MAG EIGHT-HOUR OZONE REDESIGNATION REQUEST AND MAINTENANCE PLAN FOR THE MARICOPA NONATTAINMENT AREA

APPENDICES

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MAG EIGHT-HOUR OZONE REDESIGNATION REQUEST AND MAINTENANCE PLAN FOR THE MARICOPA NONATTAINMENT AREA

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MARICOPA ASSOCIATION of GOVERNMENTS

MAG EIGHT-HOUR OZONE REDESIGNATION REQUEST AND MAINTENANCE PLAN FOR THE MARICOPA NONATTAINMENT AREA

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EXHIBIT 1:

2005 Periodic Emission Inventory for Ozone Precursors for the Maricopa County, Arizona, Nonattainment Area

Maricopa County
Air Quality Department

2005 Periodic Emission Inventory for Ozone Precursors

for the

Maricopa County, Arizona, Nonattainment Area

September 2008

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2005 PERIODIC EMISSION INVENTORY
FOR OZONE PRECURSORS

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1. Introduction

1.1 Overview

This 2005 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 require 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 nonattainment for the eight-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 Air Quality Department (MCAQD) has primary responsibility for preparing and submitting the 2005 Periodic Ozone Emissions Inventory for Maricopa County. Point, area, and nonroad mobile source emission estimates were prepared by MCAQD. The Maricopa Association of Governments (MAG) prepared the emission estimates for onroad mobile and biogenic source categories. Table 1.2–1 lists those responsible for inventory preparation and quality assurance/ quality control activities, which are described in the respective chapters.

Table 1.2–1. Chapter authors and QA/QC contacts.

Chapter	Author(s)	QA/QC contact persons
Point Sources	Bob Downing MCAQD (602) 506-6790	Matt Poppen, Eric Raisanen and Dena Konopka MCAQD (602) 506-6790
Area Sources	Matt Poppen, Eric Raisanen and Dena Konopka MCAQD (602) 506-6790	Bob Downing MCAQD (602) 506-6790
Nonroad Mobile Sources	Matt Poppen and Eric Raisanen MCAQD (602) 506-6790	Bob Downing and Dena Konopka MCAQD (602) 506-6790
Onroad Mobile Sources	Taejoo Shin MAG (602) 254-6300	Eric Raisanen MCAQD (602) 506-6790
Biogenic Sources	Taejoo Shin MAG (602) 254-6300	Eric Raisanen MCAQD (602) 506-6790

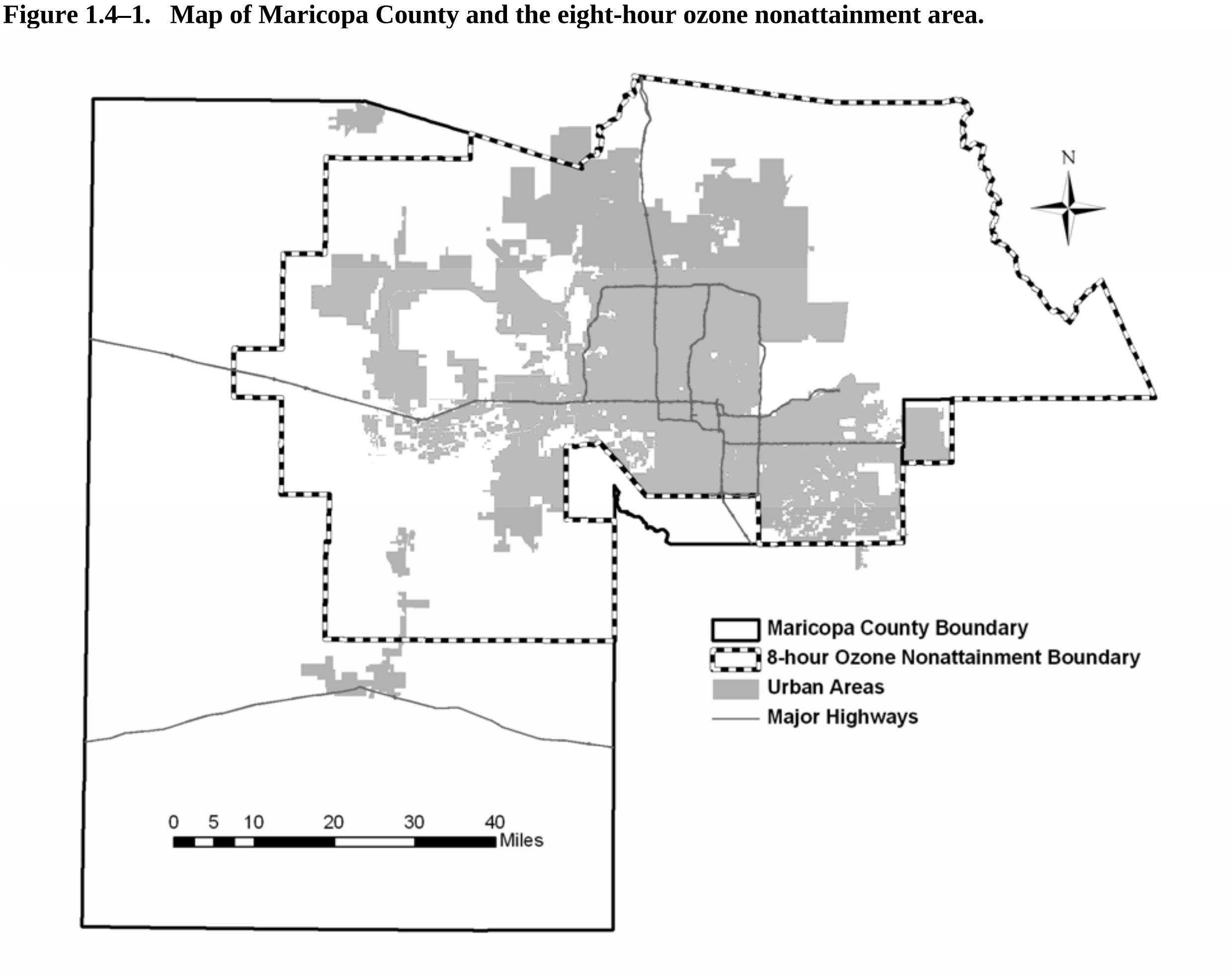
1.3 Temporal scope

Annual and ozone season-day emissions were estimated for the year 2005, for Maricopa County and the Maricopa County eight-hour 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 the 1981–1991 pattern of ozone exceedances.

