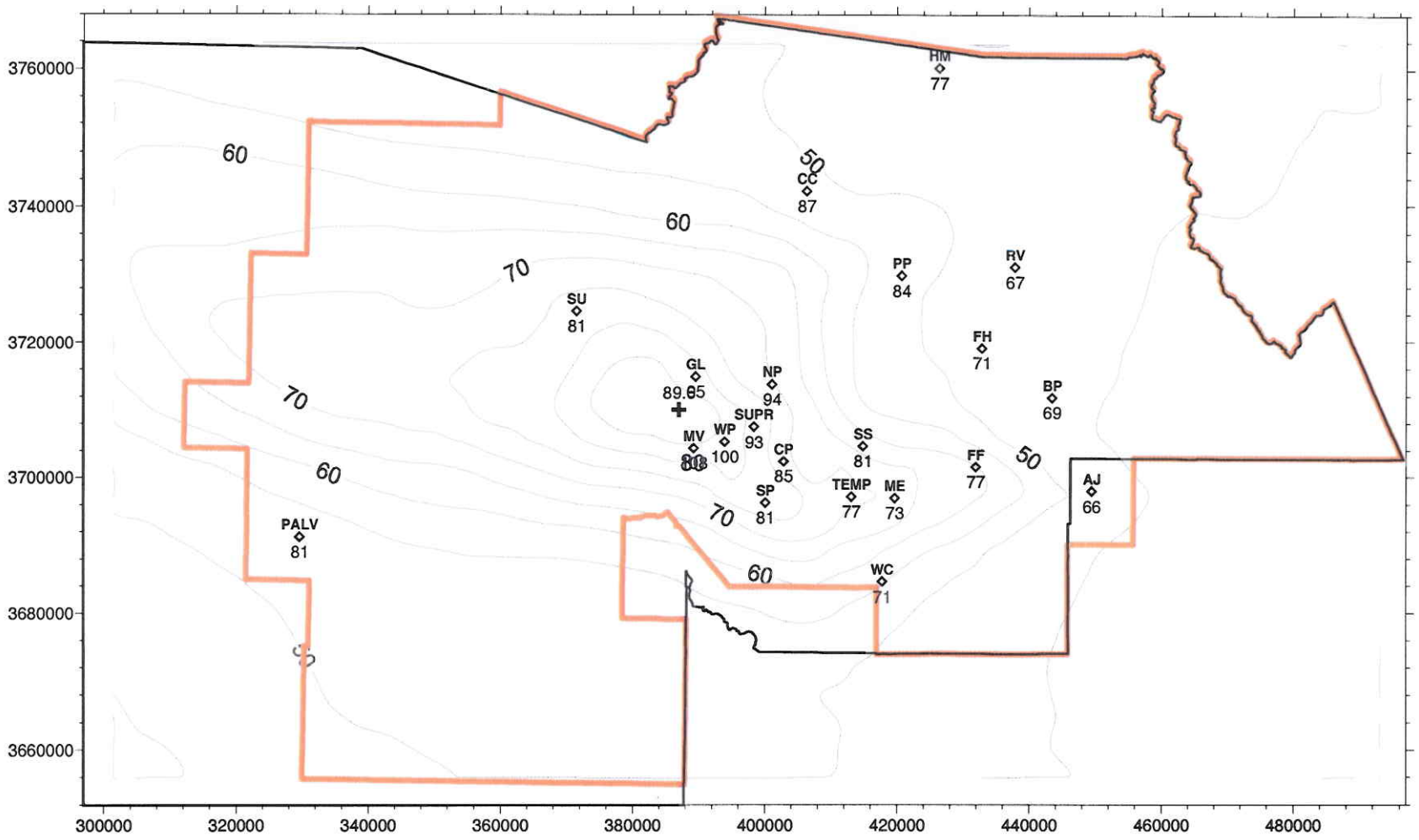


Figure IV-12(b). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 9, 2002.

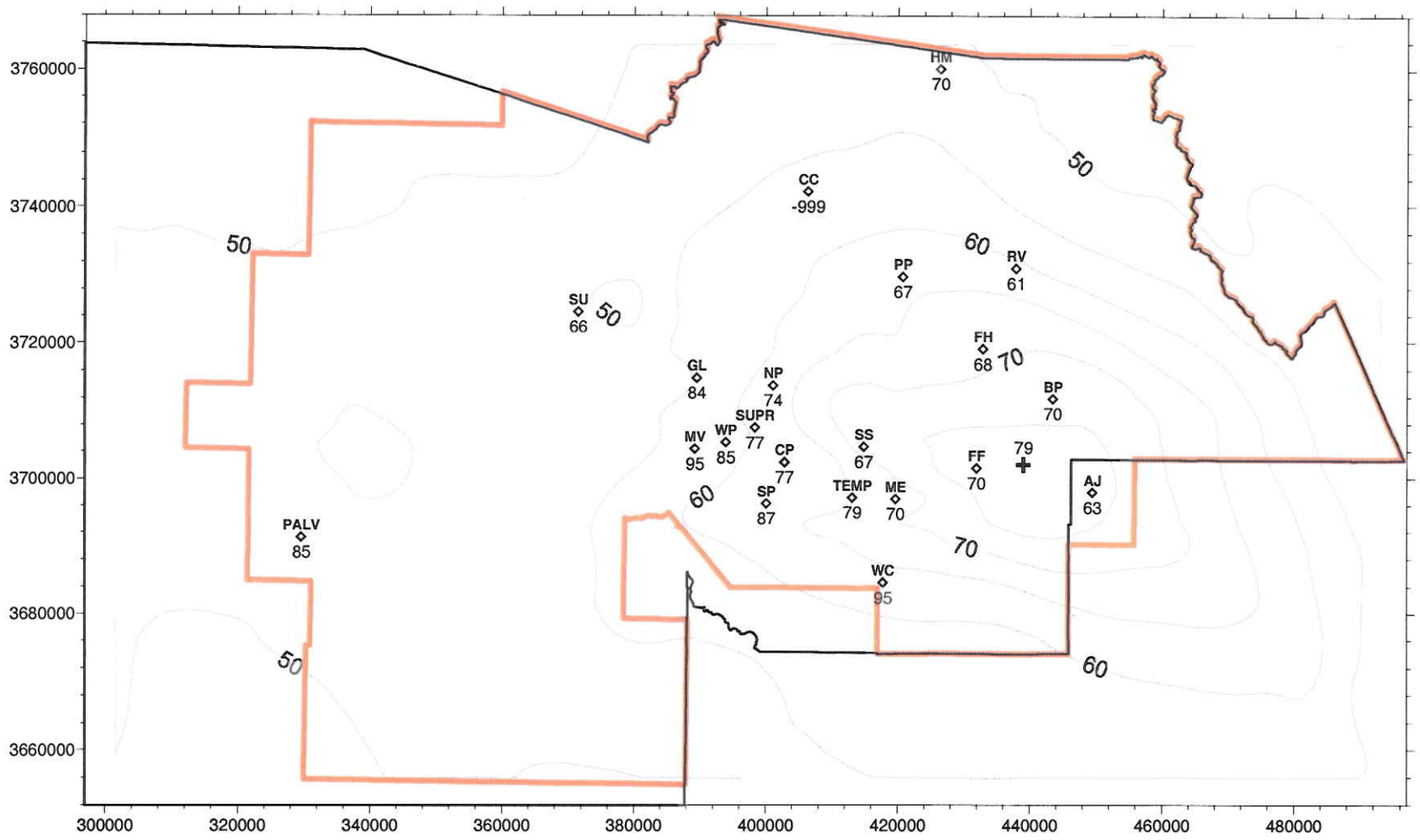


Figure IV-12(c). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 10, 2002.

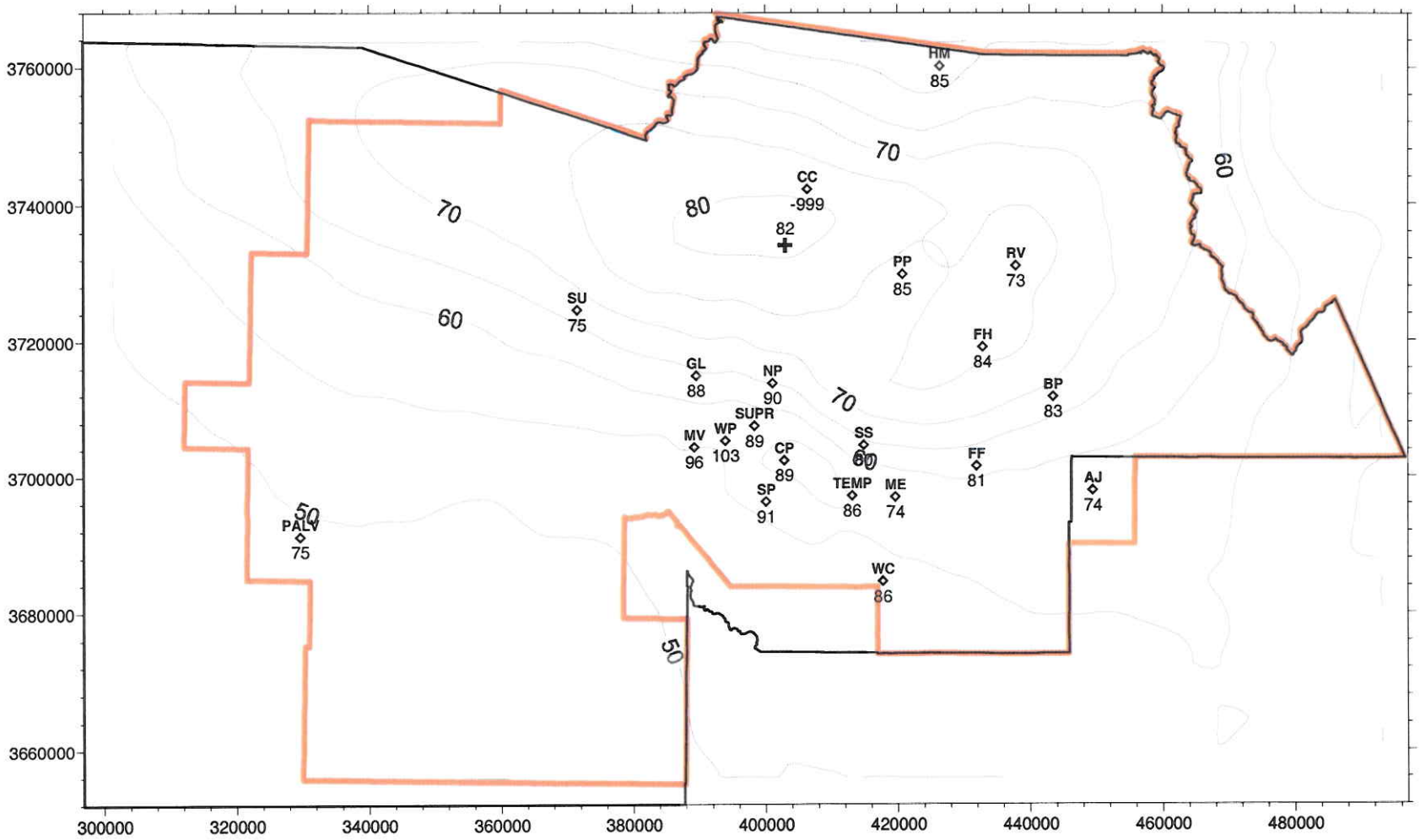


Figure IV-12(d). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 11, 2002.

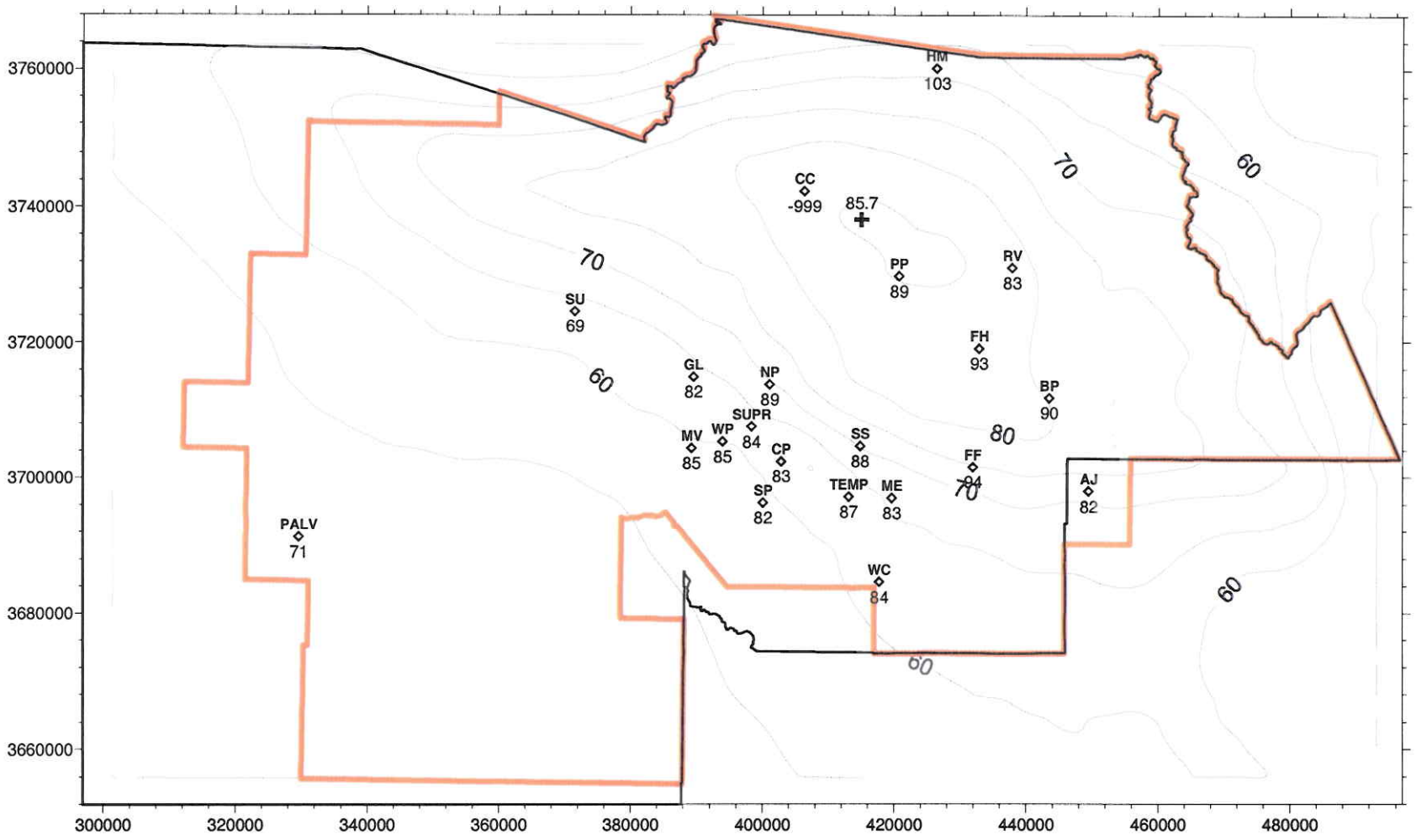


Figure IV-12(e). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 12, 2002.

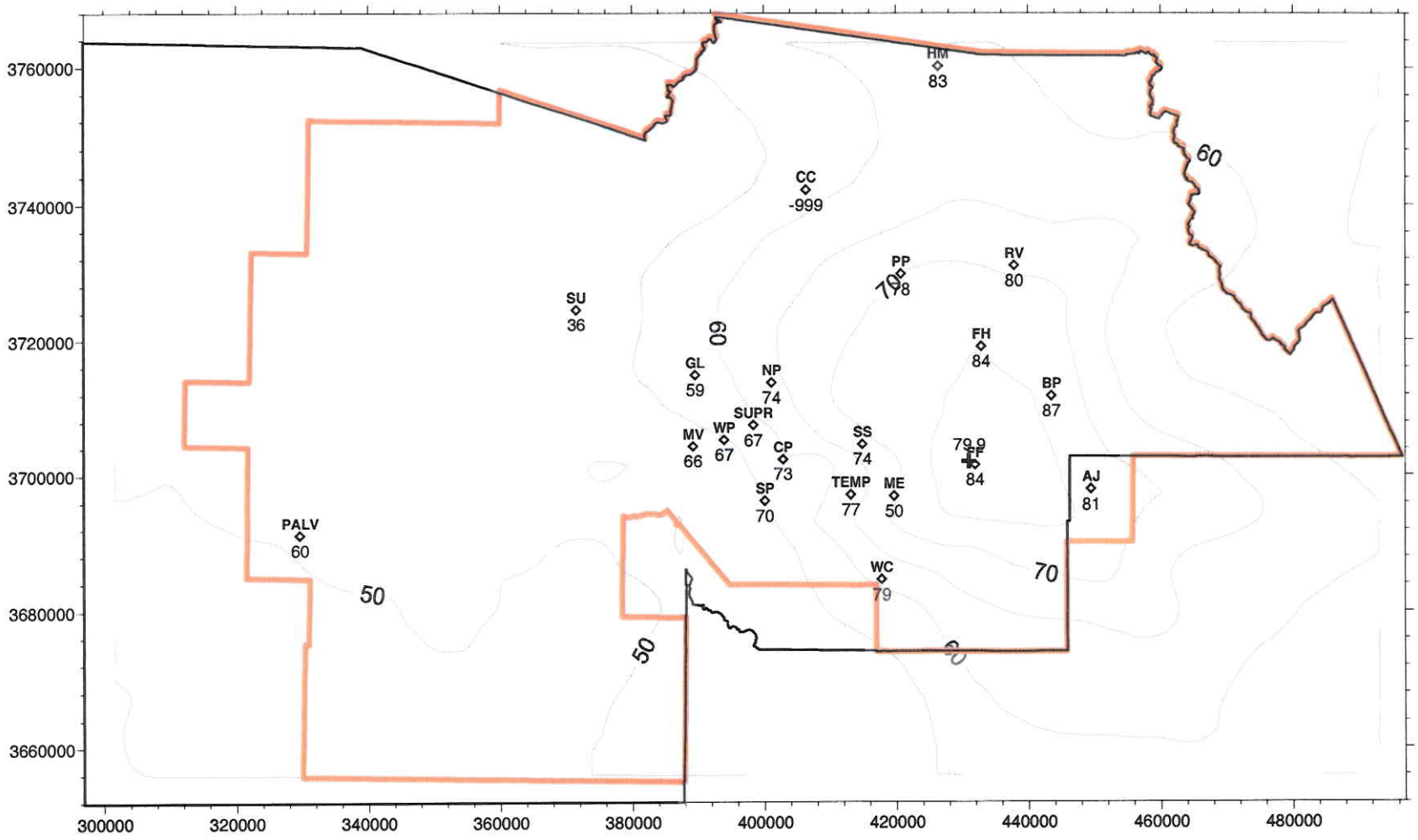


Figure IV-12(f). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 13, 2002.

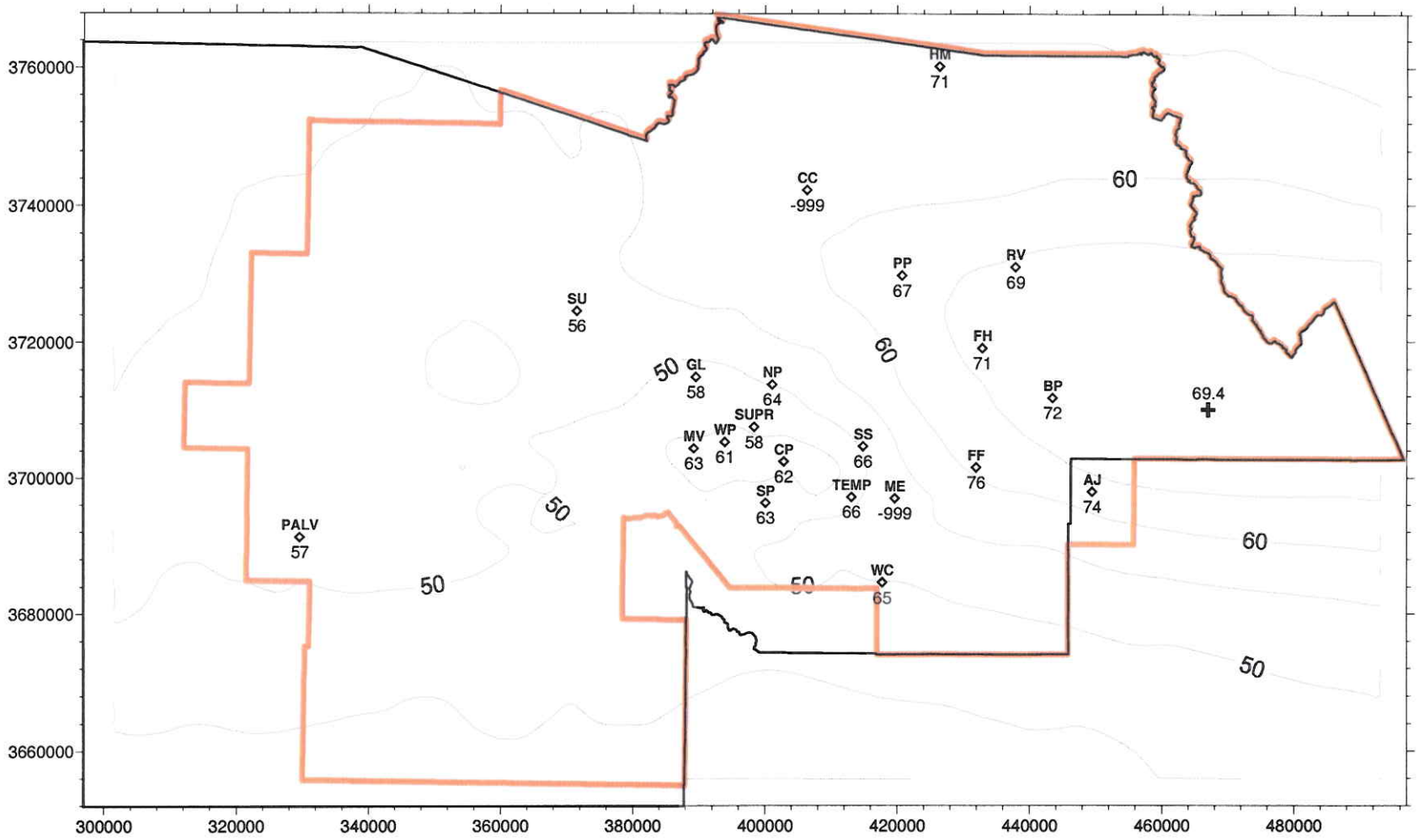


Figure IV-12(g). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on July 14, 2002.

IV-1-1-3. August 2001 Episode

The August 2001 episode occurred in a meteorological regime that represents a combination of the other two episodes.

The general pattern of ozone formation over the MNA observed in the August 2001 episode is consistent with a meteorological regime that is a mixture of two different ozone trends observed in the other two episodes. One-hour ozone concentrations start to build up rapidly around 07:00 LST and to deplete around 16:00 LST. The elevated ozone concentrations are simulated during the afternoon hours between 12:00 and 18:00 LST for one-hour ozone and between 8:00 and 14:00 LST for eight-hour ozone. Tables IV-9 through IV-12 summarize statistical modeling performance evaluations for one-hour and eight-hour ozone with/without a 60 ppb threshold. Statistics of ozone modeling performance applying a 60 ppb threshold indicate that CAMx generally under-predicts the observed ozone concentrations. Except for August 8, 2001, the normalized biases during episode days are less than -15 percent, indicating the model's under-prediction does not meet the EPA's standards. Scatter plots in Figures IV-13(a)~(b) show that CAMx has a consistent under prediction bias. Figure IV-14 shows a quantile-quantile plot of the nearest observed and predicted ozone near monitor locations in the MNA. This figure includes several performance evaluation methods:

- The scatter plot of observed/predicted pairs shows values centered on the 1:1 line with clear tendency toward under prediction for the entire ozone range.

- The observed/predicted values lie within 20% of the 1:1 line for the higher values.

- The correlation coefficients (r^2) for the scatter plot of observed/predicted pairs are 0.3844 and 0.3693 for one-hour and eight-hour ozone, respectively, which are low.

- The quantile-quantile plot (circles) indicates a consistent under prediction bias throughout the distribution. The spread is slightly larger, and the quantile values show worse performance, for the mid-range values.

As shown in Figures IV-15(a)~(c) and IV-16(a)~(c), the time series show that the modeled and observed ozone concentrations do not agree well over the region during episode days and the modeling tends to under predict ozone. Especially on August 9 and 10, 2001, severe under-prediction was observed over the MNA. In addition, the daily one-hour and eight-hour maxima contour plots of predicted ozone across the 4 km domain, with the actual observations as an overlay for the August 2001 episode, are presented in Figures IV-17(a)~(g) and IV-18(a)~(g), respectively.

The statistical and spatial analyses for the primary episode days indicate that the CAMx consistently under-predicts the observed ozone concentrations in the August 2001 episode.

Table IV-9. Summary of Statistical Modeling Performance Evaluation for the August 2001 Episode (One-Hour Ozone with a 60 ppb Threshold).

	8/5	8/6	8/7	8/8	8/9	8/10	8/11
Peak Observed (Site)	TEMP	GL	CC	CC	PP	CC	WC
(Hour)	15:00	14:00	12:00	17:00	16:00	16:00	15:00
(Concentration; ppb)	99.6	116.2	88.3	70.9	100.2	112.6	105.9
Peak Predicted (Cell X, Y)	(41, 11)	(29, 24)	(24, 24)	(35, 21)	(37, 23)	(35, 19)	(23, 15)
(Hour)	15:00	17:00	13:00	15:00	16:00	17:00	14:00
(Concentration; ppb)	82.1	101.1	89.6	104.5	75.4	91.6	109.0
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-17.6	-13.0	1.4	47.4	-24.7	-18.6	2.9
Peak Bias (unpaired time; ppb)	-31.1	-17.6	-11.6	12.8	-26.6	-26.8	-15.0
(unpaired time; %)	-37.2	-18.6	-14.3	19.3	-33.2	-30.4	-17.6
Peak Error (unpaired time; ppb)	31.1	18.0	11.6	13.5	26.6	27.0	15.0
(unpaired time; %)	37.2	19.0	14.3	20.4	33.2	30.6	17.6
Peak Bias (paired time; ppb)	-41.2	-23.4	-20.3	-20.4	-36.4	-34.7	-18.1
(paired time; %)	-49.0	-24.8	-25.6	-31.7	-45.0	-39.1	-21.0
Peak Error (paired time; ppb)	41.2	23.4	20.3	22.0	36.4	34.8	18.1
(paired time; %)	49.0	24.8	25.6	34.1	45.0	39.2	21.0
Number of Stations	20	20	20	20	20	20	20
Number of Valid Peak Pairs	19	19	18	13	20	20	20
Average Prediction (ppb)	27.7	34.2	36.7	37.4	32.1	34.0	39.8
Average Observation (ppb)	54.6	51.3	47.6	42.4	54.2	57.0	57.8
Difference in Average (ppb)	-26.9	-17.1	-10.8	-5.0	-22.1	-23.0	-18.0
(%)	-49.3	-33.4	-22.8	-11.9	-40.7	-40.4	-31.1
Bias (absolute) (ppb)	-33.4	-21.7	-15.2	-13.1	-28.2	-25.3	-15.0
(normalized) (%) (EPA Goal: < ±15)	-44.9	-28.0	-21.4	-20.3	-38.7	-32.7	-20.8
(fractional) (%)	-60.8	-34.7	-26.2	-27.4	-50.2	-43.7	-24.8
Error (absolute) (ppb)	33.4	22.4	15.8	21.2	28.2	26.6	16.0
(normalized) (%) (EPA Goal: < 35)	45.0	28.8	22.4	33.3	38.7	34.6	22.3
(fractional) (%)	60.9	35.5	27.2	38.2	50.2	45.4	26.2
RMS Error (ppb)	35.9	25.2	19.4	22.5	30.4	30.7	18.3
Number of Total Pairs	480	480	480	480	480	480	480
Number of Valid Pairs	182	180	164	65	181	207	196
Ratio of Valid to Total Pairs (%)	37.9	37.5	34.2	13.5	37.7	43.1	40.8

Table IV-10. Summary of Statistical Modeling Performance Evaluation for the August 2001 Episode (One-Hour Ozone without Threshold).

	8/5	8/6	8/7	8/8	8/9	8/10	8/11
Peak Observed (Site)	TEMP	GL	CC	CC	PP	CC	WC
(Hour)	15:00	14:00	12:00	17:00	16:00	16:00	15:00
(Concentration; ppb)	99.6	116.2	88.3	70.9	100.2	112.6	105.9
Peak Predicted (Cell X, Y)	(41, 11)	(29, 24)	(24, 24)	(35, 21)	(37, 23)	(35, 19)	(23, 15)
(Hour)	15:00	17:00	13:00	15:00	16:00	17:00	14:00
(Concentration; ppb)	82.1	101.1	89.6	104.5	75.4	91.6	109.0
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-17.6	-13.0	1.4	47.4	-24.7	-18.6	2.9
Peak Bias (unpaired time; ppb)	-31.1	-17.6	-10.6	11.4	-26.6	-26.8	-15.0
(unpaired time; %)	-37.2	-18.6	-12.7	18.0	-33.2	-30.4	-17.6
Peak Error (unpaired time; ppb)	31.1	18.0	11.5	11.9	26.6	27.0	15.0
(unpaired time; %)	37.2	19.0	14.4	18.7	33.2	30.6	17.6
Peak Bias (paired time; ppb)	-41.2	-23.4	-18.8	-19.3	-36.4	-34.7	-18.1
(paired time; %)	-49.0	-24.8	-23.4	-31.1	-45.0	-39.1	-21.0
Peak Error (paired time; ppb)	41.2	23.4	19.7	20.3	36.4	34.8	18.1
(paired time; %)	49.0	24.8	25.0	32.6	45.0	39.2	21.0
Number of Stations	20	20	20	20	20	20	20
Number of Valid Peak Pairs	19	19	19	20	20	20	20
Average Prediction (ppb)	27.7	34.2	36.7	37.4	32.1	34.0	39.8
Average Observation (ppb)	54.6	51.3	47.6	42.4	54.2	57.0	57.8
Difference in Average (ppb)	-26.9	-17.1	-10.8	-5.0	-22.1	-23.0	-18.0
(%)	-49.3	-33.4	-22.8	-11.9	-40.7	-40.4	-31.1
Bias (absolute) (ppb)	-26.9	-17.1	-10.8	-5.0	-22.1	-23.0	-18.0
(normalized) (%) (EPA Goal: < ±15)	-47.0	-34.4	-17.4	1.8	-40.6	-43.0	-35.0
(fractional) (%)	-72.0	-55.2	-31.8	-22.9	-60.7	-67.3	-52.7
Error (absolute) (ppb)	27.3	18.2	13.7	18.8	22.6	24.1	18.9
(normalized) (%) (EPA Goal: < 35)	53.3	43.2	37.1	55.8	42.4	46.2	36.6
(fractional) (%)	75.7	60.9	43.6	57.6	62.3	69.8	54.1
RMS Error (ppb)	30.1	21.7	17.2	21.6	26.3	28.1	22.6
Number of Total Pairs	480	480	480	480	480	480	480
Number of Valid Pairs	453	444	441	456	456	464	472
Ratio of Valid to Total Pairs (%)	94.4	92.5	91.9	95.0	95.0	96.7	98.3

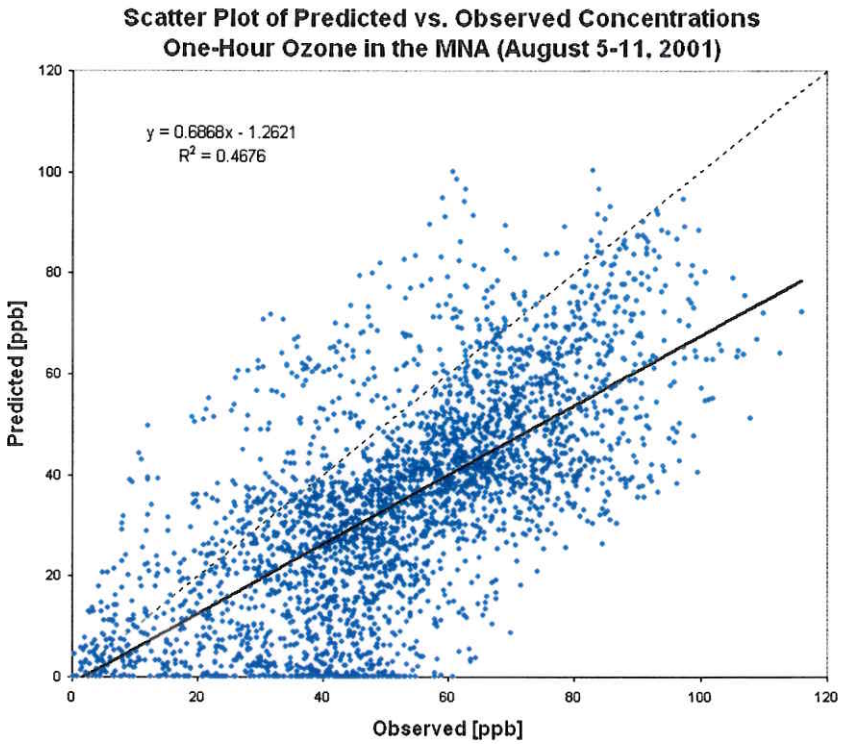
Table IV-11. Summary of Statistical Modeling Performance Evaluation for the August 2001 Episode (Eight-Hour Ozone with a 60 ppb Threshold).

	8/5	8/6	8/7	8/8	8/9	8/10	8/11
Peak Observed (Site)	FH	NP	CC	HM	PP	CC	TEMP
(Hour)	13:00	11:00	10:00	1:00	13:00	13:00	10:00
(Concentration; ppb)	84.1	94.2	82.1	66.6	89.2	100.2	89.2
Peak Predicted (Cell X, Y)	(41, 12)	(29, 24)	(20, 21)	(32, 20)	(36, 22)	(35, 21)	(23, 15)
(Hour)	11:00	14:00	10:00	10:00	12:00	13:00	11:00
(Concentration; ppb)	65.4	82.9	71.8	78.1	67.0	86.4	91.9
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-22.2	-12.1	-12.5	17.2	-24.8	-13.7	3.0
Peak Bias (unpaired time; ppb)	-32.1	-21.1	-11.6	5.4	-27.1	-25.0	-11.7
(unpaired time; %)	-42.0	-26.1	-16.5	8.8	-36.9	-31.5	-15.6
Peak Error (unpaired time; ppb)	32.1	21.1	11.6	11.7	27.1	25.2	11.7
(unpaired time; %)	42.0	26.1	16.5	18.7	36.9	31.8	15.6
Peak Bias (paired time; ppb)	-35.1	-22.5	-13.5	-8.5	-30.5	-27.3	-12.5
(paired time; %)	-45.8	-28.0	-19.2	-13.1	-41.7	-34.4	-16.7
Peak Error (paired time; ppb)	35.1	22.5	13.5	10.6	30.5	27.3	12.5
(paired time; %)	45.8	28.0	19.2	16.4	41.7	34.4	16.7
Number of Stations	20	20	20	20	20	20	20
Number of Valid Peak Pairs	18	19	17	5	19	20	20
Average Prediction (ppb)	27.2	35.8	36.5	36.6	31.8	34.7	46.1
Average Observation (ppb)	51.9	51.3	48.3	43.3	54.1	57.7	61.0
Difference in Average (ppb)	-24.8	-15.5	-11.7	-6.7	-22.2	-23.0	-14.9
(%)	-47.7	-30.2	-24.3	-15.5	-41.1	-39.9	-24.5
Bias (absolute) (ppb)	-30.8	-20.5	-15.2	-8.1	-27.4	-24.4	-13.9
(normalized) (%) (EPA Goal: < ±15)	-43.8	-27.5	-22.4	-12.6	-38.9	-33.5	-20.2
(fractional) (%)	-57.5	-33.1	-26.1	-15.6	-49.6	-43.3	-23.4
Error (absolute) (ppb)	30.8	20.5	15.2	12.0	27.4	24.7	13.9
(normalized) (%) (EPA Goal: < 35)	43.8	27.5	22.4	19.0	38.9	33.9	20.2
(fractional) (%)	57.5	33.1	26.1	21.5	49.6	43.7	23.4
RMS Error (ppb)	32.0	22.8	17.0	14.3	28.5	28.0	15.8
Number of Total Pairs	480	480	480	480	480	480	340
Number of Valid Pairs	170	174	145	37	160	212	194
Ratio of Valid to Total Pairs (%)	35.4	36.3	30.2	7.7	33.3	44.2	57.1

Table IV-12. Summary of Statistical Modeling Performance Evaluation for the August 2001 Episode (Eight-Hour Ozone without Threshold).

	8/5	8/6	8/7	8/8	8/9	8/10	8/11
Peak Observed (Site)	FH	NP	CC	HM	PP	CC	TEMP
(Hour)	13:00	11:00	10:00	1:00	13:00	13:00	10:00
(Concentration; ppb)	84.1	94.2	82.1	66.6	89.2	100.2	89.2
Peak Predicted (Cell X, Y)	(41, 12)	(29, 24)	(20, 21)	(32, 20)	(36, 22)	(35, 21)	(23, 15)
(Hour)	11:00	14:00	10:00	10:00	12:00	13:00	11:00
(Concentration; ppb)	65.4	82.9	71.8	78.1	67.0	86.4	91.9
Unpaired Peak Prediction Accuracy (%) (EPA Goal: < ±20)	-22.2	-12.1	-12.5	17.2	-24.8	-13.7	3.0
Peak Bias (unpaired time; ppb)	-31.5	-21.1	-10.5	6.9	-26.0	-25.0	-11.7
(unpaired time; %)	-41.7	-26.1	-14.9	13.4	-35.6	-31.5	-15.6
Peak Error (unpaired time; ppb)	31.5	21.1	10.7	8.5	26.0	25.2	11.7
(unpaired time; %)	41.7	26.1	15.2	15.9	35.6	31.8	15.6
Peak Bias (paired time; ppb)	-34.4	-22.5	-12.5	-11.8	-29.3	-27.3	-12.5
(paired time; %)	-45.4	-28.0	-18.1	-22.7	-40.3	-34.4	-16.7
Peak Error (paired time; ppb)	34.4	22.5	12.5	13.1	29.3	27.3	12.5
(paired time; %)	45.4	28.0	18.1	25.1	40.3	34.4	16.7
Number of Stations	20	20	20	20	20	20	20
Number of Valid Peak Pairs	19	19	19	20	20	20	20
Average Prediction (ppb)	27.2	35.8	36.5	36.6	31.8	34.7	46.1
Average Observation (ppb)	51.9	51.3	48.3	43.3	54.1	57.7	61.0
Difference in Average (ppb)	-24.8	-15.5	-11.7	-6.7	-22.2	-23.0	-14.9
(%)	-47.7	-30.2	-24.3	-15.5	-41.1	-39.9	-24.5
Bias (absolute) (ppb)	-24.8	-15.5	-11.7	-6.7	-22.2	-23.0	-14.9
(normalized) (%) (EPA Goal: < ±15)	-49.3	-31.2	-25.3	-10.3	-42.4	-42.6	-26.7
(fractional) (%)	-70.1	-41.6	-32.0	-24.5	-61.1	-61.4	-33.7
Error (absolute) (ppb)	24.8	15.9	12.3	15.8	22.3	23.2	14.9
(normalized) (%) (EPA Goal: < 35)	49.7	33.1	27.3	39.6	42.5	43.0	26.7
(fractional) (%)	70.5	43.2	33.7	46.7	61.3	61.7	33.7
RMS Error (ppb)	26.7	18.7	14.5	18.8	25.0	26.2	16.8
Number of Total Pairs	480	480	480	480	480	480	340
Number of Valid Pairs	456	445	450	460	458	470	334
Ratio of Valid to Total Pairs (%)	95.0	92.7	93.8	95.8	95.4	97.9	98.2

(a)



(b)

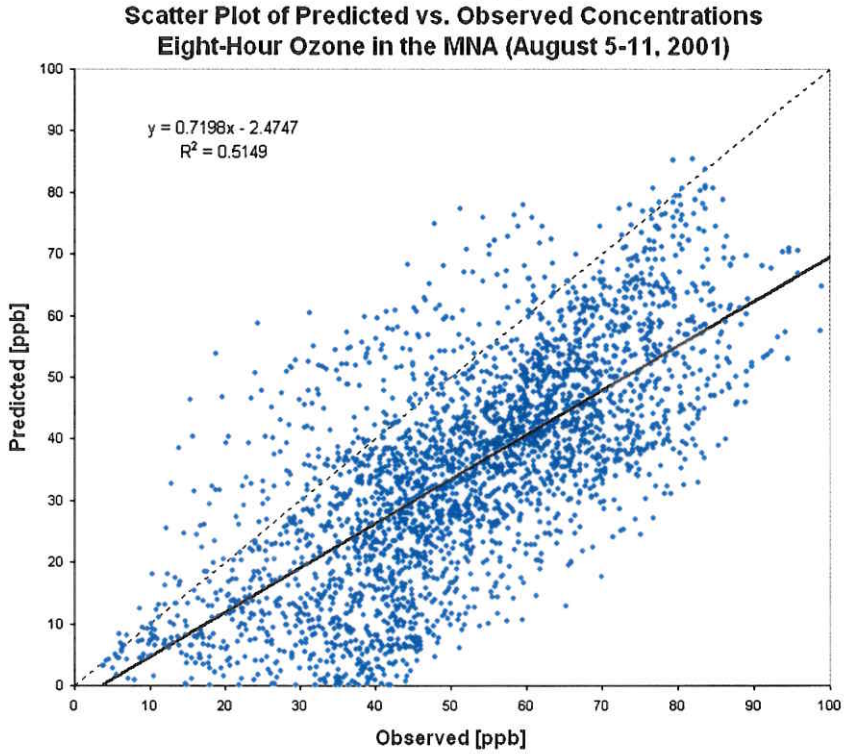
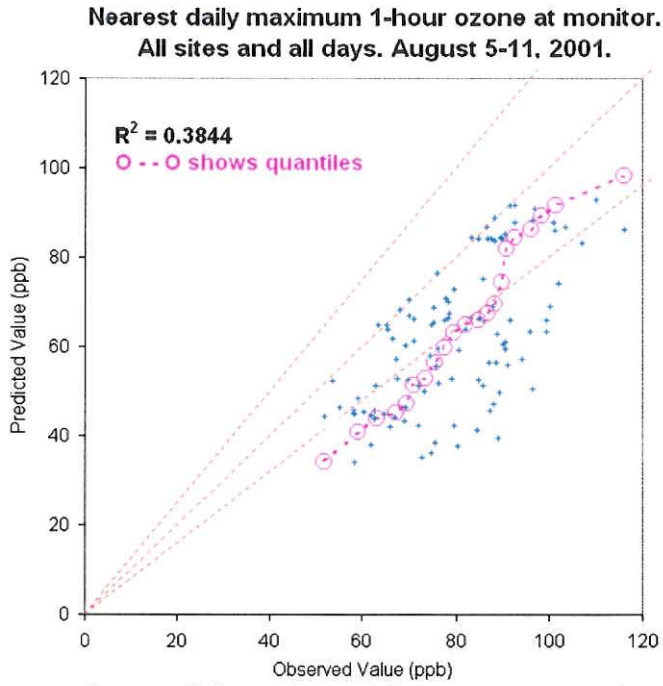


Figure IV-13. Scatter plots of predicted and observed (a) one-hour and (b) eight-hour ozone in the MNA (August 5-11, 2001).

(a)



(b)

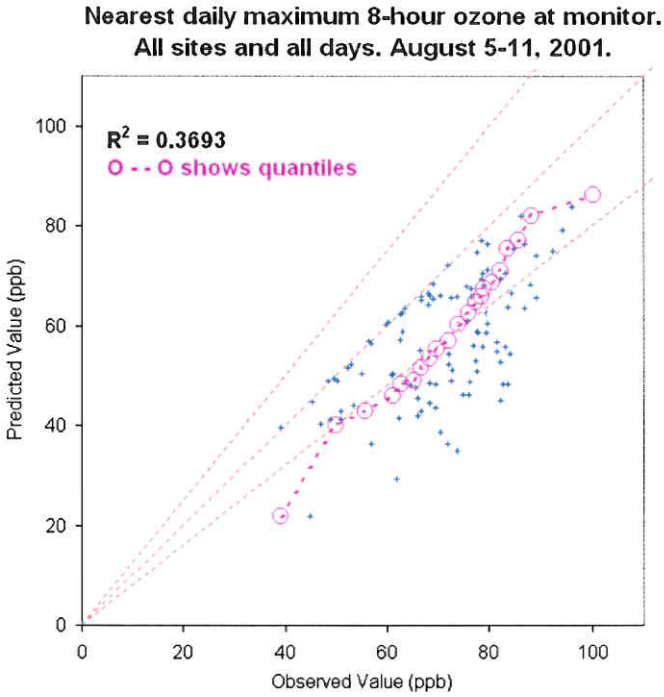


Figure IV-14. Quantile-quantile plot of nearest observed/predicted paired peak (a) one-hour and (b) eight-hour ozone near monitor locations in the MNA for each day of the August 2001 episode. [EPA recommended ±20% envelope is shown as red dotted lines surrounding 1:1 line (middle red dashed line). The r^2 value is the correlation coefficient.]

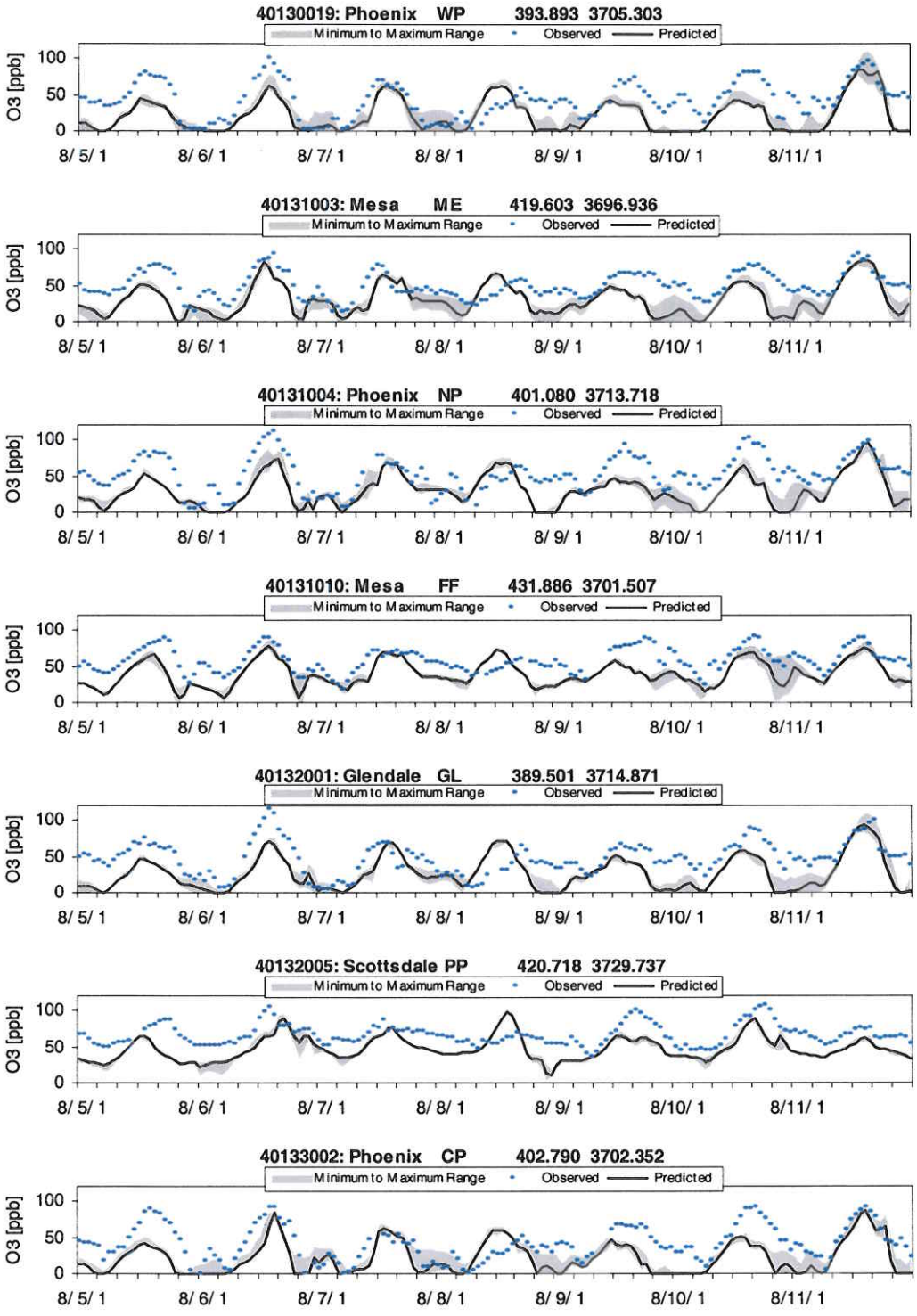


Figure IV-15(a). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the August 2001 episode.

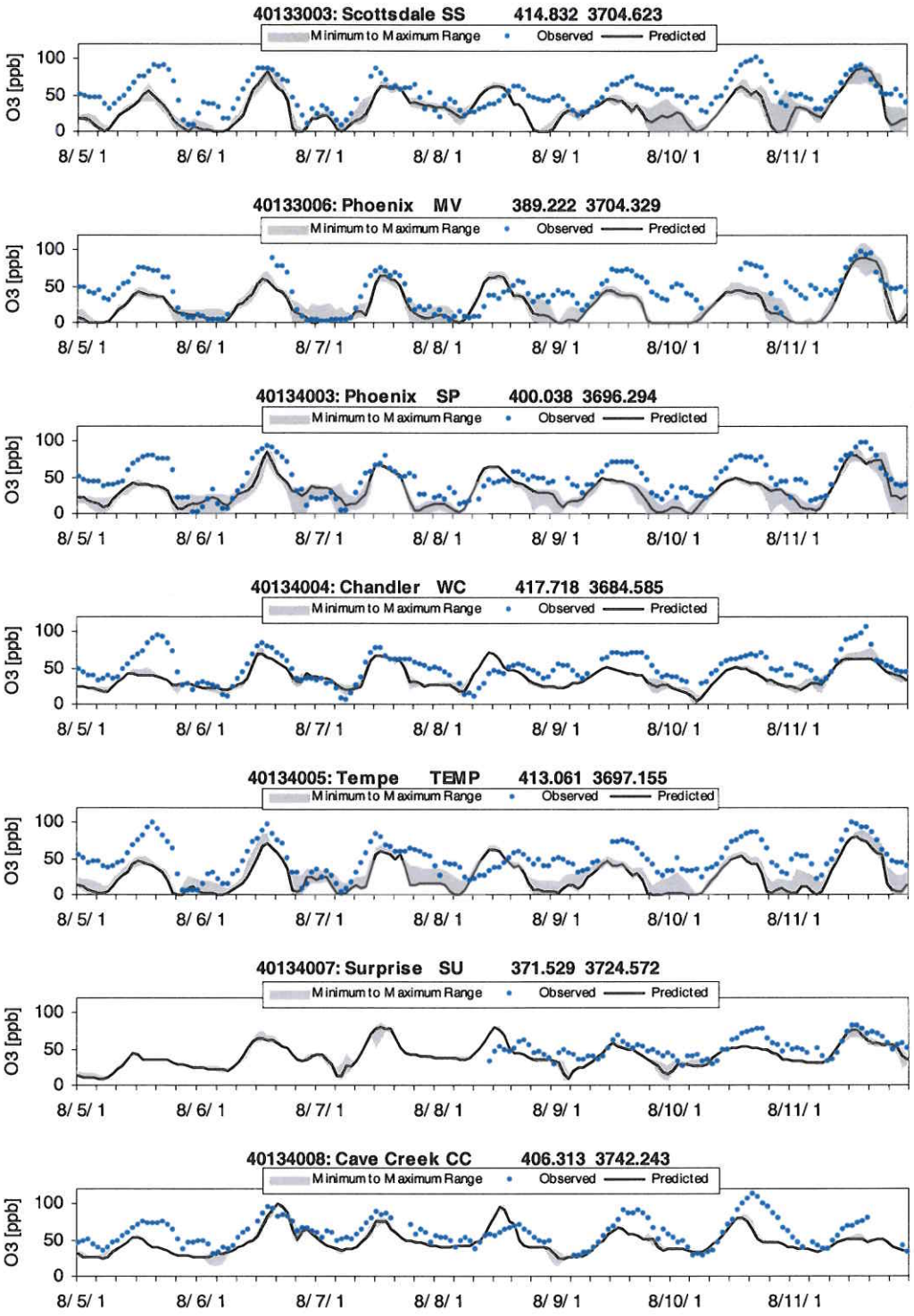


Figure IV-15(b). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the August 2001 episode.

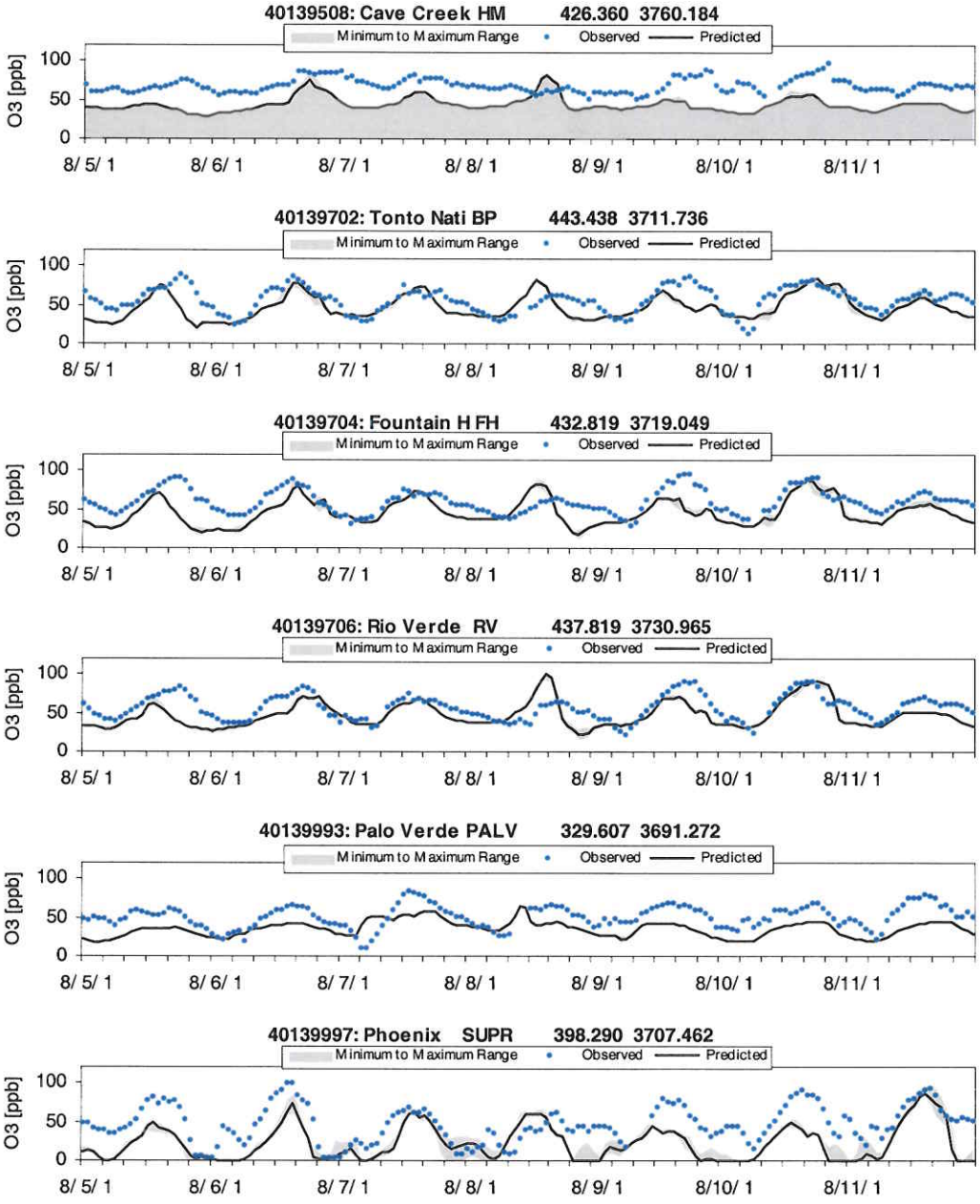


Figure IV-15(c). Time-series plots illustrating the simulated and observed one-hour ozone concentration at available stations in the MNA during the August 2001 episode.

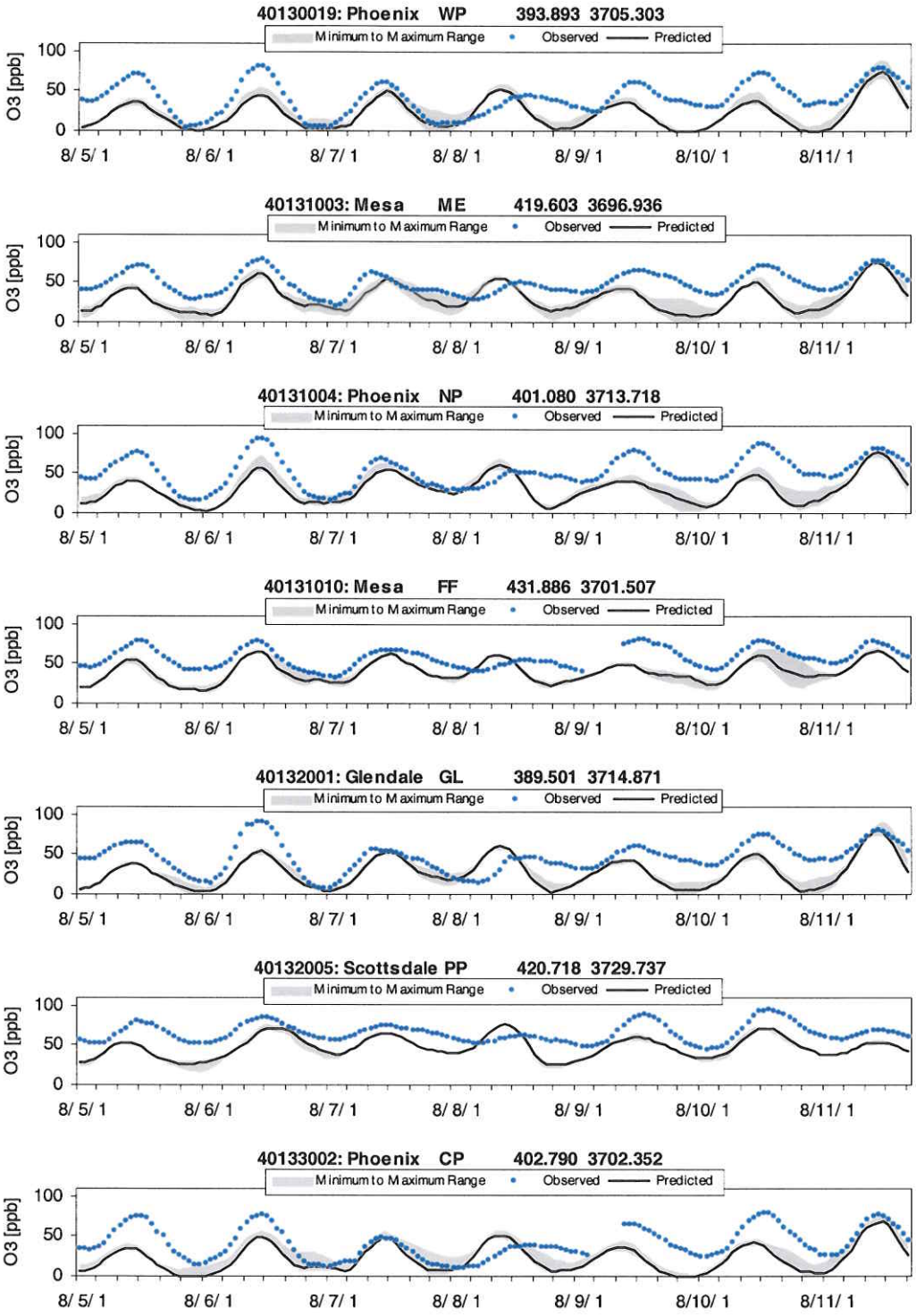


Figure IV-16(a). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the August 2001 episode.

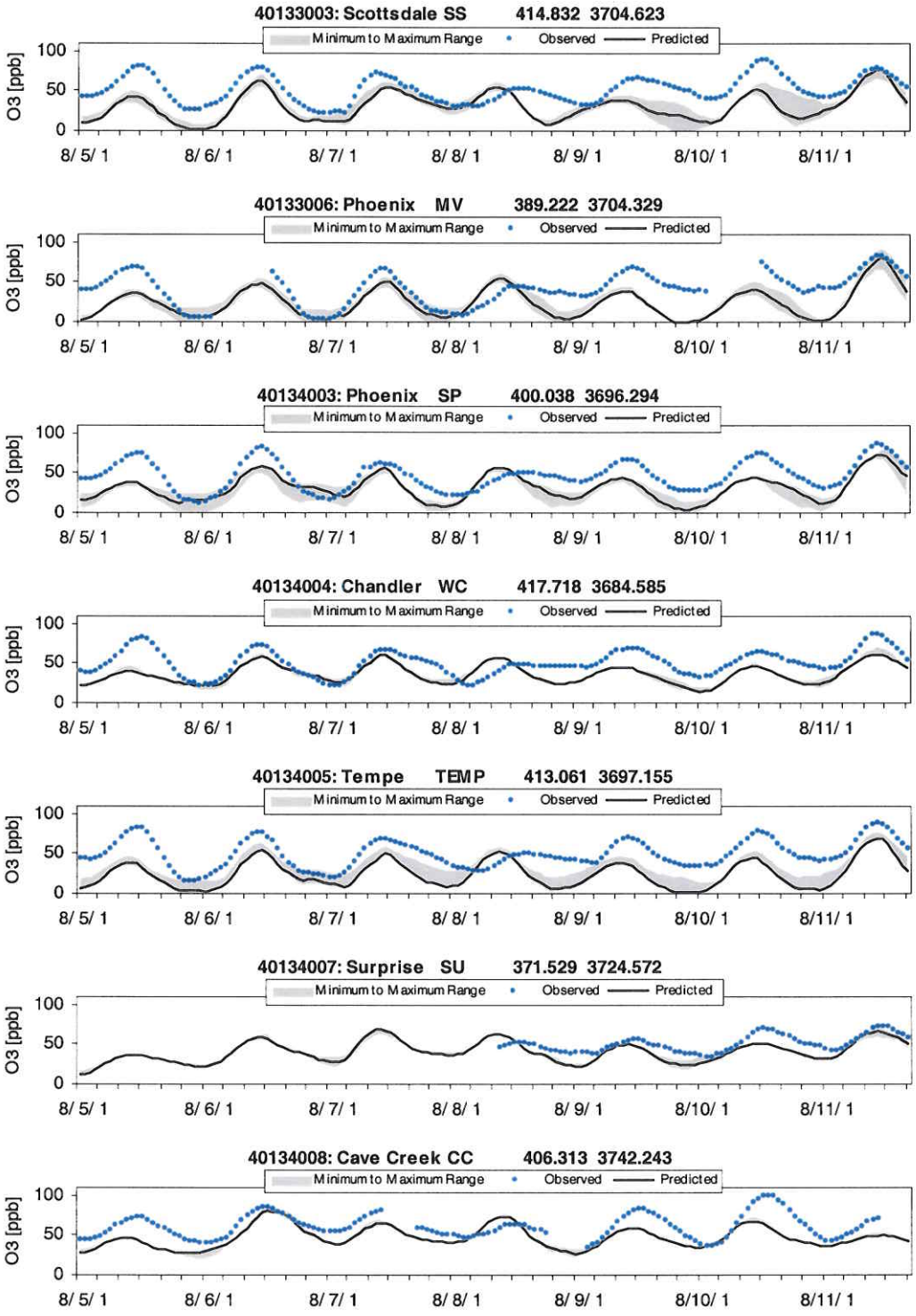


Figure IV-16(b). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the August 2001 episode.

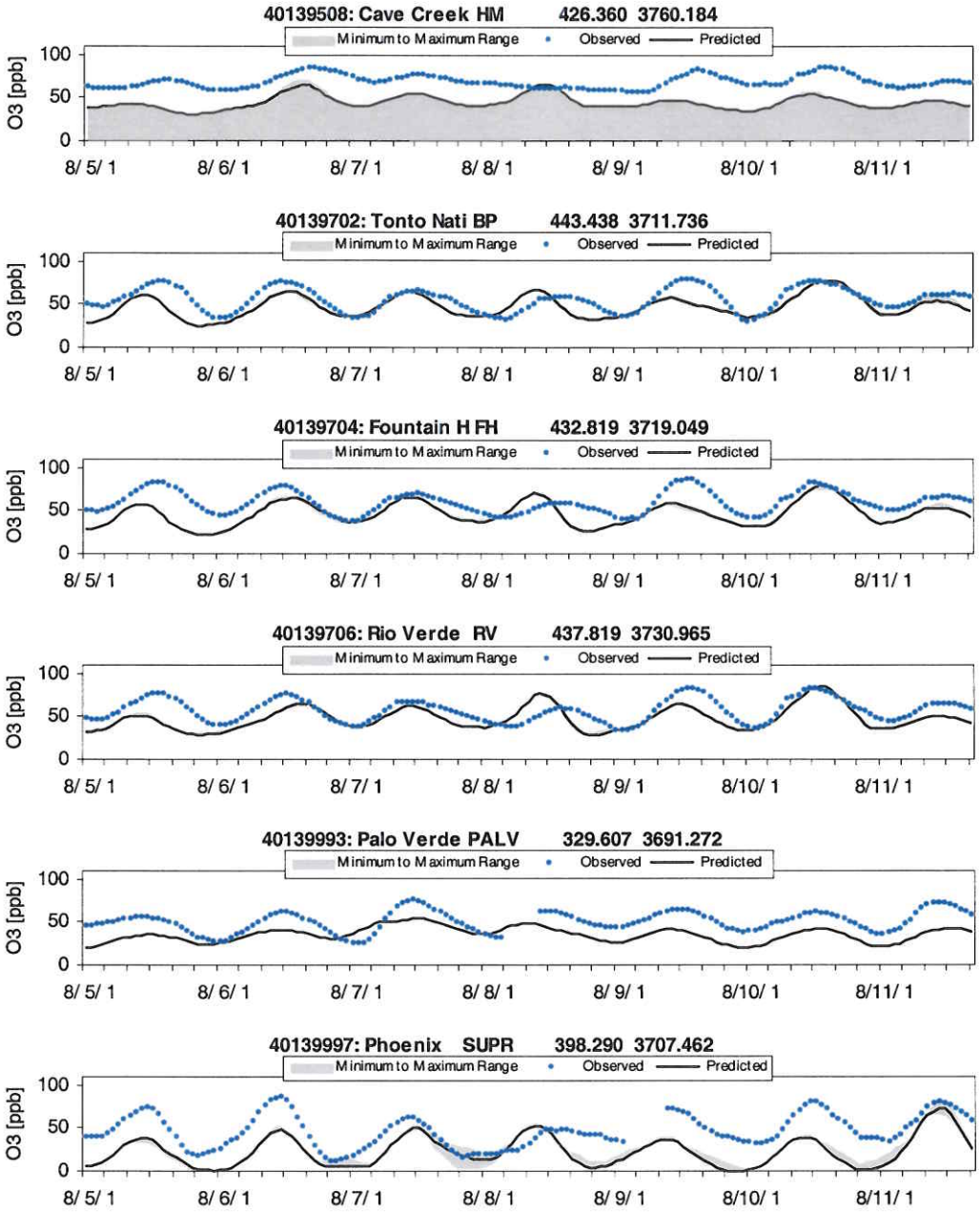


Figure IV-16(c). Time-series plots illustrating the simulated and observed eight-hour ozone concentration at available stations in the MNA during the August 2001 episode.

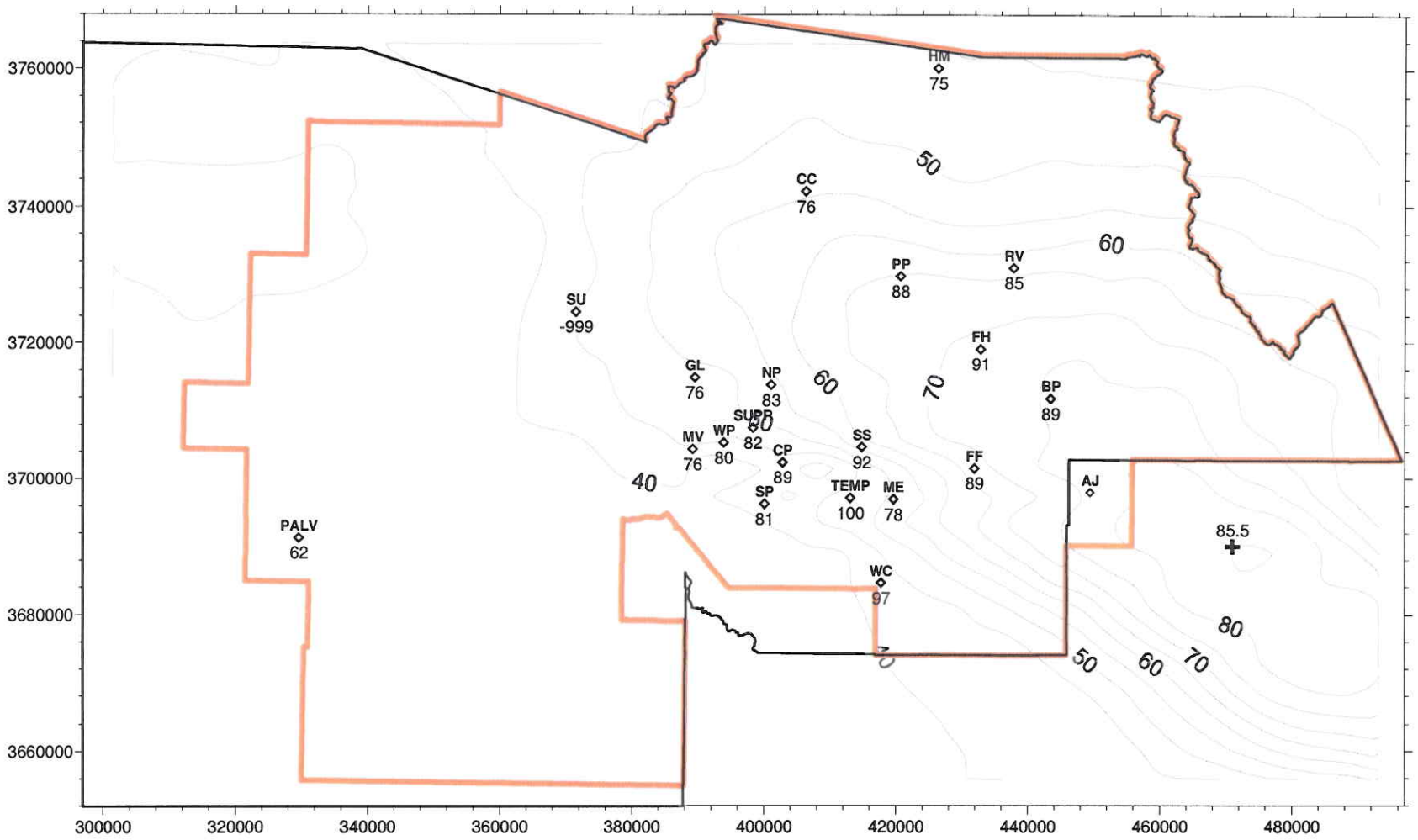


Figure IV-17(a). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 5, 2001.

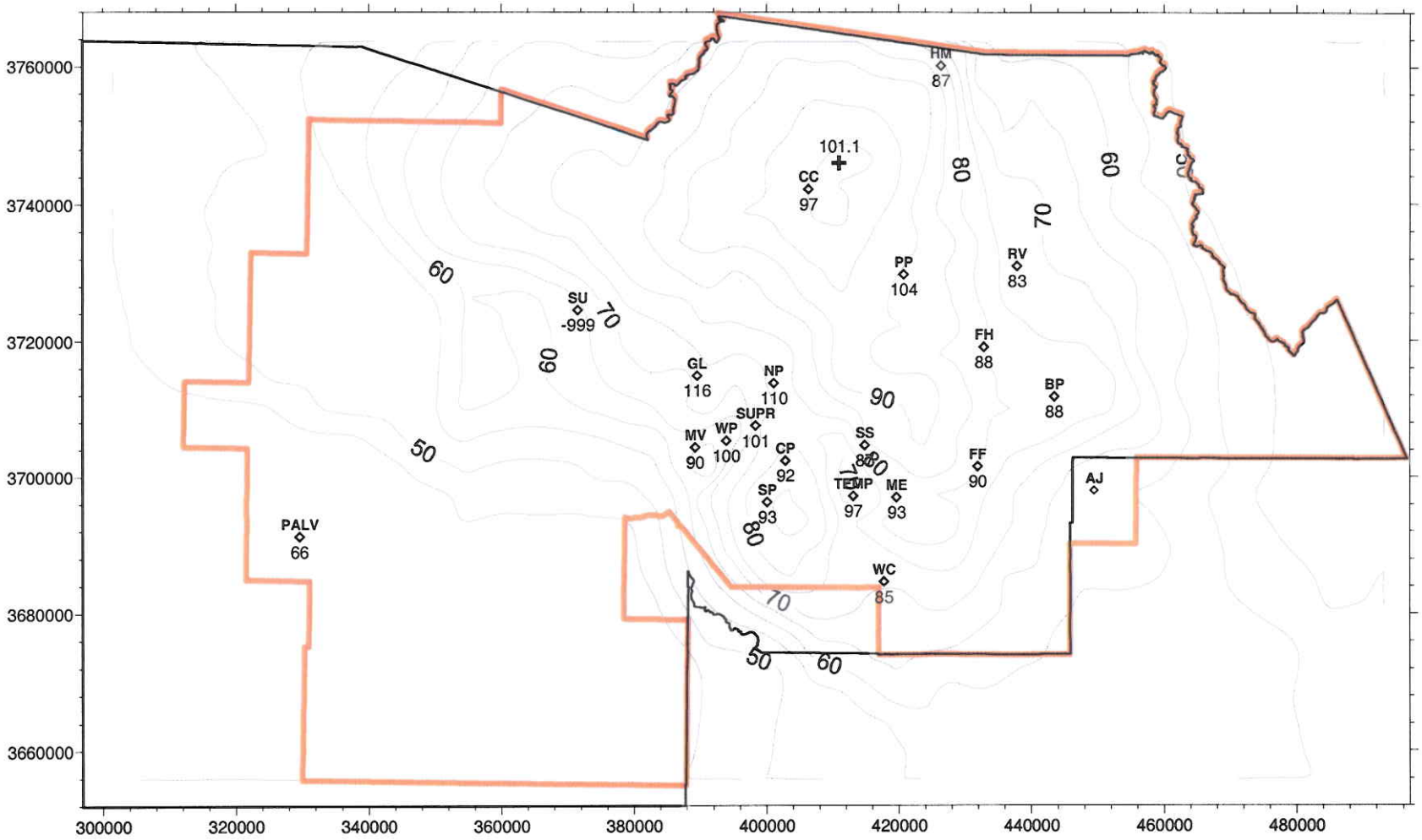


Figure IV-17(b). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 6, 2001.

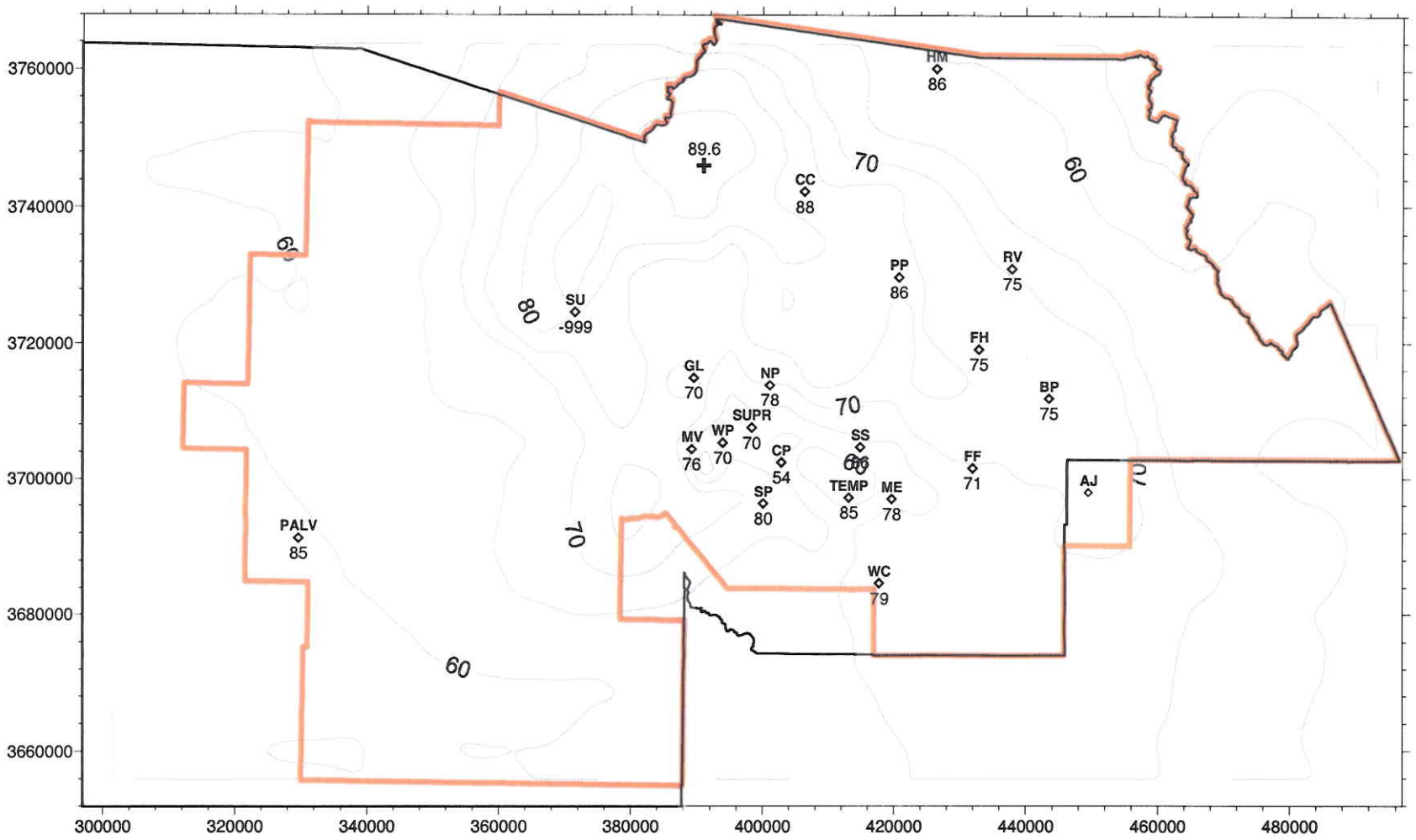


Figure IV-17(c). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 7, 2001.

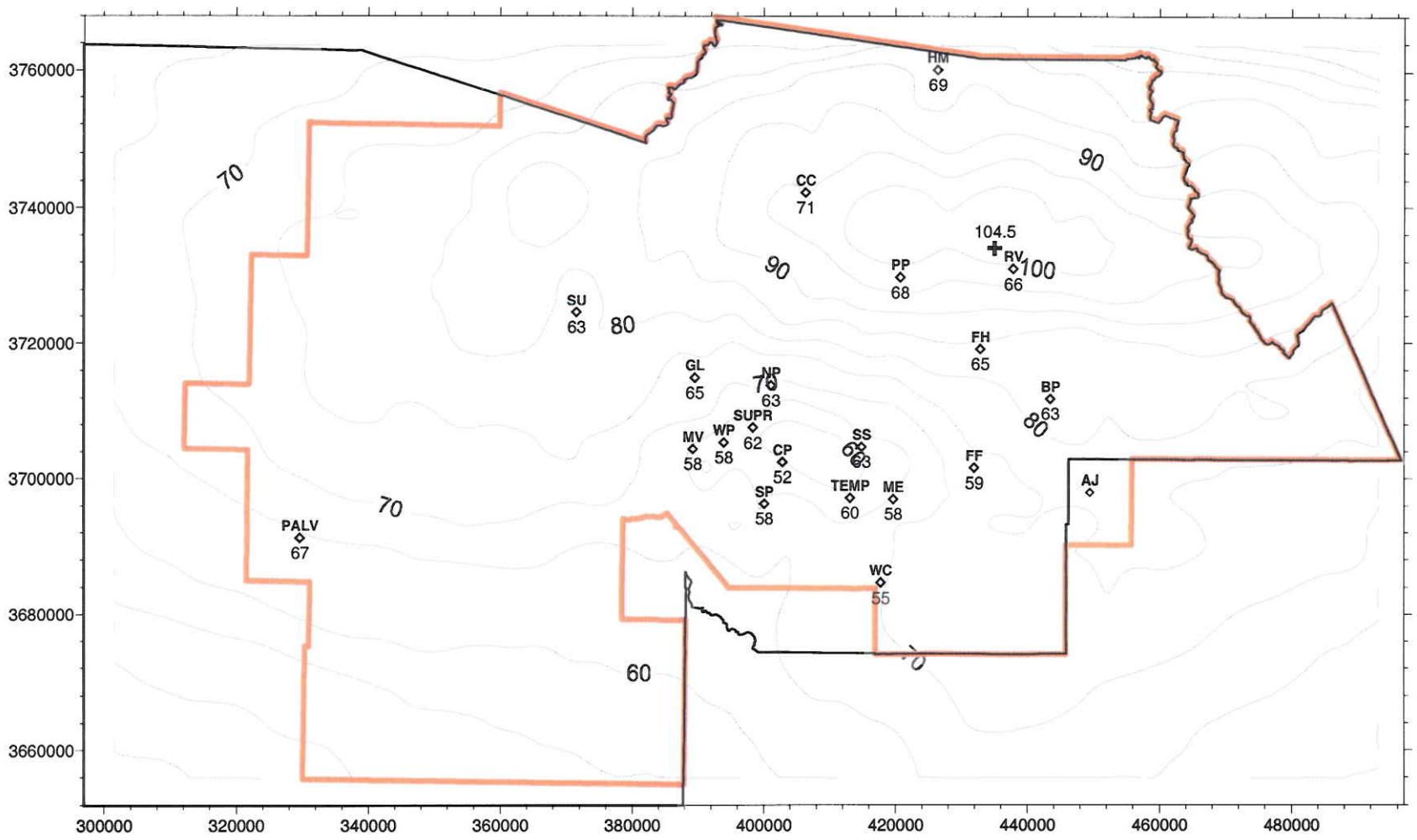


Figure IV-17(d). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 8, 2001.

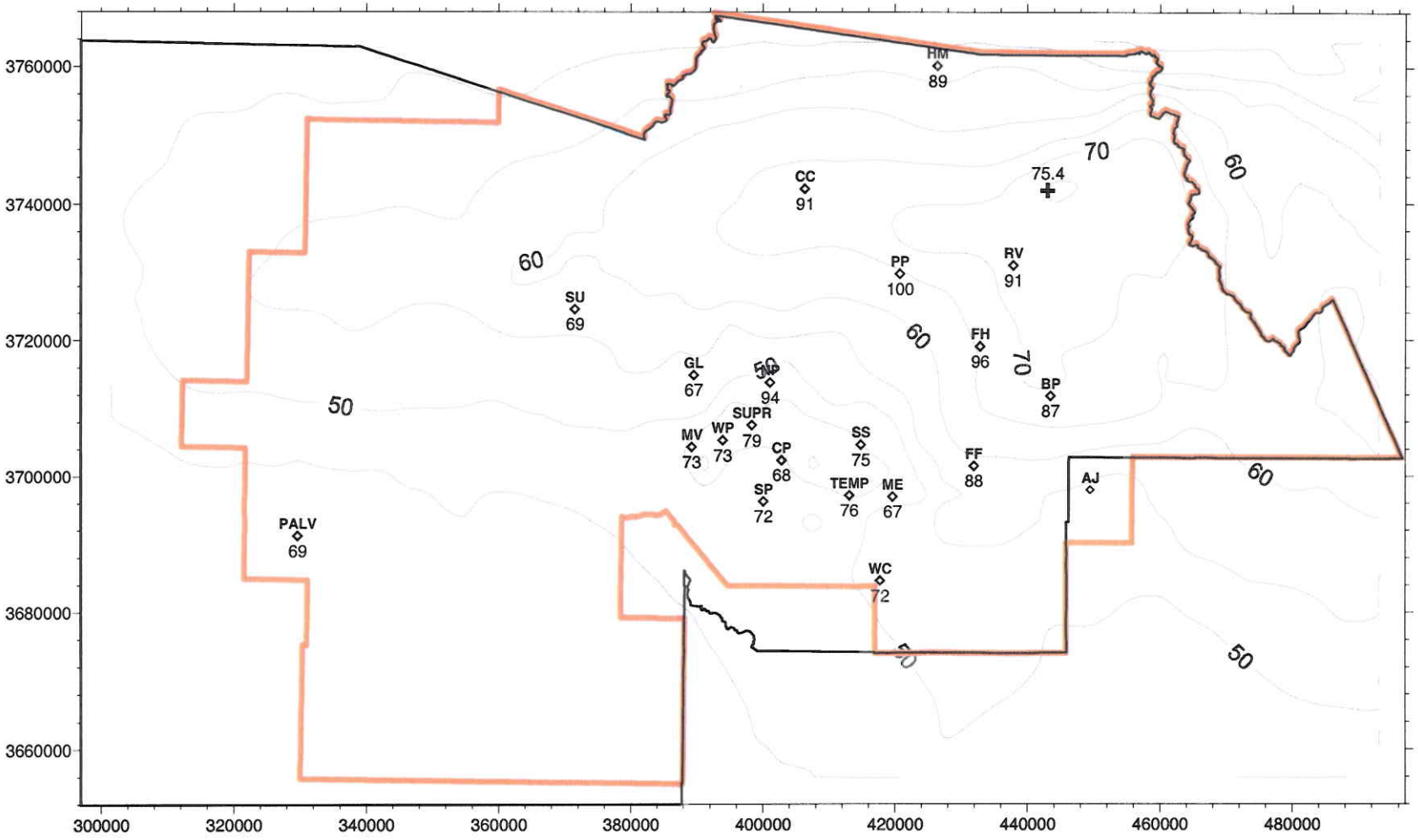


Figure IV-17(e). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 9, 2001.

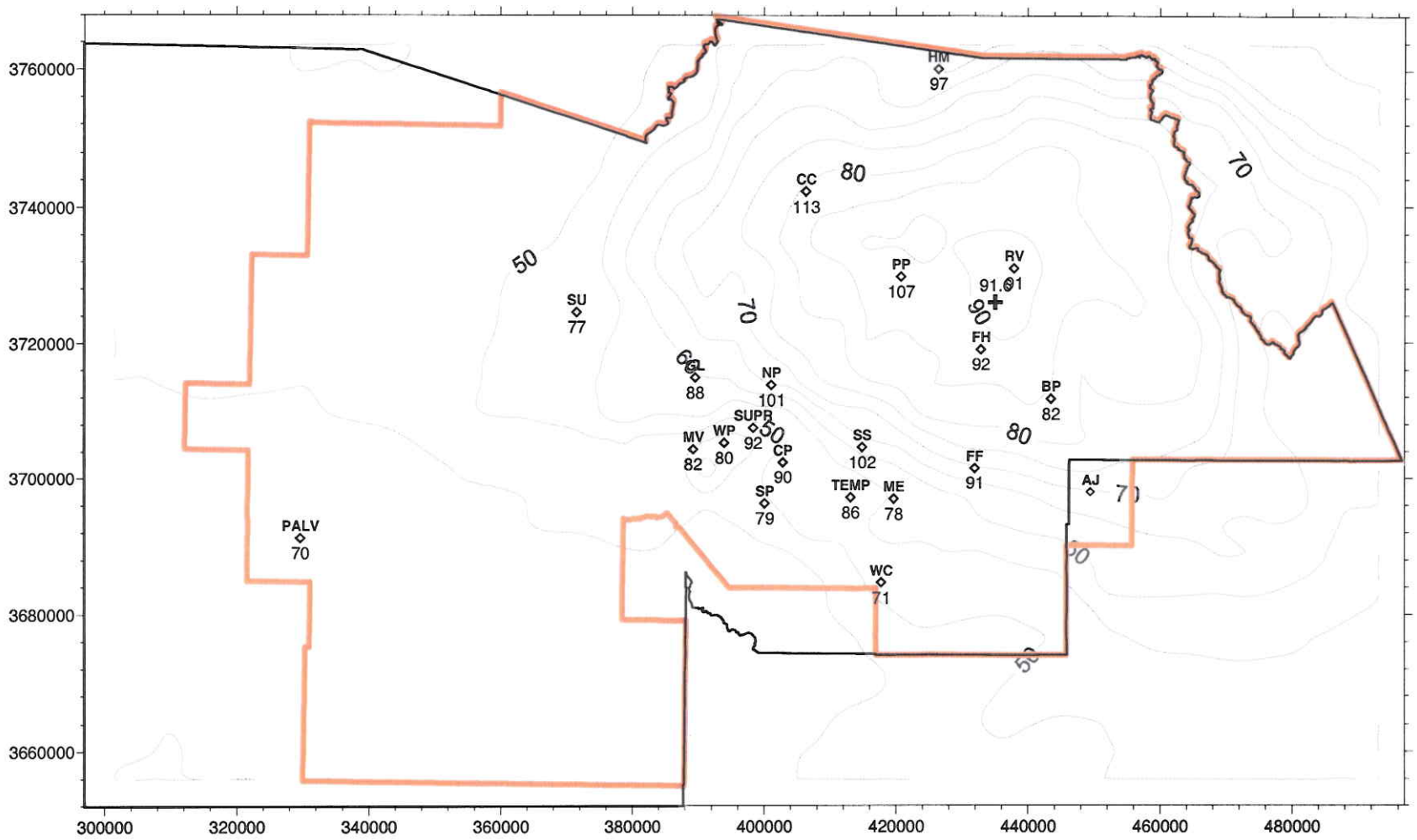


Figure IV-17(f). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 10, 2001.

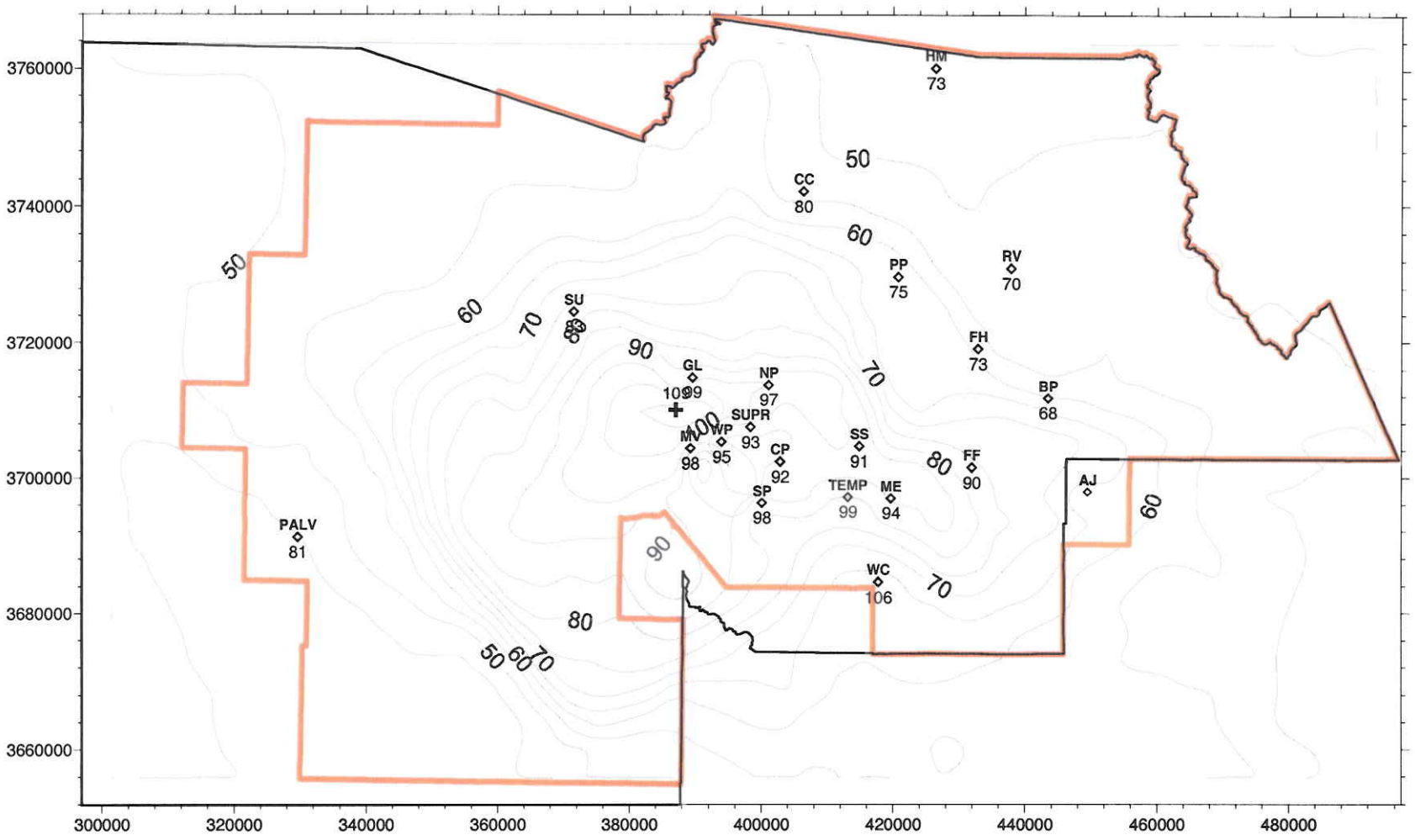


Figure IV-17(g). Daily one-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 11, 2001.

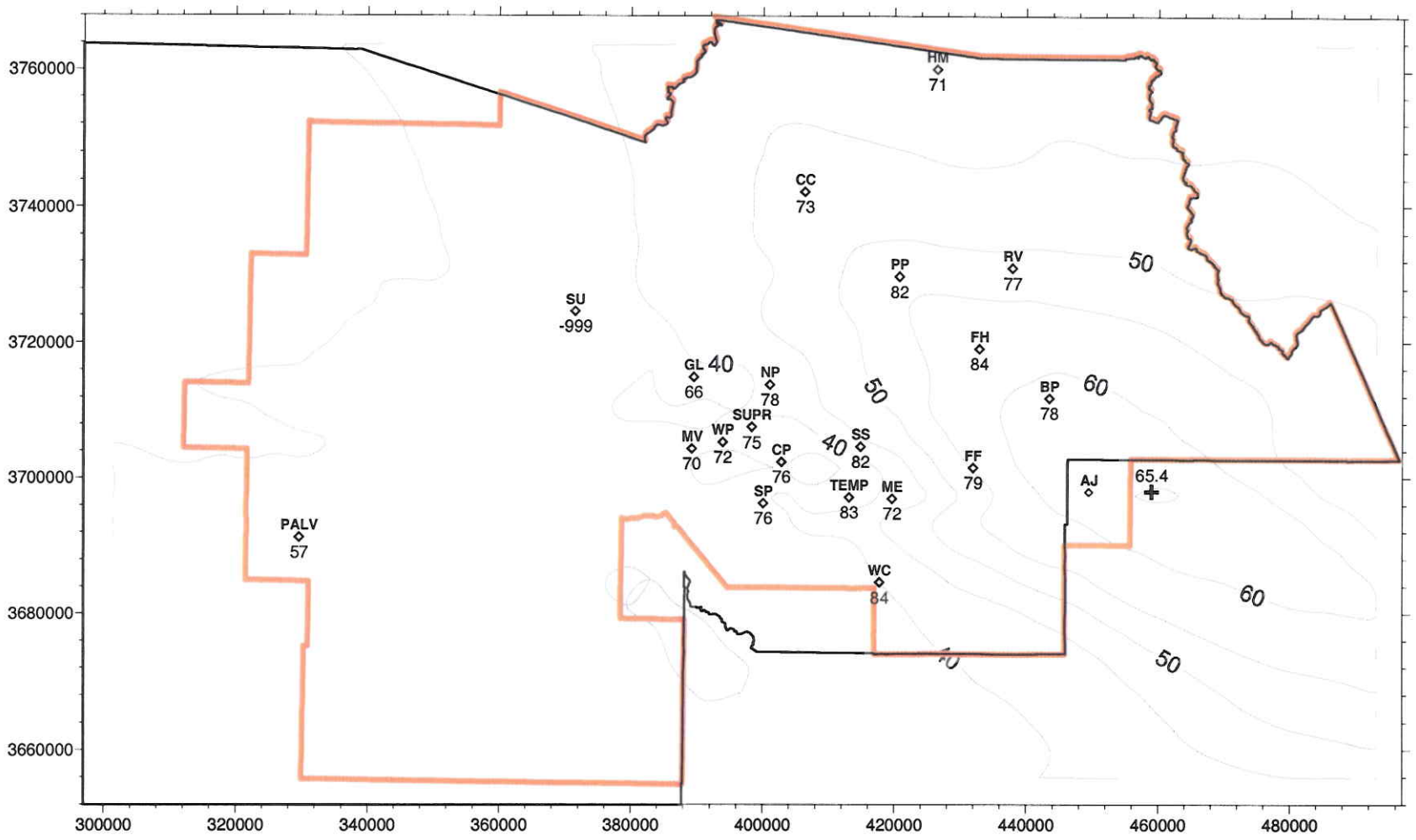


Figure IV-18(a). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 5, 2001.