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 eight-hour ozone nonattainment area is approximately 4,880 square miles or about 53 percent of the Maricopa County land area. A portion of the southeastern boundary of the eight-hour ozone nonattainment area includes areas of Pinal County totaling 48 square miles or 0.98% of the nonattainment area. A map of Maricopa County and the nonattainment area is provided in Figure 1.4–1.

Figure 1.4–1. Map of Maricopa County and the eight-hour ozone nonattainment area.



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 were apportioned to the nonattainment area using the ratio of total population 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 profile

The demographic data provided by MAG included population, employment data, and single family/multi-family splits for calendar year 2004 (as 2005 data were not yet available at the time of writing), for Maricopa County and the nonattainment area. Table 1.5–1 provides an overview of the key demographic data used in this report.

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

Demographic variable	Maricopa County totals	Within the ozone NAA	Percentage within the ozone NAA
Total resident population	3,524,175	3,542,478	100.52%
Total non-resident population	256,205	279,496	109.09%
Total population:	**3,780,380**	**3,821,974**	**101.10%**
Retail employment	437,333	435,945	99.68%
Office employment	359,824	360,295	100.13%
Industrial employment	352,827	349,419	99.03%
Public employment	216,598	215,705	99.59%
Other employment	151,751	151,824	100.05%
Construction	53,774	53,181	98.90%
Work at home	57,682	57,482	99.65%
Total employment:	**1,629,789**	**1,623,851**	**99.64%**
Single-family/multi-family household split:			
Single-family	75%	75%	
Multi-family	25%	25%	

1.5.2 Land-use data

The most recent land-use data available from MAG was for the year 2004, which was assumed to be representative of 2005. Table 1.5–2 presents a summary of the land-use categories and acreage used to develop emission estimates for this inventory.

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

Description	Acreage in Maricopa County	Acreage within the ozone NAA	Percentage within the ozone NAA
General/active open space (e.g., parks)	148,352	141,204	99.90%
Passive open space (e.g., mountain preserves)	1,748,816	1,071,509	61.27%
Golf courses	28,215	27,730	98.28%
Lakes	12,525	12,525	100.00%
Agriculture	465,833	299,870	64.37%
Vacant (e.g., developable land)	2,039,335	883,440	43.32%

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 which in 2005 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 from point sources (including emission reduction credits) in Maricopa County and the ozone nonattainment area, respectively. 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 and the ozone nonattainment area.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	3,889.18	2,880.67	1,347.38	27,234.5	26,128.8	10,569.4
Ozone nonattainment area	3,866.87	2,502.85	1,248.41	27,098.8	22,360.0	9,669.4

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 1.6–2 and 1.6–3 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 1.6–2. 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	1,981.59	6,801.33	3,886.59	2,715.4	39,777.1	12,054.1
Industrial processes	1,221.17	564.11	778.32	8,865.6	5,431.1	4,665.7
Solvent use	34,101.52			220,090.2		
Storage/transport	2,309.17			13,532.1		
Waste treatment/disposal	669.48	28.35	346.00	5,131.3	161.5	1,939.6
Miscellaneous area sources	34,391.76	15,659.58	729,163.13	230,690.8	105,095.5	4,892,985.9
All area sources:	**74,674.69**	**23,053.36**	**734,174.04**	**481,025.3**	**150,465.3**	**4,911,645.3**

Table 1.6–3. Summary of annual and season-day emissions from area sources in the ozone NAA.

Source category	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Fuel combustion	1,986.98	6,765.66	3,886.63	2,698.2	39,536.4	11,995.3
Industrial processes	1,215.54	564.05	784.75	8,817.3	5,430.8	4,701.0
Solvent use	34,264.03			221,748.8		
Storage/transport	2,309.17			13,532.1		
Waste treatment/disposal	662.81	22.38	218.87	5,114.3	130.9	1,289.8
Miscellaneous area sources	25,566.88	11,636.15	541,619.29	222,007.1	101,135.0	4,708,372.4
All area sources:	**66,005.41**	**18,988.24**	**546,509.54**	**473,917.9**	**146,233.0**	**4,726,358.5**

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 1.6–4 and 1.6–5 summarize annual and season-day emissions from nonroad mobile sources, for Maricopa County and the ozone nonattainment area, respectively. A detailed breakdown of emissions calculations for each source category is contained in Chapter 4.

Table 1.6–4. Annual and season-day emissions from nonroad mobile sources in Maricopa County.

Source category	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Agricultural	53.31	386.34	417.85	453.1	3,226.3	3,707.9
Airport ground support	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Commercial	2,339.70	1,449.72	54,941.52	17,907.0	8,553.8	410,503.5
Construction & mining	2,690.85	16,016.62	23,667.21	18,840.1	108,785.6	177,261.9
Industrial	772.17	3,316.67	13,597.40	5,035.6	21,109.0	90,844.8
Lawn & garden	6,586.38	843.10	101,879.34	74,053.0	6,409.9	1,085,431.7
Pleasure craft	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Railway maintenance	2.32	9.27	28.38	16.8	63.9	221.4
Recreational	1,416.44	59.99	10,675.34	16,532.4	535.5	135,733.8
Aircraft	1,439.91	3,029.37	6,668.71	7,911.6	16,644.9	36,641.3
Locomotives	116.82	2,955.24	295.27	640.1	16,193.1	1,617.9
All nonroad mobile sources:	**16,364.68**	**28,604.72**	**219,864.25**	**159,436.9**	**185,432.6**	**2,014,685.9**

Table 1.6–5. Annual and season-day emissions from all nonroad mobile sources in the ozone NAA.

Source category	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Agricultural	34.32	248.69	268.97	291.7	2,076.8	2,386.8
Airport ground support	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Commercial	2,331.28	1,444.50	54,743.73	17,842.5	8,523.0	409,025.7
Construction & mining	2,720.45	16,192.81	23,927.55	19,047.3	109,982.3	179,211.8
Industrial	769.39	3,304.73	13,548.45	5,017.5	21,033.0	90,517.8
Lawn & garden	6,658.83	852.37	103,000.01	74,867.6	6,480.4	1,097,371.4
Pleasure craft	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Railway maintenance	2.35	9.37	28.69	17.0	64.6	223.8
Recreational	911.28	38.59	6,868.11	10,636.3	344.5	87,326.0
Aircraft	1,419.35	2,944.42	6,512.18	7,798.6	16,178.1	35,781.2
Locomotives	79.04	1,933.42	193.95	433.1	10,594.1	1,062.7
All nonroad mobile sources:	**15,873.05**	**27,507.30**	**216,784.87**	**153,998.8**	**179,187.3**	**1,975,628.9**

1.6.4 Onroad mobile sources

Emissions 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 for each area source category is contained in Chapter 5.