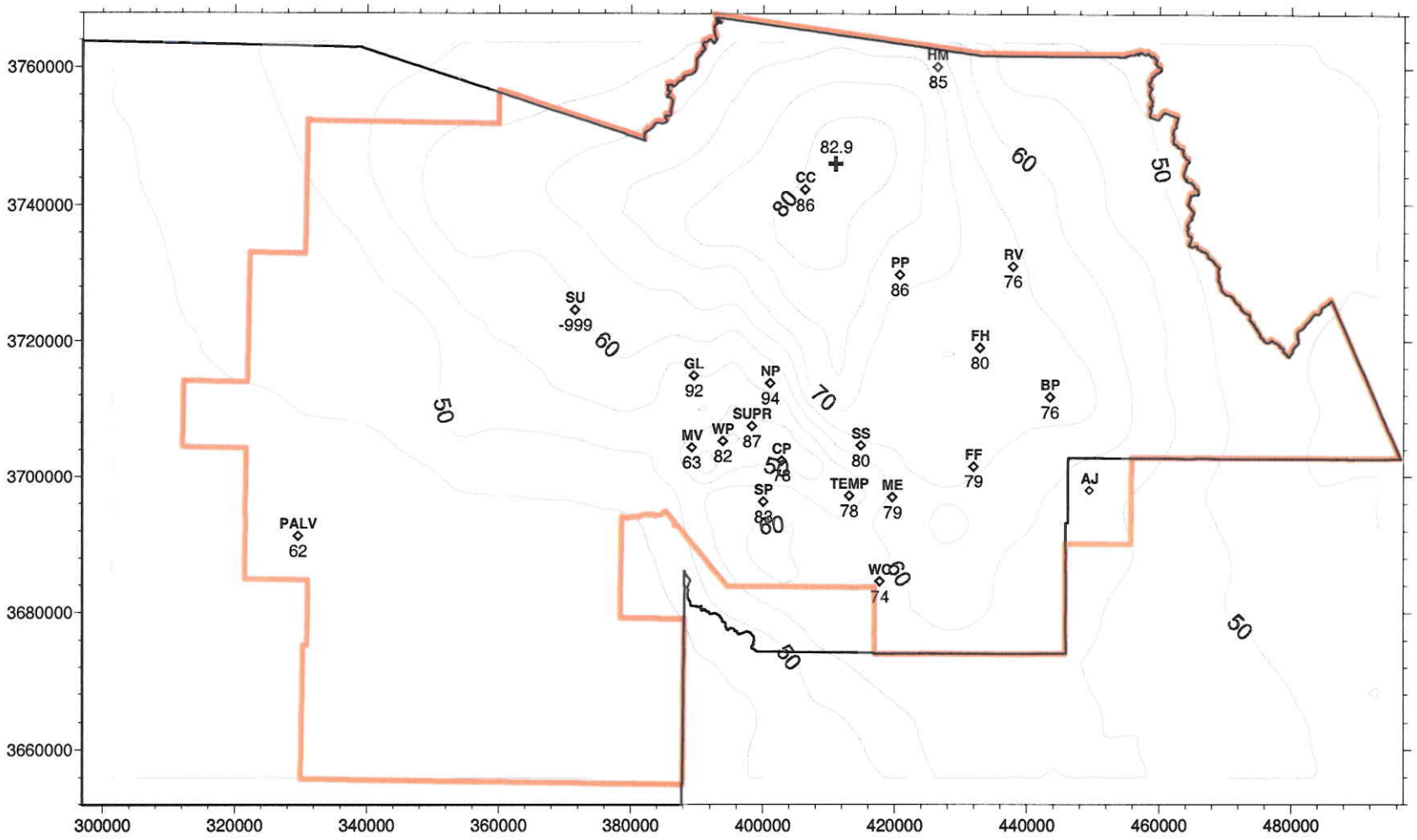


Figure IV-18(b). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 6, 2001.

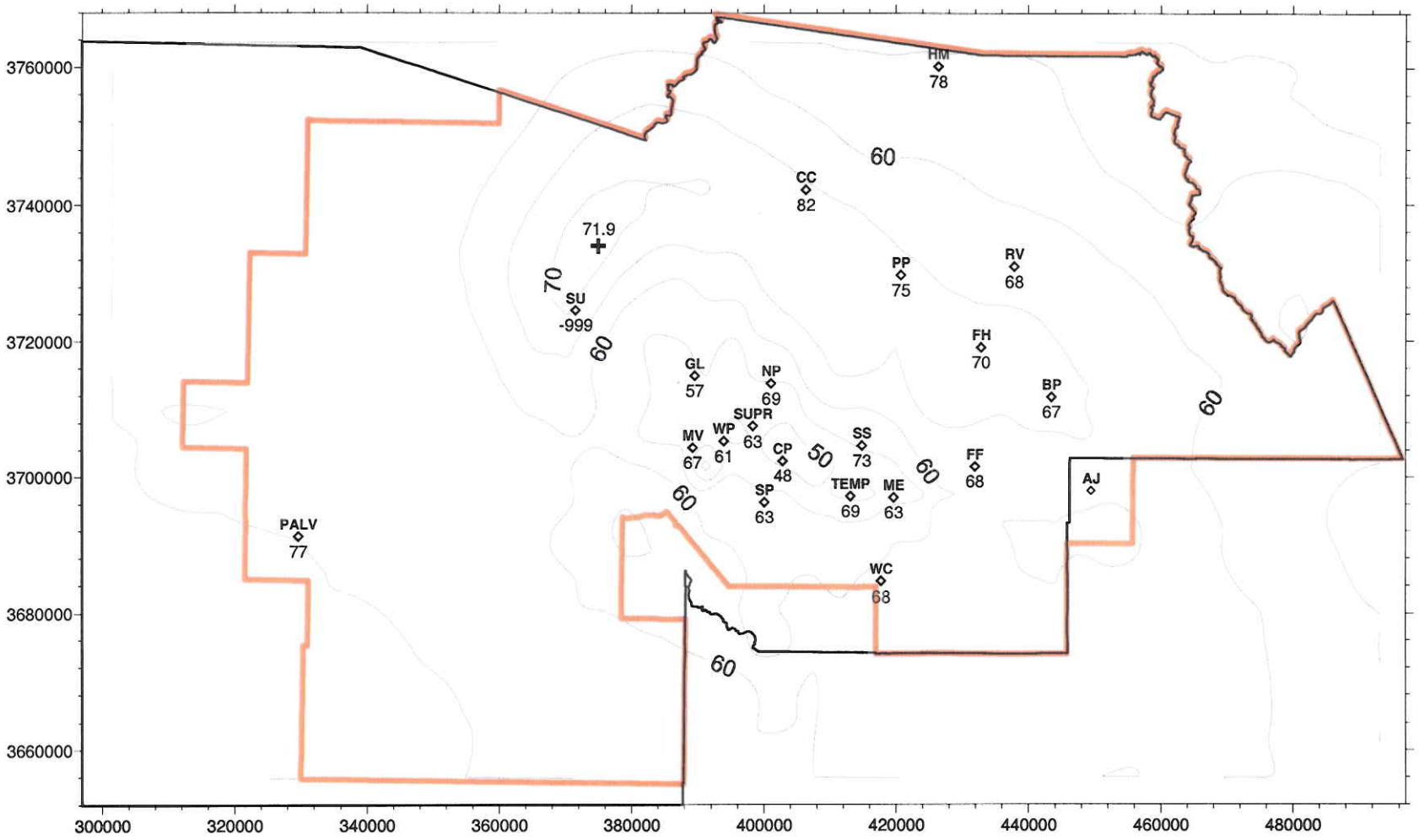


Figure IV-18(c). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 7, 2001.

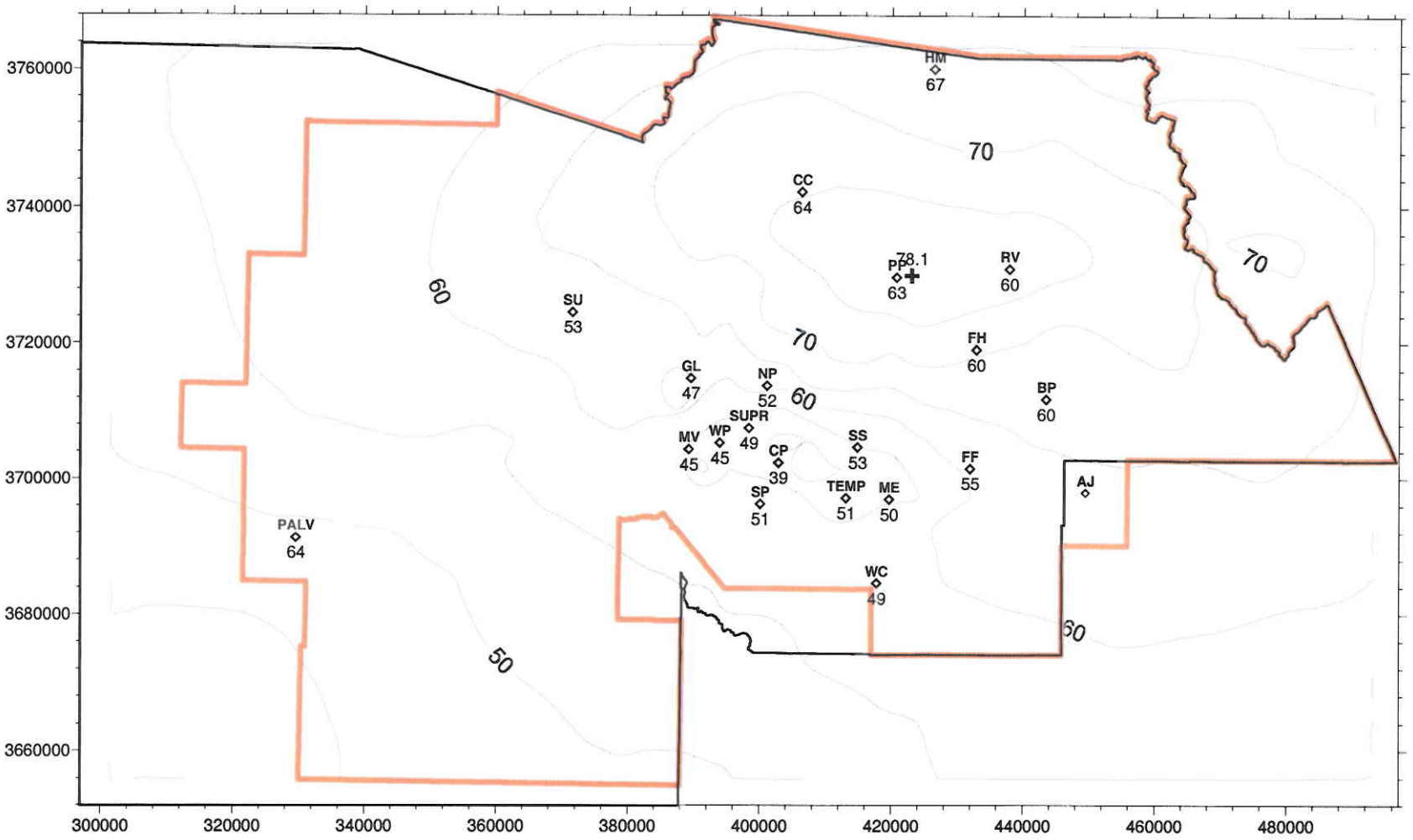


Figure IV-18(d). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 8, 2001.

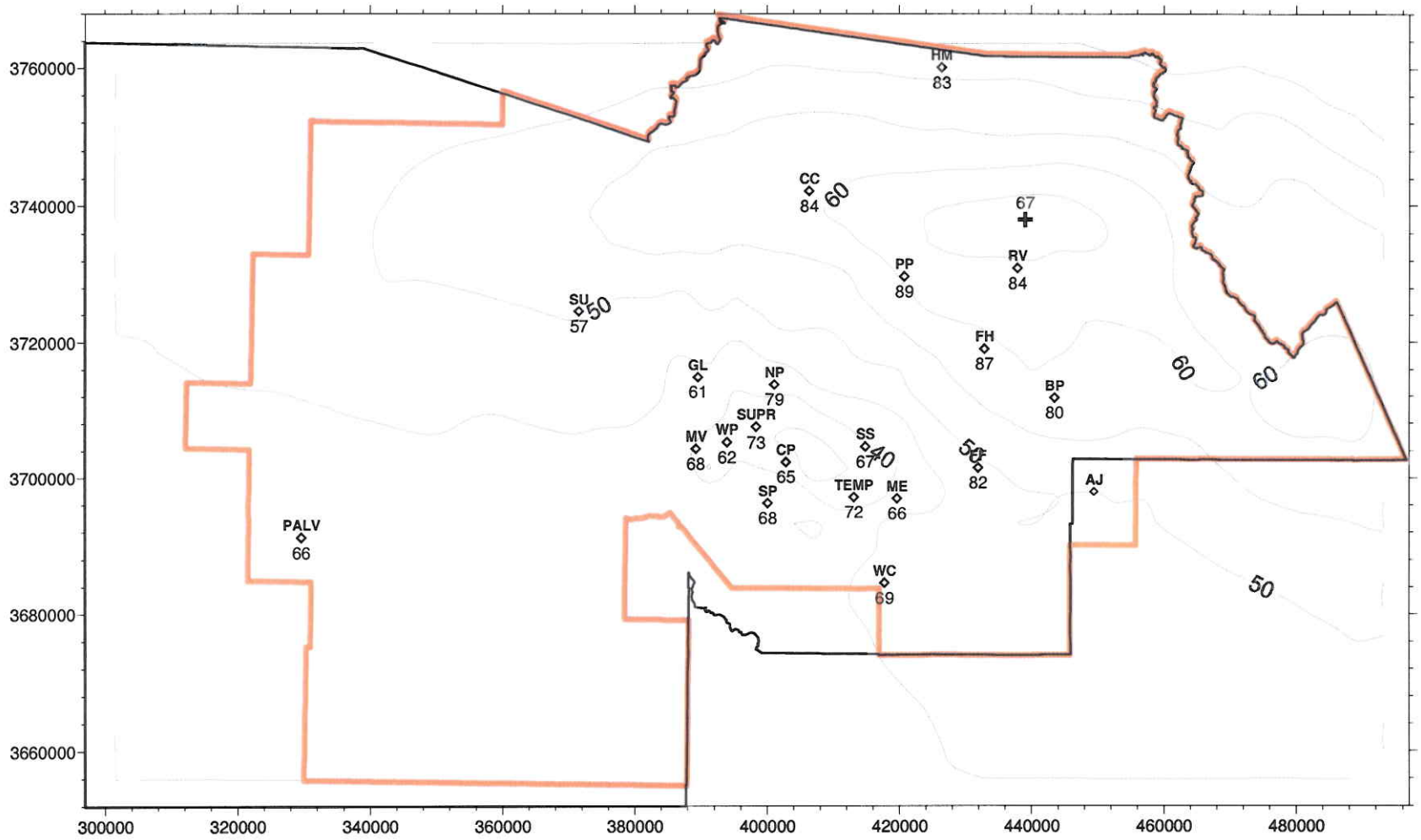


Figure IV-18(e). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 9, 2001.

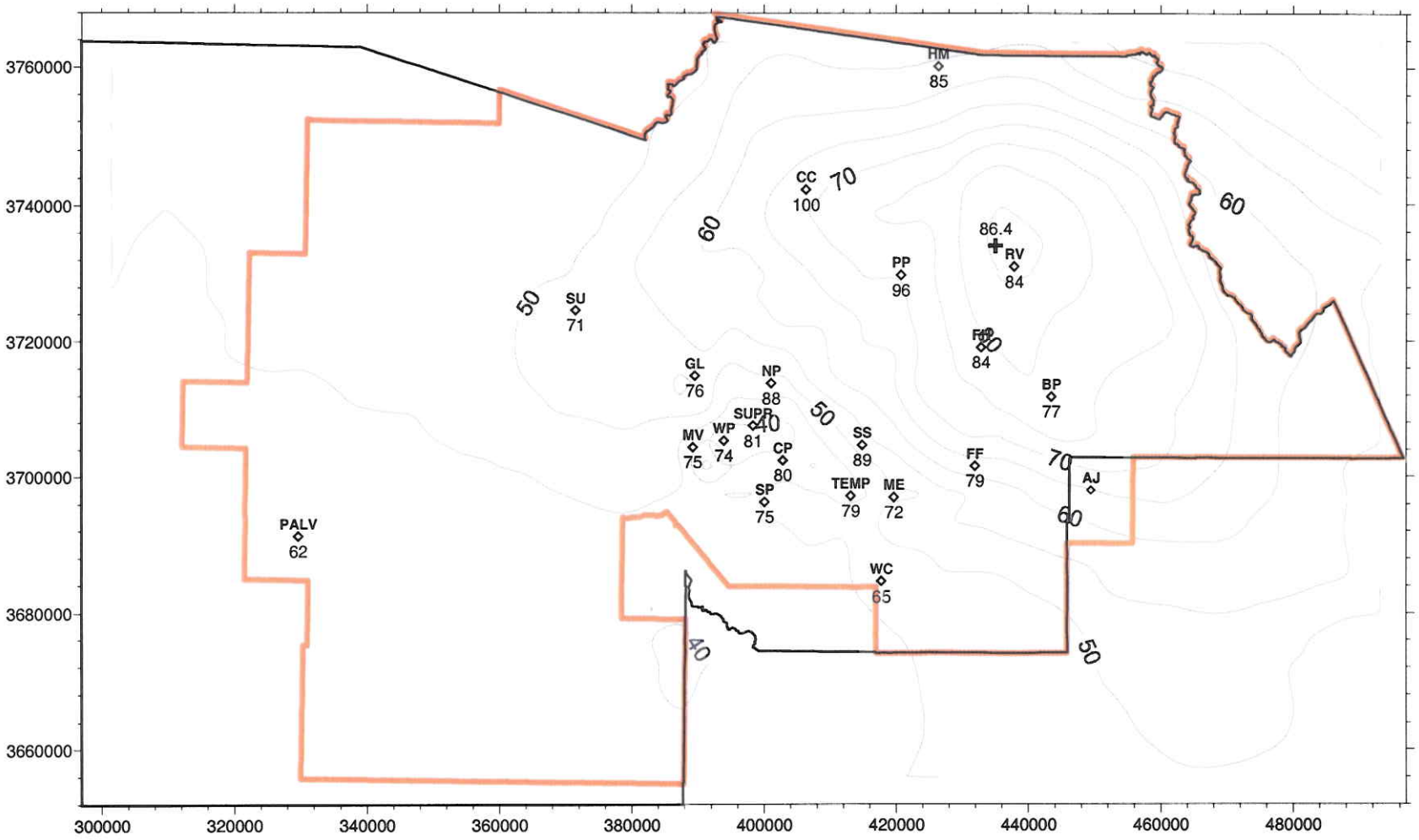


Figure IV-18(f). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 10, 2001.

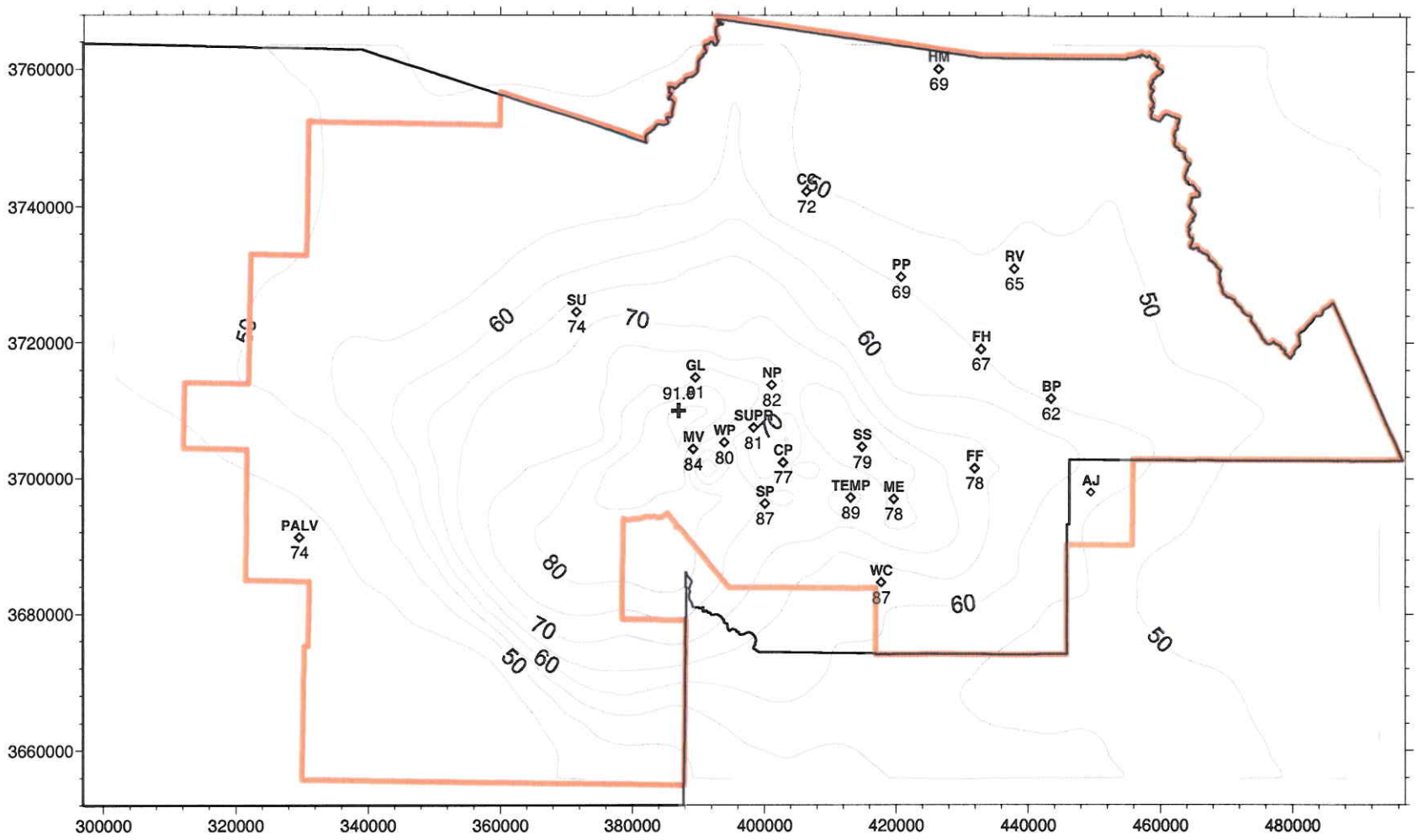


Figure IV-18(g). Daily eight-hour maxima contour plots of predicted ozone across the 4-km domain with the actual observations as an overlay on August 11, 2001.

IV-1-2. Summary of Model Performance

The following statistical performance measures were required by EPA Guidance [1]:

(A) Mean normalized bias (MNB)

(B) Mean normalized gross error (MNGE)

(C) Average peak prediction bias and error

The performance of the CAMx modeling for eight-hour ozone with a 60 ppb threshold compared to the EPA criteria is summarized below.

Statistical	EPA	CAMx Simulations				
Measure	Standard	6/3/02	6/4/02	6/5/02	6/6/02	6/7/02
(A)	± 15%	-25.1%	-3.3%	7.8%	0.2%	-8.6%
(B)	< 35%	25.1%	7.9%	9.8%	8.0%	10.3%
(C)	± 20%	-28.6%	1.0%	7.7%	-1.8%	-2.8%

Statistical	EPA	CAMx Simulations						
Measure	Standard	7/8/02	7/9/02	7/10/02	7/11/02	7/12/02	7/13/02	7/14/02
(A)	± 15%	-5.8%	-25.7%	-22.3%	-30.1%	-23.4%	-16.3%	-21.0%
(B)	< 35%	9.0%	25.8%	23.8%	30.4%	23.5%	16.4%	21.0%
(C)	± 20%	2.5%	-17.0%	-16.9%	-20.6%	-17.0%	-8.0%	-8.6%

Statistical	EPA	CAMx Simulations						
Measure	Standard	8/5/01	8/6/01	8/7/01	8/8/01	8/9/01	8/10/01	8/11/01
(A)	± 15%	-43.8%	-27.5%	-22.4%	-12.6%	-38.9%	-33.5%	-20.2%
(B)	< 35%	43.8%	27.5%	22.4%	19.0%	38.9%	33.9%	20.2%
(C)	± 20%	-22.2%	-12.1%	-12.5%	17.2%	-24.8%	-13.7%	3.0%

As shown, the three statistical measures remain within EPA acceptable ranges for the June 2002 episode.

In summary, CAMx model performance for the June 2002 episode is satisfactory and acceptable by EPA standards. Although the standard is not met on the first episode day, this does not affect the results of the attainment test. On June 3, 2002, none of data from the monitoring sites in the MNA on that day is used to calculate relative reduction factors,

because the observed daily maximum eight-hour ozone concentrations are less than the threshold value, 70 ppb, used for the attainment test. The graphical analysis component of the model performance evaluation indicates that, in general, the temporal and spatial characteristics of the observed ozone concentration patterns are reasonably replicated for this episode.

In addition to the three statistical measures recommended by EPA, the other statistics presented in this section and the multi-species comparisons provided in Section V-8, Weight of Evidence Analysis, also indicate that the model predictions agree well with observations. Model performance evaluated using newer methods comparing ozone levels near monitor locations is very good and are more consistent with the eight-hour ozone attainment methodology. It is concluded that the overall model performance for the June 2002 episode is satisfactory and the ozone modeling is suitable for the eight-hour ozone attainment demonstration for the MNA. Although model performance for the other two episodes is unsatisfactory, attainment tests for these episodes are provided to obtain a better understanding of the CAMx simulation in other meteorological schemes.

IV-2. Diagnostic Evaluation

After conducting the operational evaluation described in the previous section, diagnostic evaluation using several types of analyses recommended by EPA was conducted for the base case episodes to increase confidence in the model response. Diagnostic analysis was used to examine the model inputs, identify and correct errors in the input files, examine the effects of uncertainty (especially with regard to the assumptions invoked during the input preparation process), and to identify possible deficiencies in the model inputs.

IV-2-1. Observational Models

Several observational models were developed by ENVIRON [Emery et al., February 2007] to examine the general representativeness of the responses simulated with the CAMx. Highlights of the results from these observational models include:

- *Comparison of modeled and measured VOC composition (i.e., PAMS measurements) shows that the model is accurately reproducing VOC composition in central Phoenix. This finding builds confidence in the ability of the photochemical model to characterize ozone photochemistry in Phoenix.*

- *Analysis of measured VOC:NOx ratio during the summer of 2002, along with Process Analysis modeling results, clearly indicate that the Phoenix urban core is NOx-rich and ozone formation is VOC-limited. These findings suggest a NOx-inhibition effect on ozone formation that is consistent with observational evidence that:*

    - *Peak ozone is now occurring farther downwind than in years past;*

- *Lower weekend NOx results in higher weekend ozone;*

- *Independent weekday-weekend observational analyses for Phoenix also support the notion that reduced NOx on weekend days due to the lack of a commute (a natural analog to NOx reduction sensitivity) may lead to slightly higher ozone concentrations on the order of 1-2 ppb on high ozone days.*

The complete documentation for these observational models is provided in Appendix V, Weight of Evidence Analysis.

IV-2-2. Sensitivity Tests

Sensitivity analysis was used to investigate how the model responds to various model inputs and to ensure that the model responses to changes in the inputs were physically and chemically realistic. Following the preparation of inputs and initial application of CAMx, a series of sensitivity simulations were performed and these model results were examined and assessed using a variety of graphical and statistical measures. These sensitivity tests are described below.

IV-2-2-1. Initial Condition

Initial concentrations for all grid cells were reduced to zero. Sensitivity of concentrations within the modeling domain provided a measure of the influence of the initial conditions. The simulations with zero initial conditions decreased the simulated hourly peak ozone concentrations by 64.3 ppb (69 percent), 53.7 ppb (63 percent), and 52.4 ppb (62 percent) on the first ramp-up days for each episode, which were May 31, 2002, July 5, 2002, and August 2, 2001, respectively. However, the simulation results for the first days after the three ramp-up days, June 3, 2002, July 8, 2002, and August 5, 2001, were almost identical to the original runs. It appears that the errors associated with the initial conditions were diminished within three ramp-up days. The results strongly support that the three ramp-up days for the CAMx simulations are adequate to eliminate major uncertainties introduced in the initial condition values.

IV-2-2-2. Boundary Condition

Inflow concentrations at the lateral boundaries of the modeling domain were reduced to zero. Sensitivity of the concentrations in the inner core and downwind portions of the modeling domain provided a measure of the influence of the boundary conditions. The result indicates that the model is highly sensitive to the boundary conditions. As shown in Table IV-13, modeled ozone formation with zero boundary conditions decreased 48 to 63% of daily peak ozone concentration. This is consistent with the conceptual model by showing that high ozone levels in the MNA resulted mainly from transport of ozone in the June 2002 episode. The lower proportion of daily maximum ozone decrease, 23 to 39%, in the July 2002 episode (Table IV-14) supports the conceptual model that high ozone levels resulted mainly from local sources. The August 2001 episode that has a mixture of characteristics

from the other episodes experiences a moderate proportion of daily maximum ozone decrease, 26 to 43% (Table IV-15). The results support that CAMx is able to reflect characteristics of ozone formation described in the conceptual model [Jung, 2006].

IV-2-2-3. Emissions

Several diagnostic simulations were performed to address uncertainty in the emissions and specific features of the preliminary simulation results. These zero-out simulations help to understand which emission sources are most likely to form ground level ozone. Five CAMx simulations for each episode were performed, zeroing-out area, biogenic, nonroad, onroad, and point source emissions, respectively. The CAMx results for this sensitivity analysis are presented in Tables IV-16 through IV-21. The results show the impact on peak ozone concentrations, due to removal of source emissions for both VOC and NOx, differed by episode as shown in Figures IV-19 through IV-24. The order of impact, from the most effective to the least effective source, for each eight-hour ozone episode is shown below:

* June 2002: onroad, biogenic, area, nonroad, point source emissions
* July 2002: onroad, nonroad, biogenic, area, point source emissions
* August 2001: onroad, biogenic, area, nonroad, point source emissions

Table IV-13. Summary of daily maximum one-hour ozone difference between base case and sensitivity run with zero-out boundary conditions for the June 2002 episode. (unit: ppb)

	6/3/02	6/4/02	6/5/02	6/6/02	6/7/02
Base Case	64.6 at (22,25)	96.6 at (40,19)	103.4 at (24,11)	104.2 at (30,21)	107.1 at (40,19)
Sensitivity Test	27.3 at (37,28)	36.2 at (36,27)	43.6 at (40,9)	47.7 at (30,22)	55.4 at (46,13)
Difference	37.3 (58%)	60.4 (63%)	59.8 (58%)	56.5 (54%)	51.7 (48%)

Table IV-14. Summary of daily maximum one-hour ozone difference between base case and sensitivity run with zero-out boundary conditions for the July 2002 episode. (unit: ppb)

	7/8/02	7/9/02	7/10/02	7/11/02	7/12/02	7/13/02	7/14/02
Base Case	92.4 at (38,17)	105.6 at (24,15)	102.4 at (40,11)	112.5 at (27,21)	111.2 at (36,20)	112.6 at (36,12)	78.4 at (39,16)
Sensitivity Test	66.2 at (39,18)	64.4 at (22,16)	62.4 at (40,13)	86.4 at (27,21)	83.7 at (36,20)	80.5 at (37,12)	49.3 at (44,17)
Difference	26.2 (28%)	41.2 (39%)	40.0 (39%)	26.1 (23%)	27.5 (25%)	32.1 (29%)	29.1 (37%)

Table IV-15. Summary of daily maximum one-hour ozone difference between base case and sensitivity run with zero-out boundary conditions for the August 2001 episode. (unit: ppb)

	8/5/01	8/6/01	8/7/01	8/8/01	8/9/01	8/10/01	8/11/01
Base Case	82.1 at (41,11)	101.1 at (29,24)	89.6 at (24,24)	104.5 at (35,21)	75.4 at (37,23)	91.6 at (35,19)	109.0 at (23,15)
Sensitivity Test	60.7 at (41,15)	71.8 at (32,16)	61.3 at (22,25)	69.0 at (37,21)	43.3 at (35,22)	63.4 at (37,24)	78.6 at (23,15)
Difference	21.4 (26%)	29.3 (29%)	28.3 (32%)	35.5 (34%)	32.1 (43%)	28.2 (31%)	30.4 (28%)

Table IV-16. Summary of daily maximum one-hour ozone for the base case and sensitivity runs with zero-out emissions for the June 2002 episode (unit: ppb)

	6/3/02	6/4/02	6/5/02	6/6/02	6/7/02
Base Case	64.6 at Cell(22,25)	96.6 at Cell(40,19)	103.4 at Cell(24,11)	104.2 at Cell(30,21)	107.1 at Cell(40,19)
On-road	64.0 at Cell(22,25)	97.5 at Cell(37,16)	107.5 at Cell(22,18)	105.8 at Cell(31,16)	100.9 at Cell(31,17)
Non-road	64.5 at Cell(22,25)	97.8 at Cell(39,18)	104.7 at Cell(23,21)	106.0 at Cell(32,17)	104.6 at Cell(37,19)
Point	64.6 at Cell(22,25)	96.4 at Cell(40,19)	103.3 at Cell(24,12)	104.0 at Cell(30,21)	105.8 at Cell(40,19)
Area	64.6 at Cell(22,25)	93.7 at Cell(21,28)	101.6 at Cell(24,12)	101.0 at Cell(30,21)	99.9 at Cell(40,20)
Biogenics	64.4 at Cell(22,25)	93.6 at Cell(21,28)	100.3 at Cell(24,11)	98.4 at Cell(30,21)	99.4 at Cell(40,19)

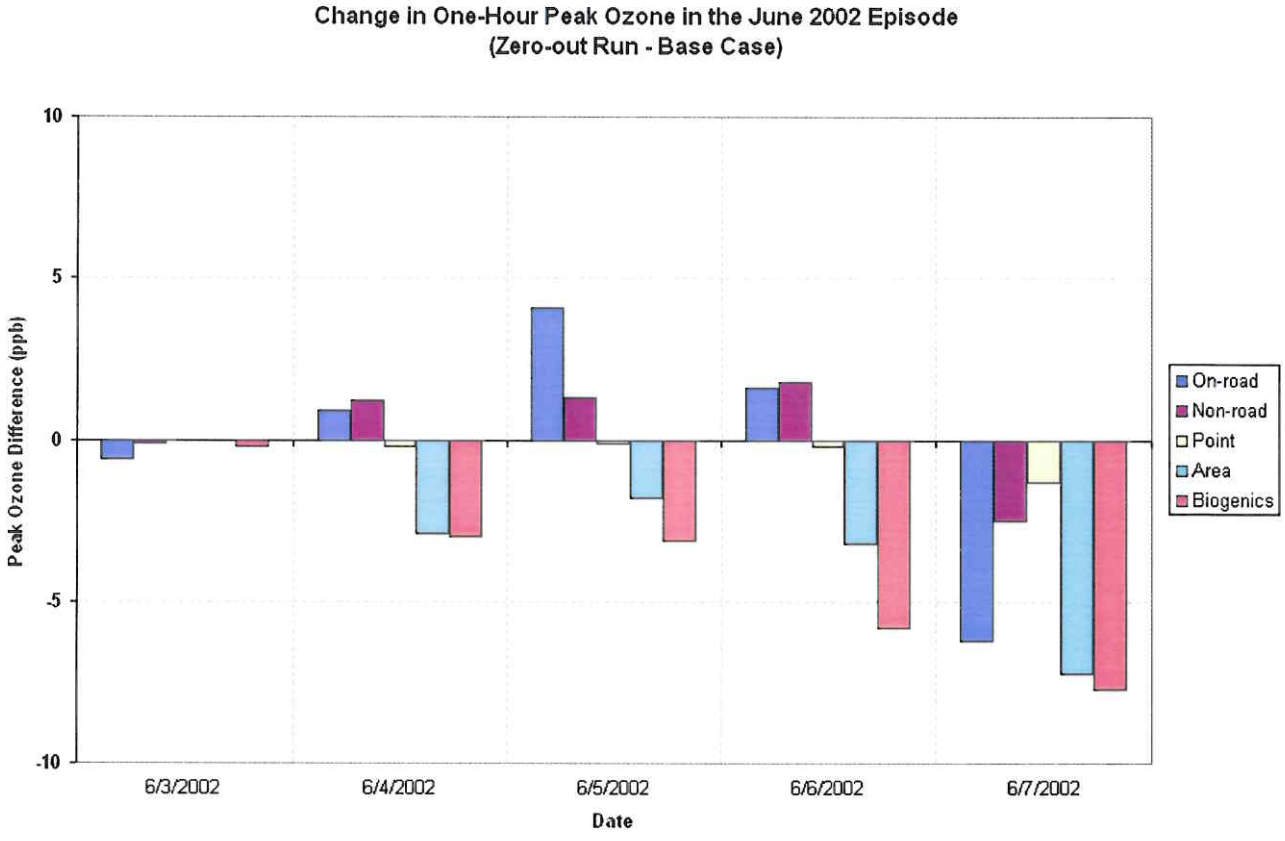


Figure IV-19. Daily maximum one-hour ozone difference between the base case and each sensitivity run with zero-out emissions for the June 2002 episode

Table IV-17. Summary of daily maximum eight-hour ozone for the base case and sensitivity runs with zero-out emissions for the June 2002 episode (unit: ppb)

	6/3/02	6/4/02	6/5/02	6/6/02	6/7/02
Base Case	64.6 at Cell(42,21)	91.1 at Cell(43,21)	98.7 at Cell(22,25)	91.3 at Cell(27,21)	87.1 at Cell(38,19)
On-road	64.4 at Cell(42,21)	91.0 at Cell(43,21)	93.6 at Cell(23,20)	86.8 at Cell(29,16)	83.4 at Cell(34,15)
Non-road	65.0 at Cell(42,21)	91.4 at Cell(43,21)	97.5 at Cell(22,25)	90.5 at Cell(32,16)	86.4 at Cell(36,18)
Point	64.6 at Cell(42,21)	91.1 at Cell(43,21)	98.6 at Cell(22,25)	91.3 at Cell(27,21)	86.7 at Cell(38,19)
Area	64.6 at Cell(42,21)	91.1 at Cell(43,21)	97.6 at Cell(22,26)	89.7 at Cell(27,21)	84.7 at Cell(38,20)
Biogenics	64.6 at Cell(42,21)	91.1 at Cell(43,21)	96.5 at Cell(22,26)	87.4 at Cell(27,21)	82.5 at Cell(38,20)

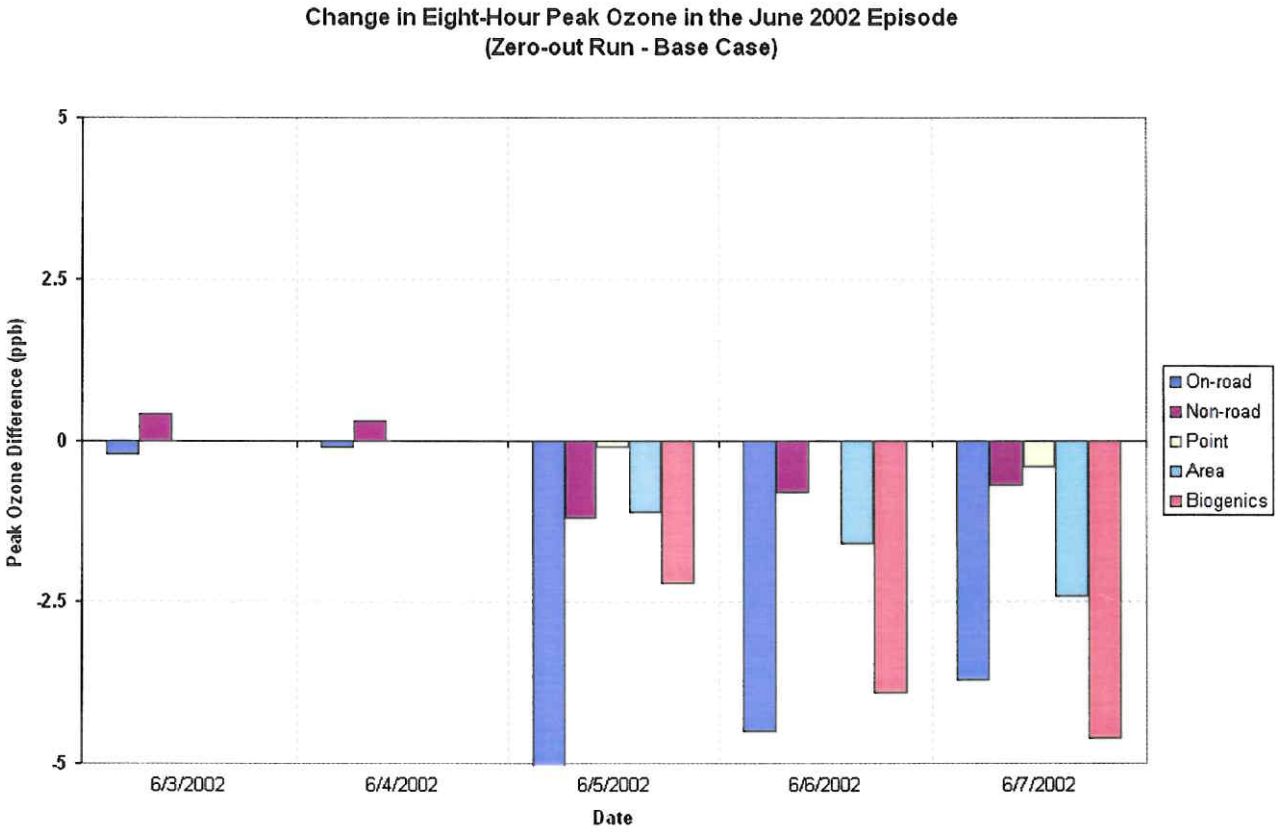


Figure IV-20. Daily maximum eight-hour ozone difference between the base case and each sensitivity run with zero-out emissions for the June 2002 episode

Table IV-18. Summary of daily maximum one-hour ozone for the base case and sensitivity runs with zero-out emissions for the July 2002 episode (unit: ppb)

	7/8/02	7/9/02	7/10/02	7/11/02	7/12/02	7/13/02	7/14/02
Base Case	92.4 at Cell(38,17)	105.6 at Cell(24,15)	102.4 at Cell(40,11)	112.5 at Cell(27,21)	111.2 at Cell(36,20)	112.6 at Cell(36,12)	78.4 at Cell(39,16)
On-road	92.8 at Cell(33,14)	86.6 at Cell(26,14)	84.3 at Cell(37,11)	85.8 at Cell(27,21)	86.2 at Cell(36,20)	95.4 at Cell(35,12)	72.1 at Cell(34,15)
Non-road	94.3 at Cell(36,15)	97.4 at Cell(24,15)	93.9 at Cell(40,11)	101.6 at Cell(27,21)	99.2 at Cell(36,20)	99.2 at Cell(36,12)	72.3 at Cell(34,17)
Point	92.3 at Cell(38,17)	104.4 at Cell(24,15)	101.6 at Cell(40,11)	111.2 at Cell(27,21)	110.2 at Cell(36,20)	111.8 at Cell(36,12)	77.9 at Cell(39,16)
Area	84.9 at Cell(36,17)	99.7 at Cell(23,15)	95.7 at Cell(40,11)	107.4 at Cell(27,21)	106.3 at Cell(36,20)	102.4 at Cell(36,12)	75.4 at Cell(45,16)
Biogenics	80.6 at Cell(36,17)	97.0 at Cell(23,15)	97.8 at Cell(40,11)	108.0 at Cell(27,21)	106.3 at Cell(36,20)	105.8 at Cell(36,12)	76.7 at Cell(39,16)

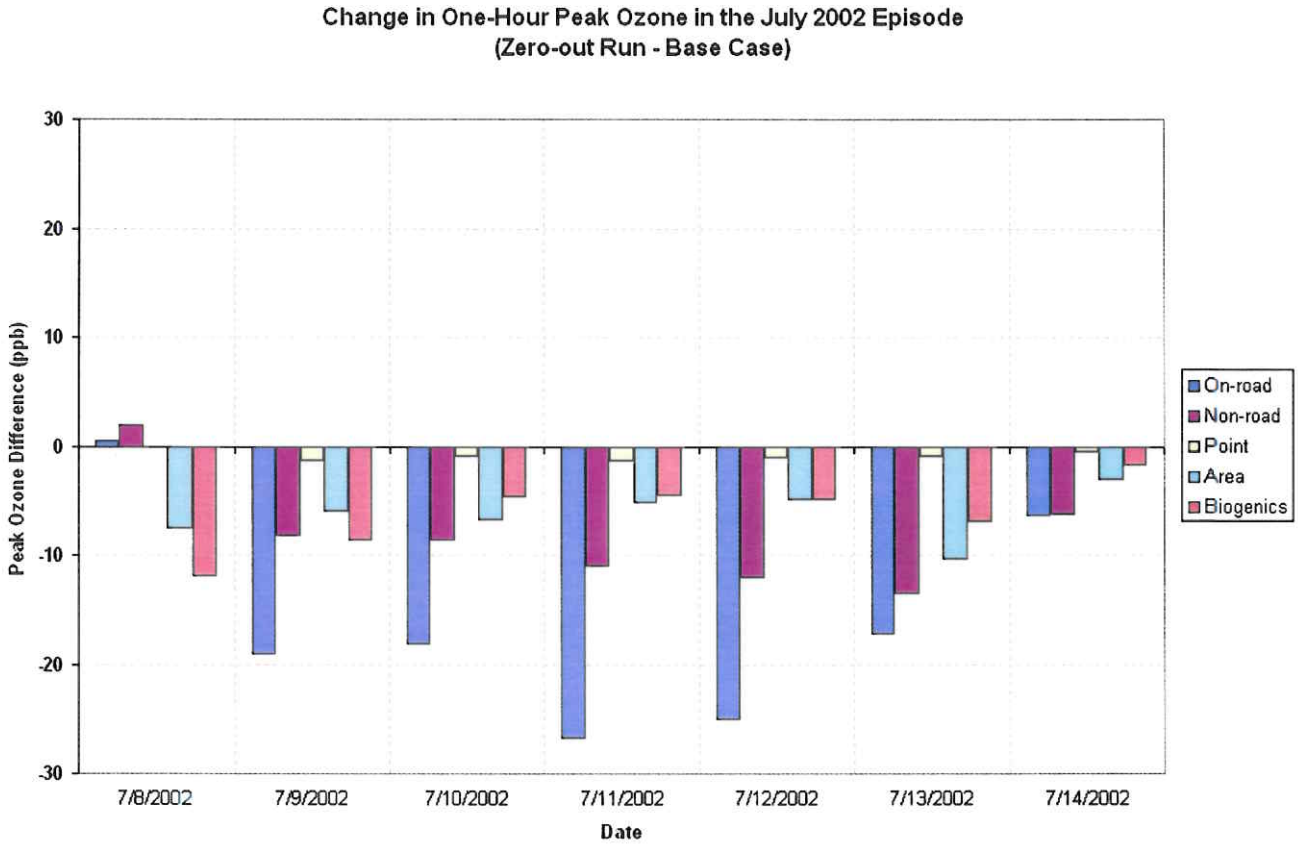


Figure IV-21. Daily maximum one-hour ozone difference between the base case and each sensitivity run with zero-out emissions for the July 2002 episode

Table IV-19. Summary of daily maximum eight-hour ozone for the base case and sensitivity runs with zero-out emissions for the July 2002 episode (unit: ppb)

	7/8/02	7/9/02	7/10/02	7/11/02	7/12/02	7/13/02	7/14/02
Base Case	75.9 at Cell(36,16)	89.6 at Cell(23,15)	79.0 at Cell(36,13)	82.0 at Cell(27,21)	85.7 at Cell(30,22)	79.9 at Cell(34,13)	69.3 at Cell(43,15)
On-road	70.4 at Cell(31,15)	73.5 at Cell(24,14)	68.0 at Cell(35,12)	66.1 at Cell(26,21)	69.9 at Cell(32,16)	71.4 at Cell(33,12)	63.6 at Cell(40,14)
Non-road	75.8 at Cell(34,15)	84.4 at Cell(23,15)	74.6 at Cell(35,13)	76.1 at Cell(27,21)	79.4 at Cell(30,22)	74.3 at Cell(33,13)	64.9 at Cell(40,18)
Point	75.8 at Cell(36,16)	88.6 at Cell(23,15)	78.5 at Cell(36,13)	81.3 at Cell(27,21)	84.7 at Cell(30,22)	79.4 at Cell(34,13)	69.1 at Cell(43,15)
Area	70.0 at Cell(36,16)	85.4 at Cell(23,15)	76.2 at Cell(36,13)	79.8 at Cell(27,21)	83.1 at Cell(32,20)	75.7 at Cell(35,13)	67.9 at Cell(45,15)
Biogenics	67.3 at Cell(36,16)	83.6 at Cell(21,15)	75.9 at Cell(36,13)	79.0 at (27,21)	82.2 at Cell(30,22)	75.3 at Cell(34,13)	67.9 at Cell(43,15)

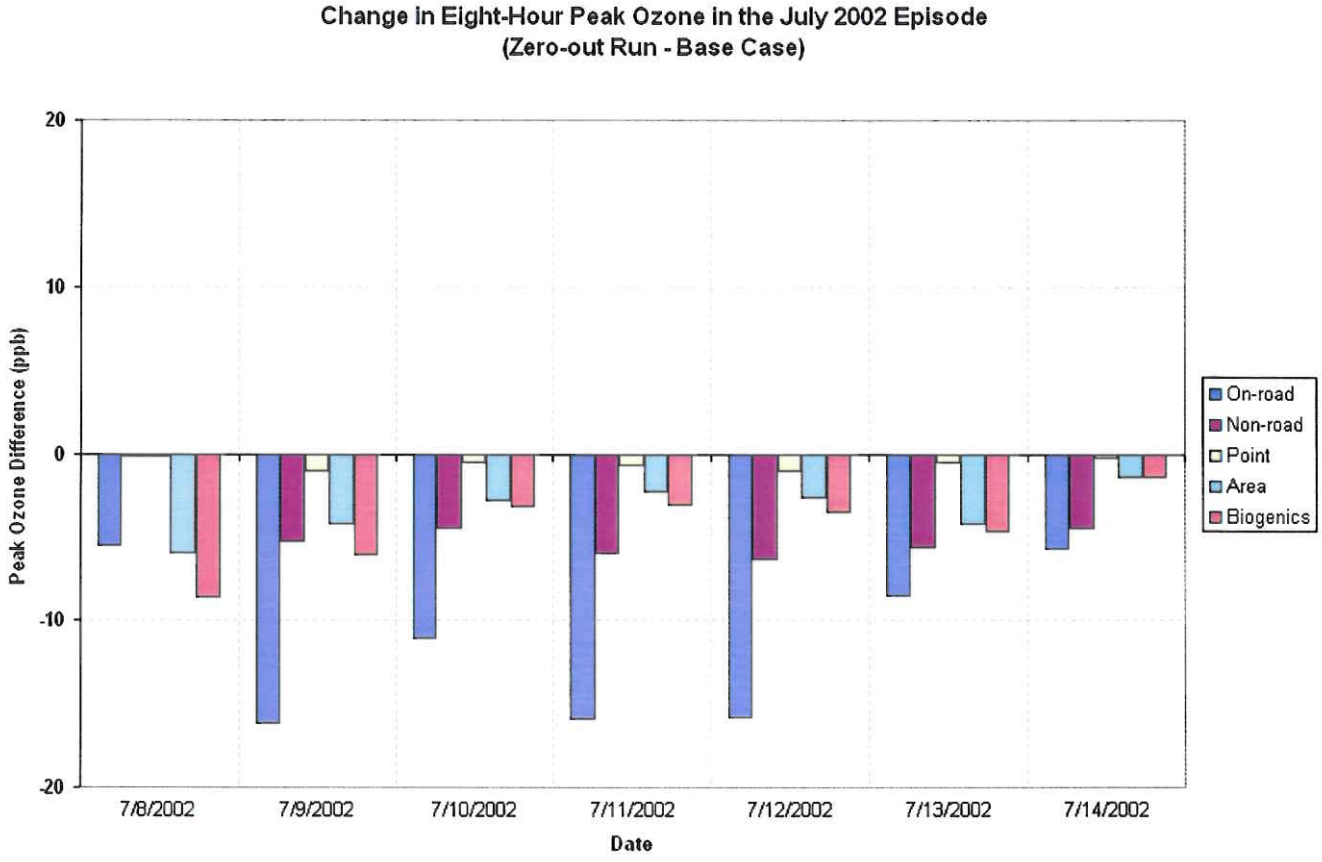


Figure IV-22. Daily maximum eight-hour ozone difference between the base case and each sensitivity run with zero-out emissions for the July 2002 episode

Table IV-20. Summary of daily maximum one-hour ozone for the base case and sensitivity runs with zero-out emissions for the August 2001 episode (unit: ppb)

	8/5/01	8/6/01	8/7/01	8/8/01	8/9/01	8/10/01	8/11/01
Base Case	82.1 at Cell(41,11)	101.1 at Cell(29,24)	89.6 at Cell(24,24)	104.5 at Cell(35,21)	75.4 at Cell(37,23)	91.6 at Cell(35,19)	109.0 at Cell(23,15)
On-road	79.7 at Cell(39,11)	106.9 at Cell(27,16)	82.0 at Cell(28,20)	89.6 at Cell(28,20)	71.3 at Cell(31,18)	84.1 at Cell(31,16)	91.7 at Cell(23,14)
Non-road	82.4 at Cell(40,12)	104.0 at Cell(29,22)	86.8 at Cell(24,24)	100.2 at Cell(31,21)	74.4 at Cell(37,20)	89.1 at Cell(35,18)	103.3 at Cell(23,15)
Point	86.7 at Cell(40,11)	106.8 at Cell(28,22)	89.8 at Cell(24,24)	103.6 at Cell(35,21)	75.5 at Cell(37,23)	91.8 at Cell(35,19)	107.9 at Cell(23,15)
Area	70.4 at Cell(41,14)	87.0 at Cell(29,23)	85.4 at Cell(24,24)	97.8 at Cell(35,21)	68.9 at Cell(37,23)	84.5 at Cell(32,21)	100.4 at Cell(24,15)
Biogenics	72.8 at Cell(41,10)	87.7 at Cell(28,24)	83.5 at Cell(23,24)	98.8 at Cell(35,21)	69.8 at Cell(37,23)	85.4 at Cell(32,21)	101.3 at Cell(23,15)

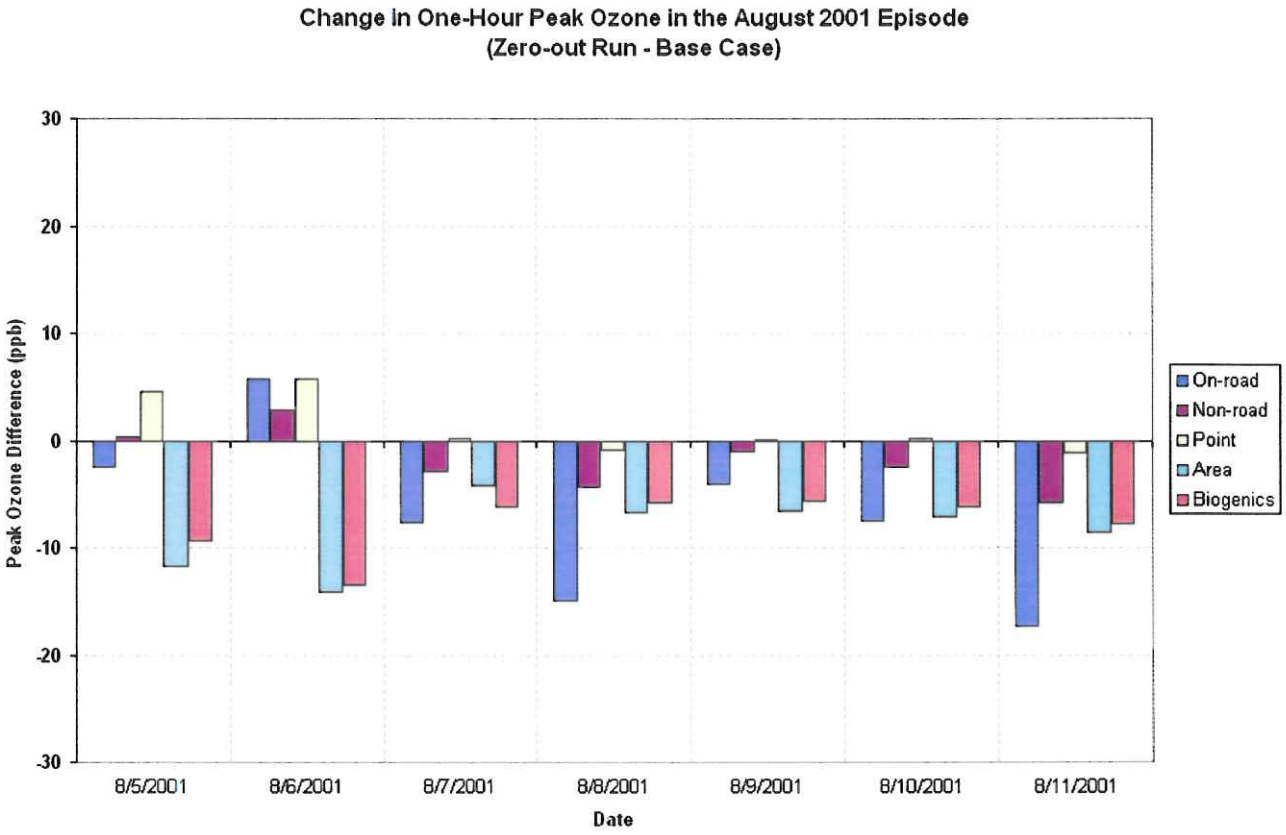


Figure IV-23. Daily maximum one-hour ozone difference between the base case and each sensitivity run with zero-out emissions for the August 2001 episode

Table IV-21. Summary of daily maximum eight-hour ozone for the base case and sensitivity runs with zero-out emissions for the August 2001 episode (unit: ppb)

	8/5/01	8/6/01	8/7/01	8/8/01	8/9/01	8/10/01	8/11/01
Base Case	65.4 at Cell(41,12)	82.9 at Cell(29,24)	71.8 at Cell(20,21)	78.1 at Cell(32,20)	67.0 at Cell(36,22)	86.4 at Cell(35,21)	91.9 at Cell(23,15)
On-road	58.3 at Cell(35,13)	78.6 at Cell(27,17)	67.3 at Cell(20,19)	68.6 at Cell(29,19)	58.7 at Cell(32,19)	67.8 at Cell(31,16)	83.9 at Cell(23,14)
Non-road	62.6 at Cell(37,13)	83.1 at Cell(28,21)	71.0 at Cell(20,21)	75.5 at Cell(31,20)	64.8 at Cell(34,21)	82.2 at Cell(35,21)	88.9 at Cell(23,15)
Point	65.5 at Cell(41,12)	84.9 at Cell(30,24)	72.7 at Cell(20,21)	77.4 at Cell(30,21)	66.9 at Cell(36,22)	86.5 at Cell(35,21)	91.0 at Cell(23,15)
Area	60.6 at Cell(41,12)	74.1 at Cell(29,24)	68.3 at Cell(20,22)	75.8 at Cell(32,20)	63.6 at Cell(36,22)	80.1 at Cell(36,21)	85.0 at Cell(23,15)
Biogenics	59.5 at Cell(41,12)	73.9 at Cell(29,24)	67.1 at Cell(20,22)	74.5 at Cell(32,20)	63.5 at Cell(36,22)	79.2 at Cell(35,21)	85.8 at Cell(23,15)

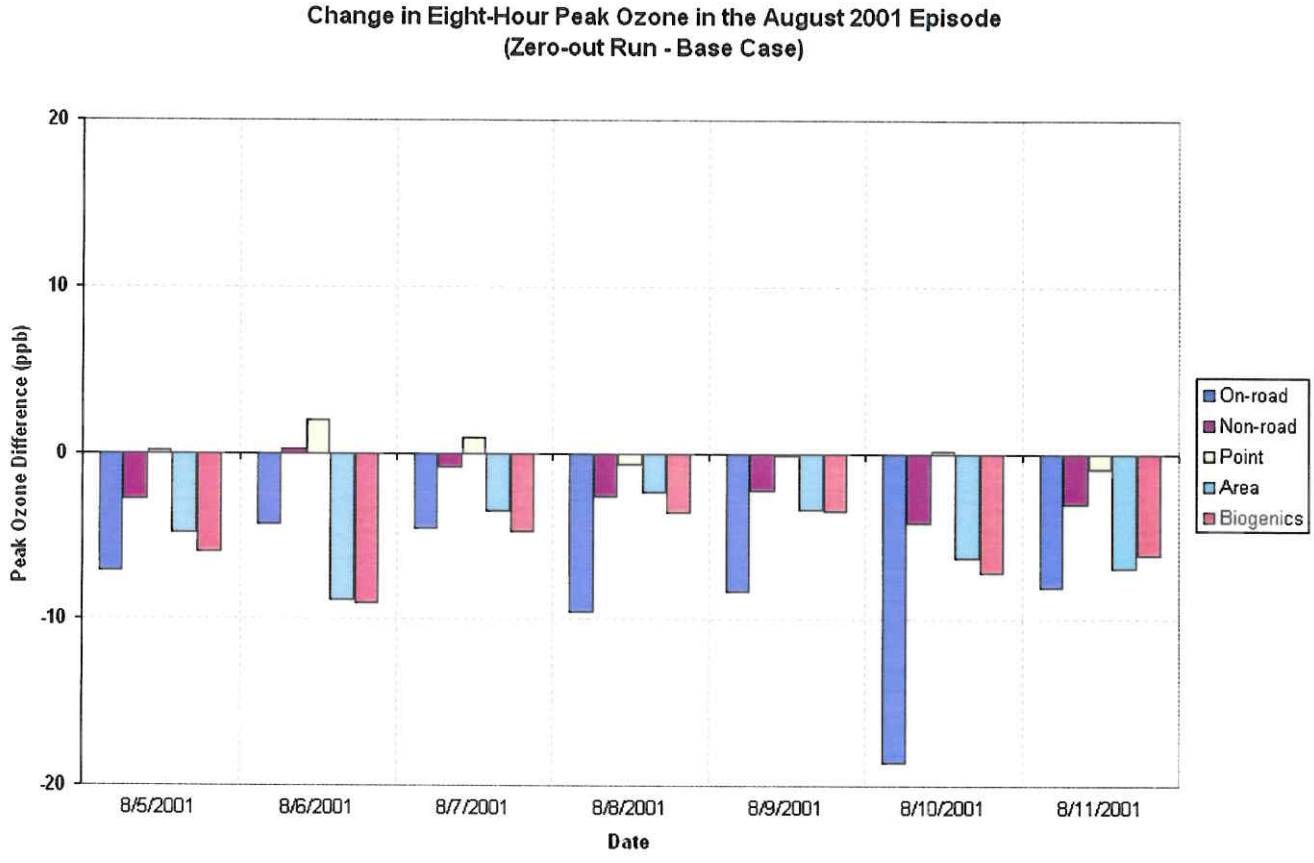


Figure IV-24. Daily maximum eight-hour ozone difference between the base case and each sensitivity run with zero-out emissions for the August 2001 episode

IV-3. Conclusions

The results presented above indicate that the assessment of model performance may vary depending upon the methodology used for evaluation. Thus, it is important to assess model performance, as a whole, and determine whether the model is suitable to use for purpose of an eight-hour ozone attainment demonstration. The overall conclusions from the performance evaluation are:

- Modeled ozone formation is consistent with conceptual model in that high ozone levels in the MNA resulted from a combination of production from local emissions sources combined with regional background and transport of ozone.

- Model performance for the June 2002 episode is acceptable on most days when evaluated using the traditional methods used for one-hour ozone modeling.

- Model performance for the June 2002 episode is very good when evaluated using newer methods that compare ozone levels near monitor locations and are more consistent with the eight-hour ozone attainment demonstration methodology.

The overall conclusion is that the ozone modeling for the June 2002 episode is suitable for use in an eight-hour ozone attainment demonstration for the MNA.

REFERENCES

1. U.S. Environmental Protection Agency (October 2005) "*Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS*". EPA-454/R-05-002. Emissions, Monitoring, and Analysis Division, Office of Air Quality Planning and Standards.

2. Emery, C. and Yarwood, G. (February 2007) *"Weight of Evidence Analysis to Support the Maricopa 8-Hour Ozone SIP*". ENVIRON Memorandum.

3. Jung, I. (January 2006) "*Review of 2000-2004 Ozone Episodes in the Maricopa County 8-Hour Ozone Nonattainment Area*". MAG Memorandum.

V. ATTAINMENT DEMONSTRATION

V-1. Identification of Attainment Date

Eight-hour ozone nonattainment areas, such as the Maricopa nonattainment area (MNA), that are classified as Basic under Part D, Subpart 1, of the Clean Air Act, must attain the standard no later than five years from the date of designation. The designation of portions of Maricopa and Pinal Counties as an eight-hour ozone nonattainment area became effective on June 15, 2004, establishing an attainment date of June 15, 2009. To ensure that the standard is achieved by this date, EPA requires that control measures be implemented and attainment be modeled for the preceding ozone season, i.e., 2008. This plan demonstrates that attainment is achieved in 2008 for three different meteorological and emissions regimes that resulted in eight-hour ozone violations in August 2001, June 2002, and July 2002.

Due to stricter federal emissions standards for 2004 and newer light duty vehicle models (Tier 2); 2007 and newer heavy duty gas and diesel engines; nonroad diesel equipment, effective between 2008 and 2012 (Tier 4); and ultra-low sulfur fuels that became available nationwide on October 15, 2006, ozone precursor emissions from onroad and nonroad mobile sources are declining and will continue to trend downward. In addition, the State, County, and local jurisdictions in the Maricopa area made legally-binding commitments in the One-Hour Ozone Maintenance Plan [1] that will continue to reduce emissions. It is anticipated that these federal and local measures will more than offset the growth in population, employment and vehicle travel in the region, resulting in attainment of the eight-hour ozone standard by June 15, 2009.

The purpose of conducting photochemical grid modeling is to demonstrate attainment of the eight-hour ozone standard with control measures that have already been implemented by the ozone season of 2008. The simulations for the June, July, and August 2008 episodes were conducted using the Comprehensive Air quality Model with Extensions (CAMx). The results from the CAMx modeling were used to determine whether the MNA will attain the federal standard for eight-hour ozone with the committed attainment measures. The modeling conducted for the Plan demonstrates attainment in 2008 for all three of the ozone episodes and meteorological regimes. However, from a strictly statistical perspective, only the June 2002 episode performed adequately in replicating eight-hour ozone concentrations. CAMx modeling for the July 2002 and August 2001 consistently underestimated ozone concentrations. Therefore, the attainment demonstration discussed in this section, unless specified otherwise, is based on modeling results for the June 2008 episode.

In general, the modeling results are shown for the meteorological conditions and diurnal and spatial pattern of emissions on June 6, 2002. This is the day on which the highest eight-hour ozone concentration was observed during the June 2002 episode. To ensure that the same meteorology and emissions patterns that led to the highest ozone concentration in June 2002 are represented in modeling attainment, the modeling results in this section refer to a Thursday in June 2008, rather than Friday, June 6, 2008.

V-2. Committed Control Measures

The overall approach taken in preparing the Eight-Hour Ozone Plan is to demonstrate attainment of the eight-hour ozone standard in 2008 with the committed measures in the One-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa County Nonattainment Area, approved by EPA on June 14, 2005. The photochemical grid modeling for the One-Hour Ozone Maintenance Plan, using UAM-IV, demonstrated maintenance of the one-hour ozone standard in 2006 and 2015.

The One-Hour Ozone Maintenance Plan relied upon control measures derived from a number of EPA-approved programs and plans for the Maricopa area, including the modified Arizona Cleaner Burning Gasoline Program, effective April 5, 2004; the Revised MAG 1999 Serious Area Carbon Monoxide Plan and Carbon Monoxide Redesignation Request and Maintenance Plan, effective April 8, 2005; and the Final Serious Area Ozone State Implementation Plan (SIP) for Maricopa County, effective June 14, 2005. The Eight-Hour Ozone Plan relies on these same committed control measures.

Although the one-hour ozone standard was revoked by EPA on June 15, 2005, all control measures in the One-Hour Ozone Maintenance Plan remain in effect as legally-binding commitments on the part of the State of Arizona, Maricopa County, and local governments. These permanent and enforceable measures will continue to reduce the volatile organic compounds (VOC) and nitrogen oxides (NOx) that contribute to the formation of ozone. Detailed descriptions of the committed control measures are contained in Chapter Eight of the Serious Area Carbon Monoxide Plan (fifty-five measures), Chapters Two and Three of the Carbon Monoxide Maintenance Plan, and Chapter Two of the Serious Area Ozone SIP.

In addition to measures in the EPA-approved plans, attainment of the eight-hour ozone standard will be facilitated by more stringent federal emissions standards for consumer products and light duty motor vehicles. Together, these federal measures and the legally-binding commitments in prior EPA-approved plans have been effective in reducing ozone in the MNA, as evidenced by the fact that there were no violations of the eight-hour standard in 2005 and 2006. These same control measures are expected to result in continued attainment of the eight-hour ozone standard in 2008 and beyond.

Descriptions of the committed control measures in the Eight-Hour Ozone Plan are organized into three groups below. The first group includes those measures for which numeric credit is assumed in the attainment demonstration. The combined emission reduction impact of this package of attainment measures is reflected in the 2008 modeling inventory described in Section V-3. The seven attainment measures listed in Table V-1 include: Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30; Phased-In Emission Test Cutpoints; One Time Waiver from Vehicle Emissions Test; Coordinate Traffic Signal Systems; Develop Intelligent Transportation Systems; Tougher Enforcement of Vehicle Registration and Emission Test Compliance; and Maricopa County Rule 358: Polystyrene Foam Operations.

Table V-1. Committed Attainment and Contingency Measures in the Eight-Hour Ozone Plan

Attainment Measures Used for Numeric Credit		Contingency Measures	
1.	Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30	1.	Expansion of Area A Boundaries (H.B. 2538)
2.	Phased-In Emission Test Cutpoints (I/M 147 Program)	2.	Gross Emitter Waiver Provision
3.	One Time Waiver from Vehicle Emissions Test	3.	Increased Waiver Repair Limit
4.	Coordinate Traffic Signal Systems	4.	Federal Heavy Duty Diesel Vehicle Emissions Standards
5.	Develop Intelligent Transportation Systems	5.	Federal Nonroad Equipment Emissions Standards
6.	Tougher Enforcement of Vehicle Registration and Emission Test Compliance		
7.	Maricopa County Rule 358: Polystyrene Foam Operations		

The second group of measures includes the contingency measures that are part of the Eight-Hour Ozone Plan. No emissions reduction credit was taken for these measures in the attainment demonstration and the impact of these measures is not reflected in the 2008 modeling inventory in Section V-3. The five contingency measures in Table V-1 include Expansion of Area A Boundaries (H.B. 2538); Gross Polluter Option for I/M Program Waivers; Increased Waiver Repair Limit Options; Federal Heavy Duty Diesel Vehicle Emissions Standards; and Federal Nonroad Equipment Emissions Standards. Descriptions of the contingency measures and the methodologies used to quantify credit for these measures are provided later in this section.

The third group of measures includes committed measures from the EPA approved Serious Area Carbon Monoxide Plan, Carbon Monoxide Redesignation Request and Maintenance Plan, and One-Hour Ozone Redesignation Request and Maintenance Plan which improve air quality that were not used for numeric credit in those approved plans. The reduction in carbon monoxide and ozone precursor emissions attributable to these measures was not easily quantified or may not have been possible to quantify. However, these committed measures may continue to reinforce the air quality benefits of the measures for which numeric credit towards attainment was taken.

V-2-1. Measures Used for Numeric Credit

In the Eight-Hour Ozone Plan, reductions in VOC and NOx emissions have been quantified for the same measures that were quantified for emissions reduction credit in the One-Hour Ozone Maintenance Plan, with one exception. In this case, Maricopa County Rule 348 has been assumed as part of the base case 2001 and 2002 VOC emissions, rather than as an attainment measure.

Figures V-1 and V-2 illustrate the reductions in VOC and NOx emissions, respectively, due to implementation of the committed attainment measures in the ozone 4 km modeling domain. Table V-2 quantifies the emission reductions from the individual measures in metric tons per day.

The base case 2008 emissions shown in Table V-2 were estimated by removing the attainment measure emissions on a Thursday in June 2008. Thursday is the day of the week during the June 2002 episode when the highest eight-hour ozone concentrations were measured, i.e., on June 6, 2002. A comparison of the base case and attainment measure package emissions by source category is provided in Table V-3. The attainment measures and the methodology used to quantify the emissions reduction credit are described below.

Descriptions of Individual Attainment Measures

1. *Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30*

   Arizona Legislature passed H.B. 2307 in 1997 which contains requirements for the sale of gasoline from and after May 1, 1999 in Area A, subject to an appropriate waiver granted under Section 211 (c)(4) of the Clean Air Act, that meets the following fuel reformulation options:

   - California Phase 2 Reformulated Gasoline, including alternative formulations allowed by the predictive model, as adopted by the California Air Resources Board pursuant to the California Code of Regulations, Title 13, Sections 2261 through 2262.7 and 2265, in effect on January 1, 1997, that meets the maximum 7.0 psi summertime vapor pressure requirements in A.R.S. Section 41-2083, Subsections D and F.

   - Gasoline that meets the standards for Federal Phase II Reformulated Gasoline, as provided in 40 CFR Section 80.41, paragraphs (a) through (h), in effect on January 1, 1997, that meets the maximum 7.0 psi summertime vapor pressure requirement in A.R.S. Section 41-2083 Subsections D and F.

Figure V-1. 2008 VOC emission reductions for individual attainment measures in the eight-hour ozone modeling domain (4 km).

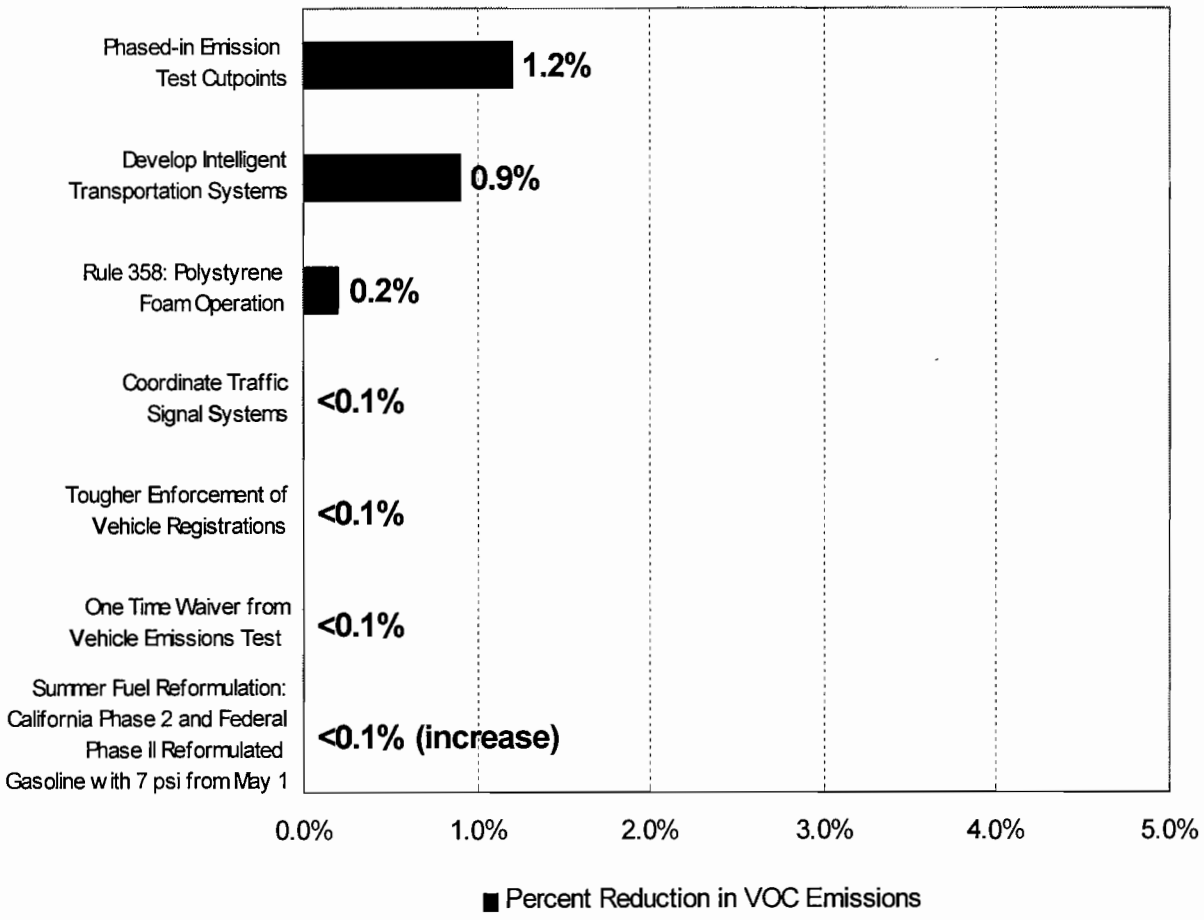


Figure V-2. 2008 NOx emission reductions from individual attainment measures in the eight-hour ozone modeling domain (4 km)

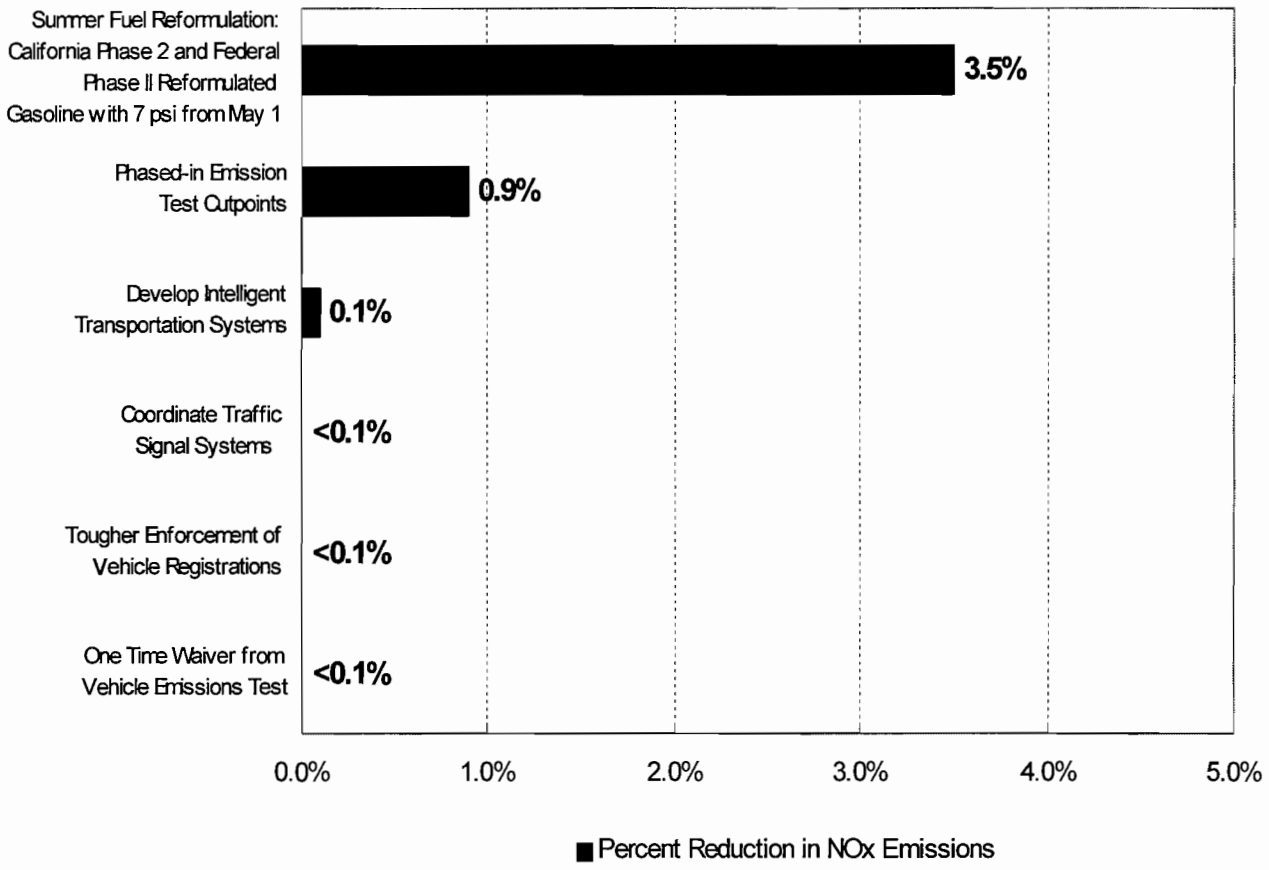


Table V-2. 2008 emission reductions in metric tons per day for committed attainment measures used for numeric credit

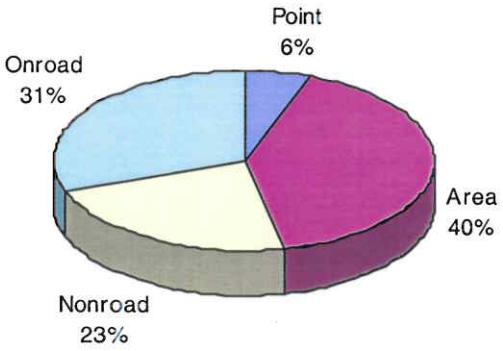
2008 Emission Reductions by Individual Measure for the Eight-Hour Ozone Modeling Domain (4 km)					
		VOC		NOx	
Total Base Case Anthropogenic Emissions on a Thursday in June 2008 (metric tons/day)		254.3		291.8	
	Attainment Measure	**Emission Reductions (metric tons/day)**	**Percent Reduction in Emissions**	**Emission Reductions (metric tons/day)**	**Percent Reduction in Emissions**
1.	Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30	0.1 (Increase)	< 0.1% (increase)	10.3	3.5%
2.	Phased-In Emission Test Cutpoints	3.1	1.2%	2.6	0.9%
3.	One Time Waiver from Vehicle Emissions Test	0.1	< 0.1%	< 0.1	< 0.1%
4.	Coordinate Traffic Signal Systems	< 0.1	< 0.1%	< 0.1	< 0.1%
5.	Develop Intelligent Transportation Systems	2.2	0.9%	0.4	0.1%
6.	Tougher Enforcement of Vehicle Registration and Emission Test Compliance	0.2	< 0.1%	0.1	< 0.1%
7.	Rule 358: Polystyrene Foam Operations	0.5	0.2%	N/A	N/A

Table V-3(a). Comparison of anthropogenic VOC emissions in 2008 for the base case and attainment measure package (AMP) in the eight-hour ozone modeling domain (4 km)

	Base Case Anthropogenic VOC Emissions on a Thursday in June 2008	Anthropogenic VOC Emissions with Attainment Measure Package (AMP) on a Thursday in June 2008	2008 AMP vs Base Case Anthropogenic VOC Emissions
Source Category	metric tons per day	metric tons per day	%
Point	14.0	13.5	-3.6
Area	105.0	105.0	0.0
Nonroad Mobile	57.5	57.5	0.0
Onroad Mobile	77.8	72.3	-7.1
Total	254.3	248.3	-2.4

Base Case Anthropogenic VOC on a Thursday in June 2008

Total: 254.3 metric tons



Anthropogenic VOC with AMP on a Thursday in June 2008

Total: 248.3 metric tons

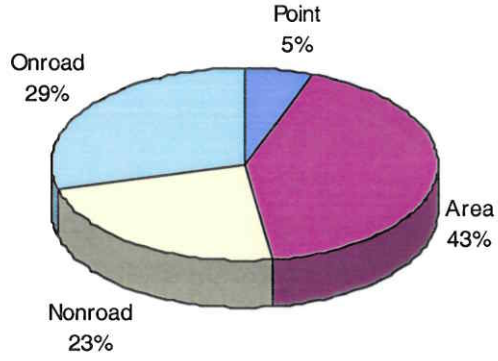
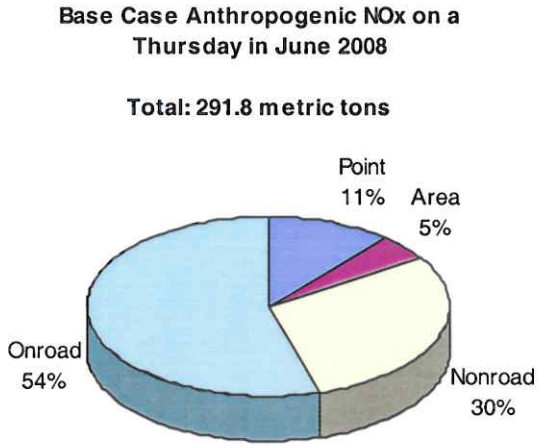
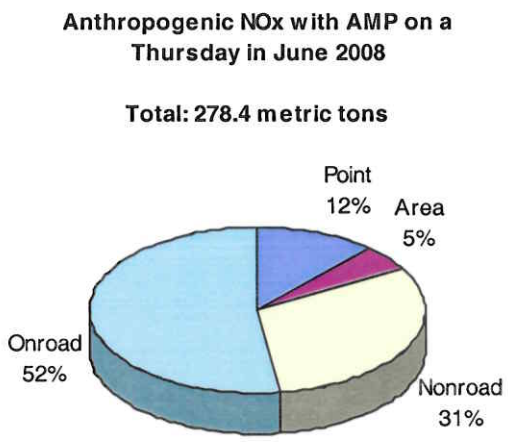


Table V-3(b). Comparison of anthropogenic NOx emissions in 2008 for the base case and attainment measure package (AMP) in the eight-hour ozone modeling domain (4 km)

	Base Case Anthropogenic NOx Emissions on a Thursday in June 2008	Anthropogenic NOx with Attainment Measure Package (AMP) on a Thursday in June 2008	2008 AMP vs. Base Case Anthropogenic NOx Emissions
Source Category	Metric Tons per Day	Metric Tons per Day	%
Point	32.8	32.8	0.0
Area	13.5	13.5	0.0
Nonroad Mobile	86.6	86.6	0.0
Onroad Mobile	158.9	145.5	-8.4
Total	291.8	278.4	-4.6





By September 15, 1997, the Director of the Arizona Department of Environmental Quality in consultation with the Director of the Weights and Measures, is required to adopt rules for the 1998 and 1999 fuel reformulation requirements.

House Bill 2307 also provides that if the Environmental Protection Agency fails to approve the sale and use of both reformulated gasolines, the Director of the Arizona Department of Environmental Quality will adopt standards by rule for one of the following fuels:

- A gasoline that meets standards for Federal Phase II Reformulated Gasoline, as provided in 40 C.F.R. Section 80.41, paragraphs (a) through (h) in effect on January 1, 1997, that meets the maximum vapor pressure requirements of A.R.S. Section 41-2083, Subsections D and F.

- California Phase 2 Reformulated Gasoline, including alternative formulations allowed by the predictive model, as adopted by the California Air Resources Board pursuant to the California Code of Regulations, Title 13, Sections 2261 through 2262.7 and 2265, in effect on January 1, 1997, that meets the maximum vapor pressure requirements of A.R.S. Section 41-2083, Subsections D and F.

On September 29, 2003, EPA published a notice of proposed approval on revisions to the Arizona Cleaner Burning Gasoline (CBG) program. On January 26, 2004, the EPA Administrator signed the final approval notice for the revisions to the Arizona Clean Burning Gasoline Program.

Modeling Methodology

This measure was modeled by the modification of MOBILE6.2 input files. MOBILE6.2 includes the option of setting a flag to one of four gasoline formulations, conventional gasoline east, reformulated gasoline, conventional gasoline west, and user-supplied gasoline sulfur levels. For the purposes of this analysis, the flag was set to reflect the reformulated gasoline described by this committed control measure. No specific credit was taken for reformulated gasoline on nonroad emissions as it is assumed that the very stringent nonroad engine standards include that the engines will use cleaner burning reformulated gasoline.

The reformulated gasoline was set to reflect the southern location of Arizona using the "S" option. Additionally, the locally required maximum RVP of 7.0 psi was input to the MOBILE6.2 model. The emissions reduction credit for this measure is applied exclusively to Area A (S.B. 1427).

The emission impacts attributable to this measure on a Thursday in June 2008 are a 0.1 metric ton per day increase in VOC and a 10.3 metric tons per day decrease in NOx. This is equivalent to an increase in total base case 2008 anthropogenic

emissions of less than 0.1 percent in VOC and a reduction of 3.5 percent in NOx.

2. *Phased-In Emission Test Cutpoints*

Arizona Legislature passed H.B. 2237 in 1997 which contains an appropriation of $120,000 from the State General Fund to the Arizona Department of Environmental Quality to develop and implement an alternative test protocol to reduce the false failure rates associated with the more stringent pass-fail standards for the Vehicle Emissions Testing Program (Section 19 of H.B. 2237).

In 1998, the Arizona Legislature passed S.B. 1427 which requires that vehicles in Area A and B be emissions tested. The vehicles subject to the Vehicle Emissions Inspection Program that have been included within the new boundaries of Area A are required to comply beginning from and after December 31, 1998. The newest five model year vehicles are exempted from the Vehicle Emissions Inspection Program on a rolling basis. Owners of these vehicles are required to pay an in lieu fee equivalent to the price of the test unless they choose to take and pay for an emissions test. The in lieu fees will be deposited into the Arizona Clean Air Fund. S.B. 1427 also allows the Vehicle Emissions Inspection contract to be extended for three additional years (A.R.S. 49-542, 49-543, 49-545 and Section 41 of S.B. 1427).

Modeling Methodology

The alternative protocol is anticipated to consist of a change from the previous I/M 240 test to a test consisting of dual composite tests where composite is the first phase of the traditional I/M 240 test.

This measure was modeled by modification of MOBILE6.2 input files. With the implementation of this measure, vehicles which are subject to the enhanced I/M program are held to the composite cutpoints than would otherwise be the case. The composite cutpoints were implemented in January 2000. If a vehicle exceeds the emissions of the cutpoint set for carbon monoxide, hydrocarbons, or NOx, the vehicle fails the test.

In 2008, model years 1980 and older are assumed to be subject to a basic I/M test. In 2008, model years 1996 and newer are expected to be subject to an on-board diagnostic test. For these reasons, it is assumed that the only model years affected by the phased-in cutpoints will be model years 1981 through 1995, when looking at a 2008 scenario. The committed attainment measure cutpoints input to the MOBILE6.2 model were derived from data provided by the Arizona Department of Environmental Quality.

The benefits of the measure were estimated by rerunning MOBILE6.2 and M6Link using data provided in an ADEQ memo [2] that reflects the composite cutpoints. The composite cutpoints were input to the MOBILE6.2 model as used in the I/M147

program. The emissions reduction credit for this measure is applied exclusively to Area A (S.B. 1427).

The emission reductions attributable to this measure on a Thursday in June 2008 are 3.1 metric tons per day of VOC and 2.6 metric tons per day of NOx. This is equivalent to a reduction in total base case 2008 anthropogenic emissions of 1.2 percent in VOC and 0.9 percent in NOx.

3. *One Time Waiver from Vehicle Emissions Test*

Arizona Legislature passed S.B. 1002 in 1996 which limits the issuance of a waiver for failure to comply with the emission testing requirements to one-time only beginning January 1, 1997.

Also, the Arizona Legislature passed House Bill 2237 in 1997 which requires the Arizona Department of Environmental Quality to submit a report on one-time vehicle waivers to the Governor, President of the Senate, and Speaker of the House of Representatives by September 30, 1997. The report is required to include: a description of the air quality benefits from the measure; recommendations on making the provision more effective, considering the impact on motorists; and recommendations on improving motorists access to the repair grant program.

Modeling Methodology

This measure was modeled by the modification of MOBILE6.2 input files. MOBILE6.2 does not have the option of limiting the number of waivers to a given number of years. However, MOBILE6.2 does have the option of changing the percentage of vehicles receiving waivers. MOBILE6.2 was run with an adjusted waiver percentage allowed in order to estimate the resulting decrease in onroad vehicle emission rates in 2008.

It is assumed that the average remaining vehicle life of a vehicle which has received a waiver is three years as estimated on page E-5 a 1993 Sierra Research report [6]. It is assumed that the base case run includes the three-year life after waiver implicitly through MOBILE6.2. This measure would effectively reduce that three-year life to one year, and result in approximately two thirds of the reductions of a change to zero waivers. The waiver rate, which was four percent for pre-81 model years and three percent for 1981 and later model years, was changed to one and one third percent and one percent, respectively. The credit for this measure is applied exclusively to Area A (S.B. 1427).

The emission reductions attributable to this measure on a Thursday in June 2008 are 0.1 metric tons per day of VOC and less than 0.1 metric tons per day of NOx. This is equivalent to a reduction in total base case 2008 anthropogenic emissions of less

than 0.1 percent of VOC and less than 0.1 percent of NOx.

4. *Coordinate Traffic Signal Systems*

House Bill 2237 contains an appropriation of $500,000 in each of fiscal years 1997-1998 and 1998-1999 from the state general fund to the Arizona Department of Transportation for distribution to cities and counties for synchronization of traffic control signals within and across jurisdictional boundaries (Section 23 of H.B. 2237).

In addition, cities and towns responded to measure 97-TC-8, Coordinate Traffic Signal Systems. The synchronization of existing signals, as well as the enhancement of coordination in signal systems which are already synchronized, has been identified by many jurisdictions through a number of programs. Enhancement efforts range from large scale programs covering broad geographic areas to incremental additions of a few synchronized signals to the network. This includes both individual city projects and regional level programs, such as AZ Tech which is noted under Develop Intelligent Transportation Systems below.

Modeling Methodology

Based on commitments from local governments, as well as the provision in H.B. 2237 for signal coordination, it is estimated that the coordination will be enhanced for approximately 151 signals in the carbon monoxide nonattainment area by the year 2008. This estimate is based upon both the commitments made by the jurisdictions and also the results of an analysis performed with GIS software.

This measure was modeled by modification of MOBILE6.2 input files and by emissions post-processing. The enhancement of traffic signal synchronization will reduce the idling time at traffic signals. The average vehicle emission rate at idle was estimated with the MOBILE6.2 model. The emission rate at idle was multiplied by the estimated reduction in idle time across the modeling domain due to the control measure. The resulting product was a total reduction in emissions in the modeling domain. This emission reduction was applied as an across-the-board reduction to the onroad emissions inventory. The emissions reduction credit for this measure is applied exclusively to Area A (S.B. 1427).

The emission reductions attributable to this measure on a Thursday in June 2008 are less than 0.1 metric tons per day of VOC and less than 0.1 metric tons per day of NOx. This is equivalent to a reduction in total base case 2008 anthropogenic emissions of less than 0.1 percent of VOC and less than 0.1 percent of NOx.

5. *Develop Intelligent Transportation Systems*

Nearly all of the local jurisdictions are planning and implementing advanced technology based solutions to address complex traffic management issues on the regional transportation network. These technologies involve the application of electronics, telecommunications and sensor technologies and are collectively referred to as Intelligent Transportation Systems (ITS).

Coordinate Traffic Signal Systems, Develop Intelligent Transportation Systems, and Reduce Traffic Congestion at Major Intersections are committed control measures in the MAG One-Hour Ozone Maintenance Plan. These measures reduce VOC and NOx emissions by increasing vehicle speeds and reducing congestion.

Modeling Methodology

The benefit of this measure was quantified for ITS projects in MAG Transportation Improvement Programs that were implemented with federal Congestion Mitigation and Air Quality Improvement (CMAQ) funds in FY 2003 through FY 2006. A summary of these projects and the attendant emission reduction benefits are provided in Appendix IV-iv. The methodology used in quantifying the benefits of the projects is documented in "*Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects,*" prepared by the Maricopa Association of Governments, August 15, 2005.

The mobile source emission reductions attributable to these FY 2003-2006 ITS projects on a Thursday in June 2008 are 2.2 metric tons per day of VOC and 0.4 metric tons per day of NOx. The reductions in anthropogenic emissions attributable to this attainment measure are 0.9 percent for VOC and 0.1 percent for NOx.

6. *Tougher Enforcement of Vehicle Registration and Emission Test Compliance*

Arizona Department of Transportation indicates that this measure would use additional methods to increase the registration compliance of residents. According to the December 1996 Report of the Governor's Air Quality Strategies Task Force, the Motor Vehicle Division (MVD) of the Arizona Department of Transportation (ADOT) has instituted a comprehensive enforcement program. Three key elements of the new program are a Registration Enforcement Team, a Registration Enforcement Tracking System, and a New Resident Tracking Program. Through public participation, consistent policy and procedure application, and new tracking methods, MVD will enforce the Arizona registration laws to ensure vehicles in question are registered properly. This will be an ongoing effort.

Another phase of the Program is an initiative to coordinate ADOT efforts with other law enforcement agencies to assist MVD personnel in enforcing registration compliance. Other initiatives include a system user agreement between MVD and the City Courts to utilize information in conjunction with registration compliance and

discussions with U.S. West for obtaining information relating to new connect customers.

The Registration Compliance Program began in January 1994 with one full time employee responding only to complaints. In April of 1996, this program was enhanced with five MVD officers periodically conducting a statewide effort locating and issuing warning notices on vehicles suspected of being in violation of Arizona registration laws. This effort resulted in a substantial increase in Vehicle Licenses Tax (VLT) for 1996. As the program continues, there will be an enhanced focus on the local vehicles not in compliance.

Administration of the program began with a required staff time equivalent to one full time employee. Currently, the required staff time is equivalent to eight full time employees. Additional staff requirements for the initial phase of the Registration Compliance Program will require a total of 12 full time (active) employees and one supervisor. The funding allocated for implementation of the Registration Compliance Program is included as part of the overall MVD budget.

Arizona Legislature passed S.B. 1427 in 1998 which requires school districts and special districts in Area A to prohibit parking in employee parking lots by employees who have not complied with emissions testing requirements. Cities, towns, and counties in Area A and Area B are currently subject to this provision (A.R.S. 49-552).

In 1999, the Arizona Legislature passed H.B. 2254 which requires each vehicle that is owned by the United States government and that is domiciled in this state for more than ninety consecutive days and each vehicle that is owned by a state or political subdivision of this state to comply with A.R.S. 49-542.

Collectively, the provisions in H.B. 2254 that apply to Tougher Enforcement of Vehicle Registration and Emissions Test Compliance include A.R.S. 49-557 and 49-541.01 D. and E.

Modeling Methodology

This measure was modeled by adjusting the weighting between I/M and non-I/M emission factors from MOBILE6.2. Consistent with the Revised CO Plan, the number of vehicles which participate in the I/M program was increased by 2.0 percent, changing the weighting from 89.6 for I/M and 10.4 for non-I/M to 91.6 and 8.4 respectively. It was assumed that the increased compliance rate will carry forward to future years through continued enforcement. The weighting of I/M versus non-I/M vehicles is applied as an input to the M6Link program.

The emissions reduction attributable to this measure on a Thursday in June 2008 is 0.2 metric tons per day of VOC and 0.1 metric tons per day of NOx. This is equivalent to a reduction in total base case 2008 anthropogenic emissions of less than 0.1 percent of VOC and less than 0.1 percent of NOx.

7. *Maricopa County Rule 358: Polystyrene Foam Operations*

Maricopa County adopted Rule 358 on April 20, 2005. This rule limits the emissions of volatile organic compounds from the manufacturing of expanded-polystyrene products. The Rule applies to any facility that expands, ages, or molds expandable polystyrene.

Modeling Methodology

According to information provided by the Maricopa County Air Quality Department, VOC emissions produced by sources controlled under Rule 358 are reduced by applying an 80% control efficiency and an 80% rule effectiveness.

The resultant VOC emissions reduction attributable to this measure on a Thursday in June 2008 is 0.5 metric tons per day. This is equivalent to a reduction in total base case 2008 anthropogenic emissions of 0.2 percent of VOC. This measure has no impact on 2008 NOx emissions.

V-2-2. Measures Included in the Contingency Plan

Five control measures are contingency measures in the Eight-Hour Ozone Plan. Table V-4 quantifies emission reductions from the individual contingency measures in metric tons per day. The benefits of the contingency measures are compared with the base case emissions on June 6, 2002. The total reduction in emissions attributable to the contingency measures are 15.9 metric tons per day of VOC and 18.8 metric tons per day of NOx. These reductions are equivalent to a 2.3 percent reduction in 2002 base case VOC emissions and a 6.4 percent reduction in 2002 base case NOx emissions.

All of these contingency measures have already been implemented. Early implementation of contingency measures is allowed by EPA [7] and helps to ensure that the standard will be attained as quickly as possible. EPA also allows the use of federal measures as contingency measures, if credit for these measures is not taken in the attainment demonstration. The Eight-Hour Ozone Plan discusses procedures that will be followed to consider and implement additional contingency measures, if they are needed.