Tables 1.6–6 summarizes annual and season-day emissions from onroad mobile sources in Maricopa County and the ozone nonattainment area, respectively.

Table 1.6–6. Annual and season-day emissions from onroad mobile sources in Maricopa County and the ozone NAA.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	36,085.90	67,839.00	344,454.30	186,486.3	366,008.9	1,792,310.0
Ozone NAA	35,773.10	67,249.70	341,465.40	184,867.9	363,196.8	1,776,755.0

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 MEGAN, a computer model developed by the ENVIRON corporation through a contract with the Maricopa Association of Governments (MAG). Annual and daily NO_x emissions from biogenic sources are shown in Table 1.6–7 for Maricopa County and the ozone nonattainment area.

Table 1.6–7. Annual and season-day emissions from biogenic sources.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	132,535.47	3,320.83	19,557.63	726,221.8	18,196.4	107,165.1
Ozone NAA	90,819.25	1,820.27	12,345.81	497,639.7	9,974.1	67,648.3

1.6.6 All sources

Tables 1.6–8 and 1.6–9 provide summary totals of annual and season-day emissions from all emission sources in Maricopa County and the ozone nonattainment area, respectively.

Table 1.6–8. Annual and season-day emissions from all sources in Maricopa County.

	Annual emissions (tons/yr)			Ozone season-day emissions (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Point Sources	**3,889.18**	**2,880.67**	**1,347.38**	**27,234.5**	**26,128.8**	**10,569.4**
Area Sources:						
Fuel combustion:						
Industrial natural gas	15.61	308.43	192.24	83.0	1,639.6	1,022.0
Industrial fuel oil	249.89	3,443.60	738.24	1,633.1	22,505.1	4,824.6
Commercial/inst. natural gas	57.78	1,146.39	702.66	293.7	5,826.5	3,571.2
Commercial/inst. fuel oil	85.08	1,110.79	238.51	558.3	7,288.2	1,564.9
Residential natural gas	45.29	774.12	329.41	147.3	2,517.8	1,071.4
Residential wood	1,527.89	17.35	1,685.35	0.0	0.0	0.0
Residential fuel oil	0.03	0.66	0.18	0.0	0.0	0.0
All fuel combustion	**1,981.59**	**6,801.33**	**3,886.59**	**2,715.4**	**39,777.1**	**12,054.1**
Industrial Processes:						
Chemical mfg.	44.71	0.39	0.03	343.9	3.0	0.2
Commercial cooking	205.15		585.43	1,127.2		3,216.7
Bakeries	87.20			670.7		
Secondary metal production	37.36	4.53	12.21	208.0	24.0	64.4
Mineral processes	0.11			0.6		
Rubber/plastics mfg.	681.03			5,238.7		
Electric equipment mfg.	87.00	0.01	0.17	478.0	0.1	0.9
State-permitted portable sources	55.66	554.60	176.52	647.4	5,377.5	1,357.8
Industrial processes, NEC	22.96	4.58	3.96	151.0	26.5	25.7
All Industrial processes	**1,221.17**	**564.11**	**778.32**	**8,865.6**	**5,431.1**	**4,665.7**
Solvent Use:						
Architectural coatings	10,914.36			79,159.1		
Auto refinishing	3,580.86			27,545.1		
Traffic markings	416.34			4,227.5		
Factory finished (flat)wood	190.82			1,405.6		
Wood furniture	892.03			6,870.4		
Aircraft	51.94			378.6		
Misc. surface coating.	369.04			2,834.9		
Degreasing	662.35			4,528.7		
Dry cleaning	21.19			162.4		
Graphics arts	208.71			1,477.9		
Misc. industrial solvent use	31.81			221.5		
Agricultural pesticide use	261.74			818.6		
Consumer/comm. solvent use	14,819.09			81,200.5		
Asphalt application	1,681.23			9,259.4		
All solvent use	**34,101.52**			**220,090.2**		
Storage/Transport:						
Bulk plants/terminals	26.35			138.6		
VOL storage/transport	17.10			126.5		
Fuel delivery	317.55			2,050.1		
Trucks in transit	58.81			379.6		
Station losses	784.07			4,338.8		
Vehicle refueling	1,105.30			6,498.6		
All storage/transport	**2,309.17**			**13,532.1**		

Table 1.6–8 (continued). Annual and season-day emissions from all sources in Maricopa County.