Table V-4. Emission reductions in metric tons per day for contingency measures

Emission Reductions by Individual Contingency Measure for the Eight-Hour Ozone Modeling Domain (4 km)				
	VOC		NOx	
Total Base Case Emissions on June 6, 2002 (metric tons/day)	696.1		291.8	
Contingency Measure	**Emission Reductions (metric tons/day)**	**Percent Reduction in Emissions**	**Emission Reductions (metric tons/day)**	**Percent Reduction in Emissions**
1. Expansion of Area A Boundaries (H.B. 2538)	1.3	0.2%	0.7	0.2%
2. Gross Polluter Option for I/M Program Waivers	<0.1	<0.1%	<0.1	<0.1%
3. Increased Waiver Repair Limit Options	<0.1	<0.1%	<0.1	<0.1%
4. Federal Heavy Duty Diesel Vehicle Standards	<0.1	<0.1%	2.5	0.9%
5. Federal Nonroad Equipment Standards	14.6	2.1%	15.6	5.3%
Total Emission Reductions due to Contingency Measures	15.9	2.3%	18.8	6.4%

Figure V-3a. VOC emission reductions from individual contingency measures in the eight-hour ozone modeling domain (4 km)

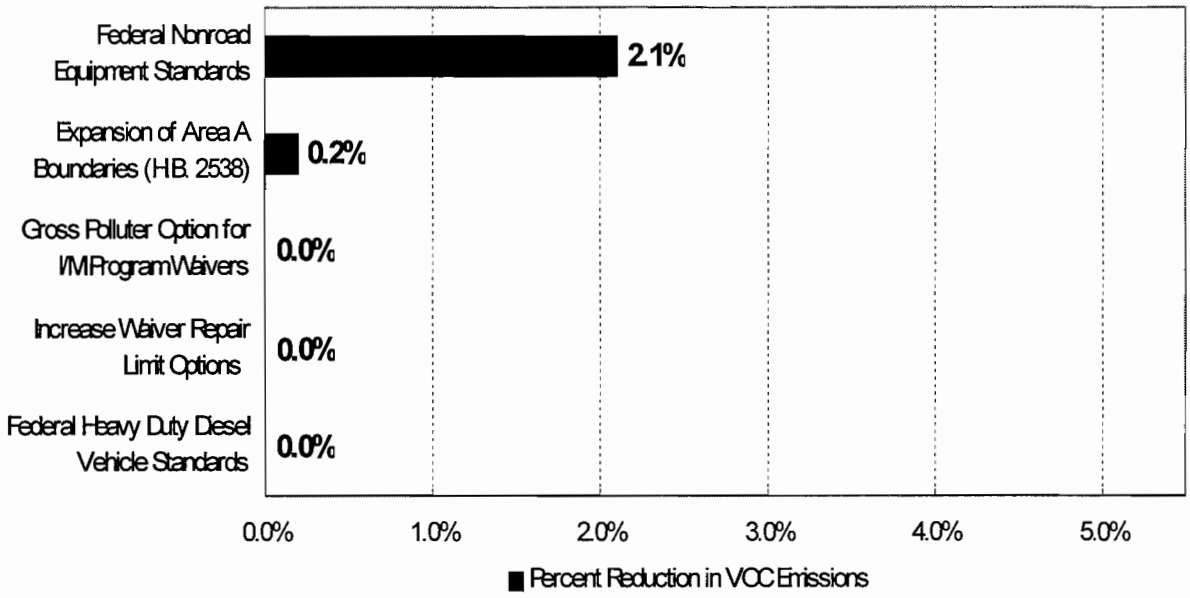
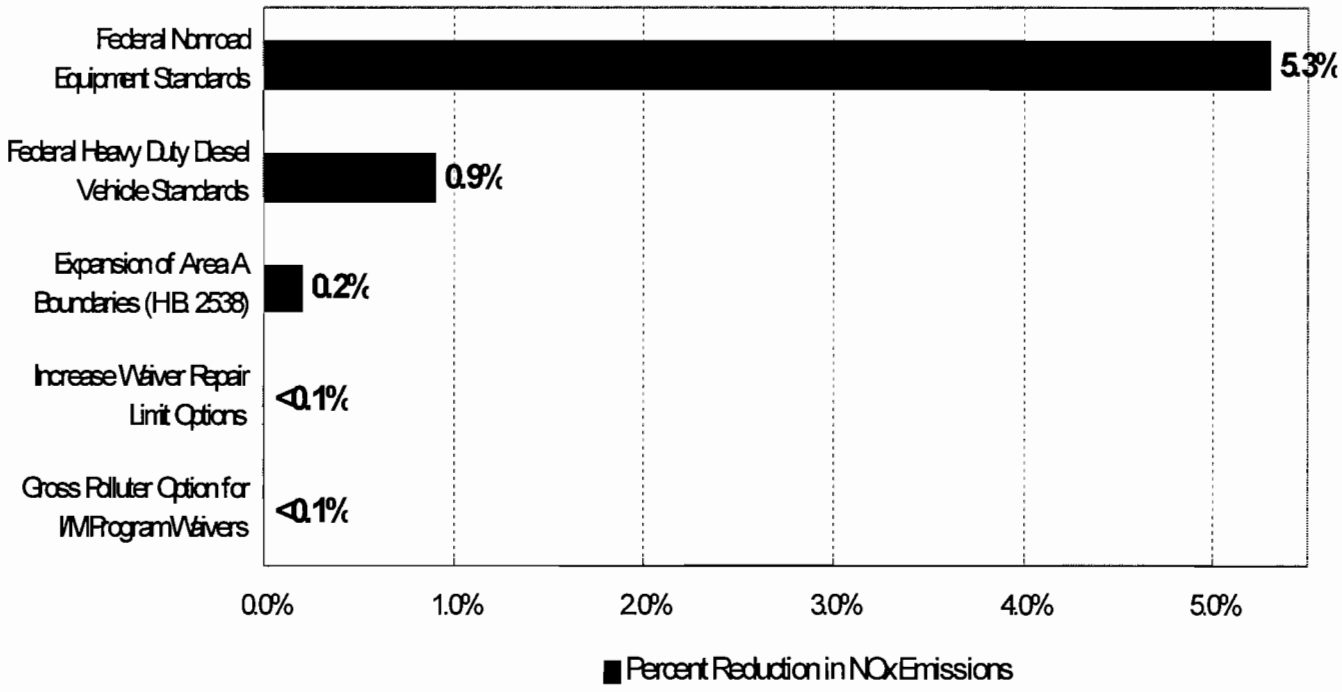


Figure V-3b. NOx emission reductions from individual contingency measures in the eight-hour ozone modeling domain (4 km)



Descriptions of Individual Contingency Measures

1. *Expansion of Area A Boundaries*

Arizona Legislature passed H.B. 2538 in 2001 which expands the boundaries of Area A. Previously, the Area A boundaries followed the boundaries defined by S.B. 1427, which was passed by the Arizona Legislature in 1998. Specifically, H.B. 2538 expands the boundaries of Area A past those described in S.B. 1427 adding additional portions of Maricopa County west of Goodyear and Peoria and a small piece of land on the north side of Lake Pleasant. The implementation of air quality measures in the areas described in H.B. 2538 began on January 1, 2002, except for public sector alternative fuel requirements that are phased in over a seven year period.

"Area A" means the area delineated as follows:

(a) In Maricopa County:
Township 8 North, Range 2 East and Range 3 East
Township 7 North, Range 2 West Through Range 5 East
Township 6 North, Range 5 West Through Range 6 East
Township 5 North, Range 5 West Through Range 7 East
Township 4 North, Range 5 West Through Range 8 East
Township 3 North, Range 5 West Through Range 8 East
Township 2 North, Range 5 West Through Range 8 East
Township 1 North, Range 5 West Through Range 7 East
Township 1 South, Range 5 West Through Range 7 East
Township 2 South, Range 5 West Through Range 7 East
Township 3 South, Range 5 West Through Range 1 East
Township 4 South, Range 5 West Through Range 1 East

(b) In Pinal County:
Township 1 North, Range 8 East And Range 9 East
Township 1 South, Range 8 East And Range 9 East
Township 2 South, Range 8 East And Range 9 East
Township 3 South, Range 7 East Through Range 9 East

(c) In Yavapai County:
Township 7 North, Range 1 East And Range 1 West Through Range 2 West
Township 6 North, Range 1 East And Range 1 West

It is important to note that under A.R.S. 49-406 (A), MAG has statutory authority to conduct nonattainment area planning within Maricopa County. However, MAG does not have air quality planning authority for either Pinal or Yavapai Counties.

Under A.R.S. 49-406 (K), the Arizona Department of Environmental Quality has air quality planning authority to adopt SIP measures in those portions of Area A in Pinal

and Yavapai Counties where MAG does not have authority. For ozone, the committed measures include the Vehicle Emissions Inspection Program, Clean Burning Gasoline Program, Stage II Vapor Recovery Program, Trip Reduction Program, Voluntary Vehicle Repair and Retrofit Program, and Traffic Signal Synchronization. For carbon monoxide, the committed measures include the Vehicle Emissions Inspection Program, Clean Burning Gasoline Program, Trip Reduction Program, Clean Burning Fireplace Construction and Conversion Program, No Burn Days and Public Participation Programs, Voluntary Vehicle Repair and Retrofit Program. MAG anticipates that ADEQ will also provide notice and public hearing on this plan, perhaps jointly with MAG, prior to ADEQ's adoption of the plan under A.R.S section 49-404 and ADEQ's subsequent submittal of the plan to EPA for approval. Upon EPA approval of the submitted plan, the contingency provisions will become an enforceable part of the Arizona SIP, which means that implementation of the specific measures included within "Expansion of Area A Boundaries" can be enforced by EPA or citizens under the Clean Air Act (once the triggering event occurs), including those specific measures that relate to actions to be taken outside of the nonattainment area. Emission reduction credit for this measure applies only to the area between the Area A boundary established by S.B. 1427 and the Area A boundary established by H.B. 2538.

Modeling Methodology

This measure was modeled by adjusting the weighting between I/M and non-I/M emission factors from MOBILE6.2. MAG estimates that an additional 48,000 people will reside in the expanded section of Area A in 2008. The vehicles registered to these people will be required to participate in the I/M program. The ratio of the number of registered vehicles (ADOT 1/25/07 data) to the number of residents in the county (MAG 2005 data) was one vehicle for every 1.28 people in the county. Assuming that this ratio is accurate for all areas of Maricopa County, it is assumed that approximately 37,400 additional vehicles will be registered in 2008 for the expanded section of Area A.

An increase of 37,400 vehicles participating in the I/M program is anticipated to increase the weighting of I/M vehicles by approximately 1.3 percent. The number of vehicles which participate in the I/M program was increased by 1.3 percent, changing the weighting ratio from 89.6/10.4 to 90.9/9.1. It is important to note that not all vehicles participating in the I/M program are subject to an I/M test because of age or vehicle type.

The emissions reduction attributable to this contingency measure on June 6, 2002 is 1.3 metric tons per day of VOC and 0.7 metric tons per day of NOx. This is equivalent to a reduction in total base case 2002 emissions of 0.2 percent for both VOC and NOx.

2. *Gross Polluter Option for I/M Program Waivers*

Arizona Legislature passed S.B. 1427 in 1998 which requires that in order to obtain a waiver from compliance with the Vehicle Emissions Inspection Program, the owner of a vehicle emitting more than twice the emission standard has to repair the vehicle sufficiently to reduce the emission levels to less than twice the standard (A.R.S. 49-542).

Modeling Methodology

The modeling analysis for this measure was based on the methodology provided by the Arizona Department of Environmental Quality (ADEQ memo to Alan Kosecki, June 11, 1998). The number of vehicles of each age that received a waiver and whose tested emissions were twice the emission cutpoints (gross emitters) was estimated. The number of gross emitters was multiplied by an age-specific estimate of the number of miles a vehicle travels in a day. The product of these two estimates is the number of miles per day driven by gross emitters of each age. The difference in emission rates, for each vehicle age, between gross emitters and double the I/M cutpoints was estimated. This emission rate difference was multiplied by the estimated number of miles per day driven by gross emitters of each age to estimate the emissions reduction achieved by repairing the gross emitters to emit at a level less than twice the standard before they are eligible for a waiver. This methodology may result in a conservative estimate of the benefits since some vehicles will be repaired to cleaner than twice the emission standard.

The emissions reduction attributable to this contingency measure on June 6, 2002 is less than 0.1 metric tons per day of VOC and less than 0.1 metric tons per day of NOx. This is equivalent to a reduction in total base case 2002 emissions of less than 0.1 percent for both VOC and NOx.

3. *Increased Waiver Repair Limit Options*

Arizona Legislature passed S.B. 1427 in 1998 which increases the amount a person must spend to repair a failing 1967-1974 vehicle in Area A to qualify for a waiver. The increased amount is $200 rather than the previous $100 (A.R.S. 49-542).

Modeling Methodology

This measure was modeled by MOBILE6.2 and M6Link. To estimate the effect of raising the waiver limit to $200 from $100, it was assumed that the base case pre-81 vehicle waiver rate is reduced from 4 percent to 2.6 percent. This estimate is based on repair cost distribution data from the Vehicle Emissions Inspection Program. Emissions reductions for this contingency measure were estimated by comparing on-road mobile emissions modeled for 4 percent and 2.6 percent of I/M waiver rates for pre-81 model year vehicles.

The emissions reduction attributable to this contingency measure on June 6, 2002 is less than 0.1 metric tons per day of VOC and less than 0.1 metric tons per day of

NOx. This is equivalent to a reduction in total base case 2002 emissions of less than 0.1 percent for both VOC and NOx.

4. *Federal Heavy Duty Diesel Vehicle Emissions Standards*

In 2001 EPA issued a final rule setting more stringent emission standards for new heavy duty diesel vehicles (EPA, Federal Register, Vol. 66, No. 12, January 18, 2001, pp. 5001-5193). The rule requires that high-efficiency catalytic converters or comparably effective technologies be installed on 2007 and later model year diesel vehicles. Because these devices are damaged by sulfur, the rule also mandates that ultra-low sulfur (i.e., 15 ppm) diesel fuel be used in all onroad diesel vehicles beginning in 2006. The requirement for all onroad diesel vehicles to use ultra-low sulfur fuel went into effect nationwide on October 15, 2006.

Modeling Methodology

As described in Section V-3-1, the attainment demonstration for 2008 used the MOBILE6.2 model with the "NO 2007 HDDV RULE" command. This contingency measure was modeled by comparing the MOBILE 6.2 emissions with and without the "NO 2007 HDDV RULE" command. The difference in emissions represents the benefit of the heavy duty diesel vehicle standards and use of ultra-low sulfur fuels in 2008.

The emissions reduction attributable to this contingency measure on June 6, 2002 is less than 0.1 metric tons per day of VOC and 2.5 metric tons per day of NOx. This is equivalent to a reduction in total base case 2002 emissions of less than 0.1 percent of VOC and 0.9 percent of NOx.

5. *Federal Nonroad Equipment Emissions Standards*

In 1998 EPA issued a final rule setting more stringent Tier 2 and Tier 3 emission standards for new diesel nonroad equipment (EPA, Federal Register, Vol. 63. No. 205, October 23, 1998, pp. 56967-57023). The Tier 2 program phased in more stringent standards for all equipment between 2001 and 2006 and Tier 3 imposed even more stringent standards for 50 to 750 hp engines beginning in 2006 through 2008.

In 2004 EPA issued the Clean Air Nonroad Diesel - Tier 4 Final Rule that requires manufacturers to produce nonroad engines with advanced emission-control technologies that will reduce emissions by more than 90 percent (EPA, Federal Register, Vol 69, No. 124, June 29, 2004, pp. 38958-39273). The Tier 4 standards apply to nonroad engines less than 25 hp, beginning in 2008. Larger engines must comply with the Tier 4 standards by 2011-2015.

Modeling Methodology

This measure was modeled by running the EPA NONROAD model for 2002 using the 2008 equipment growth factors and comparing this with a 2008 run using the 2008 growth factors. The decrease in emissions between 2008 and 2002 represents the impact of the more stringent federal nonroad diesel equipment standards implemented between 2002 and 2008.

The emissions reduction attributable to this contingency measure on June 6, 2002 is 14.6 metric tons per day of VOC and 15.6 metric tons per day of NOx. This is equivalent to a reduction in total base case 2002 emissions of 2.1 percent of VOC and 5.3 percent of NOx.

V-2-3. Measures That Improve Air Quality, Which Were Not Used for Numeric Credit

The third group of measures includes committed measures from the EPA approved Serious Area Carbon Monoxide Plan, Carbon Monoxide Redesignation Request and Maintenance Plan, and One-Hour Ozone Redesignation Request and Maintenance Plan which improve air quality that were not used for numeric credit in those approved plans. The reduction in carbon monoxide and ozone precursor emissions attributable to these measures was not easily quantified or may not have been possible to quantify. However, these committed measures may continue to reinforce the air quality benefits of the measures for which numeric credit towards attainment was taken.

V-3. Future Year Emission Inventories

This section summarizes the development of the 2008 VOC and NOx emission inventories for use in the Comprehensive Air quality Model with Extensions (CAMx). The Emissions Preprocessor System (EPS3.0) [5] was used to process the emission inventories including point, area, aviation, and other nonroad mobile sources. The onroad mobile emissions were generated by the EPA MOBILE6.2 model and M6Link. M6Link is a MAG software program applied at the transportation link level to generate gridded mobile source emissions. All onroad mobile and background emissions were merged by EPS3.0 to be ready for input to CAMx.

The base year modeling inventory was adjusted to reflect emissions expected to occur in 2008. The general methodology for creating the future year emission inventories was based on the EPA guidance on the preparation of emission projections [8]. This adjustment entailed the use of growth factors, ongoing control programs, and retirement rates for obsolete sources of emissions. The resulting 2008 modeling inventories represent the attainment measure package for VOC and NOx emissions.

The impact of individual attainment measures was derived by removing the attainment measures from the 2008 inventory. The growth factors used for the 2008 inventory reflected draft interim county population and employment forecasts prepared by the

Maricopa Association of Governments based on the 2000 Census. The 2008 emission inventory includes projected emission reductions resulting from committed control measures as described in Section V-2-1. The 2008 inventory does not take credit for the emission reductions attributable to the contingency measures.

The anthropogenic emissions for all episodes in 2008 were grown additionally by three percent to reflect an expected increase in population and employment projections for the modeling domain based on the 2005 census. This increase was applied by the EPS3.0 MRGUAM module.

In addition, the Transwestern Pipeline Company is proposing a Phoenix Expansion Project to construct pipeline and ancillary facilities to provide capacity for the transport of natural gas to delivery points in the Phoenix area. Transwestern provided MAG with emission estimates of 0.09 tons per day of VOC and 1.35 tons per day of NOx for the Phoenix Expansion Project. The nonroad construction-related emissions for the project were added to the 2008 area source emissions inventory. The emissions were spatially allocated to grid cells based upon the anticipated alignment of the pipeline through the eight-hour ozone modeling domain.

V-3-1. Onroad Mobile Source Emissions

In this ozone attainment demonstration, the onroad mobile vehicle emission factors for the years 2008 were obtained from the EPA MOBILE6.2 model. Appendix IV-i presents a detailed description of the emission factor estimation procedure for 2008. Modeling methodologies for the control measures are given in Section V-2-1. A detailed overview of the MOBILE6.2 and M6Link models can be found in Section III-1-1 of this document.

The 2008 inventory reflects the impact of the attainment measures used for numeric credit, as documented in Section V-2-1. This section presents a brief description of how the onroad mobile source measures in the attainment package were quantified for 2008. Onroad mobile source emissions were adjusted to reflect these measures via the following steps:

- MOBILE6.2 was run for both the I/M and non-I/M cases. In the case of the MOBILE6.2 runs reflecting the I/M program, one input to the MOBILE6.2 model is a fraction of tested vehicles that receive waivers from the I/M program. The committed attainment measure One-Time Waiver from Vehicle Emissions Test was modeled by changing the base case waiver rates to reflect the effect of this measure.

- The output from MOBILE6.2 runs from the I/M case versus the non-I/M case are weighted in the M6Link program. The weighting fractions of 91.6 percent I/M and 8.4 percent non-I/M were used to reflect the implementation of the control measure Tougher Enforcement of Vehicle Registration and Emission Test Compliance.

- MOBILE6.2 runs for both the I/M and non-I/M case accept as input data the properties of the gasoline used by vehicles in the modeling area to quantify the

effects of the control measure Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30, the gasoline properties were changed from the actual fuel properties in 2001 and 2002 to expected future fuel properties based upon this control measure.

- MOBILE6.2 runs for the I/M scenario include as input data the nature of the I/M program itself. In the case of enhanced I/M programs, these data include the emission levels allowed by the program (cutpoints) before a vehicle is failed for excessive emissions. The benefits from the control measure Phased-In Emission Test Cutpoints were approximated by inputting I/M147 cutpoints into the MOBILE6.2 model. Additionally, the assumptions include the use of an on-board diagnostic (OBD) test for all 1996 and newer vehicles with an exemption from testing for vehicles of the current year and, the four most recent model years older than the current year.

- The emission reduction impacts of the control measure Coordinate Traffic Signal Systems was calculated using MOBILE6.2 emission factors with new idling assumptions and speeds. The change in total emissions expected from this measure was calculated using spreadsheet calculations incorporating the MOBILE6.2 emission factors, rather than through a full M6Link run.

- The emission reduction impacts of the control measure Develop Intelligent Transportation Systems represent the total air quality benefits of ITS projects that were implemented with federal Congestion Mitigation and Air Quality Improvement (CMAQ) funds in FY 2003-2006. These projects must show emission reduction benefits in order to be eligible for CMAQ funding. The emission reductions for each of these projects were calculated based on the *Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects*, Maricopa Association of Governments, August 15, 2005. The calculations were performed in spreadsheets and were reported to the Federal Highway Administration in the FY 2003-FY2006 annual CMAQ reports.

- The onroad mobile source emission factors for the 2008 attainment demonstration were derived from MOBILE6.2 with the "NO 2007 HDDV RULE" command invoked. The EPA standards implemented for 2007 model year heavy duty diesel vehicles and the impact of the low sulfur fuels that went into effect in 2006 were modeled as a contingency measure in this Plan.

- The onroad mobile source emission factors for the Stage II program were derived from MOBILE6.2 with the "Stage II Refueling Program". The program started in 1994 and phased in over one year. The efficiency of 80.77 percent was assumed for LDGVs, LDGTs and HDGVs.

V-3-2. Biogenic Emissions

The MEGAN program creates an EPS3.0 ready gridded emissions file. The program calculates the emissions based on the MM5 generated meteorological data and vegetation characteristics such as monthly leaf area index (LAI), plant function type (PFT), and

emission factors. Gridded solar radiation, temperature, wind speed, humidity, and soil moisture are produced by MM5. The same biogenic emissions estimated for the August episode of 2001 and June and July episodes of 2002 were assumed for the August, June and July episodes of 2008. Tables V-5, V-6, and V-7 summarize the biogenic emissions by species and day for the June, July, and August episodes of 2008, respectively, for the eight-hour ozone 4 km modeling domain.

Table V-5. Summary of the June 2008 modeling domain biogenic emissions.

Date	Biogenic Emissions (metric tons/day)	
	NOx	VOC
May 31, 2008 (Friday)	8.4	451.4
June 1, 2008 (Saturday)	7.8	407.4
June 2, 2008 (Sunday)	6.8	332.3
June 3, 2008 (Monday)	6.2	286.5
June 4, 2008 (Tuesday)	6.5	303.7
June 5, 2008 (Wednesday)	7.4	374.5
June 6, 2008 (Thursday)	8.6	451.3
June 7, 2008 (Friday)	8.1	435.7

Table V-6. Summary of the July 2008 modeling domain biogenic emissions.

Date	Biogenic Emissions (metric tons/day)	
	NOx	VOC
July 5, 2008 (Friday)	10.0	566.0
July 6, 2008 (Saturday)	10.6	610.9
July 7, 2008 (Sunday)	10.9	628.1
July 8, 2008 (Monday)	11.9	651.1
July 9, 2008 (Tuesday)	11.9	639.9
July 10, 2008 (Wednesday)	10.5	522.2
July 11, 2008 (Thursday)	11.2	549.4
July 12, 2008 (Friday)	11.5	541.9
July 13, 2008 (Saturday)	11.4	589.9
July 14, 2008 (Sunday)	8.9	388.0

Table V-7. Summary of the August 2008 modeling domain biogenic emissions.

Date	Daily Emission (metric tons/day)	
	NOx	VOC
August 2, 2008 (Thursday)	9.5	394.1
August 3, 2008 (Friday)	9.2	324.5
August 4, 2008 (Saturday)	8.9	271.5
August 5, 2008 (Sunday)	9.8	437.5
August 6, 2008 (Monday)	10.9	513.7
August 7, 2008 (Tuesday)	10.0	362.3
August 8, 2008 (Wednesday)	9.4	390.7
August 9, 2008 (Thursday)	8.3	271.5
August 10, 2008 (Friday)	9.6	398.4
August 11, 2008 (Saturday)	10.3	440.6

V-3-3. Nonroad Mobile Source Emissions

Maricopa County specific temperature and fuel-related inputs were used to generate 2008 nonroad emissions with the EPA NONROAD model. Table V-8 provides the temperature and fuel-related inputs. Summer season inputs were calculated by averaging the June, July, and August data.

With the exception of aircraft emissions, Arizona-specific equipment populations developed for the Western Regional Air Partnership (WRAP) were applied in the EPA NONROAD2002 model to estimate 2001 and 2002 nonroad emissions. These emissions are consistent with the 2002 Maricopa County Periodic Emissions Inventory for Ozone Precursors (MCESD, 2004). The NONROAD model was run for the year 2002 with 2008 growth factors in order to develop 2002 emission factors to apply to projected 2008 equipment populations. This had the effect of removing the benefit of the federal Tier 2, Tier 3, and Tier 4 nonroad equipment programs between 2002 and 2008. Credit for these federal programs was taken as a contingency measure.

Table V-9 lists the growth factors by nonroad categories for 2008, relative to the base year of 1996 in the NONROAD2002 model. Table V-14 provides a summary of the nonroad

emissions by category for Maricopa County in 2008.

Table V-8. Maricopa County temperature and fuel-related inputs to the NONROAD2002 model

Month	Temperature (F) Maximum	Minimum	Average	Fuel RVP (psi)	Diesel Sulfur (ppm)	Gasoline Sulfur (ppm)
May	109	60	82.7	7	299	43
June	114	71	90.4	7	286	84
July	116	79	97.3	6	260	45
August	113	72	92.2	7	287	40

Table V-9. Growth factors for nonroad equipment populations

NONROAD Category	2008/1996 Growth Factor
Construction & Mining Equipment	1.201
Agricultural Equipment	1.333
Industrial Equipment	1.459
Lawn and Garden Equipment	1.243
Commercial Equipment	1.459
Logging Equipment	0.547
Railroad Equipment	0.831
Recreational Equipment	1.243
Oil Field Equipment	0.895

V-3-3-1. Aviation Emissions

The MAG Aviation Emissions Preprocessor was initially designed to model aviation-related emissions for 1995. In order to develop emission estimates for the future year modeled in this analysis (2008), total operations by airport from 1995 to 2000 and 2005 from the Regional Aviation System Plan [3] and FAA [4], respectively, were considered. The 2008 aircraft operations were calculated by extrapolating the above operations data. The growth factors for general aviation were calculated by using total operations ratios by airport from 2000 to 2008. The same ratios were used to grow the ground service equipment activity levels (towered airports) in Maricopa County. The calculated growth factors are provided in Table V-10. A more comprehensive description of the growth factors may be found in Appendix V. Tables V-11 through V-13 provide a summary of the aviation-related emissions by airport for the ozone modeling domain in 2008.

Table V-10. Aviation-related growth factors (Year 2008/2000)

Airport	General Aviation	Commercial	Military	GSE
Buckeye	1.08	1.00	1.00	
Chandler	1.88	1.00	1.00	2.26
Estrella	1.00	1.00	1.00	
Gila Bend	0.51	1.00	1.00	
Glendale	2.18	1.00	1.00	2.26
Memorial	5.08	1.00	1.00	
Mesa Falcon Field	1.47	1.00	1.00	
Phoenix - Deer Valley	1.19	1.00	1.00	2.08
Phoenix - Goodyear	1.72	1.00	1.00	2.08
Phoenix-Sky Harbor	0.97	1.00	1.00	0.82
Pleasant Valley	1.59	1.00	1.00	
Scottsdale	2.27	1.00	1.00	2.52
Sky Ranch Carefree	0.82	1.00	1.00	
Stellar	0.73	1.00	1.00	
Wickenburg	0.84	1.00	1.00	
Williams	1.43	1.00	1.00	1.18

Table V-11. Thursday in June 2008 summary of the aviation-related emissions (metric tons/day) by airport for Maricopa County

Airport	Aircraft		GSE		Refueling	Fuel Storage	Total	
	VOC	NOx	VOC	NOx	VOC	VOC	VOC	NOx
Buckeye	0.0236	0.0040	0.0001	0.0000	0.0001	0.0020	0.0286	0.0045
Chandler	0.0653	0.0111	0.0006	0.0072	0.0006	0.0095	0.0359	0.0158
Estrella	0.0043	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Glendale	0.0296	0.0050	0.0004	0.0058	0.0004	0.0061	0.0454	0.0180
Memorial	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0042	0.0007
Mesa Falcon Field	0.0720	0.0122	0.0011	0.0115	0.0012	0.0168	0.1642	0.0450
Deer Valley	0.0971	0.0165	0.0006	0.0006	0.0006	0.0086	0.1949	0.0325
Goodyear	0.0373	0.0063	0.0015	0.0311	0.0015	0.0220	0.1294	0.0753
Sky Harbor	0.5777	4.7918	0.4202	1.1815	0.4201	6.3430	7.6674	7.1332
Pleasant Valley	0.0134	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Scottsdale	0.0538	0.0091	0.0057	0.0139	0.0057	0.0859	0.2385	0.0610
Sky Ranch	0.0012	0.0002	0.0001	0.0000	0.0001	0.0009	0.0022	0.0002
Carefree								
Stellar Airpark	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0063	0.0011
Williams Gateway	0.0409	0.0070	0.0032	0.0427	0.0032	0.0486	0.1085	0.0509

Table V-12. Tuesday in July 2008 summary of the aviation-related emissions (metric tons/day) by airport for Maricopa County

Airport	Aircraft		GSE		Refueling	Fuel Storage	Total	
	VOC	NOx	VOC	NOx	VOC	VOC	VOC	NOx
Buckeye	0.0236	0.0040	0.0001	0.0000	0.0020	0.0020	0.0286	0.0045
Chandler	0.0653	0.0111	0.0006	0.0072	0.0095	0.0095	0.0359	0.0158
Estrella	0.0043	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Glendale	0.0296	0.0050	0.0004	0.0058	0.0061	0.0061	0.0454	0.0180
Memorial	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0042	0.0007
Mesa Falcon Field	0.0720	0.0122	0.0011	0.0115	0.0168	0.0168	0.1642	0.0450
Deer Valley	0.0971	0.0165	0.0006	0.0006	0.0086	0.0086	0.1949	0.0325
Goodyear	0.0373	0.0063	0.0015	0.0311	0.0220	0.0220	0.1294	0.0753
Sky Harbor	0.5777	4.7918	0.4202	1.1815	6.3430	6.3430	7.6464	5.7489
Pleasant Valley	0.0134	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Scottsdale	0.0538	0.0091	0.0057	0.0139	0.0859	0.0859	0.2385	0.0610
Sky Ranch	0.0012	0.0002	0.0001	0.0000	0.0009	0.0009	0.0022	0.0002
Carefree								
Stellar Airpark	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0063	0.0011
Williams Gateway	0.0409	0.0070	0.0032	0.0427	0.0486	0.0486	0.1085	0.0509

Table V-13. Friday in August 2008 summary of the aviation-related emissions (metric tons/day) by airport for Maricopa County

Airport	Aircraft		GSE		Refueling	Fuel Storage	Total	
	VOC	NOx	VOC	NOx	VOC	VOC	VOC	NOx
Buckeye	0.0236	0.0040	0.0001	0.0000	0.0001	0.0020	0.0286	0.0045
Chandler	0.0653	0.0111	0.0006	0.0072	0.0006	0.0095	0.0359	0.0158
Estrella	0.0043	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Glendale	0.0296	0.0050	0.0004	0.0058	0.0004	0.0061	0.0454	0.0180
Memorial	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0042	0.0007
Mesa Falcon Field	0.0720	0.0122	0.0011	0.0115	0.0012	0.0168	0.1642	0.0450
Deer Valley	0.0971	0.0165	0.0006	0.0006	0.0006	0.0086	0.1949	0.0325
Goodyear	0.0373	0.0063	0.0015	0.0311	0.0015	0.0220	0.1294	0.0753
Sky Harbor	0.5777	4.7918	0.4202	1.1815	0.4201	6.3430	7.6737	7.4765
Pleasant Valley	0.0134	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Scottsdale	0.0538	0.0091	0.0057	0.0139	0.0057	0.0859	0.2385	0.0610
Sky Ranch Carefree	0.0012	0.0002	0.0001	0.0000	0.0001	0.0009	0.0022	0.0002
Stellar Airpark	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0063	0.0011
Williams Gateway	0.0409	0.0070	0.0032	0.0427	0.0032	0.0486	0.1085	0.0509

V-3-3-2. Summary of Nonroad Emissions

Total nonroad emissions for Maricopa County in the summer season of 2008 are summarized in this section. Table V-14a presents the 2008 VOC and NOx emissions without emission reduction credit for the federal Tier 2, 3 and 4 nonroad equipment programs that are built into the EPA NONROAD model.

Table V-14b provides the 2008 emissions without credit for the federal Tier 2-4 nonroad equipment programs. Credit was removed by running the NONROAD model for 2002 using 2008 equipment populations (assuming EPA defaults for projected growth in equipment populations in Maricopa County). This had the effect of increasing the emissions for most nonroad equipment categories, except locomotives, ground support equipment and aircraft. The difference between the emissions in Tables V-14b and V-14a represents the benefit of the federal Tier 2-4 programs, which is a contingency measure in this Eight-Hour Ozone Plan.

Table V-14a. 2008 nonroad emissions (metric tons/summer season) for Maricopa County without federal Tier 2-4 nonroad equipment programs

Nonroad Category	VOC	NOx
Agricultural Equipment*	19.3	143.7
Commercial Equipment*	855.46	420.42
Construction and Mining Equipment*	852.33	5083.67
Industrial Equipment*	414.09	1032.02
Lawn and Garden Equipment (Res)*	1231.34	94.57
Lawn and Garden Equipment (Com)*	827.94	109.47
Pleasure Craft*	333.07	29.93
Railroad Equipment*	0.63	2.55
Recreational Equipment*	603.95	18.77
Locomotives**	30.31	680.55
Ground Support Equipment**	32.79	106.29
Aircraft**	755.57	680.61
Total	**5,956.78**	**8,402.55**

*2008 growth factors with 2002 emission factors were used for these categories
**2008 growth and 2008 emission factors were used for these categories

Table V-14b. 2008 nonroad emissions (metric tons/summer season) for Maricopa County with federal Tier 2-4 nonroad equipment programs

Nonroad Category*	VOC	NOx
Agricultural Equipment	14.43	123.00
Commercial Equipment	530.70	325.84
Construction and Mining Equipment	568.41	4010.20
Industrial Equipment	242.11	651.67
Lawn and Garden Equipment (Res)	841.65	74.23
Lawn and Garden Equipment (Com)	431.97	120.71
Pleasure Craft	241.68	33.38
Railroad Equipment	0.52	2.26
Recreational Equipment	536.12	18.13
Locomotives	30.31	680.55
Ground Support Equipment	32.79	106.29
Aircraft	755.57	680.61
Total	**4,226.26**	**6,826.85**

*2008 growth and emission factors were used for all categories

V-3-4. Background Emissions

Emissions for source types other than onroad mobile and biogenics are developed for a base year and then projected to 2008 through the application of appropriate growth factors. The growth factors for point and area source emissions are included in Appendix V. The growth factors were based on the interim population and employment projections accepted by the MAG Regional Council in June 2003 based on the 2000 Census. The 2008 employment factors by SIC were derived from these projections. The 2008 growth factors for nonroad equipment are described in Section V-3-3. For point and area sources, the projection factors were applied in an Excel spreadsheet and processed through EPS3.0. For point sources, a utility program was used to project facility-specific sources, because CNTLEM cannot apply facility-specific growth factors.

Several additional power plant units have been issued permits since 2002. To properly account for the ozone emissions from these power plants, MCAQD has coordinated with the power companies to obtain emission rates for the new units that have come on line since 2002.

The projected 2008 emission rates for VOC and NOx by power plant and unit are provided in Tables VI-15 and VI-16, respectively. Projected power plant emission rates provided by APS are provided in Appendix V, Attachment One. For the 2008 ozone simulations, the power plant emissions for the base load units are assumed to operate at their maximum potential to emit (PTE). In 2008, the emissions from power plants that operate only during peak demand periods (i.e., peaking units) are derived by applying the maximum hourly emission rates defined in the permits or applications for starting up and shutting off these units in the base year, i.e., 2001 or 2002. For peaking units put into operation after 2002, the maximum hourly rates represent the first year of operation.

For all other point sources in the inventory, 2002 annual emission rates are projected to 2008. VOC and NOx emissions from point sources and other source types for the peak day in 2002 and 2008 for each episode may be found in Tables V-17(a) through (f). Density plots of background emissions by type for these same episode days in 2008 are provided in Figures V-4a through 4f.

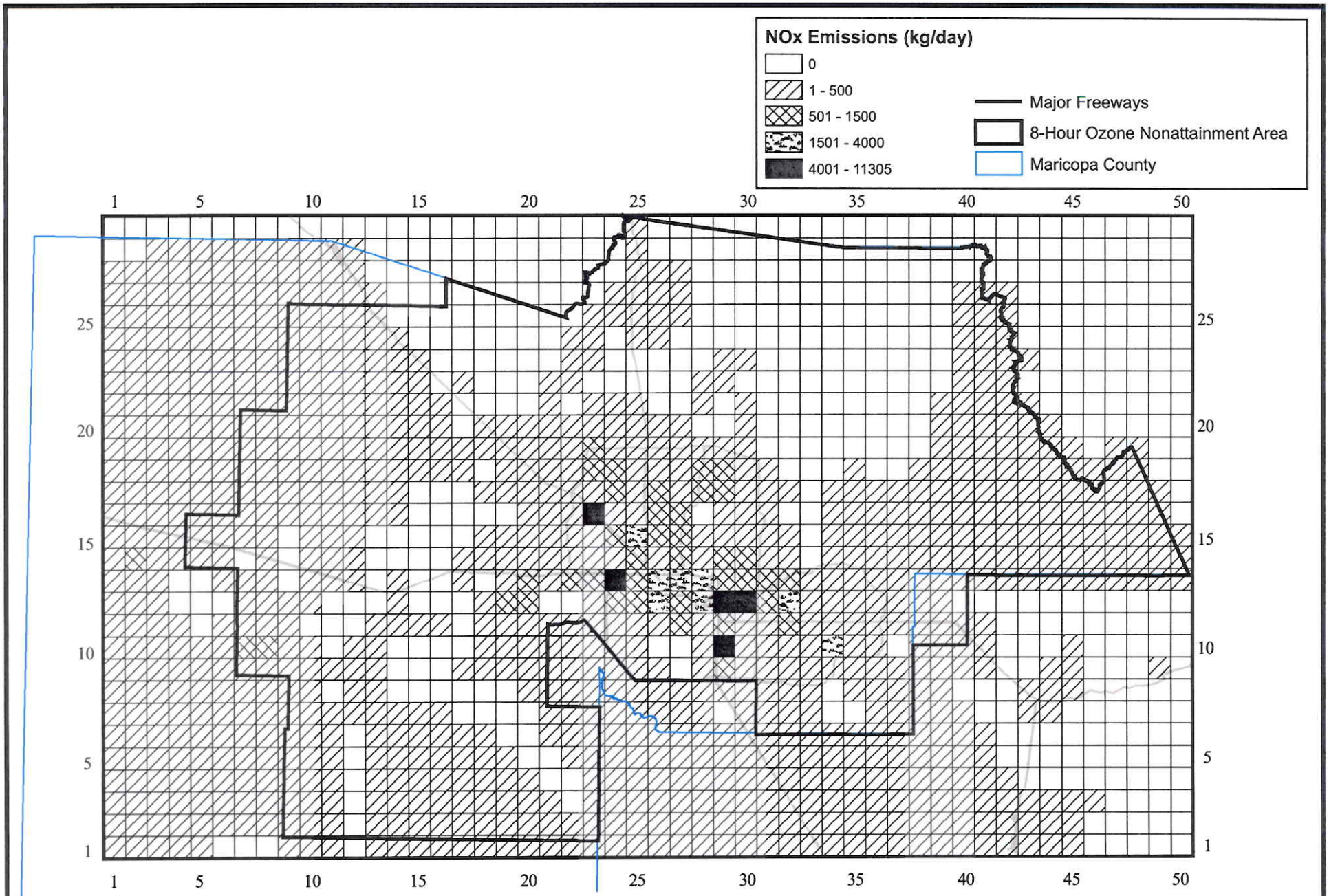


FIGURE V-4a. Background Source NOx Emissions for a Thursday in June, 2008
Total emissions = 128,889 kg/day
Total emissions in 8-hour ozone nonattainment area = 121,079 kg/day
Maximum = 11,305 kg/day at Cell (23,16)

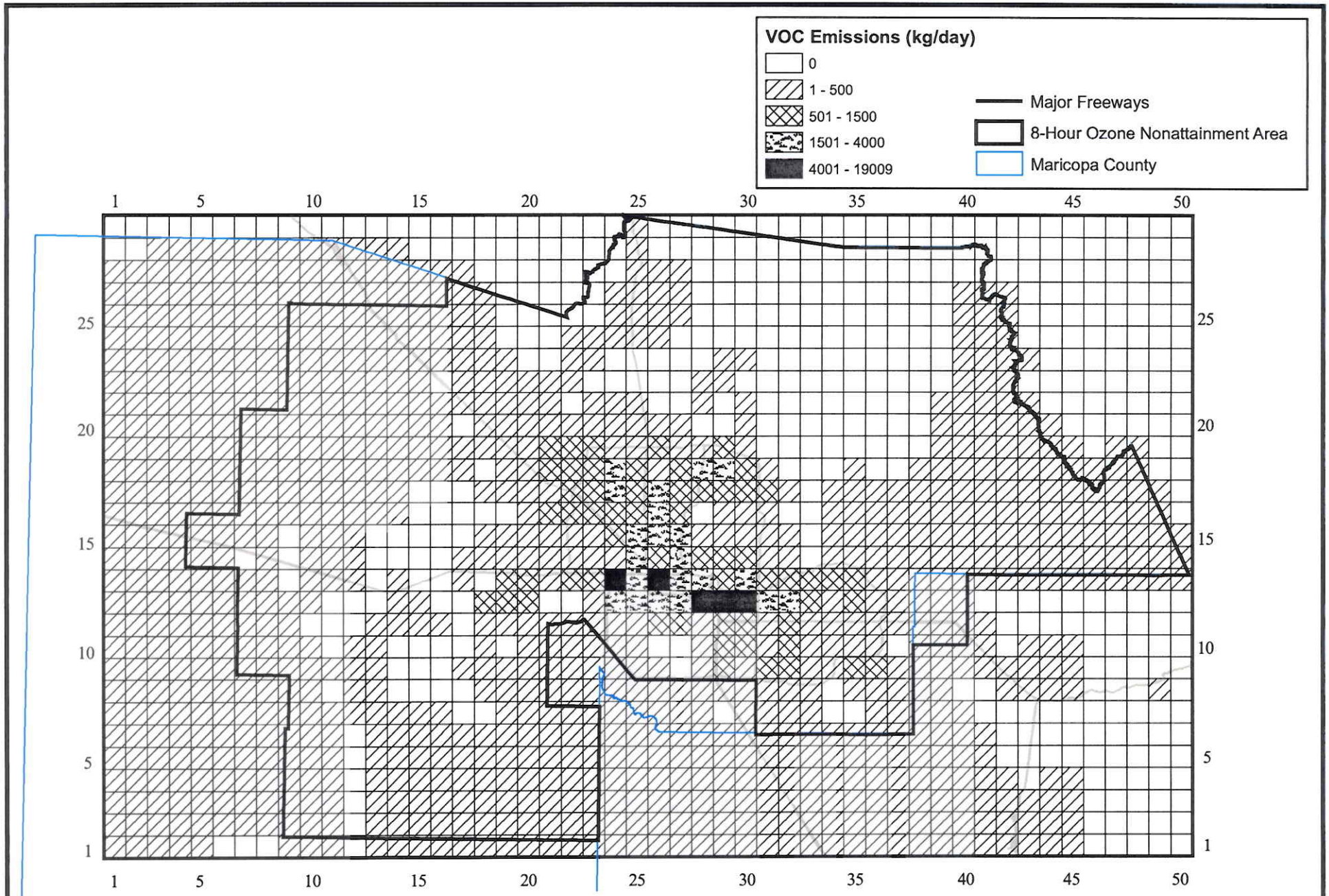


FIGURE V-4b. Background Source VOC Emissions for a Thursday in June, 2008
Total emissions = 175,947 kg/day
Total emissions in 8-hour ozone nonattainment area = 168,212 kg/day
Maximum = 19,009 kg/day at Cell (30,12)

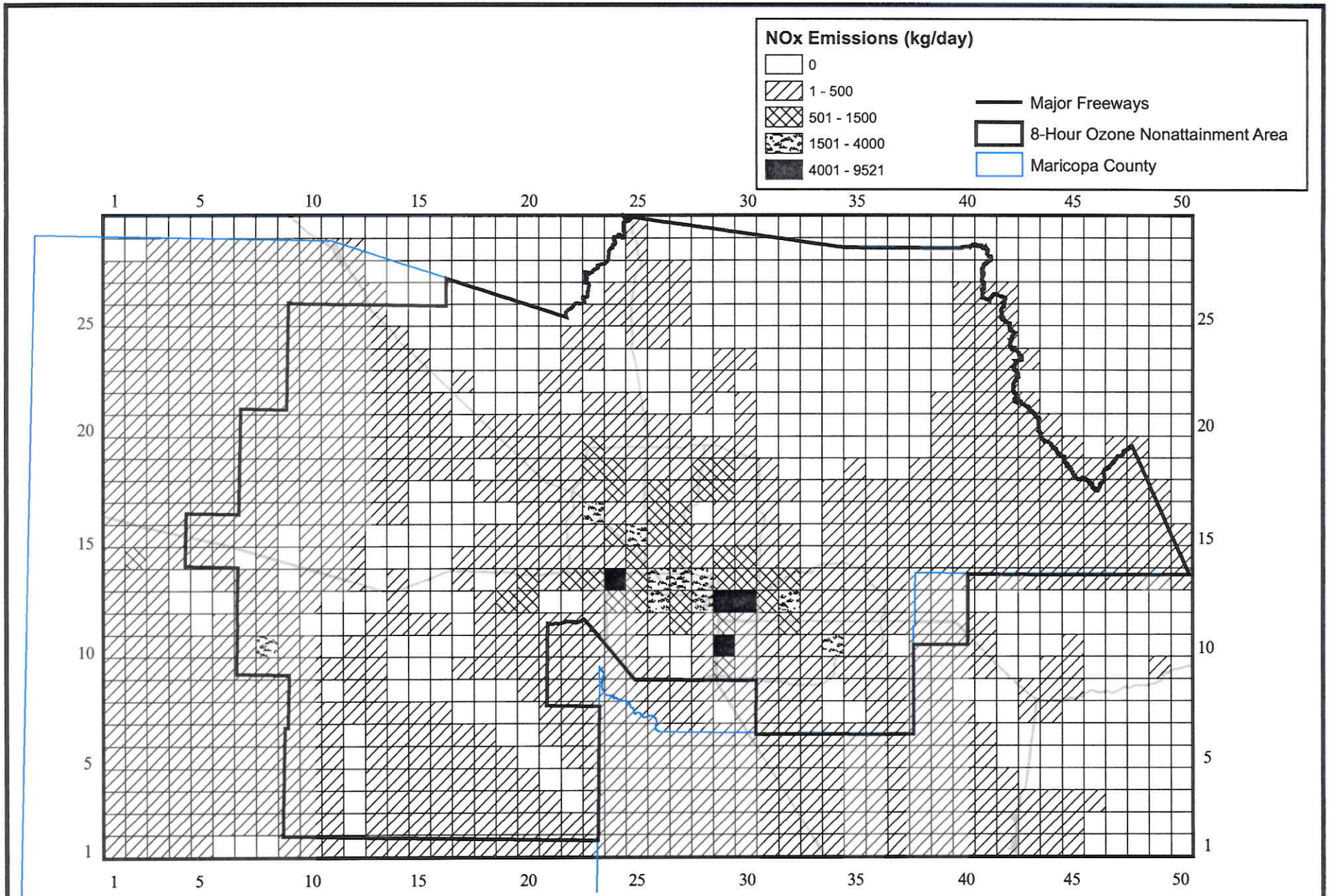


FIGURE V-4c. Background Source NOx Emissions for a Tuesday in July, 2008
Total emissions = 120,327 kg/day
Total emissions in 8-hour ozone nonattainment area = 112,517 kg/day
Maximum = 9,521 kg/day at Cell (30,12)

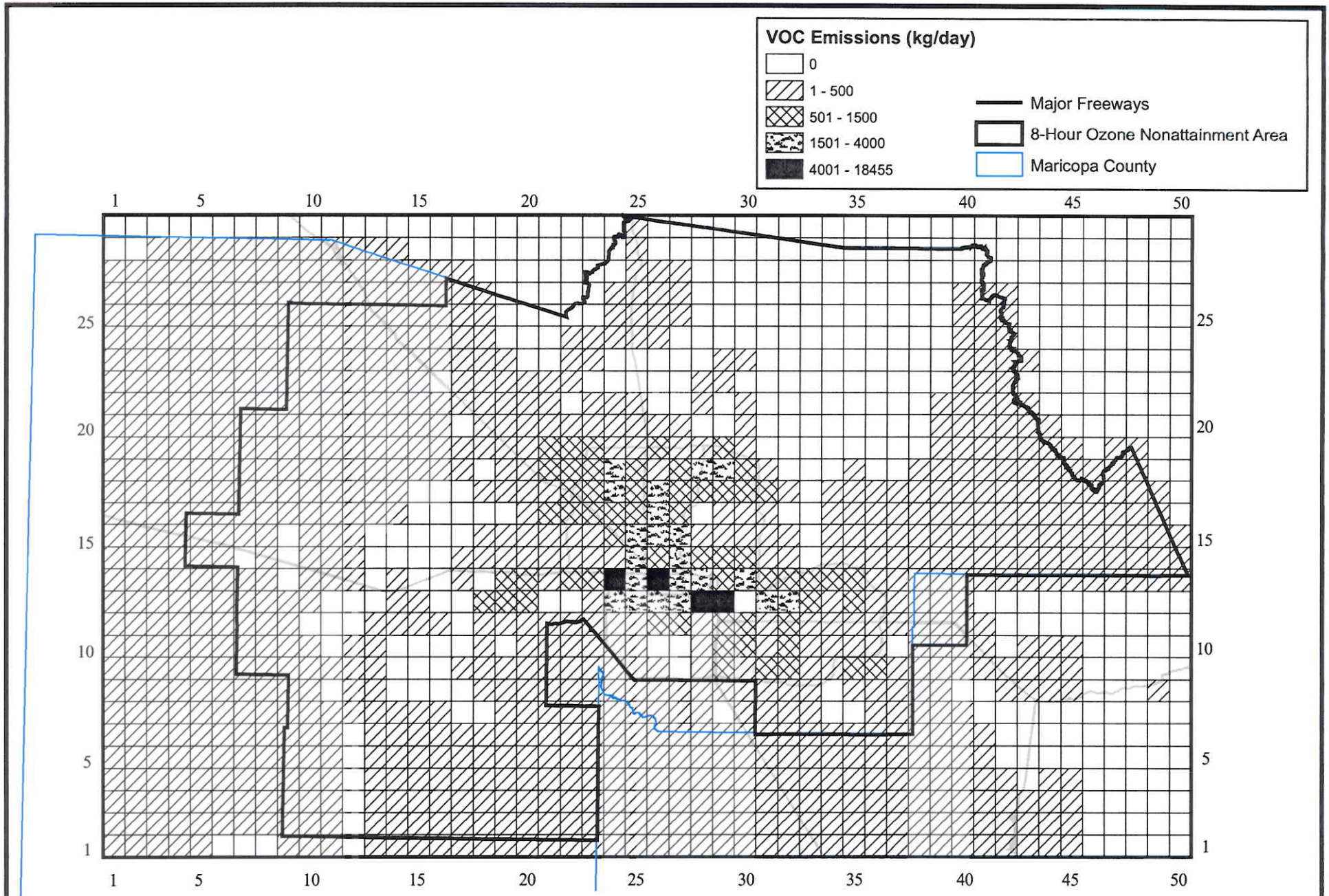


FIGURE V-4d. Background Source VOC Emissions for a Tuesday in July, 2008
Total emissions = 175,809 kg/day
Total emissions in 8-hour ozone nonattainment area = 168,074 kg/day
Maximum = 19,009 kg/day at Cell (30,12)

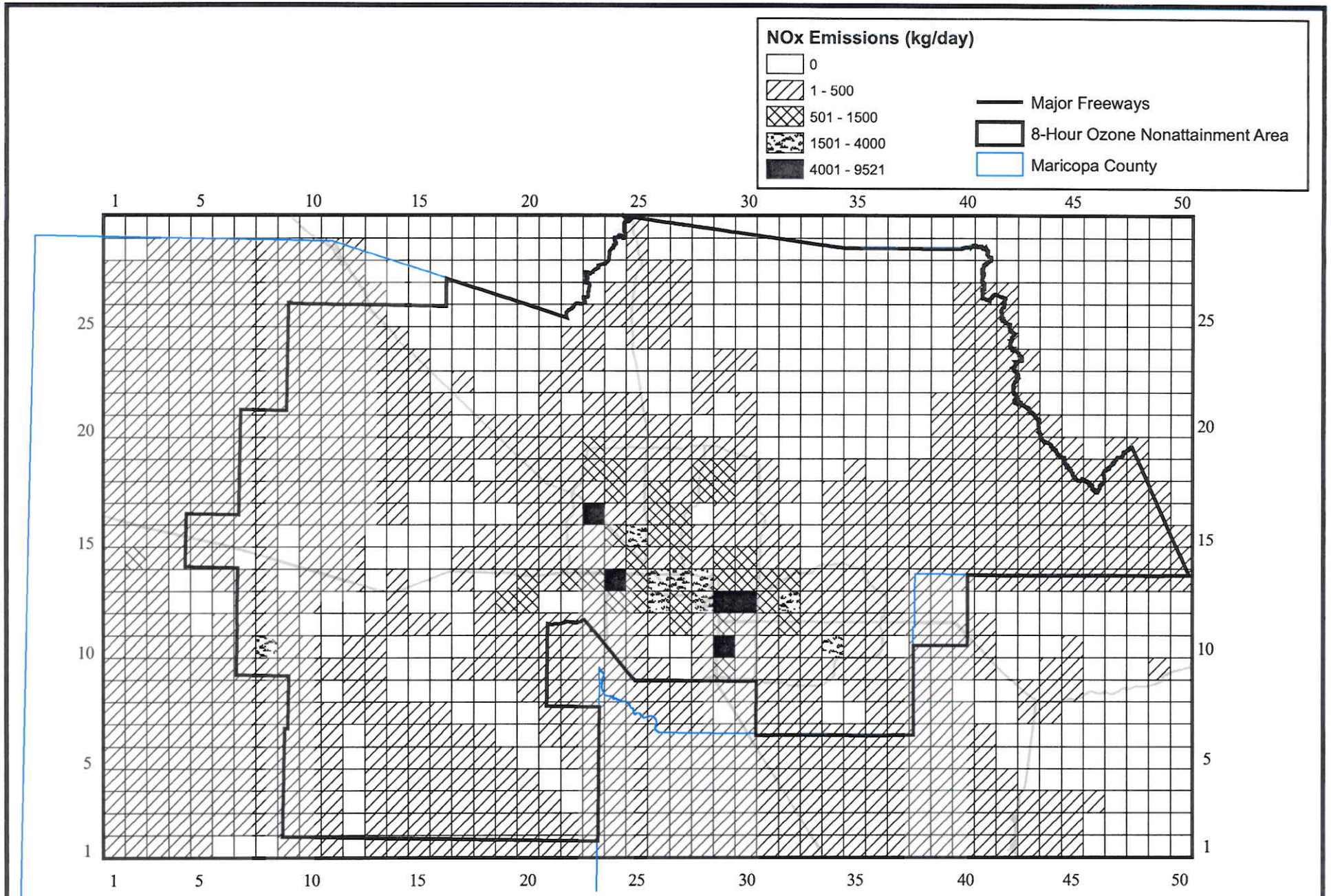


FIGURE V-4e. Background Source NOx Emissions for a Friday in August, 2008
Total emissions = 125,276 kg/day
Total emissions in 8-hour ozone nonattainment area = 117,466 kg/day
Maximum = 9,521 kg/day at Cell (30,12)

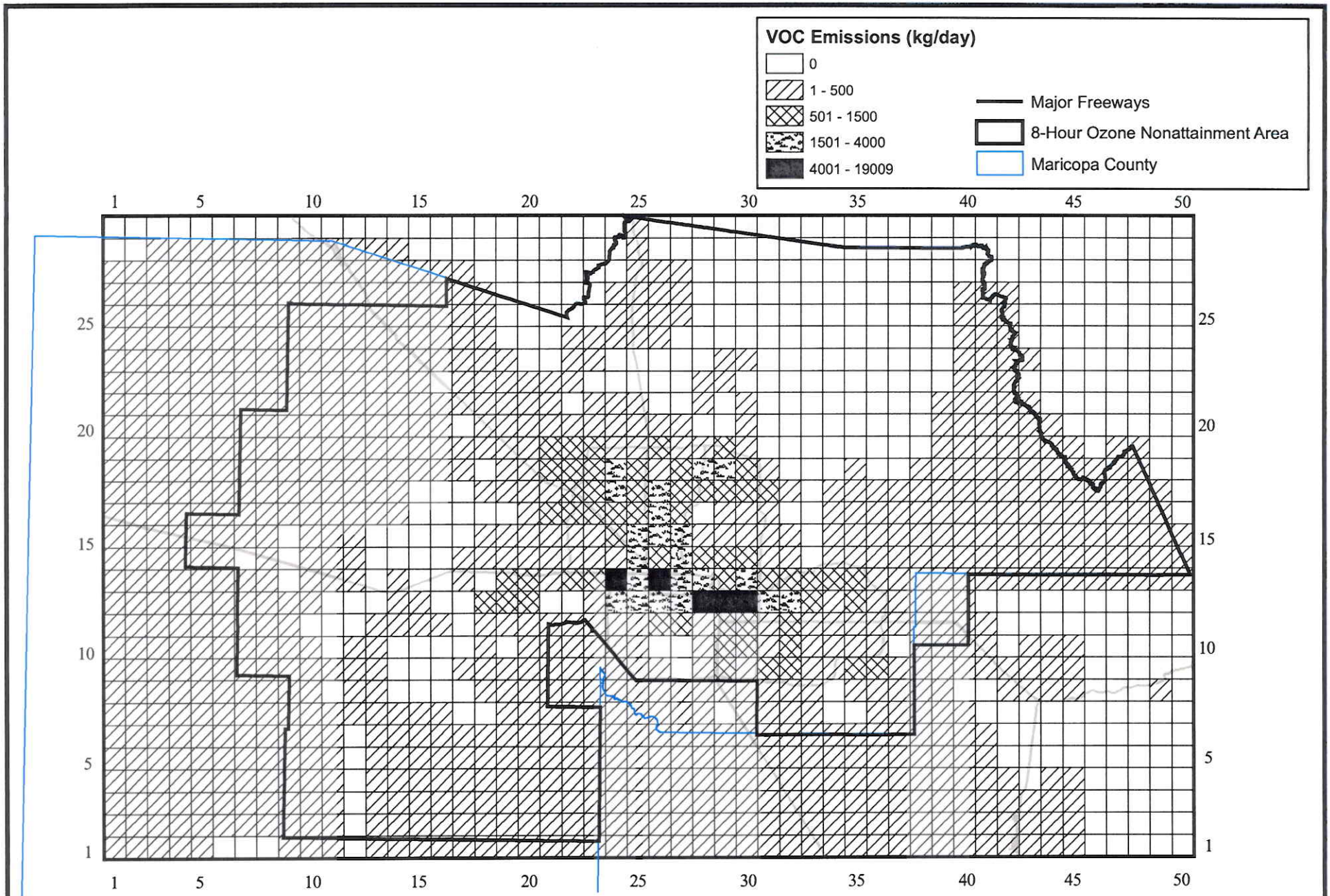


FIGURE V-4f. Background Source VOC Emissions for a Friday in August, 2008
Total emissions = 175,827 kg/day
Total emissions in 8-hour ozone nonattainment area = 168,092 kg/day
Maximum = 19,009 kg/day at Cell (30,12)

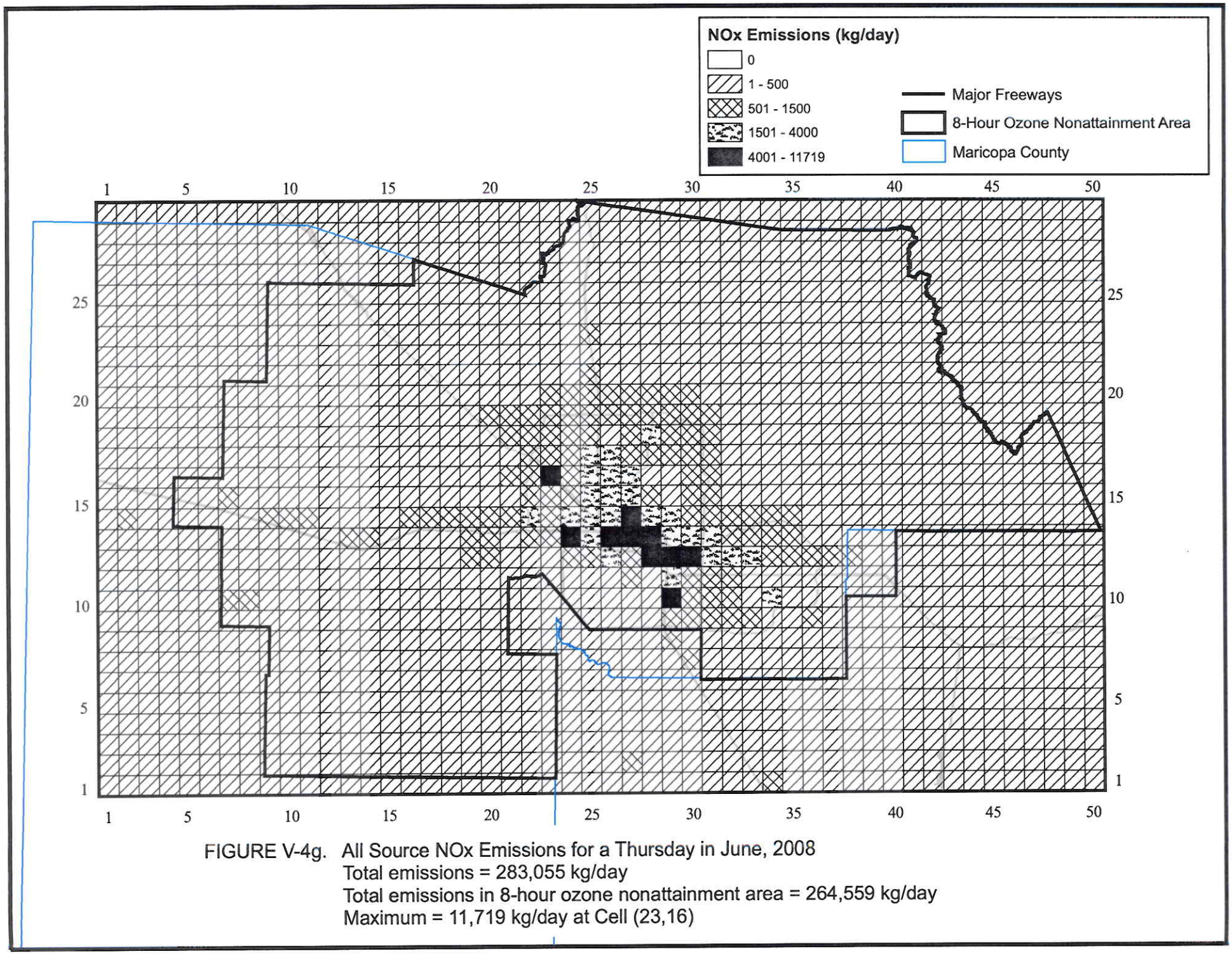


FIGURE V-4g. All Source NOx Emissions for a Thursday in June, 2008
Total emissions = 283,055 kg/day
Total emissions in 8-hour ozone nonattainment area = 264,559 kg/day
Maximum = 11,719 kg/day at Cell (23,16)

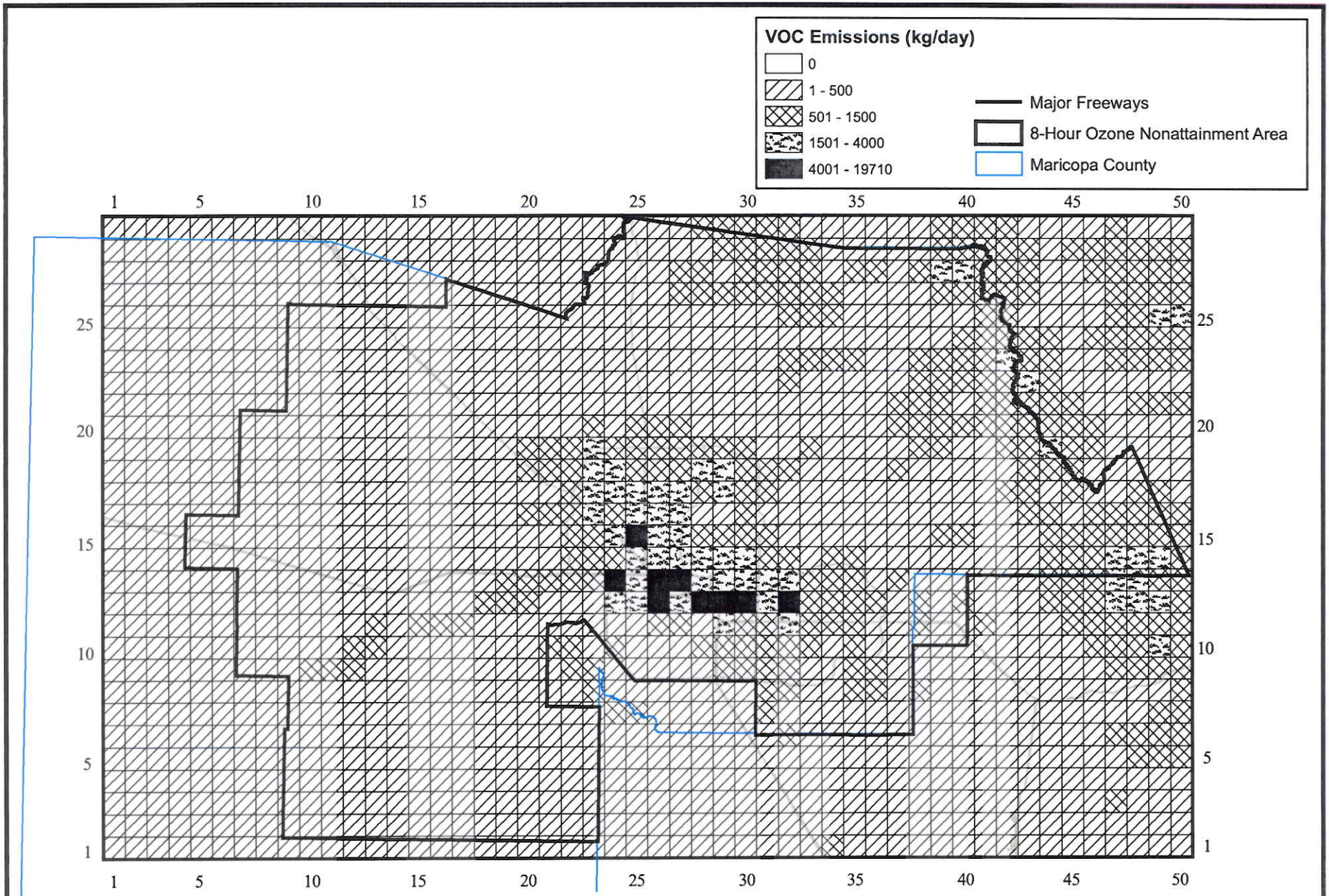


FIGURE V-4h. All Source VOC Emissions for a Thursday in June, 2008
Total emissions = 699,628 kg/day
Total emissions in 8-hour ozone nonattainment area = 503,646 kg/day
Maximum = 19,710 kg/day at Cell (30,12)

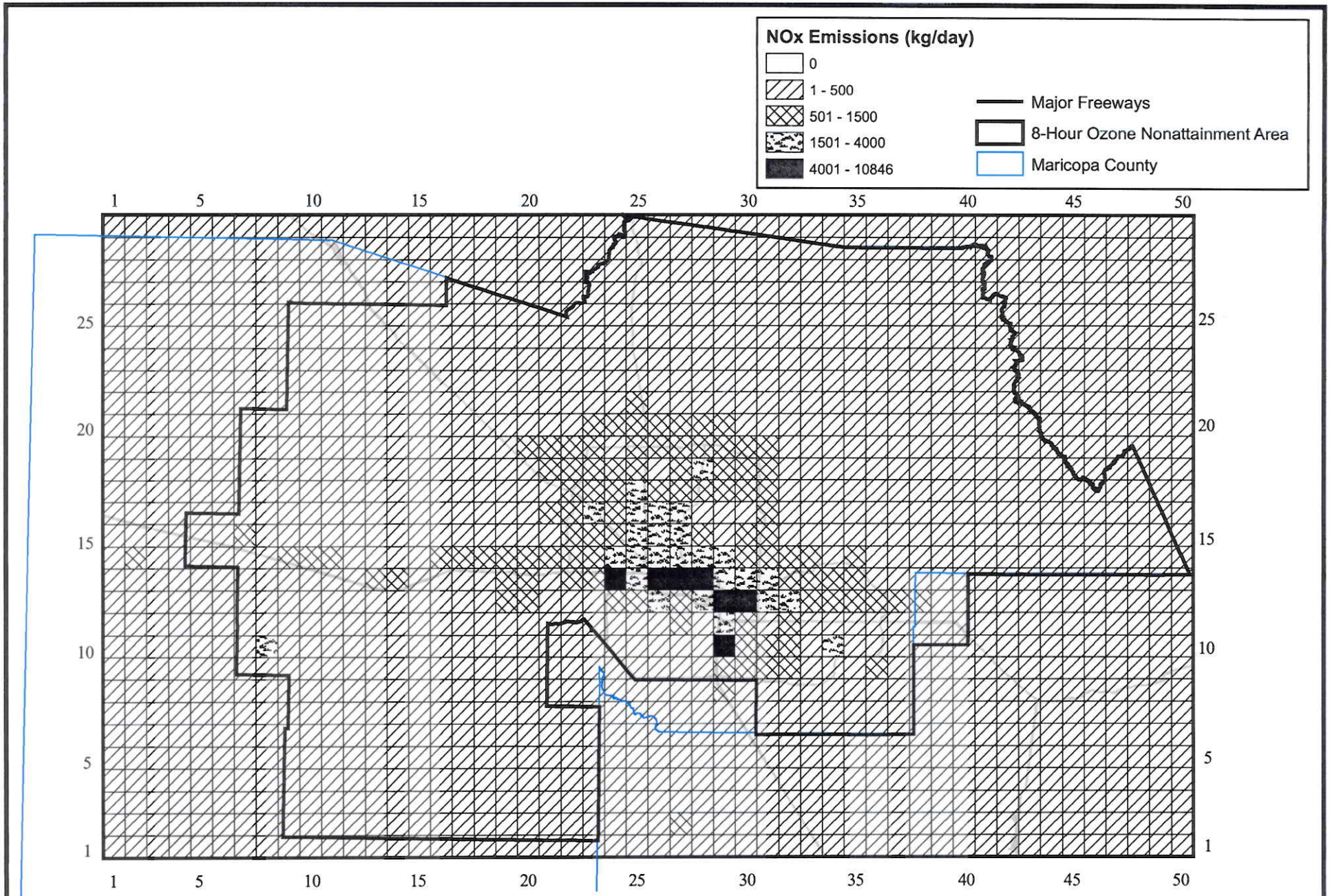


FIGURE V-4i All Source NOx Emissions for a Tuesday in July, 2008
Total emissions = 261,613 kg/day
Total emissions in 8-hour ozone nonattainment area = 242,627 kg/day
Maximum = 10,846 kg/day at Cell (30,12)

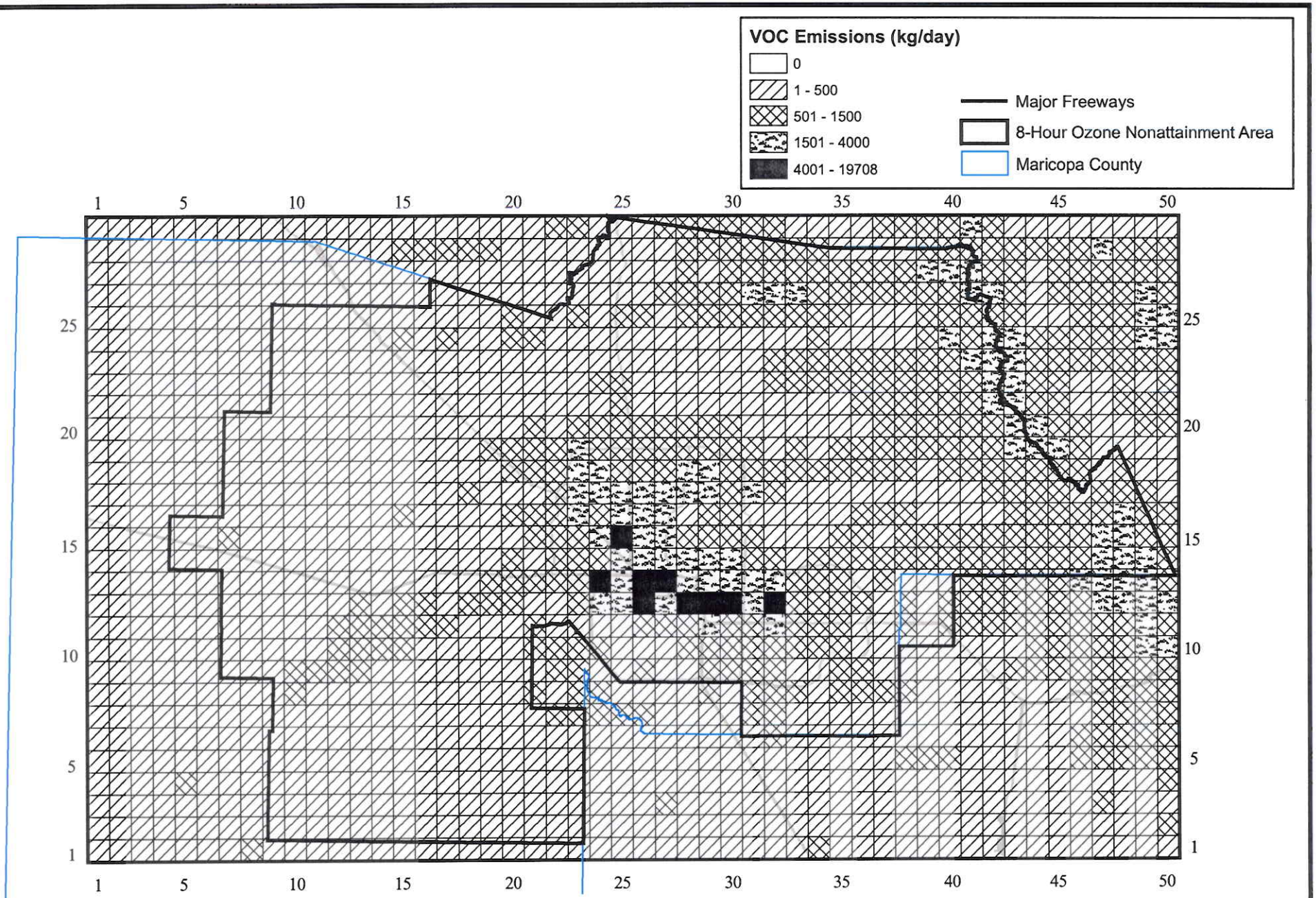


FIGURE V-4j. All Source VOC Emissions for a Tuesday in July, 2008
Total emissions = 883,579 kg/day
Total emissions in 8-hour ozone nonattainment area = 615,050 kg/day
Maximum = 19,708 kg/day at Cell (30,12)

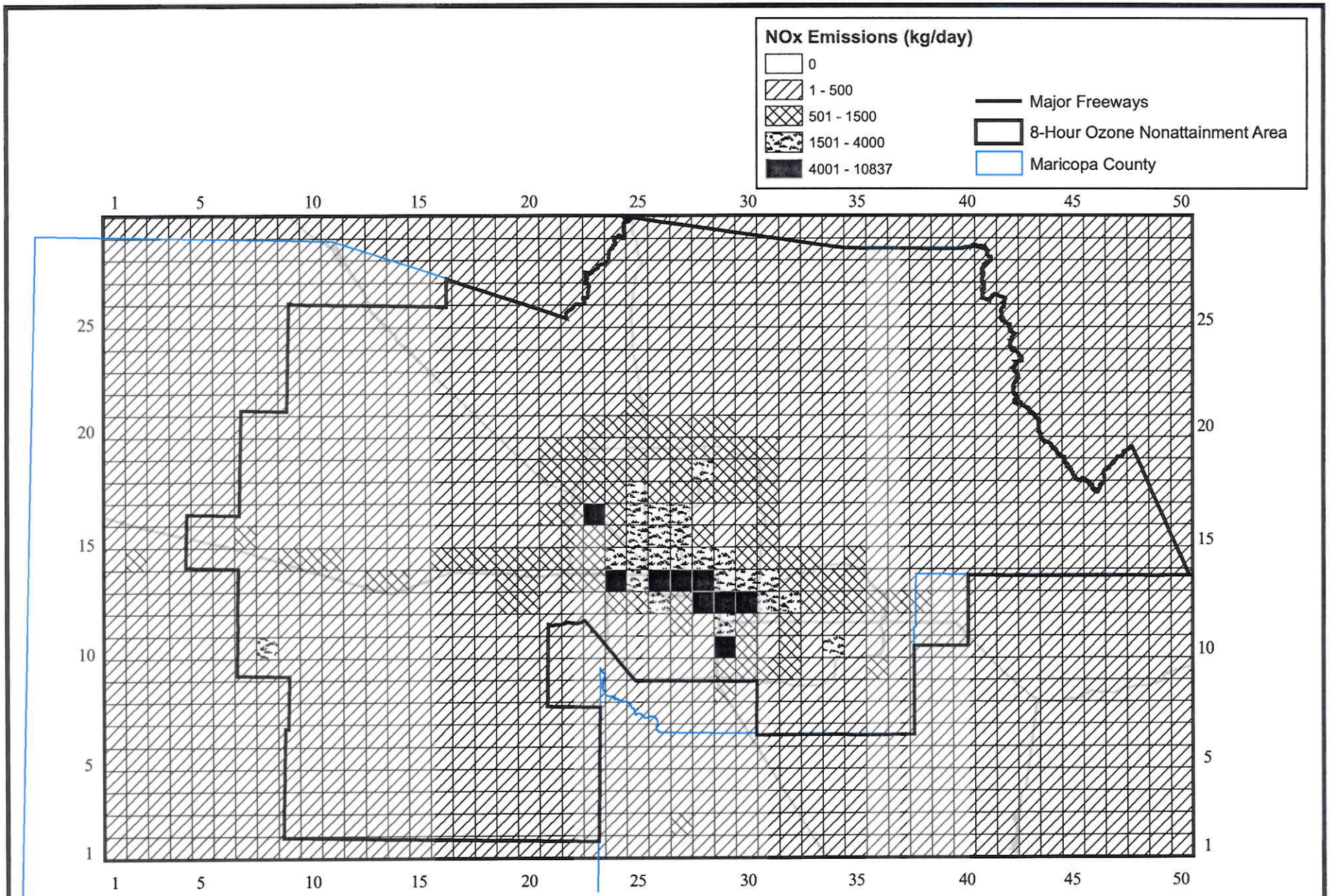


FIGURE V-4k. All Source NOx Emissions for a Friday in August , 2008
Total emissions = 263,133 kg/day
Total emissions in 8-hour ozone nonattainment area = 245,008 kg/day
Maximum = 10,837 kg/day at Cell (30,12)

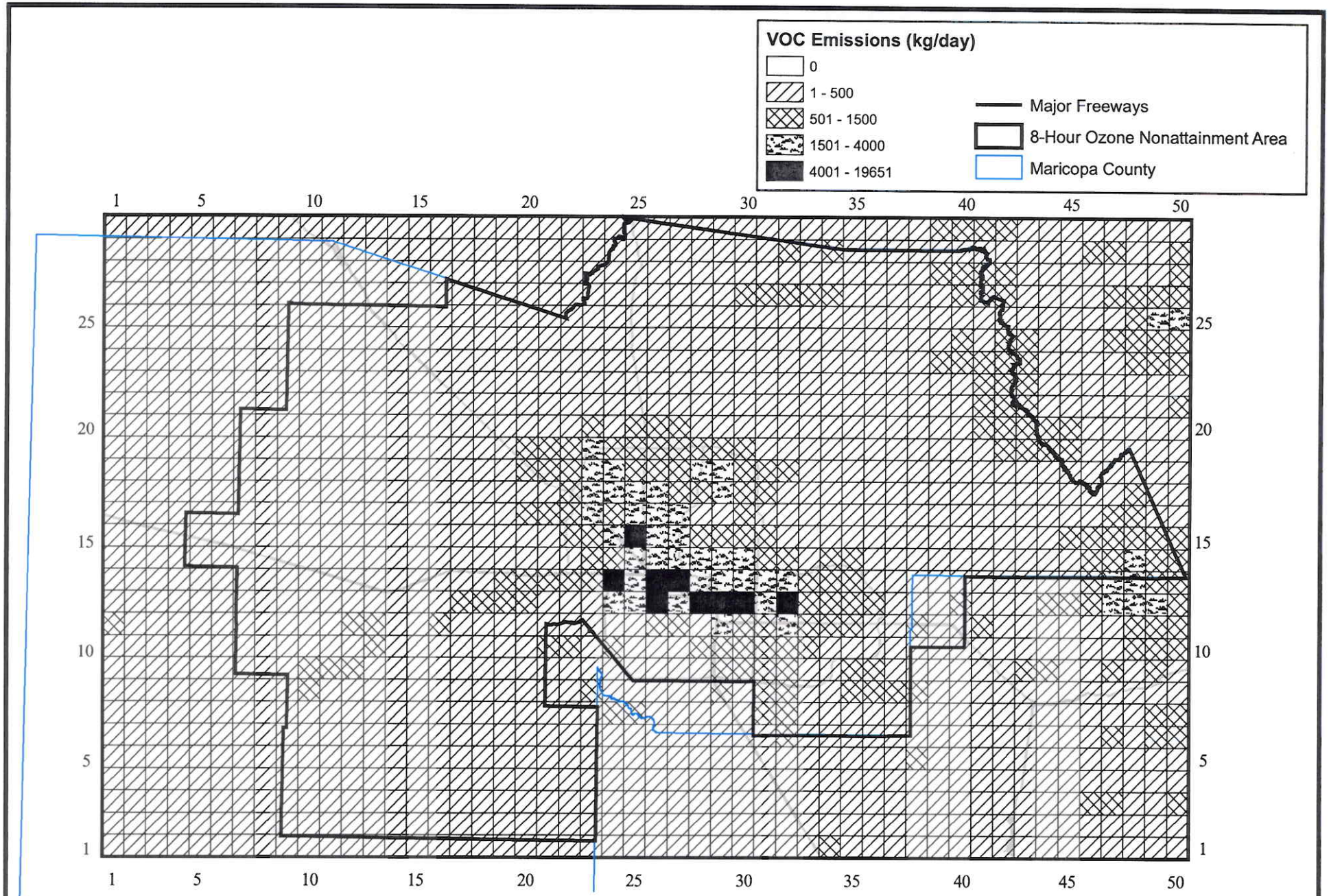


FIGURE V-4l. All Source VOC Emissions for a Friday in August, 2008
Total emissions = 640,497 kg/day
Total emissions in 8-hour ozone nonattainment area = 462,878 kg/day
Maximum = 19,651 kg/day at Cell (30,12)

Table V-15. Projected 2008 VOC emission rates for power plants in the modeling domain (source: Maricopa County Air Quality Department).

Plant Name	Unit Name	Annual VOC PTE (tons/yr)	PTE Normal Operation (lbs/hr)	Startup/ shutdown (lbs/hr)	Startup/ shutdown (no. hrs.)	Startup/ shutdown (lbs/event)	SCC	Zone 12 UTM_X	Zone 12 UTM_Y	stack ht (ft)	diameter (ft)	velocity (ft/sec)	temp (°F)
SRP													
Agua Fria	Boiler Unit 1	11	2.45				10100601	387108	3713387	120.00	8.00	50.00	300
MCAQD	Boiler Unit 2	7	1.50				10100601	387108	3713387	120.00	8.00	50.00	300
Permit #	Boiler Unit 3	21	4.79				10100601	387108	3713387	123.00	9.25	58.00	242
V95010	Unit 4 CT	2	0.36				10100501	387108	3713387	34.00	23.42	63.50	942
	Unit 5 CT	2	0.35				10100501	387108	3713387	39.00	19.17	92.80	942
	Unit 6 CT	1	0.30				10100501	387108	3713387	39.00	19.17	92.80	942
SRP Kyrene													
MCAQD	Boiler Unit 1	—	0.34	—			10100601	412877	3691004	23.16	8.00	47.00	350
Permit #	Boiler Unit 2	—	1.15	—			10100601	412877	3691004	36.58	10.99	43.98	338
V95009	Unit 4 CT	—	0.15	—			20100201	412877	3691004	37.00	18.76	91.97	894
	Unit 5 CT	—	0.19	—			20100201	412877	3691004	31.98	18.93	146.98	1190
	Unit 6 CT	0.6	0.17	—			20100201	412877	3691004	31.98	18.93	146.98	1190
	NEW Unit K7 CC	25.5	3.9	93.3			20100201	412877	3691004	149.96	18.01	61.43	181
SRP Santan													
MCAQD	Unit S-1	—	0.82	—			20100201	430407	3688183	49.00	13.25	84.20	370
Permit #	Unit S-2	—	0.81	—			20100201	430407	3688183	49.00	13.25	85.20	371
V95008	Unit S-3	—	0.64	—			20100201	430407	3688183	49.00	13.25	86.20	372
	Unit S-4	33.68	0.77				20100201	430407	3688183	52.00	13.25	87.20	373
	NEW unit S-5A						20100201	430407	3688183	149.96	18.01	61.43	181
	NEW unit S-5B						20100201	430407	3688183	149.96	18.01	61.43	181
	NEW unit S-6A	59.80	17.40				20100201	430407	3688183	149.96	18.01	61.43	181
APS													
West Phoenix	Unit 1 CC	85.28	1.17				20100201	392414	3701190	54.00	15.40	70.40	342
MCAQD	Unit 2 CC	85.28	1.17				20100201	392414	3701190	54.00	15.40	70.40	342
Permit #	Unit 3 CC	56.10	1.22	12.4	2		20100201	392334	3701685	54.00	15.40	70.40	350
V95006	Unit 4 CC		2.45	13	4		20100201	392292	3700520	120.00	14.00	66.00	170
	Unit 5CC, Stack1		5.38	29	4		20100201	392325	3700805	175.00	18.00	65.00	170
	Unit 5 CC, Stack2		5.38	29	4		20100201	392325	3700805	175.00	18.00	65.00	170
	Unit 1 Ct		0.19	—			20100201	392414	3701190	32.00	17.17	108.40	846
	Unit 2 Ct		0.27	—			20100201	392414	3701190	32.00	17.17	108.40	846
APS: Ocotillo													
MCAQD	Boiler Unit 1, Stack 1	14.3	0.46	—			10100604	415224	3698573	178.00	8.58	55.60	274
Permit #	Boiler Unit 1, Stack 2	14.3	0.46	—			10100604	415224	3698573	178.00	8.58	55.60	274
V95007	Boiler Unit 2, Stack 1	14.3	0.46	—			10100604	415224	3698573	178.00	8.58	55.60	274
	Boiler Unit 2, Stack 2	14.3	0.46	—			10100604	415224	3698573	178.00	8.58	55.60	274
	Unit 1 Ct		0.26	—			38500101	415224	3698573	35.00	17.17	108.00	846
	Unit 2 Ct		0.25	—			38500101	415224	3698573	36.00	17.17	108.00	846
Redhawk													
Generating	CC1A		0.41	29.00			20100201	328664	3690049	175	18	65	170
Facility	CC1B		0.15	29.00			20100201	328664	3690049	175	18	65	170
MCAQD	CC2A		0.04	29.00			20100201	328664	3690049	175	18	65	170
Permit #	CC2B		0.38	29.00			20100201	328664	3690049	175	18	65	170
V99013	(plantwide total PTE)	242.00											
Duke Energy													
Arlington	CTG1	61.60	1.21			71.00	20100201	324297	3690571	185.00	18.00	64.60	182
Valley LLC	CTG2	61.60	0.99			71.00	20100201	324297	3690571	185.00	18.00	64.60	182
MCAQD Permit #	CTG3	59.70	12.80			71.00	20100201	324297	3690571	185.00	18.00	64.60	182
V99014	CTG4	59.70	12.80			71.00	20100201	324297	3690571	185.00	18.00	64.60	182

Plant Name	Unit Name	Annual VOC PTE (tons/yr)	PTE Normal Operation (lbs/hr)	Startup/ shutdown (lbs/hr)	Startup/ shutdown (no. hrs.)	Startup/ shutdown (lbs/event)	SCC	Zone 12 UTM_X	Zone 12 UTM_Y	stack ht (ft)	diameter (ft)	velocity (ft/sec)	temp (°F)
New Harquahala													
Generating Co	CTG1	34	7.8	440			20100201	303619	3705788	180	19	65	170
MCAQD Permit #	CTG2	34	7.8	440			20100201	303688	3705787	180	19	65	170
V99015	CTG3	34	7.8	440			20100201	303758	3705786	180	19	65	170
Mesquite													
Generating Station	CC1	73.8	16.6			100	20100201	326602	3691016	170	18	61.2	168.9
MCAQD Permit #	CC2	73.8	16.6			100	20100201	326602	3691016	170	18	61.2	168.9
V99017	CC3	73.8	16.6			100	20100201	326602	3691016	170	18	61.2	168.9
	CC4	73.8	16.6			100	20100201	326602	3691016	170	18	61.2	168.9
Gila River													
Power Station	CT/DB 1A	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
MCAQD Permit #	CT/DB 1B	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
V99018	CT/DB 2A	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
	CT/DB 2B	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
	CT/DB 3A	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
	CT/DB 3B	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
	CT/DB 4A	18	4.1	21.6			20100201	341423	3649546	130	18	62	180
	CT/DB 4B	18	4.1	21.6			20100201	341423	3649546	130	18	62	180

Table V-16. Projected 2008 NOx emission rates for power plants in the modeling domain (source: Maricopa County Air Quality Department).

Plant Name	Unit Name	Annual VOC PTE (tons/yr)	PTE Normal Operation (lbs/hr)	Startup/ shutdown (lbs/hr)	Startup/ shutdown (no. hrs.)	Startup/ shutdown (lbs/event)	SCC	Zone 12 UTM_X	Zone 12 UTM_Y	stack ht (ft)	diameter (ft)	velocity (ft/sec)	temp (°F)
SRP													
Agua Fria	Boiler Unit 1	214.655	49.0079401	----			10100601	387108	3713387	120	8	50	300
MCAQD	Boiler Unit 2	302.704	69.1105752	----			10100601	387108	3713387	120	8	50	300
Permit #	Boiler Unit 3	1157.61	264.294618	----			10100601	387108	3713387	123	9.25	58	242
V95010	Unit 4 CT	241.136	55.1	----			10100501	387108	3713387	34.00	23.42	63.50	942
	Unit 5 CT	237.0	54.1	----			10100501	387108	3713387	39	19.167	92.8	942
	Unit 6 CT	204.1	46.6	----			10100501	387108	3713387	39	19.167	92.8	942
SRP Kyrene													
MCAQD	Boiler Unit 1	----	25.5	----			10100601	412877	3691004	23.16	8.0032	47.0024	350
Permit #	Boiler Unit 2	----	254.8	----			10100601	412877	3691004	36.58	10.99	43.98	338
V95009	Unit 4 CT	----	22.6	----			20100201	412877	3691004	37	19	92	894
	Unit 5 CT	----	29.3	----			20100201	412877	3691004	32	19	147	1190
	Unit 6 CT	48.9	26.5	----			20100201	412877	3691004	32	19	147	1190
	NEW Unit K7 CC	92.1	18.3	146.1			20100201	412877	3691004	150	18	61	181
SRP Santan													
MCAQD	Unit S-1	----	31.3	----			20100201	430407	3688183	49	13	84	370
Permit #	Unit S-2	----	31.0	----			20100201	430407	3688183	49	13	85	371
V95008	Unit S-3	----	49.0	----			20100201	430407	3688183	49	13	86	372
	Unit S-4	1056	61.4				20100201	430407	3688183	52	13	87	373
	NEW unit S-5A						20100201	430407	3688183	150	18	61	181
	NEW unit S-5B						20100201	430407	3688183	150	18	61	181
	NEW unit S-6A	212.8	49.8				20100201	430407	3688183	150	18	61	181

Plant Name	Unit Name	Annual VOC PTE (tons/yr)	PTE Normal Operation (lbs/hr)	Startup/ shutdown (lbs/hr)	Startup/ shutdown (no. hrs.)	Startup/ shutdown (lbs/event)	SCC	Zone 12 UTM_X	Zone 12 UTM_Y	stack ht (ft)	diameter (ft)	velocity (ft/sec)	temp (°F)
APS													
West Phoenix	Unit 1 CC	615.787	169.495868	----			20100201	392414	3701190	54	15.4	70.4	342
MCAQD	Unit 2 CC	615.787	169.495868	----			20100201	392414	3701190	54	15.4	70.4	342
Permit #	Unit 3 CC	405.1	176.7	273.7		0700-0800 or 1800-1900	20100201	392334	3701685	54.00	15.40	70.40	350
V95006	Unit 4 CC		23.6	87.8		0700-0800 or 1800-1900	20100201	392292	3700520	120	14	66	170
	Unit 5CC, Stack1		24.3	169.0		0700-0800 or 1800-1900	20100201	392325	3700805	175	18	65	170
	Unit 5 CC, Stack2		24.3	169.0		0700-0800 or 1800-1901	20100201	392325	3700805	175	18	65	170
	Unit 1 Ct		29.1				20100201	392414	3701190	32	17.167	108.4	846
	Unit 2 Ct		41.5				20100201	392414	3701190	32.00	17.17	108.40	846
APS: Ocotillo													
MCAQD	Boiler Unit 1, Stack 1	792	68.1	----			10100604	415224	3698573	178	9	56	274
Permit #	Boiler Unit 1, Stack 2	792	68.1	----			10100604	415224	3698573	178	9	56	274
V95007	Boiler Unit 2, Stack 1	792	68.1	----			10100604	415224	3698573	178	9	56	274
	Boiler Unit 2, Stack 2	792	68.1	----			10100604	415224	3698573	178	9	56	274
	Unit 1 Ct		39.7	----			38500101	415224	3698573	35	17	108	846
	Unit 2 Ct		38.1	----			38500101	415224	3698573	36	17	108	846
Redhawk													
Generating	CC1A		18.2	338.0			20100201	328664	3690049	175	18	65	170
Facility	CC1B		18.0	338.0			20100201	328664	3690049	175	18	65	170
MCAQD	CC2A		1.4	338.0			20100201	328664	3690049	175	18	65	170
Permit #	CC2B		5.3	338.0			20100201	328664	3690049	175	18	65	170
V99013	(plantwide total PTE)	1452											
Duke Energy													
Arlington	CTG1	121.1	13.8958333		399.5		20100201	324297	3690571	185	18	64.6	182
Valley LLC	CTG2	121.1	13.4028274		399.5		20100201	324297	3690571	185	18	64.6	182
MCAQD Permit #	CTG3	101.2	24		399.5		20100201	324297	3690571	185	18	64.6	182
V99014	CTG4	101.2	24.0		399.5		20100201	324297	3690571	185.00	18.00	64.60	182
New Harquahala													
Generating Co	CTG1	108.0	25.0	220.0			20100201	303619	3705788	180	19	65	170
MCAQD	CTG2	108.0	25.0	220.0			20100201	303688	3705787	180	19	65	170
Permit # V99015	CTG3	108.0	25.0	220.0			20100201	303758	3705786	180	19	65	170
Mesquite													
Generating	CC1	102	22.2		460		20100201	326602	3691016	170	18	61	168.9
station	CC2	102	22.2		460		20100201	326602	3691016	170	18	61	168.9
MCAQD	CC3	102	22.2		460		20100201	326602	3691016	170	18	61	168.9
Permit # V99017	CC4	102	22.2		460		20100201	326602	3691016	170	18	61	168.9
Gila River													
Power Station	CT/DB 1A	107.5	22.9	230.0			20100201	341423	3649546	130	18	62	180
MCAQD	CT/DB 1B	107.5	22.9	230.0			20100201	341423	3649546	130	18	62	180
Permit	CT/DB 2A	107.5	22.9	230.0			20100201	341423	3649546	130	18	62	180
# V99018	CT/DB 2B	107.5	22.9	230.0			20100201	341423	3649546	130	18	62	180
	CT/DB 3A	107.5	22.9	230.0			20100201	341423	3649546	130	18	62	180
	CT/DB 3B	107.5	22.9	230.0			20100201	341423	3649546	130	18	62	180
	CT/DB 4A	107.5	22.9	230			20100201	341423	3649546	130.00	18.00	62.00	180
	CT/DB 4B	107.5	22.9	230			20100201	341423	3649546	130	18	62	180

V-3-4-1. Temporal Allocation of Background Emissions

The temporal allocation of background (i.e., point, area and nonroad) emissions is assumed to be constant between the base year (2002) and the future year (2008). There are no committed measures that affect the distribution of emissions temporally. Therefore, the temporal profiles for the background emissions are identical between the base year and future year. Temporal plots of the 2008 NOx and VOC emissions for the peak day in each episode may be found in Figures V-5a through V-5f.

V-3-4-2. Allocation of the Emissions Spatially

Point sources are spatially allocated on the basis of the location (UTM coordinates or latitude/longitude) of each source. Area and nonroad mobile source emissions, with the exception of aviation-related emissions, are spatially distributed based on surrogate factors that indicate emission level or activity. For this analysis, projections based on MAG land use data (2004) have been used to determine the spatial allocation factors for all of the area and nonroad mobile sources except for aviation. The 2004 land use was employed in developing all of the area and nonroad mobile spatial surrogates with the exception of non-developable forest, railroad, agricultural stockyards, and other uses that were obtained from the MAG GIS group. Spatial plots of the 2008 NOx and VOC background emissions are found in Figures V-4a through V-4f.

V-3-5. Summary of the Modeling Inventories

The 2001 and 2002 base year and the 2008 attainment year emission inventories for NOx and VOC for each episode are summarized in Tables V-17(a) through V-17(f). The corresponding total emission density plots for each episode in 2008 are shown in Figures V-4g through V-4l.

In the base and forecast years, onroad mobile source emissions constitute between 48 and 63 percent of the total NOx emissions and biogenic emissions contribute 63 to 73 percent of the total VOC emissions. These two categories represent the largest emission sources for NOx and VOC, respectively.