Source category	Annual emissions (tons/yr) VOC	Annual emissions (tons/yr) NO_x	Annual emissions (tons/yr) CO	Ozone season-day emissions (lbs/day) VOC	Ozone season-day emissions (lbs/day) NO_x	Ozone season-day emissions (lbs/day) CO
Waste Treatment/Disposal:						
On-site incineration	0.07	2.54	0.46	0.3	18.0	3.4
Open burning	34.09	15.16	322.54	191.8	85.2	1,809.9
Landfills	6.81	6.50	8.42	37.0	35.5	46.2
Publicly owned treatment works	614.03			4,723.3		
Leaking undergd. storage tanks	3.92			120.6		
Other waste disposal	10.56	4.15	14.57	58.2	22.8	80.1
All waste treatment/disposal	**669.48**	**28.35**	**346.00**	**5,131.3**	**161.5**	**1,939.6**
Misc. Area Sources:						
Wildfires	34,305.99	15,639.50	729,002.36	230,220.1	104,953.3	4,892,178.0
Prescribed fires	0.05	0.05	0.56	0.0	0.0	0.0
Structure fires	22.94	2.92	125.15	112.5	14.3	613.4
Vehicle fires	8.45	1.06	33.02	46.3	5.8	180.9
Aircraft engine testing	0.48	4.61	1.41	1.3	34.1	8.7
Hospitals	53.52			308.2		
Crematories	0.28	11.45	0.63	2.1	88.0	4.8
Accidental releases	0.03	0.00	0.00	0.2	0.0	0.0
All misc. area sources	**34,391.76**	**15,659.58**	**729,163.13**	**230,690.8**	**105,095.5**	**4,892,985.9**
All Area Sources:	**74,674.69**	**23,053.36**	**734,174.04**	**481,025.3**	**150,465.3**	**4,911,645.3**
Nonroad Sources:						
Agricultural equipment	53.31	386.34	417.85	453.1	3,226.3	3,707.9
Airport gd. support equip.	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Commercial equipment	2,339.70	1,449.72	54,941.52	17,907.0	8,553.8	410,503.5
Construction & mining equipmt.	2,690.85	16,016.62	23,667.21	18,840.1	108,785.6	177,261.9
Industrial equipment	772.17	3,316.67	13,597.40	5,035.6	21,109.0	90,844.8
Lawn & garden equipment	6,586.38	843.10	101,879.34	74,053.0	6,409.9	1,085,431.7
Pleasure craft	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Railway maintenance equipment	2.32	9.27	28.38	16.8	63.9	221.4
Recreational equipment	1,416.44	59.99	10,675.34	16,532.4	535.5	135,733.8
Aircraft	1,439.91	3,029.37	6,668.71	7,911.6	16,644.9	36,641.3
Locomotives	116.82	2,955.24	295.27	640.1	16,193.1	1,617.9
All Nonroad Sources:	**16,364.68**	**28,604.72**	**219,864.25**	**159,436.9**	**185,432.6**	**2,014,685.9**
Onroad Sources:						
Exhaust	36,085.90	67,839.00	344,454.30	186,486.3	366,008.9	1,792,310.0
All Mobile Sources:	**52,450.58**	**96,443.72**	**564,318.55**	**345,923.17**	**551,441.49**	**3,806,995.91**
Biogenic Sources:	132,535.47	3,320.83	19,557.63	726,221.8	18,196.4	107,165.1
TOTAL, All Sources:	**263,549.91**	**125,698.59**	**1,319,397.60**	**1,580,404.7**	**746,232.0**	**8,836,375.7**

Table 1.6–9. Annual and season-day emissions from all sources in the ozone nonattainment area.

	Annual emissions (tons/yr)			Ozone season-day emissions (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Point Sources	**3,866.87**	**2,502.85**	**1,248.41**	**27,098.8**	**22,360.0**	**9,669.4**
Area Sources:						
Fuel combustion:						
Industrial natural gas	15.46	305.44	190.37	82.2	1,623.7	1,012.0
Industrial fuel oil	247.47	3,410.20	731.08	1,617.3	22,286.8	4,777.8
Commercial/inst. natural gas	57.70	1,144.67	701.60	293.2	5,817.7	3,565.9
Commercial/inst. fuel oil	84.96	1,109.13	238.15	557.4	7,277.2	1,562.6
Residential natural gas	45.53	778.14	331.12	148.1	2,530.8	1,077.0
Residential wood	1,535.84	17.44	1,694.12	0.0	0.0	0.0
Residential fuel oil	0.03	0.66	0.18	0.0	0.0	0.0
All fuel combustion	**1,986.98**	**6,765.66**	**3,886.63**	**2,698.2**	**39,536.4**	**11,995.3**
Industrial Processes:						
Chemical mfg.	44.28	0.38	0.03	340.6	2.9	0.2
Commercial cooking	207.40		591.87	1,139.6		3,252.0
Bakeries	86.35			664.2		
Secondary metal production	37.36	4.53	12.21	208.0	24.0	64.4
Mineral processes	0.11			0.6		
Rubber/plastics mfg.	674.42			5,187.8		
Electric equipment mfg.	87.00	0.01	0.17	478.0	0.1	0.9
State-permitted portable sources	55.66	554.60	176.52	647.4	5,377.5	1,357.8
Industrial processes, NEC	22.96	4.53	3.95	151.0	26.3	25.6
All Industrial processes	**1,215.54**	**564.05**	**784.75**	**8,817.3**	**5,430.8**	**4,701.0**
Solvent Use:						
Architectural coatings	11,034.45			80,030.1		
Auto refinishing	3,620.38			27,849.0		
Traffic markings	420.92			4,273.8		
Factory finished (flat)wood	188.97			1,392.0		
Wood furniture	883.38			6,803.8		
Aircraft	51.94			378.6		
Misc. surface coating.	365.46			2,807.4		
Degreasing	655.93			4,484.7		
Dry cleaning	21.19			162.4		
Graphics arts	206.69			1,463.5		
Misc. industrial solvent use	31.50			219.4		
Agricultural pesticide use	69.62			255.3		
Consumer/comm. solvent use	14,982.14			82,093.9		
Asphalt application	1,731.47			9,534.9		
All solvent use	**34,264.03**			**221,748.8**		
Storage/Transport:						
Bulk plants/terminals	26.35			138.6		
VOL storage/transport	17.10			126.5		
Fuel delivery	317.55			2,050.1		
Trucks in transit	58.81			379.6		
Station losses	784.07			4,338.8		
Vehicle refueling	1,105.30			6,498.6		
All storage/transport	**2,309.17**			**13,532.1**		

Table 1.6–9 (continued). Annual and season-day emissions from all sources in the ozone nonattainment area.