Due to the implementation of the committed attainment measures and stricter Federal controls on light duty vehicles, onroad mobile source NOx emissions decrease by 24-27 percent and onroad mobile source VOC emissions decrease by 21-27 percent between the base years and 2008.

Area source NOx emissions increase by about 37- 44 percent between the base years and 2008. Area source VOC emissions increase by 16 percent between 2002 and 2008 and 20 percent between 2001 and 2008.

Due to the assumption of potential to emit (PTEs) for base load units and maximum hourly emission rates for peaking units in 2008, point source NOx emissions are 1.5 - 2 times

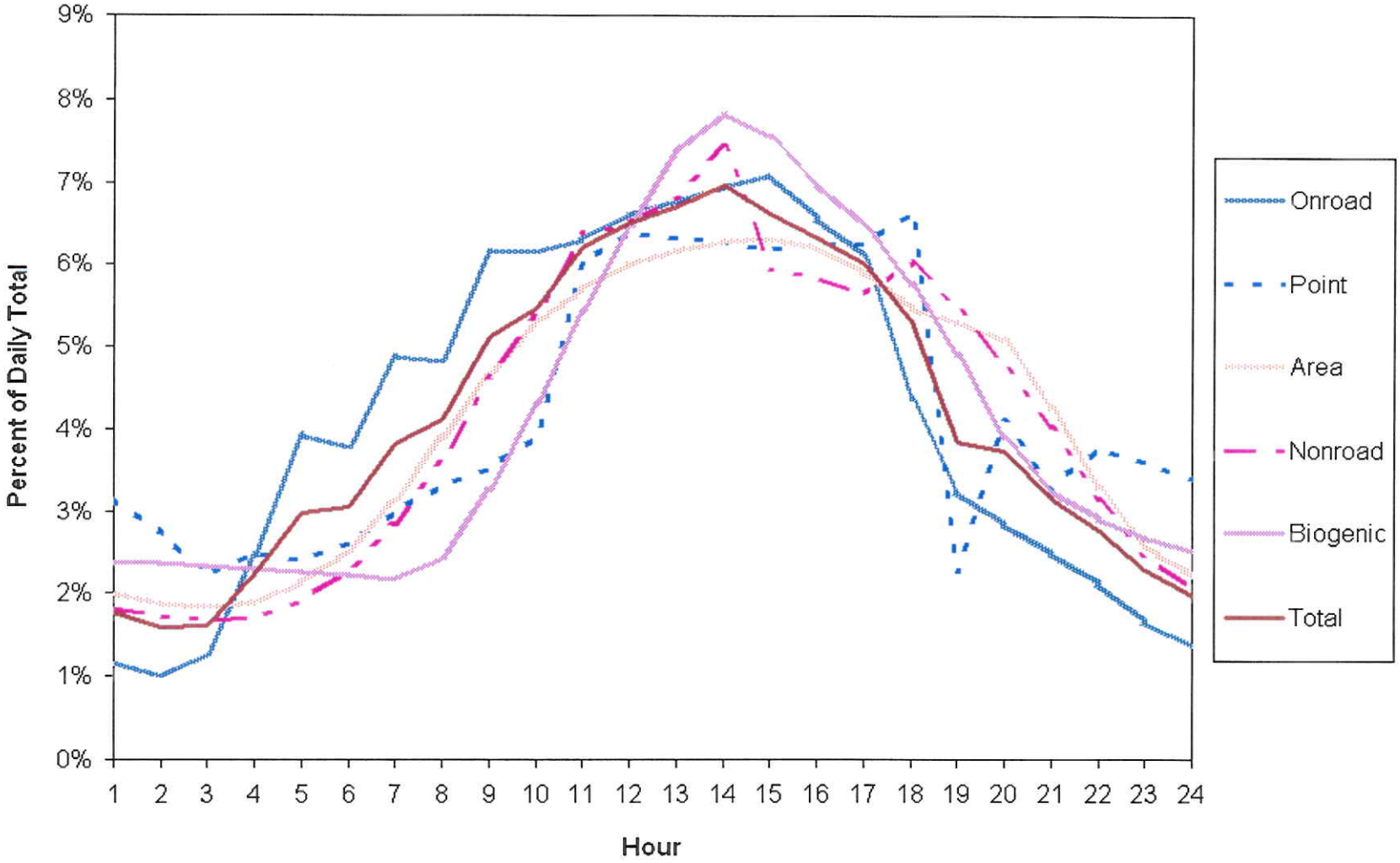


Figure V-5a. Temporal Distribution of NOx Emission Sources (Modeling Domain), August 10, 2008

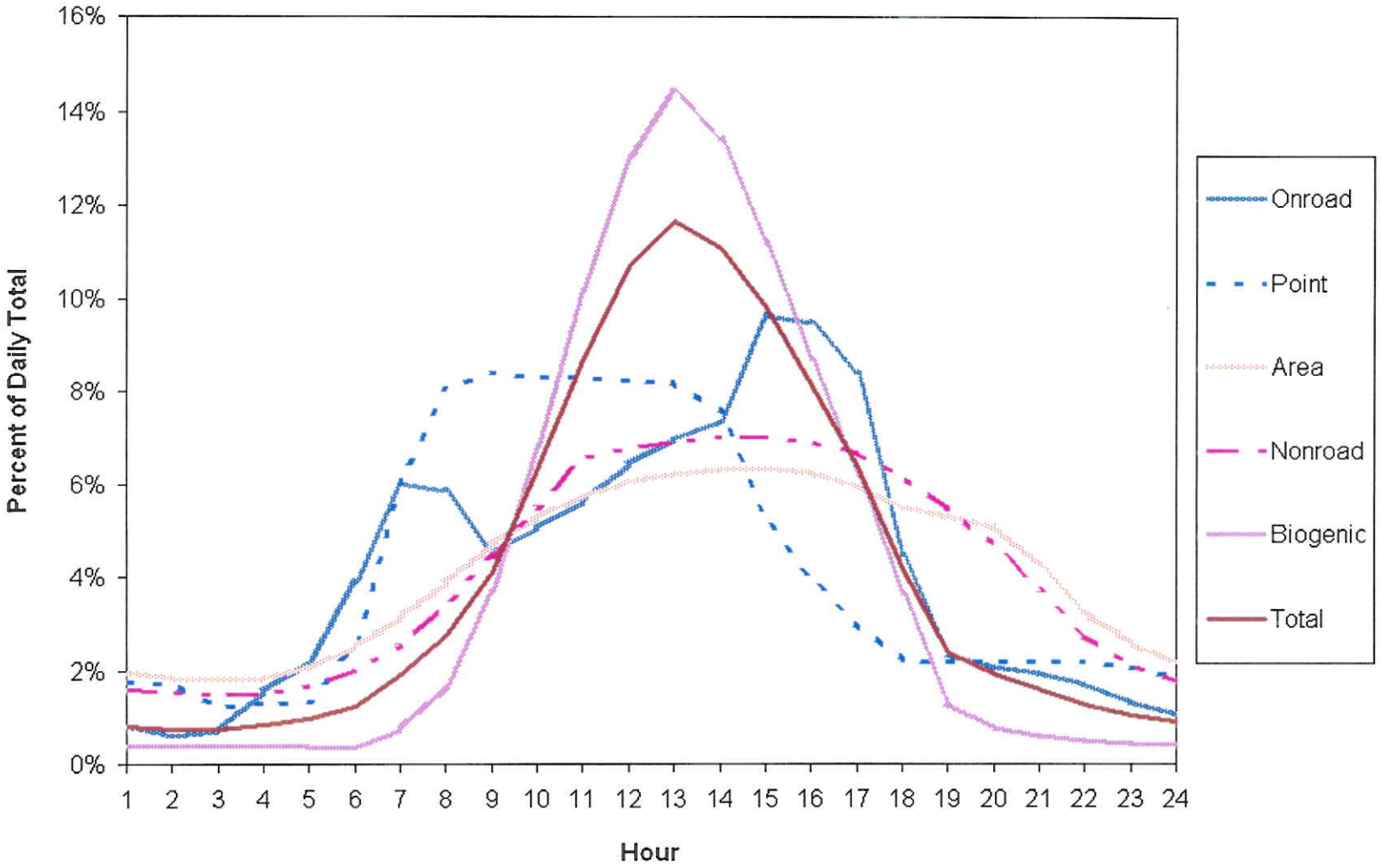


Figure V-5b. Temporal Distribution of VOC Emission Sources (Modeling Domain), August 10, 2008

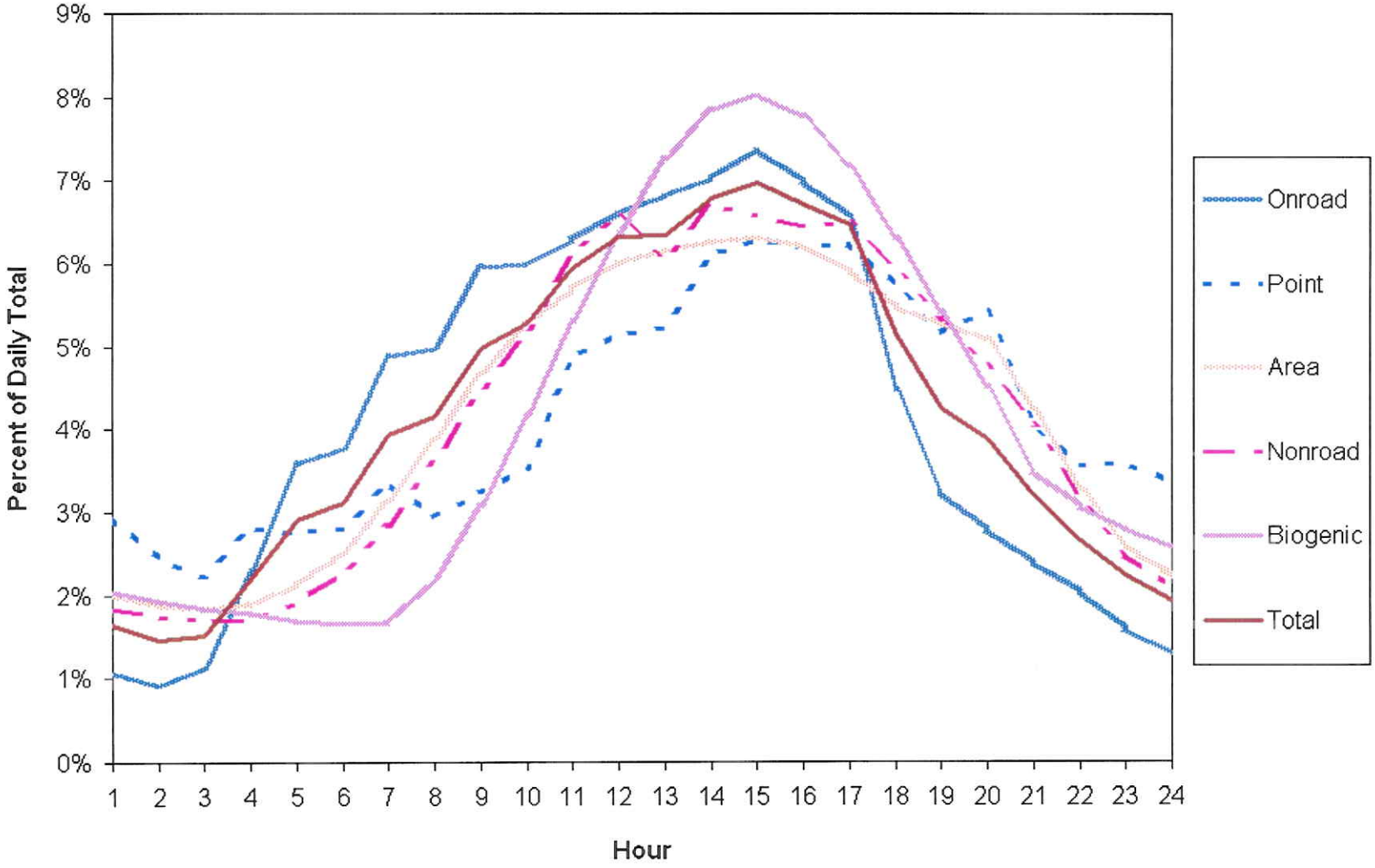


Figure V-5c. Temporal Distribution of NOx Emission Sources (Modeling Domain), June 06, 2008

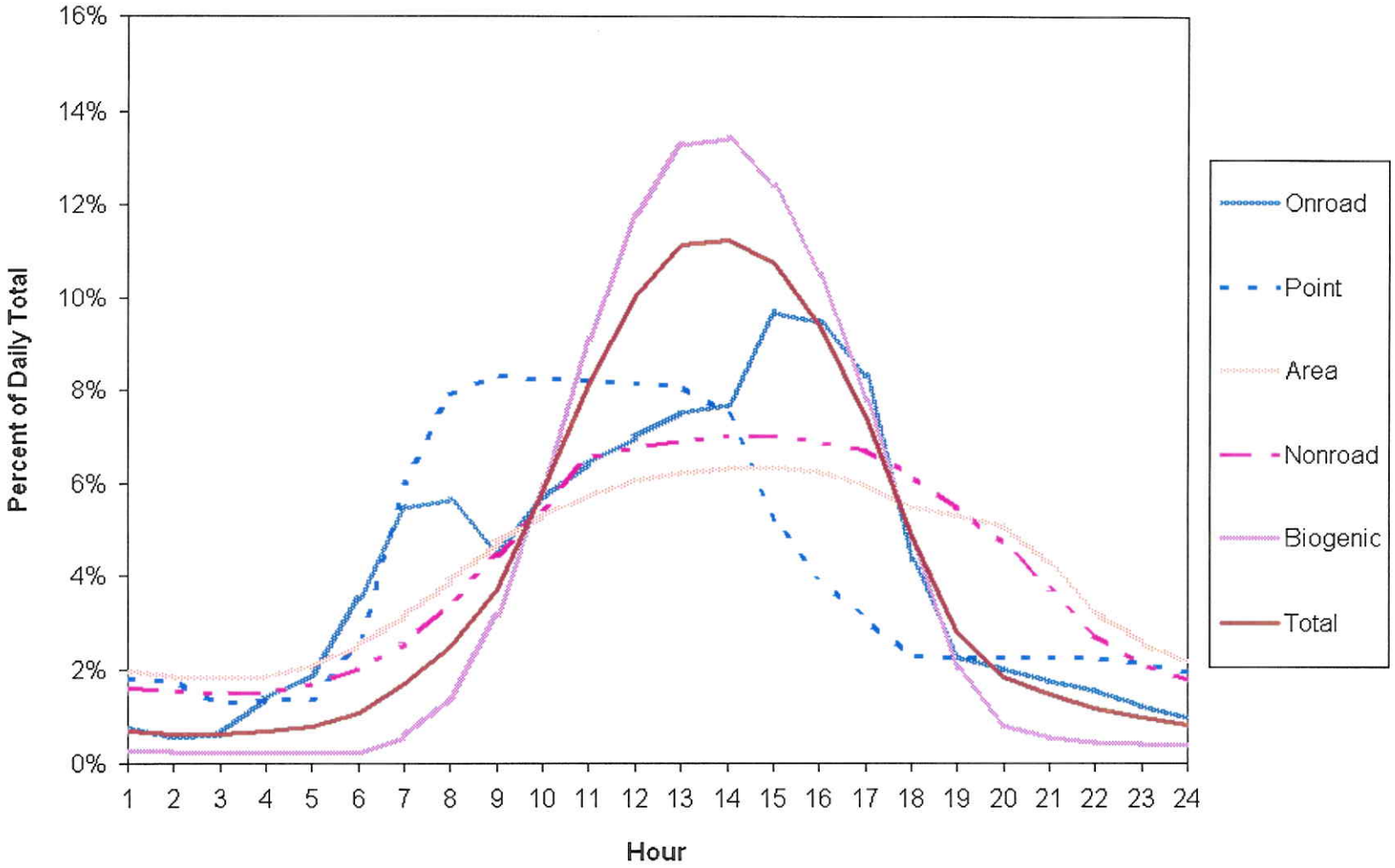


Figure V-5d. Temporal Distribution of VOC Emission Sources (Modeling Domain), June 06, 2008

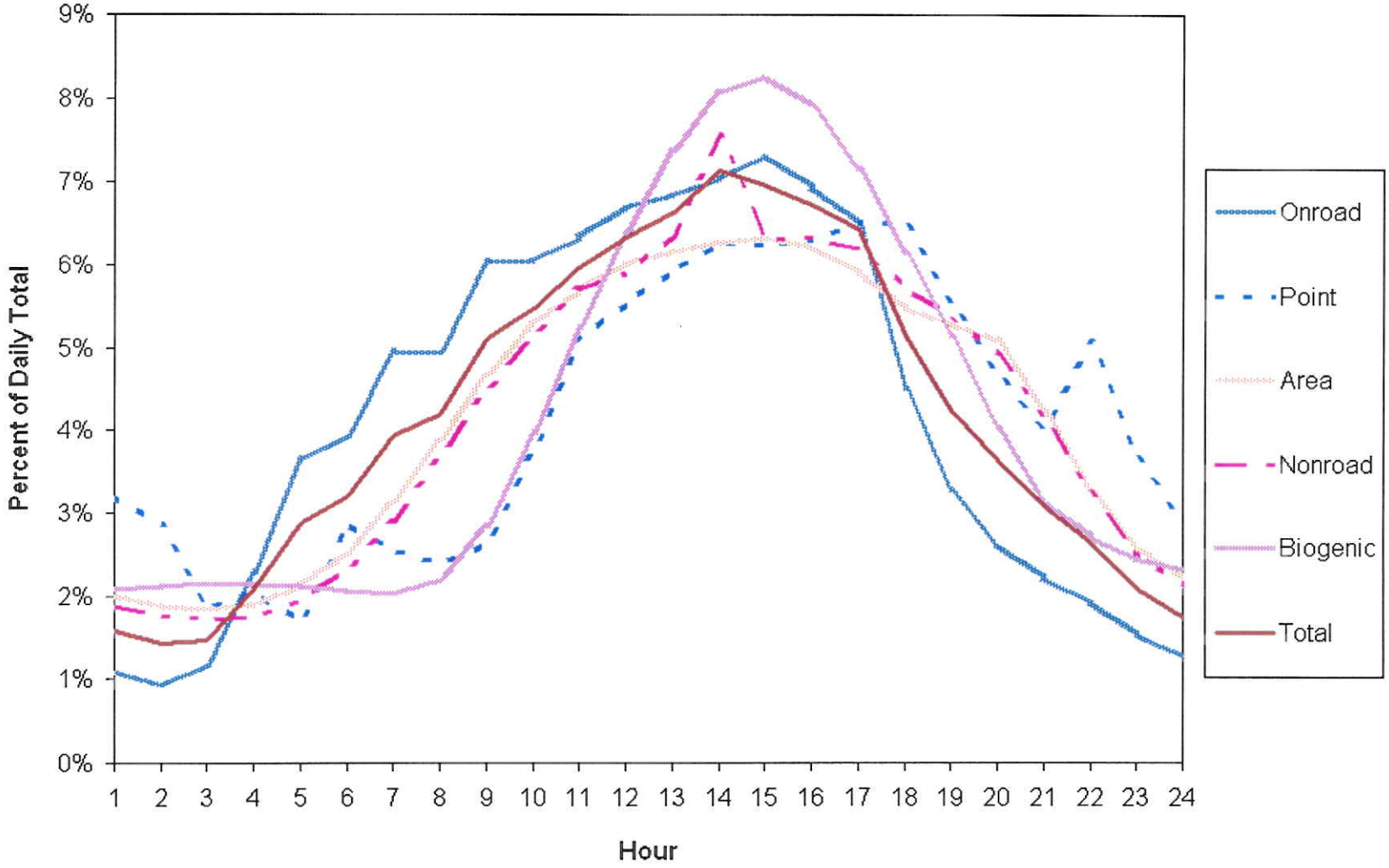


Figure V-5e. Temporal Distribution of NOx Emission Sources (Modeling Domain), July 09, 2008

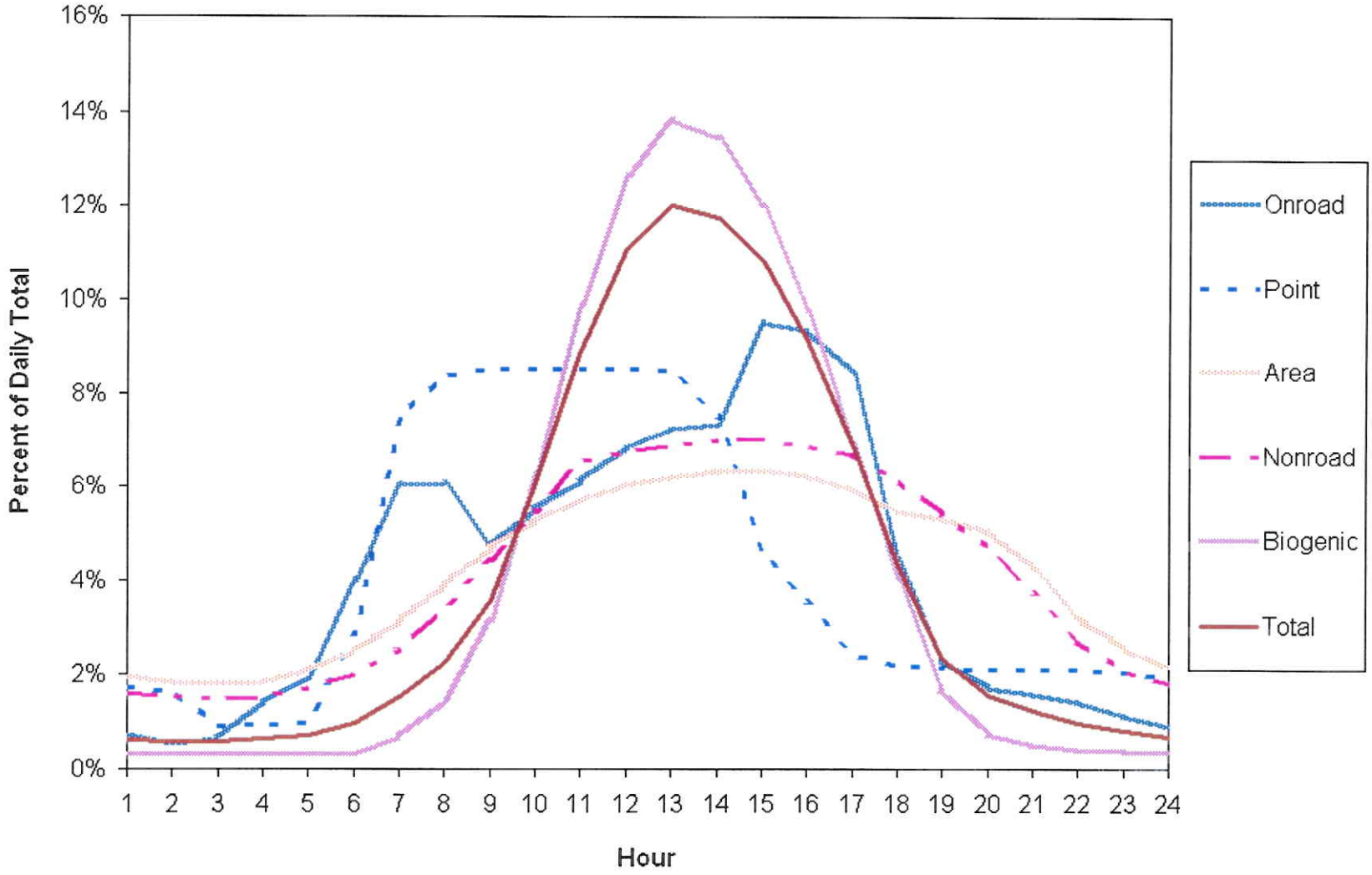
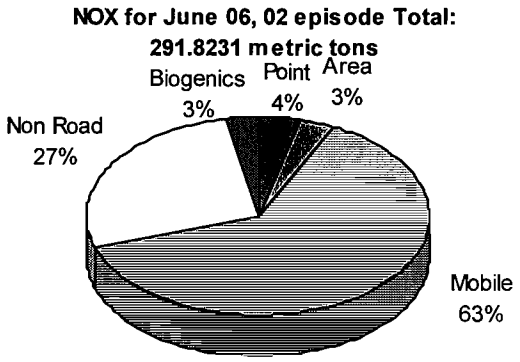


Figure V-5f. Temporal Distribution of VOC Emission Sources (Modeling Domain), July 09, 2008

Table V-17(a). NOx emissions by source category for a June episode day in 2002 and 2008 in the ozone modeling domain.

Source Category	June 6, 2002	Thursday in June 2008	2008-2002 Difference
	Metric Tons per Day	Metric Tons per Day	%
Point	11.15	32.78	194.0
Area	9.79	13.49	37.8
Nonroad Mobile	79.97	86.58	8.3
Onroad Mobile	182.36	145.52	-20.2
Biogenics	8.56	8.56	0.0
Total	291.82	286.93	-1.7



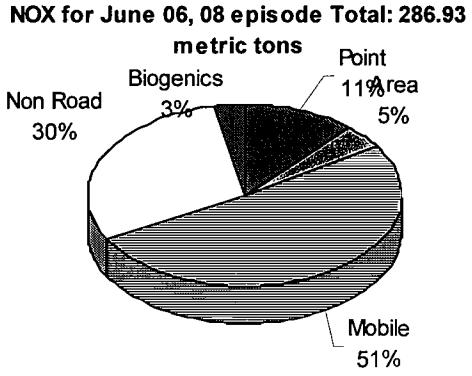
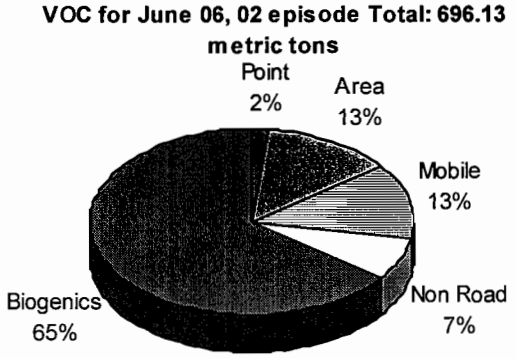


Table V-17(b). VOC emissions by source category for a June episode day in 2002 and 2008 for the ozone modeling domain.

Source Category	June 6, 2002	Thursday in June 2008	2008-2002 Difference
	Metric Tons per Day	Metric Tons per Day	%
Point	11.72	13.55	15.6
Area	90.56	105.03	16.0
Nonroad Mobile	50.73	57.55	13.4
Onroad Mobile	91.84	72.34	-21.2
Biogenics	451.28	451.28	0.0
Total	696.13	699.75	-0.5



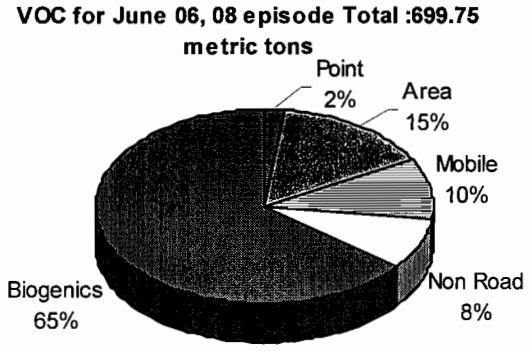
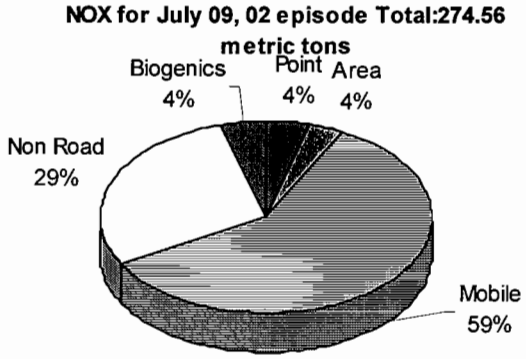


Table V-17(c). NOx emissions by source category for a July episode day in 2002 and 2008 in the ozone modeling domain.

Source Category	July 9, 2002	Tuesday in July 2008	2008-2002 Difference
	Metric Tons per Day	Metric Tons per Day	%
Point	11.15	27.31	145.03
Area	9.79	13.49	37.8
Nonroad Mobile	78.53	85.28	8.6
Onroad Mobile	163.24	129.34	- 20.76
Biogenics	11.86	11.86	0.0
Total	274.56	267.29	- 2.56



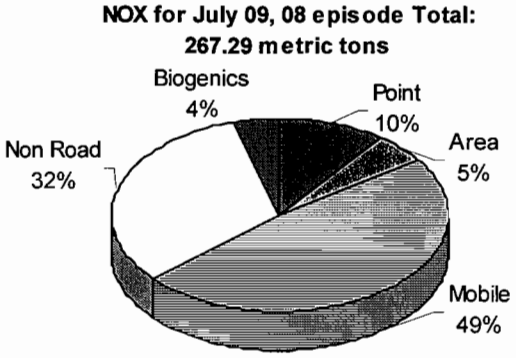
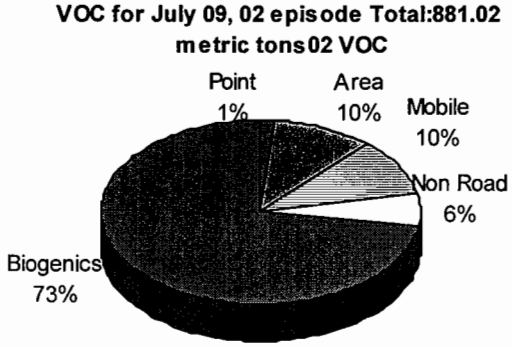


Table V-17(d). VOC emissions by source category for a July episode day in 2002 and 2008 for the ozone modeling domain.

Source Category	July 9, 2002	Tuesday in July 2008	2008-2002 Difference
	Metric Tons per Day	Metric Tons per Day	%
Point	11.73	13.42	14.4
Area	90.56	105.44	15.99
Nonroad Mobile	50.72	57.53	13.4
Onroad Mobile	88.11	67.71	- 23.2
Biogenics	639.90	639.90	0.0
Total	881.02	883.60	- 0.2



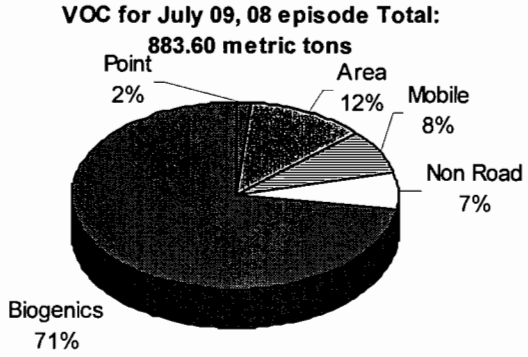
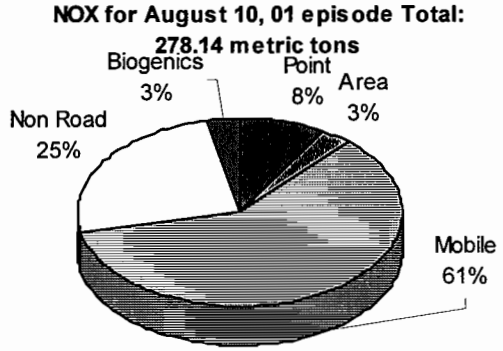


Table V-17(e). NOx emissions by source category for an August episode day in 2001 and 2008 in the ozone modeling domain.

Source Category	August 10, 2001	Friday in August 2008	2008-2001 Difference
	Metric Tons per Day	Metric Tons per Day	%
Point	23.25	26.19	12.64
Area	9.39	13.49	44.01
Nonroad Mobile	68.87	86.90	26.2
Onroad Mobile	167.09	128.21	- 23.27
Biogenics	9.56	9.56	0.0
Total	278.14	264.35	- 4.96



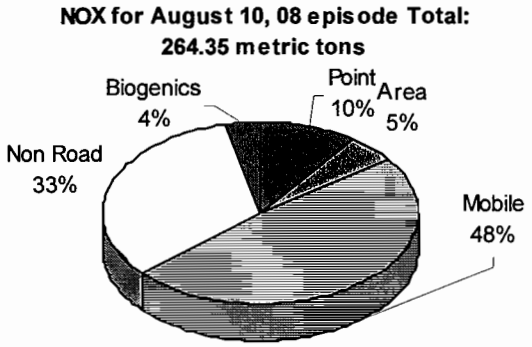
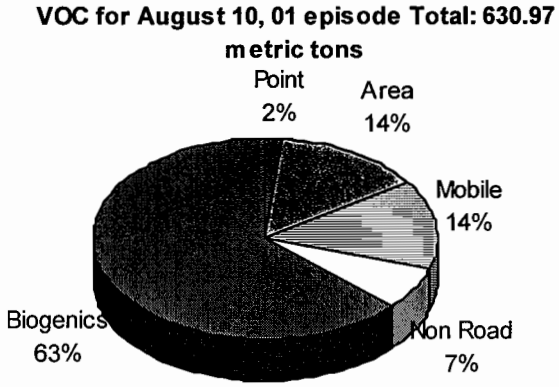
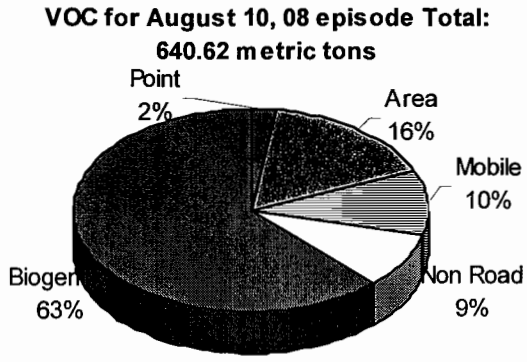


Table V-17(f). VOC emissions by source category for an August episode day in 2001 and 2008 for the ozone modeling domain.

Source Category	August 10, 2001	Friday in August 2008	2008-2001 Difference
	Metric Tons per Day	Metric Tons per Day	%
Point	10.27	13.42	30.7
Area	87.66	105.04	19.81
Nonroad Mobile	44.19	57.55	30.25
Onroad Mobile	90.43	66.18	- 26.8
Biogenics	398.43	398.43	0.0
Total	630.97	640.62	1.53





higher for the June and July episodes in 2008 than in 2002. However, for the August episode, the increase in NOx between 2001 and 2008 is only 13 percent. This is due to the fact that there was an energy crisis during the summer of 2001 and the power plants in the MNA were operating at peak capacity. For the June and July episodes, point source VOC emissions increase by 14-16 percent between 2002 and 2008. The point source VOC emissions increase by 30 percent between August 2001 and August 2008.

Nonroad mobile source emissions increase by 26 percent for NOx and 30 percent for VOC between August 2001 and 2008. Between 2002 and 2008, the increases are 8-9 percent for NOx and 13 percent for VOC. These increases between the base and forecast years occur because the 2008 nonroad emissions were derived by applying 2002 emission factors from the EPA NONROAD model to the projected nonroad equipment population in 2008. The emission reductions associated with the more stringent federal standards for new nonroad equipment purchased between 2002 and 2008 have been excluded from the attainment demonstration. Instead, credit for these emission reductions has been applied as a contingency measure, as discussed in Section V-5.

V-4. Attainment Demonstration

To demonstrate attainment of the national ambient air quality standard for eight-hour ozone, future estimates of eight-hour ozone concentrations should be less than 85 ppb under meteorological conditions for episodes that occurred in the modeling domain. The attainment demonstration followed the deterministic procedure described in the EPA guidance [8].

EPA provided the modeled attainment test (equation (1)) to be applied to individual monitoring sites in the modeling domain.

$$(DVF)_I = (RRF)_I \, (DVB)_I \qquad \text{... (1)}$$

where:

$(DVB)_I$ = the baseline concentration monitored at site I, units in ppb;

$(RRF)_I$ = the relative reduction factor, calculated near site I, unitless
The relative reduction factor is the ratio of the future 8-hour daily maximum concentration predicted near a monitor (averaged over multiple days) to the baseline 8-hour daily maximum concentration predicted near the monitor (averaged over the same days), and

$(DVF)_I$ = the estimated future design value for the year attainment is required, units in ppb. Note that the final future design value is truncated[1].

[1] This effectively defines attainment in the modeled test as <= 84.9 ppb and nonattainment as >= 85.0 ppb [8].

Applying this test requires that several issues be resolved beforehand, such as calculating site-specific baseline concentrations, identifying surface grid cells near a monitoring site, choosing model predicted values to calculate RRF, limiting modeled values chosen to calculate RRF, choosing adequate base years to calculate RRF, and choosing a future year.

The design values at each monitor in 2002 were calculated as the average of the current design values for the periods: 2000-2002, 2001-2003, and 2002-2004. Similarly, the site-specific 2001 design values were calculated as the average of the current design values for the periods: 1999-2001, 2000-2002, and 2001-2003. The current design value for each period was defined as the three year average of the fourth highest daily 8-hour maximum ozone concentration at each site. Tables V-18 and V-19 present calculations of site-specific baseline design values for 2002 and 2001, respectively.

The default recommendation for defining nearby cells for grid systems, which is an array of 7 x 7 grid cells, in the case of 4 km grid cells, was applied in this attainment test. The highest eight-hour ozone maximum value predicted by CAMx among the grid cells near a monitor was used to calculate RRF for each day in the episode period. These daily values were averaged over the number of episode days to obtain the future and baseline concentrations. A minimum concentration threshold of 70 ppb was applied to calculate RRF in this attainment test.

Figure V-6 depicts the daily RRFs vs. the base case daily maximum predicted ozone for all episode days. Tables V-20 through V-22 show that the mean RRF (averaged across all sites) is sensitive to the minimum threshold. As the minimum ozone threshold is increased from 60 ppb to 85 ppb, the RRFs are decreased. On average, the model predicts greater ozone reductions for every 5 ppb increase in the minimum threshold by 0.1 %, 0.3 %, and 0.2 % for the June, July and August episodes, respectively.

Tables V-23 through V-25 present calculations of future design values $(DVF)_i$ for each monitoring site for each episode in June 2008, July 2008, and August 2008, respectively. For the June episode, twelve monitoring sites located in the urban core have incremental RRFs greater than 1, while eight sites in the August episode and three sites in the July episode meet this criteria. Calculated maximum future design values are predicted at the North Phoenix site for all three episodes. In addition to the North Phoenix site, the Humboldt Mountain site has peak 2008 design values of 84 ppb and 83 ppb during the June and July episodes, respectively. The Blue Point monitor also has peak 2008 design values of 83 ppb and 84 ppb during the July and August episodes, respectively. The Pinnacle Peak monitor has a peak 2008 design value of 84 ppb during the August episode. Future design value ranges for the June, July, and August 2008 episodes are: 76~84 ppb, 75~83 ppb, and 73~84 ppb, respectively. Since all of these values are less than the EPA standard of 85 ppb, the MNA passes the eight-hour ozone attainment test for all three modeled episodes during the ozone season of 2008.

Table V-18. Calculation of Site-Specific Baseline Design Value $(DVB)_I$ for Year 2002

Site*	2000-2002	2001-2003	2002-2004	Mean
BP	84	84	82	83.3
CC	-	84	81	82.5
CP	75	76	76	75.7
FF	80	81	77	79.3
FH	84	84	81	83
GL	80	82	81	81
HM	85	87	85	85.7
MV	79	80	-	79.5
NP	85	85	83	84.3
PALV	77	75	75	75.7
PP	85	84	78	82.3
RV	84	83	80	82.3
SP	80	77	76	77.7
SS	79	79	77	78.3
SUPR	77	76	74	75.7
TEMP	79	79	77	78.3
WC	79	79	77	78.3
WP	80	78	77	78.3

* Three sites (AJ, SU, and ME) having only one valid design value period are removed from this table and excluded from attainment test.

Table V-19. Calculation of Site-Specific Baseline Design Value $(DVB)_I$ for Year 2001

Site*	1999-2001	2000-2002	2001-2003	Mean
BP	84	84	84	84
CP	76	75	76	75.7
FF	79	80	81	80
FH	84	84	84	84
GL	79	80	82	80.3
HM	84	85	87	85.3
MV	77	79	80	78.7
ME	77	73	-	75
NP	85	85	85	85
PALV	78	77	75	76.7
PP	85	85	84	84.7
RV	85	84	83	84
SP	74	80	77	77
SS	77	79	79	78.3
SUPR	67	77	76	73.3
TEMP	-	79	79	79
WC	-	79	79	79
WP	82	80	78	80

* Three sites (AJ, SU, and CC) having only one valid design value period are removed from this table.

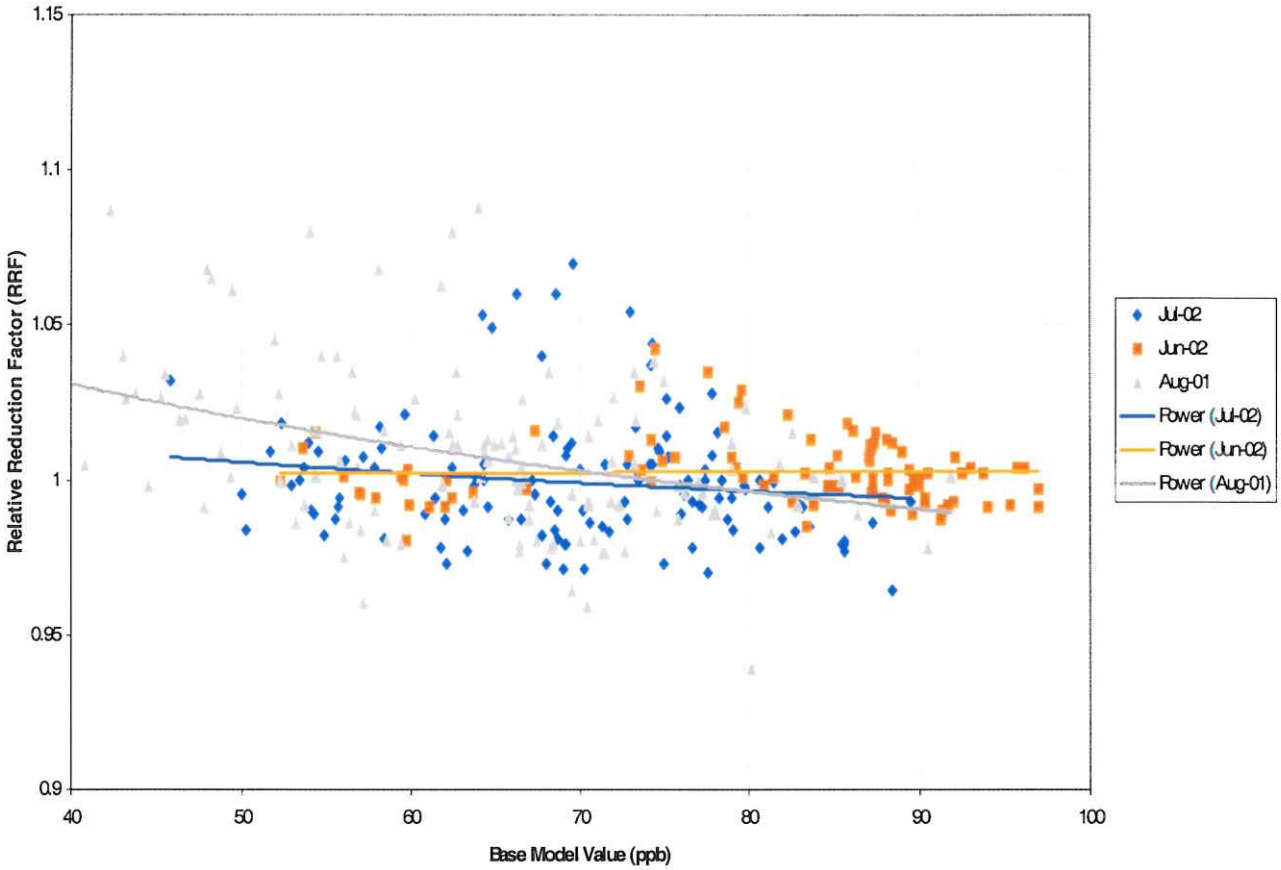


Figure V-6. Daily relative reduction factors as a function of daily maximum base modeled concentrations for monitors in the MNA.

Table V-20. Mean RRFs and standard deviations as a function of various minimum thresholds for the June 2002 episode

Minimum Threshold	Mean RRF	Mean Standard Deviation
60	1.003	0.01
65	1.004	0.01
70	1.004	0.01
75	1.003	0.009
80	1.001	0.008
85	1.001	0.007

Table V-21. Mean RRFs and standard deviations as a function of various minimum thresholds for the July 2002 episode

Minimum Threshold	Mean RRF	Mean Standard Deviation
60	0.999	0.02
65	0.998	0.02
70	0.997	0.016
75	0.996	0.014
80	0.987	0.009
85	0.985	0.009

Table V-22. Mean RRFs and standard deviations as a function of various minimum thresholds for the August 2001 episode

Minimum Threshold	Mean RRF	Mean Standard Deviation
60	1.002	0.022
65	0.998	0.017
70	0.997	0.018
75	0.996	0.015
80	0.992	0.017
85	0.994	0.01

Table V-23. Calculation of Site-Specific Future Design Values $(DVF)_i$ for the June Episode

Site: WP					
Day	Calculated baseline design value, $(DVB)_i$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_i$, (ppb)
6/3		61.98	Not Considered	-	-
6/4		81.5	81.6	-	-
6/5		96.15	96.52	-	-
6/6		86.18	87.54	-	-
6/7		73.69	73.94	-	-
Mean	78.3	84.4	84.9	1.006	78.8 = 78 ppb

Site: NP					
Day	Calculated baseline design value, $(DVB)_i$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_i$, (ppb)
6/3		53.64	Not Considered	-	-
6/4		79.67	79.72	-	-
6/5		93.01	93.4	-	-
6/6		89.49	89.26	-	-
6/7		78.59	79.96	-	-
Mean	84.3	85.2	85.6	1.005	84.7 = 84 ppb

Site: FF					
Day	Calculated baseline design value, $(DVB)_i$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_i$, (ppb)
6/3		52.3	Not Considered	-	-
6/4		83.64	84.74	-	-
6/5		90.02	89.83	-	-
6/6		90.5	90.71	-	-
6/7		85.83	87.34	-	-
Mean	79.3	87.5	88.2	1.008	79.9 = 79 ppb

Table V-23. (Continued).

Site: GL					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
6/3		59.76	Not Considered	-	-
6/4		82.54	81.95	-	-
6/5		93.01	93.4	-	-
6/6		88.12	89.23	-	-
6/7		74.28	75.21	-	-
Mean	81	84.5	84.9	1.005	81.4 = 81 ppb

Site: PP					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
6/3		59.45	Not Considered	-	-
6/4		85.29	85.13	-	-
6/5		95.39	94.59	-	-
6/6		91.25	90.07	-	-
6/7		85.2	85.85	-	-
Mean	82.3	89.3	88.9	0.996	82 = 82 ppb

Site: CP					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
6/3		59.93	Not Considered	-	-
6/4		80.92	80.77	-	-
6/5		95.8	96.15	-	-
6/6		87.47	88.77	-	-
6/7		74.56	77.7	-	-
Mean	75.7	84.7	85.8	1.013	76.7 = 76 ppb

Table V-23. (Continued).

Site: SS					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		56.05	Not Considered	-	-
6/4		79.42	81.4	-	-
6/5		92.13	92.73	-	-
6/6		90.5	90.71	-	-
6/7		82.33	84.1	-	-
Mean	78.3	86.1	87.2	1.013	79.3 = 79 ppb

Site: MV					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		62.42	Not Considered	-	-
6/4		82.54	81.95	-	-
6/5		96.15	96.51	-	-
6/6		87.87	87.36	-	-
6/7		74.28	74.24	-	-
Mean	79.5	85.2	85	0.998	79.3 = 79 ppb

Site: SP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		61.08	Not Considered	-	-
6/4		81.48	81.6	-	-
6/5		96.15	96.51	-	-
6/6		84.77	85.07	-	-
6/7		72.95	73.52	-	-
Mean	77.7	83.8	84.2	1.005	78.1 = 78 ppb

Table V-23. (Continued).

Site: WC					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		57	Not Considered	-	-
6/4		78.98	79.57	-	-
6/5		92.53	92.75	-	-
6/6		85.13	84.93	-	-
6/7		75.67	76.17	-	-
Mean	78.3	83.1	83.4	1.004	78.6 = 78 ppb

Site: TEMP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		57.89	Not Considered	-	-
6/4		79.25	79.59	-	-
6/5		93.79	93.99	-	-
6/6		89.08	89.87	-	-
6/7		77.62	80.35	-	-
Mean	78.3	84.9	85.9	1.012	79.2 = 79 ppb

Site: CC					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		59.56	Not Considered	-	-
6/4		87.22	86.84	-	-
6/5		97.03	96.15	-	-
6/6		91.35	90.4	-	-
6/7		83.33	83.47	-	-
Mean	82.5	89.7	89.2	0.994	82 = 82 ppb

Table V-23. (Continued).

Site: HM					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		59.56	Not Considered	-	-
6/4		88.41	87.55	-	-
6/5		94.03	93.21	-	-
6/6		83.44	82.22	-	-
6/7		83.83	83.12	-	-
Mean	85.7	87.4	86.5	0.99	84.8 = 84 ppb

Site: BP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		59.85	Not Considered	-	-
6/4		88.2	88.19	-	-
6/5		90.35	89.78	-	-
6/6		89.67	89.68	-	-
6/7		87.11	88.08	-	-
Mean	83.3	88.8	88.9	1.001	83.4 = 83 ppb

Site: FH					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
6/3		59.45	Not Considered	-	-
6/4		86.31	86.37	-	-
6/5		91.66	90.93	-	-
6/6		90.5	90.71	-	-
6/7		87.07	87.64	-	-
Mean	83	88.9	88.9	1	83 = 83 ppb

Table V-23. (Concluded).