	Annual emissions (tons/yr)			Ozone season-day emissions (lbs/day)		
Source category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Waste Treatment/Disposal:						
On-site incineration	0.07	2.54	0.46	0.3	18.0	3.4
Open burning	20.66	9.19	195.41	122.9	54.6	1,160.2
Landfills	6.81	6.50	8.42	37.0	35.5	46.2
Publicly owned treatment works	620.78			4,775.3		
Leaking undergd. storage tanks	3.92			120.6		
Other waste disposal	10.56	4.15	14.57	58.2	22.8	80.1
All waste treatment/disposal	**662.81**	**22.38**	**218.87**	**5,114.3**	**130.9**	**1,289.8**
Misc. Area Sources:						
Wildfires	25,480.36	11,616.05	541,457.70	221,532.3	100,992.6	4,707,560.5
Prescribed fires	0.05	0.05	0.56	0.0	0.0	0.0
Structure fires	23.06	2.94	125.80	113.0	14.4	616.6
Vehicle fires	8.50	1.06	33.19	46.6	5.8	181.9
Aircraft engine testing	0.48	4.61	1.41	1.3	34.1	8.7
Hospitals	54.11			311.6		
Crematories	0.28	11.45	0.63	2.1	88.0	4.8
Accidental releases	0.03	0.00	0.00	0.2	0.0	0.0
All misc. area sources	**25,566.88**	**11,636.15**	**541,619.29**	**222,007.1**	**101,135.0**	**4,708,372.4**
All Area Sources:	**66,005.41**	**18,988.24**	**546,509.54**	**473,917.9**	**146,233.0**	**4,726,358.5**
Nonroad Sources:						
Agricultural equipment	34.32	248.69	268.97	291.7	2,076.8	2,386.8
Airport gd. support equip.	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Commercial equipment	2,331.28	1,444.50	54,743.73	17,842.5	8,523.0	409,025.7
Construction & mining equipmt.	2,720.45	16,192.81	23,927.55	19,047.3	109,982.3	179,211.8
Industrial equipment	769.39	3,304.73	13,548.45	5,017.5	21,033.0	90,517.8
Lawn & garden equipment	6,658.83	852.37	103,000.01	74,867.6	6,480.4	1,097,371.4
Pleasure craft	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Railway maintenance equipment	2.35	9.37	28.69	17.0	64.6	223.8
Recreational equipment	911.28	38.59	6,868.11	10,636.3	344.5	87,326.0
Aircraft	1,419.35	2,944.42	6,512.18	7,798.6	16,178.1	35,781.2
Locomotives	79.04	1,933.42	193.95	433.1	10,594.1	1,062.7
All Nonroad Sources:	**15,873.05**	**27,507.30**	**216,784.87**	**153,998.8**	**179,187.3**	**1,975,628.9**
Onroad Sources:						
Exhaust	35,773.10	67,249.70	341,465.40	184,867.9	363,196.8	1,776,755.0
All Mobile Sources:	51,646.15	94,757.00	558,250.27	338,866.68	542,384.15	3,752,383.89
Biogenic Sources:	90,819.25	1,820.27	12,345.81	497,639.7	9,974.1	67,648.3
TOTAL, All Sources:	**212,337.68**	**118,068.36**	**1,118,354.03**	**1,337,523.0**	**720,951.3**	**8,556,060.0**

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 2005. This inventory has been developed concurrently with similar inventories for PM_{10}, $PM_{2.5}$, NO_x, SO_x, and NH_3, as part of Maricopa County's requirements under the CERR.

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, 2003)

Since 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, which in 2005 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).

Applying the above criteria, a total of 173 point sources in Maricopa County were identified (there were no point sources in the Pinal County portion of the nonattainment area). Additionally, EPA guidance requires emission inventories prepared for SIP development purposes to consider point sources with 25 miles of the nonattainment area boundary. For these sources, the traditional "major source" threshold definitions for attainment areas were applied. No additional point sources met this reporting threshold.

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 2005, as well as an average day during the ozone season (defined as July through September). A map with descriptions of the ozone nonattainment area and Maricopa County, are provided in Chapter 1. Questions concerning point source emissions may be directed to Bob Downing of MCAQD at (602) 506-6790.

Several tables have been constructed to provide the point source emissions and category totals. Table 2.2–1 provides an alphabetical list of all point sources and their location. Table 2.4–1 shows the 2005 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 2005 annual and ozone season-day emissions broken out by individual process types. Table 2.5–1 list emission reduction credits by eligible facility. 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

The Maricopa County Air Quality Department (MCAQD) identified point sources within Maricopa County through its permit system database and the 2005 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 2002 periodic inventory was compiled.

A total of 173 Maricopa County 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 these 173 stationary point sources, 164 are MCAQD-permitted sources which reported emissions of VOC, NO_x and/or CO (160 located within the ozone nonattainment area, and 4 outside the ozone NAA). There are no facilities large enough to meet the point source definition in the Pinal County portion of the ozone NAA. Additionally, EPA guidance requires emission inventories prepared for SIP development purposes to consider point sources within 25 miles of the nonattainment area boundary. For these sources, the traditional “major source” threshold definitions for attainment areas were applied. No additional point sources met this reporting threshold.

Table 2.2–1 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 2002 periodic inventory), and physical address.

Table 2.2–1. Name and location of all point sources.

ID #	NAICS	Business name	Address	City	ZIP
1074	221320	23rd Ave Wastewater Treatment Plant	2470 S 22nd Ave	Phoenix	85009
1075	221320	91st Ave Wastewater Treatment Plant	5615 S 91st Ave	Tolleson	85353
1387	332312	Able Steel Fabricators	4150 E Quartz Cir	Mesa	85215
1952	423110	Adesa Phoenix LLC	400 N Beck Ave	Chandler	85226
245	337122	AF Lorts Manufacturing Company	8120 W Harrison St	Tolleson	85353
956	336413	All Pro Industrial Finishes	1531 W 17th St	Tempe	85281
35541	33121	Allied Tube and Conduit	2525 N 27th Ave	Phoenix	85009
1834	518210	American Express IPC Facility	3151 W Behrend Dr	Phoenix	85027
35567	332323	Ameri-Fab Inc.	22640 N 21st Ave	Phoenix	85027
31637	115111	Anderson Clayton Corp.-Valencia Gin	25500 W Southern Ave	Buckeye	85326
3313	221112	APS West Phx Power Plant	4606 W Hadley St	Phoenix	85043

* = Facility is outside the eight-hour ozone nonattainment area.

Table 2.2–1. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP	
3938	332812	Arizona Galvanizing Inc.	15775Elwood St	Goodyear	85338	
4364	61131	Arizona State University	1551 S Rural Rd	Tempe	85287	
27711	339999	Armorworks LLC	7306 S Harl Ave	Tempe	85283	
36485	54185	Billboard Poster Company Inc.	3940 W Montecito Ave	Phoenix	85019	
74058	321918	Biltmore Shutters Inc.	1138 W Watkins St	Phoenix	85007	
43124	313230	Bonded Logic Inc.	411 E Ray Rd	Chandler	85225	
3441	42471	BP West Coast Products LLC/PHX Terminal	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	
56105	33711	Burdette Cabinet Co. Inc.	3941 N Higley Rd	Mesa	85215	
1218	562212	Butterfield Station Facility	40404 S 99th Ave	Mobile	85239	
3442	493190	Caljet	125 N 53rd Ave	Phoenix	85043	
3296	42471	Calvert Oil Co.	214 Arizona Eastern Ave	Buckeye	85326	
60598	337211	Case Furniture & Design LLC	4645 W Polk St	Phoenix	85043	
1318	321991	Cavco Industries Inc. (Litchfield)	1366 S Litchfield Rd	Goodyear	85338	
1317	321991	Cavco Industries Inc. (S. 35th Ave.)	2602 S 35th Ave	Phoenix	85009	
1316	321991	Cavco Industries LLC/Durango Plant	2502 W Durango St	Phoenix	85009	
1267	32732	Cemex Mesa Plants No #61 & #71	1901 N Alma School Rd	Mesa	85201	
1310	32311	Century Graphics LLC	2960Grand Ave	Phoenix	85017	
3297	42471	Chevron USA Inc	5110 W Madison St	Phoenix	85043	
3976	33711	Cholla Custom Cabinets Inc.	1727 E Deer Valley Dr	Phoenix	85024	
61573	212322	Circle H Sand & Rock	6400 S El Mirage Rd	Tolleson	85353	
35819	562212	City of Chandler Landfill	3850 S McQueen Rd	Chandler	85249	
38731	321991	Clayton Homes-El Mirage	12345 W Butler Dr	El Mirage	85335	
3443	42471	Conoco Phillips Phoenix Terminal	10 S 51st Ave	Phoenix	85043	
113723	212321	Contractors Landfill & Recycling	2425 N Center St	Mesa	85201	
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	
1389	541380	Daimlerchrysler Arizona Proving Grounds	33040 N 203rd Ave	Wittmann	85361	
3744	325991	Desert Sun Fiberglass	21412 N 14th Ave	Phoenix	85027	
130	331512	Dolphin Inc.	740 S 59th Ave	Phoenix	85043	
48771	32739	Eagle Roofing Products	4602 W Elwood St	Phoenix	85043	
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	
1488	115111	Farmer's Gin Inc.	8400 S Turner Rd	Buckeye	85326	
544	321991	Fleetwood Homes of Arizona Inc #21	6112 N 56th Ave	Glendale	85311	
27728	334413	Flipchip International LLC	3701 E University Dr	Phoenix	85034	
881	334413	Freescale Semiconductor Inc. (Alma School)	1300 N Alma School Rd	Chandler	85224	
1109	334413	Freescale Semiconductor Inc. (Elliott Rd.)	2100 E Elliot Rd	Tempe	85284	
44439	221112	Gila River Power Station	1250 E Watermelon Rd	Gila Bend	85337	*
73110	424910	Glenn Weinberger Topsoil Inc.	39500 S 99th Ave	Maricopa Co.	85239	
508	337122	Golden Eagle Manufacturing	601 S 65th Ave	Phoenix	85043	
1418	326299	Goodrich Aircraft Interior Products	3414 S 5th St	Phoenix	85040	
699	212321	Hanson Aggregates of AZ (S. 51st Ave.)	4002 S 51st Ave	Phoenix	85043	
4498	212321	Hanson Aggregates of AZ (W. Indian Sch.)	33500 W Indian School	Phoenix	85340	
44183	332312	Haulmark Industries Inc.	8230 N El Mirage Rd	El Mirage	85335	
31565	32614	Henry Products Inc.	302 S 23rd Ave	Phoenix	85009	
138	321918	Heritage Shutters Inc.	602 W Lone Cactus Dr	Phoenix	85027	
529	32614	Highland Products Inc.	43 N 48th Ave	Phoenix	85043	
3536	311812	Holsum Bakery Inc.	2322 W Lincoln St	Phoenix	85009	

* = Facility is outside the eight-hour ozone nonattainment area.

Table 2.2–1. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP	
1059	336412	Honeywell Engines Sys & Service Phx R&O	1944 E Sky Harbor Cir	Phoenix	85034	
247	336413	Honeywell Engines Systems Accessories	1300 W Warner Rd	Tempe	85284	
355	336412	Honeywell-Engines Systems & Services	111 S 34th St	Phoenix	85034	
403	331316	Hydro Aluminum North America Inc.	249 S 51st Ave	Phoenix	85043	
777	32614	Insulfoam	3401 W Cocopah St	Phoenix	85009	
3966	334413	Intel Corp.-Ocotillo Campus (Fabs 12 & 22)	4500 S Dobson Rd	Chandler	85248	
732	334418	Jabil Circuit Inc.	615 S River Dr	Tempe	85281	
341	325991	L & M Laminates & Marble	813 E University Dr	Phoenix	85034	
96886	337122	Legends Furniture	10300 W Buckeye Rd	Tolleson	85353	
4360	32311	Litho Tech Inc.	2020 N 22nd Ave	Phoenix	85009	
857	334411	Litton Electro-Optical Systems	1215 S 52nd St	Tempe	85281	
43063	221112	LSP Arlington Valley LLC	39027 W Elliot Rd	Arlington	85322	
3300	92811	Luke Air Force Base	14002 W Marauder St	Glendale	85309	
744	331513	M E Global Inc.	5857 S Kyrene Rd	Tempe	85283	
1248	325991	Maax Spas Arizona	25605 S Arizona Ave	Chandler	85248	
31261	21231	Madison Granite Supplies	30600 N 23rd Ave	Phoenix	85027	
353	326199	Marlam Industries Inc	834 E Hammond Ln	Phoenix	85034	
289	115111	Martori Farms	51040 W Valley Rd	Aguila	85320	*
62	33711	Mastercraft Cabinets Inc.	305 S Brooks	Mesa	85202	
3326	325991	Mesa Fully Formed Inc.	1111 S Sirrine St	Mesa	85210	
1415	212321	Mesa Materials Inc (Broadway)	7845 W Broadway Rd	Phoenix	85043	
1414	212321	Mesa Materials Inc (Higley)	3410 N Higley Rd	Mesa	85205	
44186	221112	Mesquite Generating Station	37625 W Elliot Rd	Arlington	85322	
1875	334413	Microchip Technology Inc.	1200 S 52nd St	Tempe	85281	
226	32739	Monier Lifetile LLC	1832 S 51st Ave	Phoenix	85043	
34197	327420	National Gypsum Co.	1414 E Hadley St	Phoenix	85034	
910	334412	Neltec Inc.	1420 W 12th Pl	Tempe	85281	
73084	337122	New Directions Incorporated	402 S 63rd Ave	Phoenix	85009	
43530	221112	New Harquahala Generating Co.	2530 N 491st Ave	Tonopah	85354	*
1879	562212	Northwest Regional Landfill	19401 W Deer Valley	Surprise	85374	
1331	337122	Oak Canyon Manufacturing Inc.	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	
52382	221112	Ocotillo Power Plant	1500 E University Dr	Tempe	85281	
3982	32311	O'Neil Printing Inc.	366 N 2nd Ave	Phoenix	85003	
528	322211	Packaging Corporation of America Inc.	441 S 53rd Ave	Phoenix	85043	
1344	321991	Palm Harbor Homes Inc.	309 S Perry Ln	Tempe	85281	
98	221113	Palo Verde Nuclear Generating Station	5801 S Wintersburg Rd	Tonopah	85354	
428	115111	Paloma Gin Properties LLC	I-8	Gila Bend	85337	*
733	811412	Pan-Glo Services	2401 W Sherman St	Phoenix	85009	
419	336412	Parker Hannifin GTFSD	7777 N Glen Harbor Blvd	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	
1154	33992	Ping Inc.	2201 W Desert Cove	Phoenix	85029	
148	331528	Presto Casting Co.	5440 W Missouri Ave	Glendale	85301	
60889	811198	Purcells Western States Tire	420 S 35th Ave	Phoenix	85009	
1030	32311	Quebecor World-Phoenix Division	1850 E Watkins St	Phoenix	85034	
44182	332312	Quincy Joist Company	22253 W Southern Ave	Buckeye	85326	
50299	713910	Quintero Area Water System	16752 W St Rt 74	Peoria	85382	
537	327999	Red Mountain Mining Inc.	4520 N Power Rd	Mesa	85215	
42956	221112	Redhawk Generating Facility	11600 S 363rd Ave	Arlington	85322	
303	332431	Rexam Beverage Can Company	211 N 51st Ave	Phoenix	85043	