Site: RV					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
6/3		62.1	Not Considered	-	-
6/4		88.08	87.5	-	-
6/5		90.4	89.69	-	-
6/6		89.95	90.03	-	-
6/7		87.12	87.64	-	-
Mean	82.3	88.9	88.7	0.998	82.1 = 82 ppb

Site: PALV					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
6/3		66.85	Not Considered	-	-
6/4		84.64	84.51	-	-
6/5		88.46	89.48	-	-
6/6		89.44	89.71	-	-
6/7		67.42	Not Considered	-	-
Mean	75.7	87.5	87.9	1.005	76.1 = 76 ppb

Site: SUPR					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
6/3		61.08	Not Considered	-	-
6/4		81.48	81.6	-	-
6/5		96.15	96.51	-	-
6/6		87.37	88.41	-	-
6/7		73.63	75.87	-	-
Mean	75.7	84.7	85.6	1.011	76.5 = 76 ppb

Table V-24. Calculation of Site-Specific Future Design Values $(DVF)_l$ for the July Episode

Site: WP					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
7/8		66.3	Not Considered	-	-
7/9		89.56	88.92	-	-
7/10		68.34	Not Considered	-	-
7/11		71.57	71.9	-	-
7/12		77.45	77.7	-	-
7/13		68.71	Not Considered	-	-
7/14		54.54	Not Considered	-	-
Mean	78.3	79.5	79.5	1	78.3 = 78 ppb

Site: NP					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
7/8		73.36	74.61	-	-
7/9		87.28	86.04	-	-
7/10		72.67	72.13	-	-
7/11		76.68	76.12	-	-
7/12		83.58	82.29	-	-
7/13		71.75	70.51	-	-
7/14		61.4	Not Considered	-	-
Mean	84.3	77.6	77	0.992	83.6 = 83 ppb

Site: FF					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
7/8		75.94	77.7	-	-
7/9		68.53	Not Considered	-	-
7/10		79.01	78.56	-	-
7/11		75.91	75.75	-	-
7/12		83.02	82.38	-	-
7/13		79.87	79.62	-	-
7/14		67.26	Not Considered	-	-
Mean	79.3	78.8	78.8	1	79.3 = 79 ppb

Table V-24. (Continued).

Site: GL					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		67.79	Not Considered	-	-
7/9		89.56	88.92	-	-
7/10		64.3	Not Considered	-	-
7/11		76.68	76.12	-	-
7/12		78.46	78.45	-	-
7/13		65.83	Not Considered	-	-
7/14		57.88	Not Considered	-	-
Mean	81	81.6	81.2	0.995	80.6 = 80 ppb

Site: PP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		74.66	75.39	-	-
7/9		62.1	Not Considered	-	-
7/10		69.03	Not Considered	-	-
7/11		80.69	78.9	-	-
7/12		85.65	83.87	-	-
7/13		75	72.97	-	-
7/14		66.53	Not Considered	-	-
Mean	82.3	79	77.8	0.985	81.1 = 81 ppb

Site: CP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		69.6	Not Considered	-	-
7/9		87.28	86.04	-	-
7/10		72.67	72.13	-	-
7/11		74.22	74.58	-	-
7/12		80.65	80.66	-	-
7/13		71.75	70.51	-	-
7/14		57.21	Not Considered	-	-
Mean	75.7	77.3	76.8	0.994	75.2 = 75 ppb

Table V-24. (Continued).

Site: SS					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		74.27	77.02	-	-
7/9		77.82	79.99	-	-
7/10		76.41	76.4	-	-
7/11		76.16	75.75	-	-
7/12		83.14	82.38	-	-
7/13		77.86	78.5	-	-
7/14		64.54	Not Considered	-	-
Mean	78.3	77.6	78.3	1.009	79 = 79 ppb

Site: MV					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		64.27	Not Considered	-	-
7/9		89.56	88.92	-	-
7/10		64.3	Not Considered	-	-
7/11		70.01	70.24	-	-
7/12		74.34	74.74	-	-
7/13		65.83	Not Considered	-	-
7/14		53.71	Not Considered	-	-
Mean	79.5	78	78	1	79.5 = 79 ppb

Site: SP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		64.81	Not Considered	-	-
7/9		89.56	88.92	-	-
7/10		71.41	70.35	-	-
7/11		68.43	Not Considered	-	-
7/12		74.8	75.51	-	-
7/13		70.2	69.48	-	-
7/14		52.35	Not Considered	-	-
Mean	77.7	76.5	76.1	0.995	77.3 = 77 ppb

Table V-24. (Continued).

Site: WC					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		59.69	Not Considered	-	-
7/9		73.4	73.64	-	-
7/10		75.15	76.23	-	-
7/11		58.22	Not Considered	-	-
7/12		69.55	Not Considered	-	-
7/13		78.18	79.34	-	-
7/14		58.14	Not Considered	-	-
Mean	78.3	75.6	76.4	1.011	79.2 = 79 ppb

Site: TEMP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		73.06	77.02	-	-
7/9		77.82	79.99	-	-
7/10		76.41	76.4	-	-
7/11		72.84	73.21	-	-
7/12		81.4	81.4	-	-
7/13		77.86	78.5	-	-
7/14		62.43	Not Considered	-	-
Mean	78.3	76.6	77.8	1.016	79.6 = 79 ppb

Site: CC					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		72.9	71.98	-	-
7/9		68.05	Not Considered	-	-
7/10		63.35	Not Considered	-	-
7/11		81.97	80.45	-	-
7/12		85.65	83.65	-	-
7/13		69.25	Not Considered	-	-
7/14		63.04	Not Considered	-	-
Mean	82.5	80.2	78.7	0.981	80.9 = 80 ppb

Table V-24. (Continued).

Site: HM					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		61.71	Not Considered	-	-
7/9		50.02	Not Considered	-	-
7/10		54.88	Not Considered	-	-
7/11		67.8	Not Considered	-	-
7/12		77.57	75.25	-	-
7/13		62	Not Considered	-	-
7/14		56.92	Not Considered	-	-
Mean	85.7	77.6	75.2	0.969	83 = 83 ppb

Site: BP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		75.94	77.7	-	-
7/9		60.8	Not Considered	-	-
7/10		79.01	78.56	-	-
7/11		77.11	76.52	-	-
7/12		82.75	81.34	-	-
7/13		79.87	79.62	-	-
7/14		69.19	Not Considered	-	-
Mean	83.3	78.9	78.7	0.997	83.1 = 83 ppb

Site: FH					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		75.94	77.7	-	-
7/9		58.39	Not Considered	-	-
7/10		76.67	75.02	-	-
7/11		77.25	76.52	-	-
7/12		85.61	83.87	-	-
7/13		78.79	77.75	-	-
7/14		68.72	Not Considered	-	-
Mean	83	78.9	78.2	0.991	82.3 = 82 ppb

Table V-24. (Concluded).

Site: RV					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		75.27	75.8	-	-
7/9		50.25	Not Considered	-	-
7/10		70.29	68.24	-	-
7/11		77.25	76.52	-	-
7/12		85.5	83.7	-	-
7/13		75	72.97	-	-
7/14		69.17	Not Considered	-	-
Mean	82.3	76.7	75.4	0.983	80.9 = 80 ppb

Site: PALV					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		45.91	Not Considered	-	-
7/9		63.72	Not Considered	-	-
7/10		55.54	Not Considered	-	-
7/11		51.73	Not Considered	-	-
7/12		53.96	Not Considered	-	-
7/13		52.94	Not Considered	-	-
7/14		53.48	Not Considered	-	-
Mean	75.7	N/A	N/A	N/A	N/A

Site: SUPR					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
7/8		68.64	Not Considered	-	-
7/9		89.56	88.92	-	-
7/10		71.41	70.35	-	-
7/11		73.49	73.52	-	-
7/12		79.79	79.63	-	-
7/13		70.6	69.6	-	-
7/14		56.06	Not Considered	-	-
Mean	75.7	77	76.4	0.992	75.1 = 75 ppb

Table V-25. Calculation of Site-Specific Future Design Values (DVF) for the August Episode.

Site: WP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, (DVF), (ppb)
8/5		45.55	Not Considered	-	-
8/6		73.26	75.83	-	-
8/7		64.3	Not Considered	-	-
8/8		68.7	Not Considered	-	-
8/9		48.23	Not Considered	-	-
8/10		58.1	Not Considered	-	-
8/11		91.87	91.94	-	-
Mean	80	82.6	83.9	1.016	81.3 = 81 ppb

Site: ME					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		58.46	Not Considered	-	-
8/6		70.53	70.01	-	-
8/7		65.78	Not Considered	-	-
8/8		65.38	Not Considered	-	-
8/9		54.38	Not Considered	-	-
8/10		73.32	74.69	-	-
8/11		78.97	79.89	-	-
Mean	75	74.3	74.9	1.008	75.6 = 75 ppb

Site: NP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		52.32	Not Considered	-	-
8/6		79.03	79.26	-	-
8/7		68.44	Not Considered	-	-
8/8		75.82	75.7	-	-
8/9		55.63	Not Considered	-	-
8/10		68.2	Not Considered	-	-
8/11		90.56	88.53	-	-
Mean	85	81.8	81.2	0.993	84.4 = 84 ppb

Table V-25. (Continued).

Site: FF					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
8/5		62.78	Not Considered	-	-
8/6		68.28	Not Considered	-	-
8/7		66.54	Not Considered	-	-
8/8		67.84	Not Considered	-	-
8/9		59.46	Not Considered	-	-
8/10		79.83	81.67	-	-
8/11		77.2	76.88	-	-
Mean	80	78.5	79.3	1.01	80.8 = 80 ppb

Site: GL					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
8/5		46.74	Not Considered	-	-
8/6		74.99	77.41	-	-
8/7		66.44	Not Considered	-	-
8/8		71.93	72.34	-	-
8/9		51.95	Not Considered	-	-
8/10		62.69	Not Considered	-	-
8/11		91.87	91.94	-	-
Mean	80.3	79.6	80.6	1.013	81.3 = 81 ppb

Site: PP					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
8/5		57.86	Not Considered	-	-
8/6		81.84	82.24	-	-
8/7		69.54	Not Considered	-	-
8/8		78.09	77.26	-	-
8/9		66.59	Not Considered	-	-
8/10		83.78	83.88	-	-
8/11		70.56	70.01	-	-
Mean	84.7	78.6	78.3	0.996	84.4 = 84 ppb

Table V-25. (Continued).

Site: CP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		49.75	Not Considered	-	-
8/6		74.63	73.89	-	-
8/7		64.58	Not Considered	-	-
8/8		66.64	Not Considered	-	-
8/9		47.95	Not Considered	-	-
8/10		62.41	Not Considered	-	-
8/11		90.56	88.53	-	-
Mean	75.7	82.6	81.2	0.983	74.4 = 74 ppb

Site: SS					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		56.76	Not Considered	-	-
8/6		76.16	75.83	-	-
8/7		66.79	Not Considered	-	-
8/8		71.15	72.5	-	-
8/9		56.5	Not Considered	-	-
8/10		74.42	77.26	-	-
8/11		78.97	79.89	-	-
Mean	78.3	75.2	76.4	1.016	79.6 = 79 ppb

Site: MV					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		43.81	Not Considered	-	-
8/6		63.99	Not Considered	-	-
8/7		66.03	Not Considered	-	-
8/8		66.25	Not Considered	-	-
8/9		48.79	Not Considered	-	-
8/10		54.72	Not Considered	-	-
8/11		91.87	91.94	-	-
Mean	78.7	91.9	91.9	1	78.7 = 78 ppb

Table V-25. (Continued).

Site: SP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		46.35	Not Considered	-	-
8/6		70.53	70.01	-	-
8/7		62.38	Not Considered	-	-
8/8		60.24	Not Considered	-	-
8/9		45.3	Not Considered	-	-
8/10		54.06	Not Considered	-	-
8/11		91.87	91.94	-	-
Mean	77	81.2	81	0.998	76.8 = 76 ppb

Site: WC					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		54.32	Not Considered	-	-
8/6		66.27	Not Considered	-	-
8/7		64.13	Not Considered	-	-
8/8		61.79	Not Considered	-	-
8/9		49.36	Not Considered	-	-
8/10		55.8	Not Considered	-	-
8/11		76.99	76.88	-	-
Mean	79	77	76.9	0.999	78.9 = 78 ppb

Site: TEMP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		56.69	Not Considered	-	-
8/6		70.53	70.01	-	-
8/7		65.78	Not Considered	-	-
8/8		64.58	Not Considered	-	-
8/9		52.18	Not Considered	-	-
8/10		72	73.93	-	-
8/11		78.97	79.89	-	-
Mean	79	73.8	74.6	1.011	79.9 = 79 ppb

Table V-25. (Continued).

Site: HM					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		44.59	Not Considered	-	-
8/6		81.33	79.91	-	-
8/7		58.6	Not Considered	-	-
8/8		70.91	69.54	-	-
8/9		56.04	Not Considered	-	-
8/10		70.43	67.53	-	-
8/11		47.76	Not Considered	-	-
Mean	85.3	74.2	72.3	0.974	83.1 = 83 ppb

Site: BP					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		64.99	Not Considered	-	-
8/6		67.5	Not Considered	-	-
8/7		66.21	Not Considered	-	-
8/8		73.31	73.69	-	-
8/9		62.25	Not Considered	-	-
8/10		82.61	83.86	-	-
8/11		67.09	Not Considered	-	-
Mean	84	78	78.8	1.01	84.8 = 84 ppb

Site: FH					
Day	Calculated baseline design value, $(DVB)_I$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_I$, (ppb)
8/5		62.78	Not Considered	-	-
8/6		72.67	70.98	-	-
8/7		66.79	Not Considered	-	-
8/8		78.09	77.26	-	-
8/9		64.3	Not Considered	-	-
8/10		85.44	85.45	-	-
8/11		71.36	69.64	-	-
Mean	84	76.9	75.8	0.986	82.8 = 82 ppb

Table V-25. (Concluded).

Site: RV					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
8/5		59.41	Not Considered	-	-
8/6		71.56	69.82	-	-
8/7		66.22	Not Considered	-	-
8/8		77.81	76.97	-	-
8/9		67.02	Not Considered	-	-
8/10		86.43	85.47	-	-
8/11		57.19	Not Considered	-	-
Mean	84	78.6	77.4	0.985	82.7 = 82 ppb

Site: PALV					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
8/5		36.79	Not Considered	-	-
8/6		42.33	Not Considered	-	-
8/7		56.81	Not Considered	-	-
8/8		52.94	Not Considered	-	-
8/9		43.21	Not Considered	-	-
8/10		43.07	Not Considered	-	-
8/11		53.69	Not Considered	-	-
Mean	76.7	N/A	N/A	N/A	N/A

Site: SUPR					
Day	Calculated baseline design value, $(DVB)_l$, (ppb)	Baseline 8-hr daily max. concentration at monitor (ppb)	Future predicted 8-hr daily max. concentration at monitor (ppb)	Relative reduction factor (RRF)	Future design value, $(DVF)_l$, (ppb)
8/5		47.55	Not Considered	-	-
8/6		76.16	75.83	-	-
8/7		66.48	Not Considered	-	-
8/8		70.53	71.52	-	-
8/9		49.5	Not Considered	-	-
8/10		61.78	Not Considered	-	-
8/11		91.87	91.94	-	-
Mean	73.3	79.5	79.8	1.004	73.6 = 73 ppb

CORROBORATORY TESTS

Because the 2008 design values exceeded 80 ppb, as described in the modeling protocol for the Eight-Hour Ozone Plan, additional analyses were conducted to confirm that attainment of the NAAQS for eight-hour ozone is likely to occur. One of these analyses was a screening test recommended by EPA[8].

The screening test is intended to ensure that ozone will not exceed the standard in locations that are not near (i.e., in the 7 x 7 grid array surrounding) a monitor. In general, this test is performed for the identified areas in the nonattainment area where predicted eight-hour daily maximum ozone concentrations are "consistently greater" than any predicted in the vicinity of a monitoring site. However, this test was performed for the entire 4 km domain (i.e., 50 x 29 cells; 1450 cells) in this attainment demonstration. A 7 x 7 array of grid cells was constructed around each cell in the 4 km domain. For each cell, the design value was estimated by multiplying the modeled RRF by the current design value of each cell estimated by spatial interpolation. Figures V-7 and V-8 show isopleth plots of the current design value estimated by spatial interpolation for the years 2001 and 2002, respectively. The isopleth plots of modeled RRFs for the June 2002, July 2002, and August 2001 episodes are depicted in Figures V-9 through V-11, respectively. The resulting estimates shown in Figures V-12 through V-14 are less than or equal to 84 ppb at all locations in the nonattainment area for each modeling episode. So the screening test is passed.

In addition to the screening test, a weight of evidence analysis was conducted to support the modeling conclusion that the eight-hour ozone standard will be attained by June 15, 2009 [6]. Excerpts from the summary section of the weight of evidence analysis prepared by ENVIRON International Corporation are quoted below (see Pages 26- 27 of Appendix 5).

> *The weight of evidence analyses support the numerical modeling demonstration that the MNA will attain the 8-hour ozone standard by the attainment year of 2009 with current emission reduction programs and existing assumptions for population growth and economic development. The weight of evidence analyses considered...ambient ozone and NOx concentration trends, precursor emission trends, and ozone sensitivity to changes in NOx vs. VOC.*

Highlights of the conclusions from the weight of evidence analysis include:

- *The MNA is exhibiting downward trends in ozone using several metrics, namely the number of annual violations of the 8-hour standard, the basinwide 8-hour ozone Design Value, and the basinwide annual 4th highest 8-hour ozone concentration;*
- *The largest ozone reductions have occurred for urban sites;*
- *The MNA is exhibiting large reductions in ozone precursor (NOx and VOC) emissions;*
    - *Historically, mobile-source controls have more than offset VMT growth in the region and have contributed to reductions in ozone precursor concentrations;*

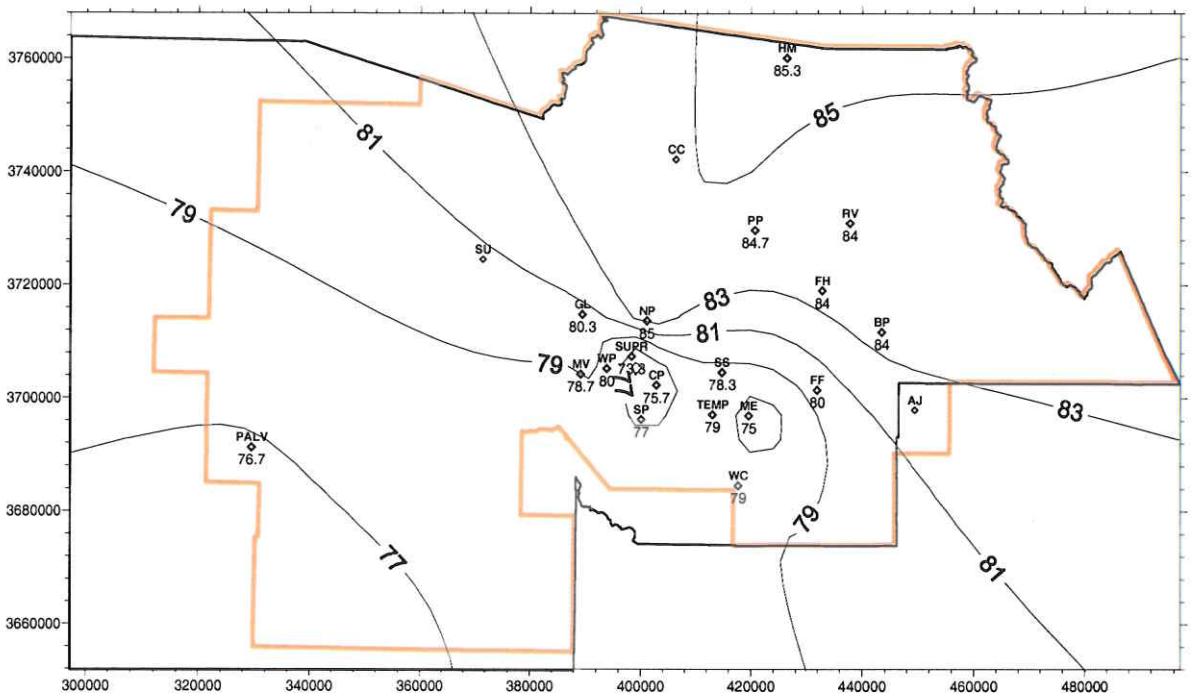


Figure V-7. Isopleth of the current design value estimated by spatial interpolation for the year 2001.

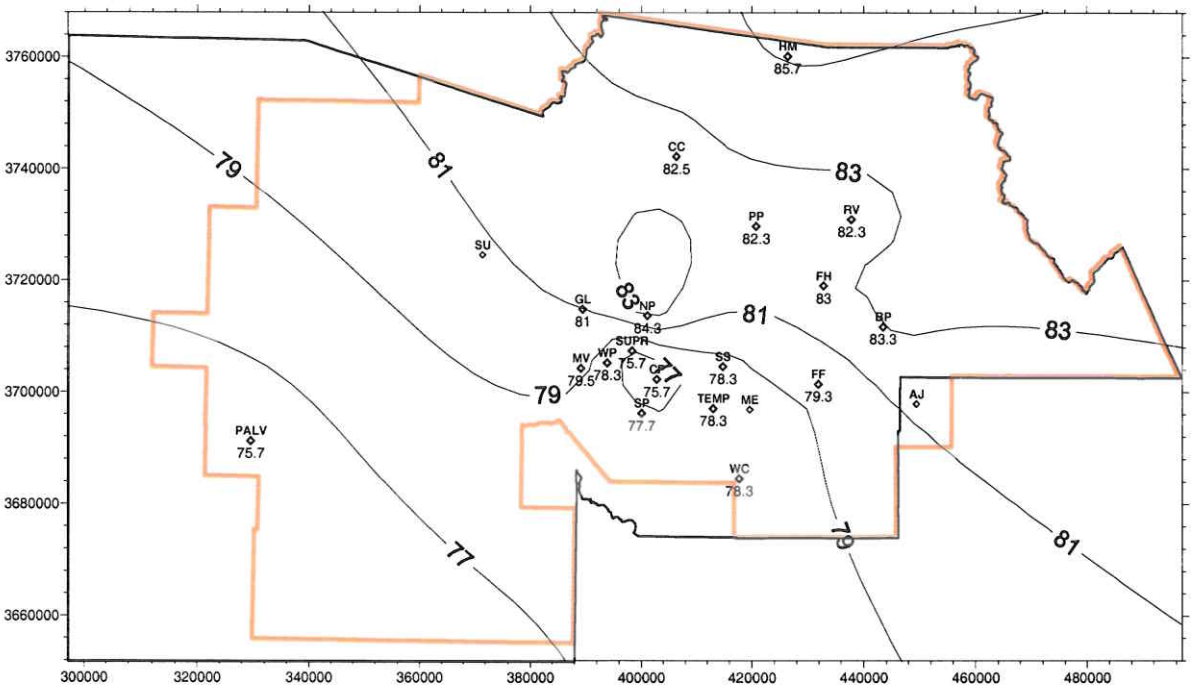


Figure V-8. Isopleth of the current design value estimated by spatial interpolation for the year 2002.

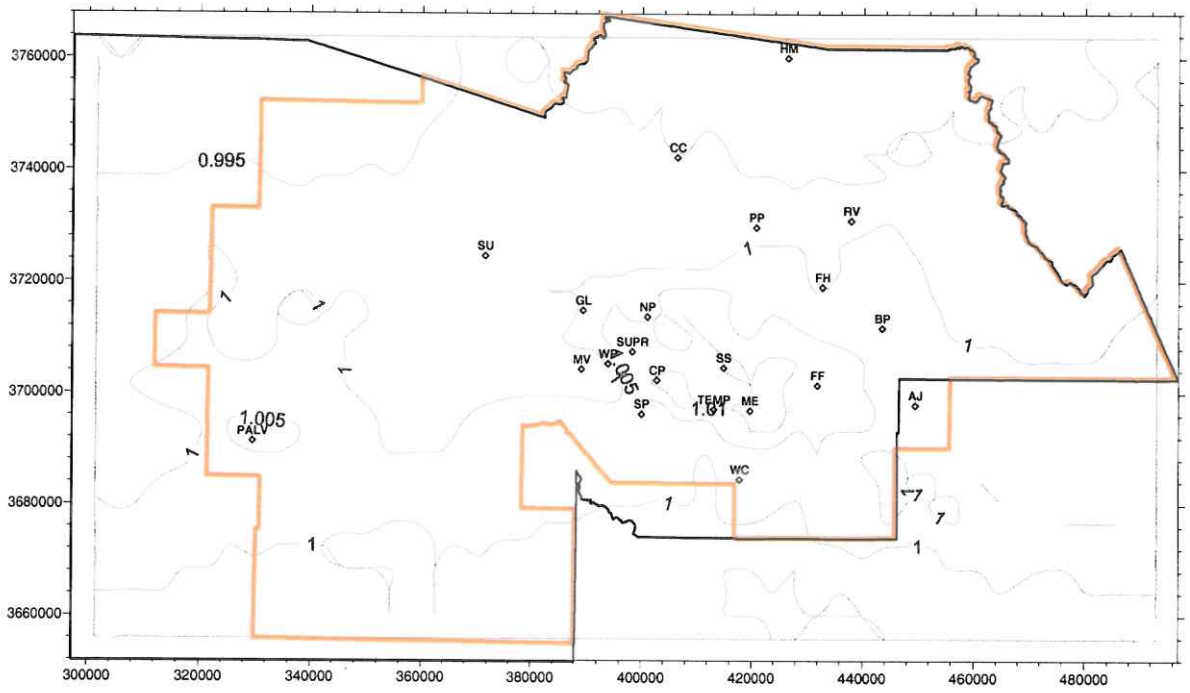


Figure V-9. Isopleth of the modeled RRF for the June 2002 episode.

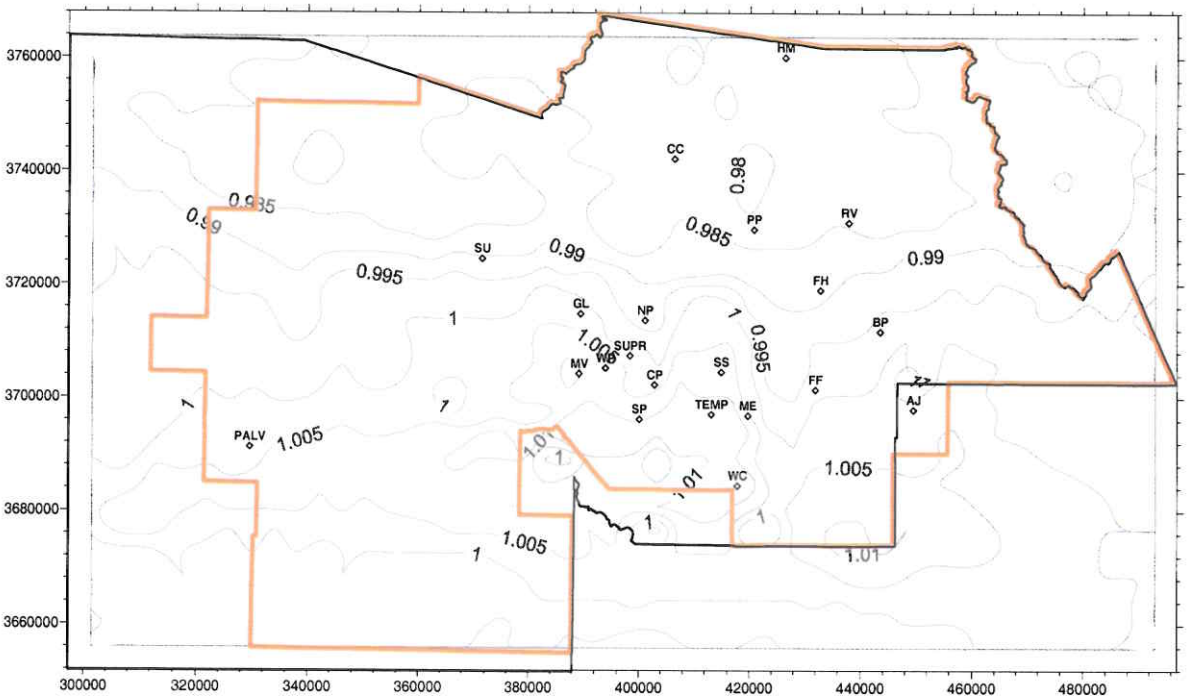


Figure V-10. Isopleth of the modeled RRF for the July 2002 episode

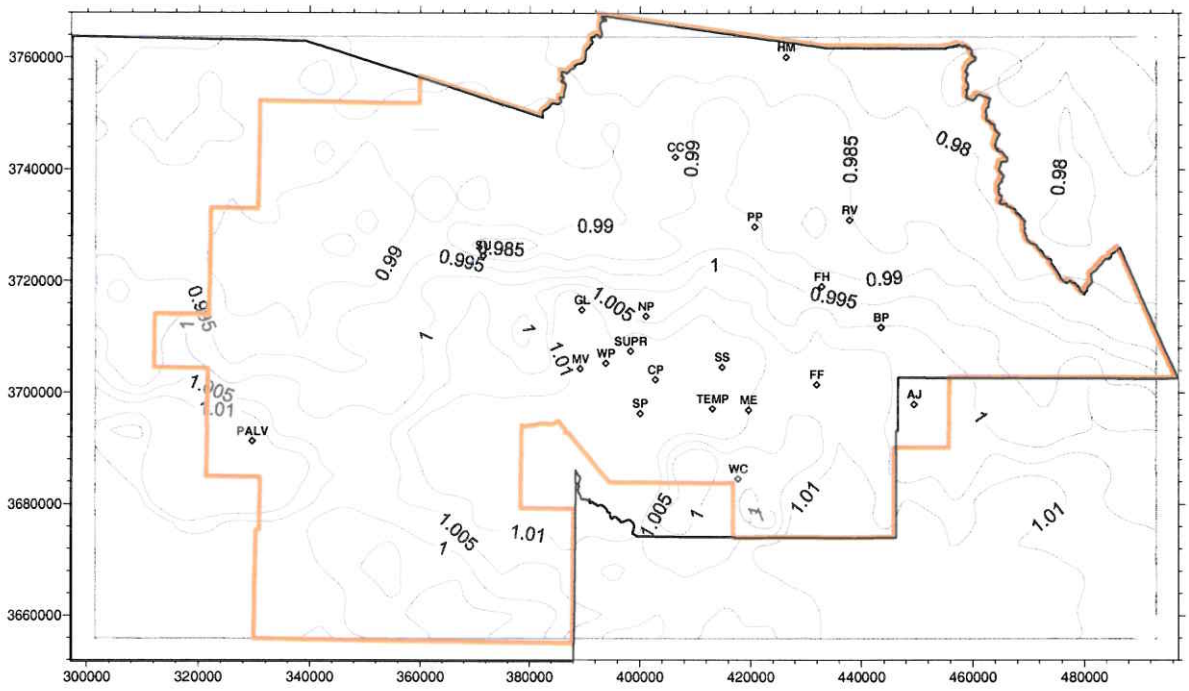


Figure V-11. Isopleth of the modeled RRF for the August 2001 episode

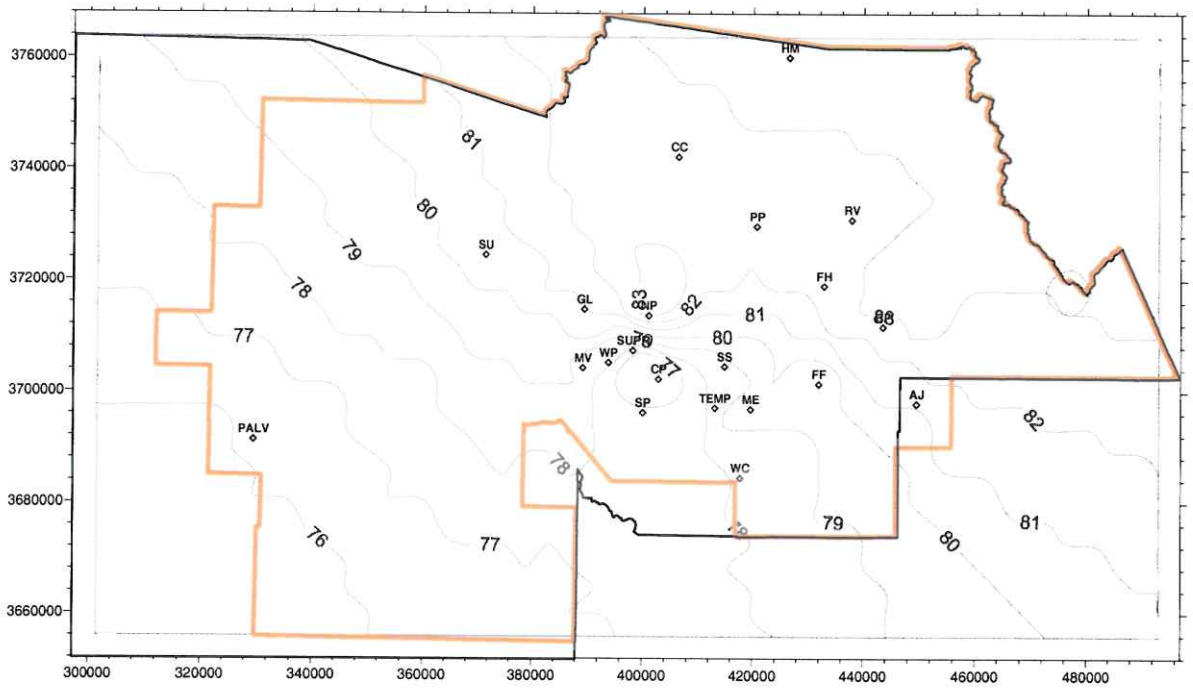


Figure V-12. Isopleth of the future design value for the June 2002 episode. (Max: 84 ppb)

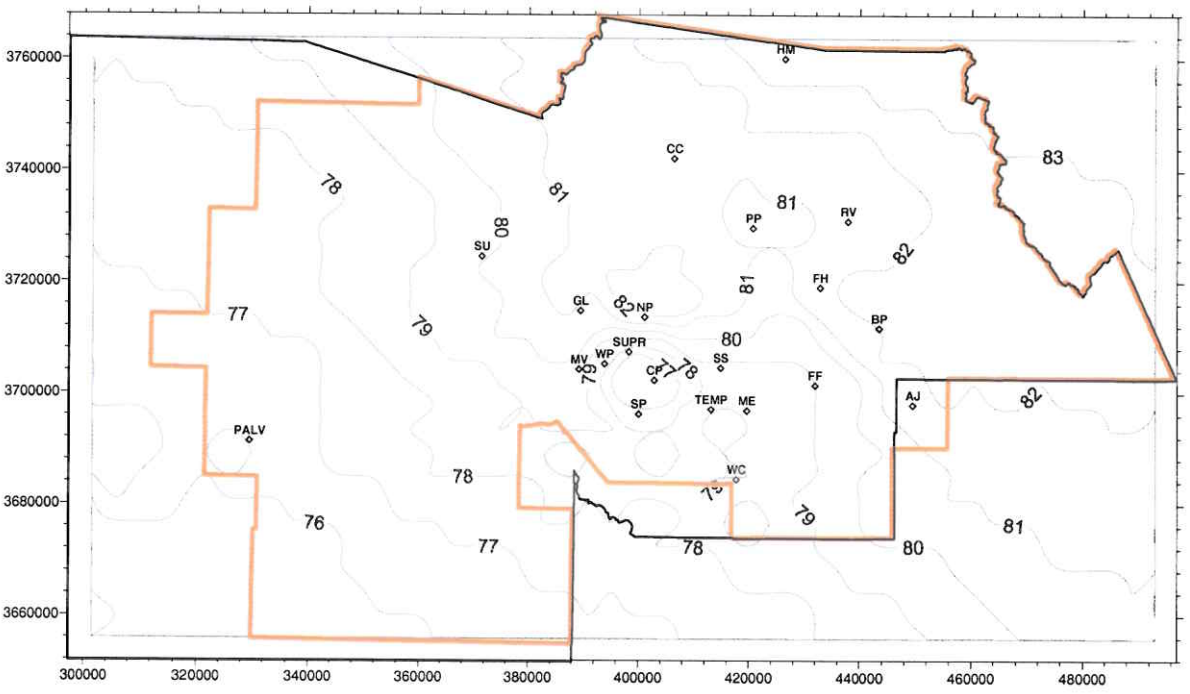


Figure V-13. Isopleth of the future design value for the July 2002 episode. (Max: 83 ppb)

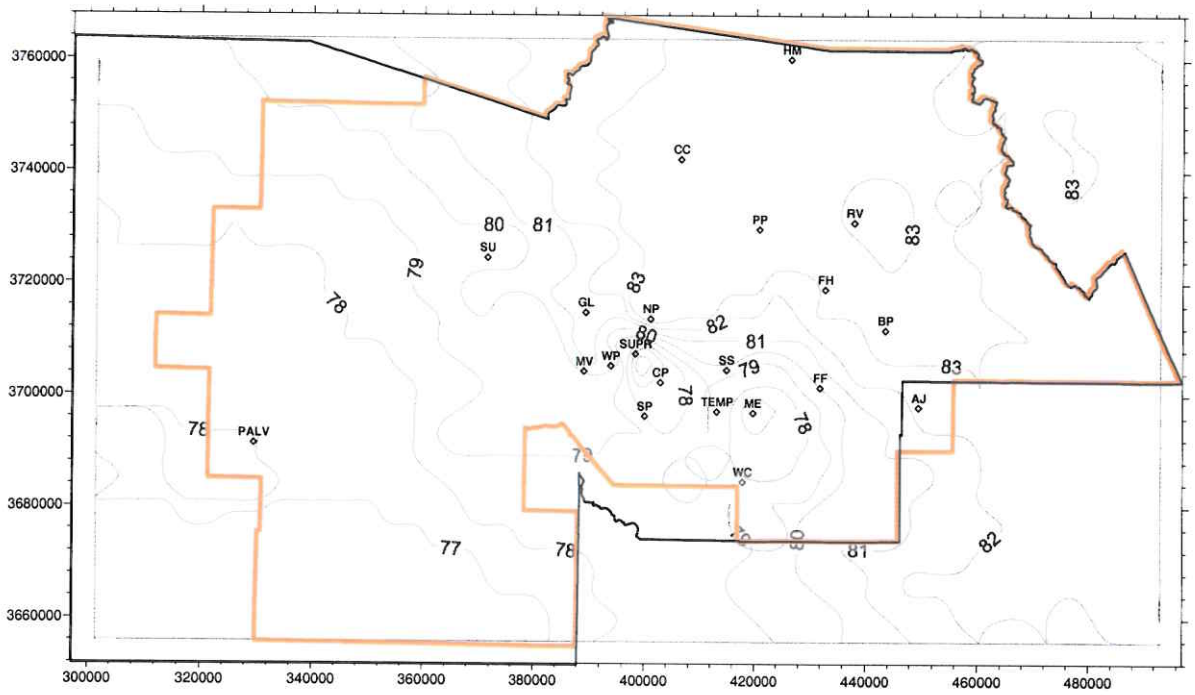


Figure V-14. Isopleth of the future design value for the August 2001 episode. (Max: 84 ppb)

- *In the future, VMT is projected to grow by 84% in th next 20 years but increasingly stringent federal emission standards for vehicles and fuels will lead to VOC and NOx emissions reductions that are about double the needed offsets to maintain the ozone standard;*

- *Comparison of modeled and measured VOC composition (i.e., PAMS measurements) shows that the model is accurately reproducing VOC composition in central Phoenix. This finding build confidence in the ability of the photochemical model to characterize ozone photochemistry in Phoenix.*

The complete documentation for the weight of evidence analysis is provided in Appendix V.

MODELING RELIABILITY AND UNCERTAINTIES

The CAMx photochemical grid model has been identified as one tool for projecting attainment of the air quality standard for ozone. However, future year modeling results should not be considered absolute guarantees of future air quality. Uncertainties in the models used and their inputs, along with meteorological variability, may result in actual future air quality that differs from predicted air quality. Higher concentrations than those modeled may occur for any of the following reasons:

- Meteorological variability - In selecting a modeling episode, the goal is to select periods that represent worst-case conditions. If episodes with more severe stagnation occur in the future, emission controls designed to reach attainment for a historical episode may not be adequate.

- Emissions variability - Emission estimates are based on average source usage, taking into account seasonal, diurnal, and day-of-week factors. Onroad mobile emissions take into account day-specific temperatures as well. However, emissions on a given day may be greater than average due to greater than average usage, lower temperatures, or other factors.

- Uncertainty in growth projections - If growth projections underestimate true growth rates, future year emissions may be greater than projected emissions.

- Uncertainty in control measure effectiveness - If actual emission reductions from a given control measure are smaller than the estimated emission reductions, future year concentrations may be greater than modeled concentrations.

- Model performance - If the model under predicted concentrations at a particular site, or failed to capture a particular aspect of the meteorology, then a level of emission reduction that appeared to be adequate during modeling may not actually be adequate.

By similar reasoning, future measured concentrations may be lower than modeled concentrations because of these variability and uncertainties.

SUMMARY

As discussed above, the CAMx simulations incorporated existing committed control measures to demonstrate attainment of the eight-hour ozone standard in 2008. Based on the photochemical modeling, the peak ozone concentration is estimated to be 0.084 ppm in 2008, which is less than the 0.085 ppm standard. It is important to note that the measures discussed in Section V are legally enforceable commitments that will continue to provide air quality benefits beyond the attainment date. The strength and level of commitments provided by the State, County, and local governments, combined with no monitored violations of the ozone standard since 2004, provide confidence in the attainment demonstration and the prospect for continued clean air in 2008 and beyond.

V-5. Contingency Measures

Section 172(c)(9) of the Clean Air Act requires that nonattainment plans contain contingency measures. Such measures are to be undertaken without further action by the State or the EPA Administrator if the area fails to make reasonable further progress or meet the standard by the attainment date. Committed measures that have already been implemented may be contingency measures if they are not needed to show attainment and do not hasten attainment. EPA also allows federal measures to be contingency measures if they are not needed for attainment [9].

The five contingency measures in the Eight-Hour Ozone Plan are: Area A Expansion (H.B. 2538); Gross Polluter Option for I/M Program Waivers; Increased Waiver Repair Limit Options; Federal Heavy Duty Diesel Vehicle Emission Standards, and Federal Nonroad Equipment Emission Standards. Emission reduction credit for these contingency measures was not taken in modeling attainment of the eight-hour ozone standard in 2008.

A description of the individual contingency measures was provided in Section V-2-2. Early implementation of the local contingency measures and the phased implementation of the federal measures provide additional confidence that the eight-hour ozone standard will be attained in 2008 and beyond.

Table V-4 quantifies the emission reduction credit attributable to each of the contingency measures, relative to the base case emissions on June 6, 2002. Figures V-3 and V-4 compare the emission reductions for individual contingency measures. The methodologies for quantifying the emission reduction credit for the contingency measures were described in Section Four.

Although there is no mandated emissions reduction threshold for contingency measures, EPA recommends that contingency measures provide a minimum reduction of three percent, relative to the base year, in VOC and NOx emissions, with at least a 0.3 percent reduction in VOC emissions [7]. As indicated in Table V-4, the reductions attributable to the contingency measures are 15.9 metric tons per day of VOC and 18.8 metric tons per day of NOx. These represent a 2.3 percent reduction in VOC emissions and a 6.4 percent reduction in NOx emissions, relative to base case emissions on June 6, 2002.

The combined VOC and NOx reductions of 8.7 percent surpasses the EPA-recommended value of three percent. In addition, the 2.3 percent reduction in VOC emissions exceeds the EPA-recommended value of 0.3 percent. Therefore, the EPA recommendations for emission reductions from contingency measures are satisfied.

The modeled attainment demonstration discussed earlier in this section did not assume emission reduction credit for the contingency measures . Supplemental analyses have indicated that the contingency measures would not reduce the peak modeled ozone concentrations in June, July, or August 2008. Therefore, inclusion of these contingency measures in the modeling for the attainment demonstration would not hasten attainment, (i.e., advance the attainment date from 2008 to 2007).

V-6. Onroad Mobile Emissions Budgets for Conformity

In accordance with the 1990 Clean Air Act Amendments, transportation conformity requirements are intended to ensure that transportation activities do not result in air quality degradation. Section 176 of the Amendments requires that transportation plans, programs, and projects conform to applicable air quality plans before the transportation action is approved by a Metropolitan Planning Organization (MPO). The designated MPO for Maricopa County is the Maricopa Association of Governments.

Section 176(c) of CAAA provides the framework for ensuring that Federal actions conform to air quality plans under section 110. Conformity to an implementation plan means that proposed activities must not (1) cause or contribute to any new violation of any standard in any area, (2) increase the frequency or severity of any existing violation of any standard in any area, or (3) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

EPA transportation conformity regulations establish criteria involving comparison of projected transportation plan emissions with the motor vehicle emissions assumed in applicable air quality plans. The regulations define the term "motor vehicle emissions budget" as meaning "the portion of the total allowable emissions defined in a revision of the applicable implementation plan (or in an implementation plan revision which was endorsed by the Governor or his or her designee) for a certain date for the purpose of meeting reasonable further progress milestones or attainment demonstrations, for any criteria pollutant or its precursors, allocated by the applicable implementation plan to highway and transit vehicles."

EPA approved the One-Hour Ozone Maintenance Plan for the Maricopa Area on June 14, 2005. The Maintenance Plan contained 2006 and 2015 transportation conformity budgets for VOC and NOx for the one-hour ozone nonattainment area. On June 15, 2005, EPA revoked the one-hour ozone standard.

The EPA transportation conformity guidance for eight-hour ozone [10] indicates that the appropriate interim emissions tests for the Maricopa eight-hour ozone nonattainment area, which is larger than the former one-hour ozone nonattainment area, are: a budget test, based on the approved one-hour ozone budgets, and a no-greater-than-2002 baseline

emissions. For the eight-hour ozone interim budget test, the one-hour ozone budgets have been adjusted to remove local travel in the Gila River Indian Community. This adjustment is done, because the Maricopa County portion of the Gila River Indian Community was previously in the one-hour ozone nonattainment area, but was excluded from the eight-hour ozone nonattainment area by EPA [11].

The interim budget and no-greater-than-2002 emissions tests for eight-hour ozone were applied in the transportation conformity analyses conducted in 2005 and 2006 and will continue to be used until eight-hour ozone budgets are found to be adequate or approved in a SIP by EPA. This Eight-Hour Ozone Plan establishes conformity budgets based on 2008 onroad mobile source VOC and NOx emissions in the eight-hour ozone nonattainment area.

The conformity budget is represented by the onroad mobile VOC and NOx emissions for the peak episode day in June 2008 that was used to model attainment of the eight-hour ozone standard, as discussed in the previous section. As shown in Tables V-17(a) and 17(b), the onroad mobile source emissions in the ozone modeling domain on a Thursday in June 2008 are 145.5 metric tons per day for NOx and 72.3 metric tons per day for VOC, respectively.

GIS was applied to extract the onroad mobile emissions in the eight-hour ozone nonattainment area from the larger modeling domain. The resultant onroad mobile emissions for the nonattainment area are 67.9 metric tons per day for VOC and 138.2 metric tons per day for NOx. These represent the 2008 eight-hour emissions budgets for use in transportation conformity.

MAG will replace the interim eight-hour ozone emissions tests with the new VOC and NOx emissions budgets for use in the conformity analysis that begins after the budgets are found to be adequate or approved by EPA as part of the Eight-Hour Ozone Attainment Plan. In subsequent conformity analyses, onroad mobile source emissions for conformity horizon years can not exceed these 2008 budgets.

The methodology used to estimate onroad mobile source emissions for 2008 is documented in Section V-3-1. The models and assumptions used in estimating onroad mobile source emissions for future conformity analyses may differ from those described in this Technical Support Document, because the latest planning assumptions (e.g., new emissions models, vehicle registrations, speeds, population and travel projections) must be used each time a conformity analysis is performed [12].

Due to the inherent uncertainties in using latest planning assumptions in conformity analyses, the onroad mobile NOx emissions used in modeling attainment were increased by five percent to create a safety margin for the NOx conformity budget. EPA has indicated that safety margins are allowed, if attainment can be modeled with the increased emissions [13,14]. The onroad mobile source NOx emissions used in modeling attainment of the eight-hour ozone standard for all three episodes were increased by five percent. The increase was distributed spatially in the ozone modeling domain based on the proportion of onroad mobile emissions assigned to each 4 km grid cell. The five percent increase is reflected in

the onroad mobile source NOx emissions in Table V-17a, as well as the NOx conformity budget of 138.2 metric tons per day.

V-7. Conclusions

As discussed in Section V-4, the CAMx modeling demonstrates attainment of the eight-hour ozone standard by June 15, 2009 for three episodes with differing meteorological and emissions regimes. The modeling indicates that predicted eight-hour ozone design values throughout the nonattainment area will be less than 0.085 ppm for all three episodes in the ozone season of 2008. The peak design value of 0.0848 ppm occurs at the Humboldt Mountain monitor in the June 2008 episode. A peak design value of 0.0848 ppm also occurs at the Blue Point monitor in the August 2008 episode. The peak design value in the July 2008 episode is 0 .0836 ppm at the North Phoenix monitor.

EPA modeling guidance for eight-hour ozone [8] indicates that the future design values should be expressed in terms of three significant digits, with values less than one-thousandth of a ppm being truncated. After applying this procedure, the peak design value in the June and August episodes is 0.084 ppm, the peak design value for the July episode is 0.083 ppm, and all three episodes demonstrate attainment of the standard in 2008.

While these values are only slightly below the standard, the screening test described above and the weight of evidence analysis documented in Appendix V support the results of the modeled attainment demonstration. The weight of evidence analysis concludes that "eight hour ozone air quality in the MNA is improving as a result of existing control measures. Despite a continuous increase in the population in Maricopa and Pinal counties...and increases in other factors such as vehicle miles traveled..., the MNA is exhibiting decreasing trends for ozone and its precursors, NOx and VOC."

The fact that the nonattainment area has not violated the eight-hour ozone standard in the past two years lends additional credence to the conclusions of the modeled attainment demonstration, screening test, and weight of evidence analysis. It is important to reiterate that the measures that have enabled the nonattainment area to achieve "clean data" at the monitors in 2005 and 2006 are ongoing federal and legally-enforceable local commitments that should continue to improve ozone air quality in 2008 and beyond.

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