* = Facility is outside the eight-hour ozone nonattainment area.

Table 2.2–1. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
63	212321	Rinker Materials (El Mirage)	8635 N El Mirage Rd	El Mirage	85335
260	212321	Rinker Materials (S. 19th Ave.)	3640 S 19th Ave	Phoenix	85009
64781	212313	Rinker Materials (S. 59th Ave.)	5605 S 59th Ave	Laveen	85339
213	212321	Rinker Materials (W. Glendale)	11920 W Glendale Ave	Glendale	85307
4318	32732	River Ranch Plant #40	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	5020 S 36th St	Phoenix	85040
3315	221112	Santan Generating Station	1005 S Val Vista Rd	Gilbert	85296
266	332312	Schuff Steel Co.	420 S 19th Ave	Phoenix	85009
246	321991	Schult Homes	231 N Apache Rd	Buckeye	85326
4175	424710	SFPP LP Phoenix Terminal	49 N 53rd Ave	Phoenix	85043
50422	336413	Simula Safety Systems Inc.	7822 S 46th St	Phoenix	85044
27933	562212	Skunk Creek Landfill	3165 W Happy Valley	Phoenix	85027
331	321999	Smurfit Stone Container Corp.	6900 W Northern Ave	Glendale	85303
46277	321999	Southwest Forest Products Inc.	2828 S 35th Ave	Phoenix	85009
3316	221112	SRP Agua Fria Generating Station	7302 W Northern Ave	Glendale	85303
3317	221112	SRP Kyrene Generating Station	7005 S Kyrene Rd	Tempe	85283
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
4400	334413	Sumco Southwest Corporation	19801 N Tatum Blvd	Phoenix	85050
378	212321	Sun Land Materials	6950 W Southern Ave	Laveen	85339
281	212321	Sun State Rock & Materials	11500 W Beardsley Rd	Sun City	85373
101	31161	Sunland Beef Company	651 S 91st Ave	Tolleson	85353
42102	334511	Suntron Corp.	2401 W Grandview Rd	Phoenix	85023
31643	562212	SW Reg Municipal Solid Waste Landfill	24427 S Hwy 85	Buckeye	85326
249	336411	The Boeing Company	5000 E McDowell Rd	Mesa	85215
552	337122	Thornwood Furniture Mfg.	5125 E Madison St	Phoenix	85034
363	337122	Thunderbird Furniture	7501 E Redfield Rd	Scottsdale	85260
56	32739	TPAC A Division of Kiewit Western Co.	3052 S 19th Ave	Phoenix	85009
1211	337122	Trendwood Inc (E. University)	261 E University Dr	Phoenix	85004
1210	337122	Trendwood Inc (S. 15th Ave.)	2402 S 15th Ave	Phoenix	85007
37546	32739	Trenwyth Industries	4626 N 42nd Ave	Phoenix	85019
169	811111	U-Haul Intl. Technical Center	11298 S Priest Dr	Tempe	85284
234	311514	United Dairymen of Arizona	2008 S Hardy Dr	Tempe	85282
53	32739	Utility Vault Co.	411 E Frye Rd	Chandler	85225
827	332812	Valley Industrial Painting	1131 W Watkins St	Phoenix	85007
2	32412	Vulcan Materials Co. (115th Ave.)	14521 N 115th Ave	El Mirage	85335
90	32732	Vulcan Materials Co. (43rd Ave.)	4830 S 43rd Ave	Phoenix	85041
344	212321	Vulcan Materials Co. (W. Indian School Rd.)	11923 W Indian School	Avondale	85039
174	325998	W R Meadows of Az Inc.	4220 S Sarival Ave	Goodyear	85338
1239	332321	Wastequip-AG	2525 W Broadway Rd	Phoenix	85041
36676	311119	Western Milling	310 S 24th Ave	Phoenix	85009
141	424910	Western Organics Inc.	2807 S 27th Ave	Phoenix	85009
398	212321	Wickenburg Facility	44605 Grand Ave	Wickenburg	85390
20706	32614	Wincup Holdings Inc.	7980 W Buckeye Rd	Phoenix	85043
1382	33711	Woodcase Fine Cabinetry Inc.	3255 W Osborn Rd	Phoenix	85017

* = Facility is outside the eight-hour ozone nonattainment area.

2.3 Procedures for estimating emissions from point sources

Both annual and average ozone season-day emissions were estimated from annual source emission reports, MCAQD 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.

MCAQD distributes annual emissions survey forms to nearly all facilities for which MCAQD 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. (Appendix 2.1 contains a copy of instructions provided to complete the annual emissions survey.) These instructions include examples and explanations on how to complete the annual emissions reporting forms that facilities must submit to MCAQD. 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 MCAQD, emissions inventory staff checks 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. MCAQD 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 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.

In prior years, EPA guidance (US EPA, 1992) recommended using a default RE value of 80%. More recently, a workgroup consisting of emissions inventory staff from state, local and EPA offices convened to review existing rule effectiveness guidance, and develop consensus recommendation for improvements to this guidance. This work resulted in the development of questionnaires for point and area sources, which identify control program factors most likely to affect RE.

MCAQD applied this revised approach (US EPA, 2005, Appendix B) to controlled processes reported by facilities on their annual emission reports. The quantification of RE was performed for three groups of industrial processes:

- For manually controlled processes that are regulated by Maricopa County Rule 316 (Nonmetallic Mineral Processing), EPA's non-point source guidance was applied to determine the rule effectiveness of County Rule 316. Results showed an overall rule effectiveness of 54.36%; see MCAQD (2007) for details.

- For most other processes that claimed emissions reductions through the use of a control device, EPA's point source guidance was applied to determine the effectiveness of the reported capture and control efficiencies. Calculations were performed separately for Title V and non-Title V sources. Application of the 2005 EPA guidance resulted in overall RE values of 90.55% (for Title V processes) and 87.95% (for non-Title V). A sample questionnaire and documentation of calculations for these processes is included in Appendix 2.2.

Section 2.3.3 contains a detailed description of the application of RE for a specific process. The following sections illustrate how emission estimates were obtained for the Maricopa County-permitted sources listed in Table 2.2–1.

2.3.2 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 (MMCF)	CO emission factor (lb/ MMCF)	CO emissions (lbs/yr)
10100604	Natural gas boilers	2,078.90	24	49,893.6
20100201	Natural gas turbines	71.69	77.9	5,584.7

<u>Calculation of annual CO emissions</u>:

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

CO emissions from natural-gas boilers = 2,078.90 MMCF × 24 lb CO/MMCF
= 49,893.6 lbs CO/yr

CO emissions from natural-gas turbines = 71.69 MMCF × 77.9 lb CO/MMCF
= 5,584.7 lbs CO/yr

Total CO emissions = 49,893.6 lbs + 5,584.7 lbs

= 55,478.3 lbs/yr

= 27.74 tons CO/yr

APS provided seasonal operating data for each boiler and turbine. The seasonal activity reported for the June–August time period ranged from 25 to 95 percent among the four units. The average season-day emissions were calculated individually, as illustrated in the following example, and then summed to derive daily totals.

Calculation of ozone season-day emissions:

Season-day emissions from steam unit #2	= annual emissions × seasonal activity factor ÷ (days/week × weeks/season)
	= 23,480.9 lb × 44% ÷ (7 × 13)
	= 113.5 lbs CO/season day

2.3.3 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 VOC emissions (lbs)	= Material usage × VOC emission factor
	= 732,239 lb xylene/yr × 1 lb/lb
	= 732,239 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	= (92,099 lbs/yr × 90.7% VOC) + (64,634 lbs/yr × 47.3% VOC) + (11,639 lbs/yr × 12%)
	= 83,534 + 30,572 + 1,397 lbs/yr
	= 115,503 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	= 732,239 lb/yr – 115,503 lb/yr × [1 – (99.5% capture × 99.3% control)]
	= 616,736 × [1 – (0.988035)]
	= 7,379 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 (99.3%), following EPA guidelines.

As described in Section 2.3.1, a value of 87.95% RE was applied to this process. 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)]
	= 616,736 lbs/yr × [1 – (87.95% × 99.5% × 99.3%)]
	= 80,807 lbs VOC/yr

Calculation of ozone season-day emissions:

Season-day emissions (lbs/day)	= Annual emissions	× seasonal activity factor	÷ (days/week × weeks/season)
	= 80,807 lbs/yr	× 25%	÷ (7 × 13)
	= 222.0 lbs VOC/day		

2.4 Summary 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.

		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	0.45	4.18	53.51	2.2	18.2	279.1
1075	91st Ave Wastewater Treatment Plant	0.66	14.75	6.94	2.9	79.7	47.9
1387	Able Steel Fabricators	11.56			88.9		
1952	Adesa Phoenix LLC	10.28	0.11	0.09	79.1	0.8	0.7
245	AF Lorts Manufacturing Company	77.72	0.02	0.02	747.4	0.2	0.2
956	All Pro Industrial Finishes	12.27			100.6		
35541	Allied Tube and Conduit	29.52	0.11	0.10	272.5	1.0	0.8
1834	American Express IPC Facility	0.90	11.01	2.37	4.9	60.5	13.0
35567	Ameri-Fab Inc.	35.19			270.7		
31637	Anderson Clayton Corp.-Valencia Gin	0.00	0.05	0.01	0.0	0.0	0.0
3313	APS West Phx Power Plant	36.20	518.91	72.36	299.9	4,651.7	637.8
3938	Arizona Galvanizing Inc.	0.16	2.84	2.38	0.9	15.6	13.1
4364	Arizona State University	1.86	11.66	14.87	8.1	31.7	23.2
27711	Armorworks LLC	10.69			68.6		
36485	Billboard Poster Company Inc.	23.49			216.8		
74058	Biltmore Shutters Inc.	11.70			90.0		
43124	Bonded Logic Inc.	0.01	0.19	0.16	0.1	1.5	1.3

* = Source for which rule effectiveness has been applied.

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

ID #	Business name	Annual (tons/yr) VOC	Annual (tons/yr) NO_x	Annual (tons/yr) CO	Ozone season day (lbs/day) VOC	Ozone season day (lbs/day) NO_x	Ozone season day (lbs/day) CO	
3441	BP West Coast Products LLC	24.26			124.9			
458	Bryant Industries Inc.	18.61			143.1			
217	Building Products Co.	3.33	5.34	17.75	24.9	29.8	97.9	
56105	Burdette Cabinet Co. Inc.	11.06			85.1			
1218	Butterfield Station Facility	0.94	2.08	4.32	5.3	13.3	24.1	*
3442	Caljet	21.58	1.38	6.89	118.6	7.6	37.9	
3296	Calvert Oil Co.	11.47			63.9			*
60598	Case Furniture & Design LLC	37.47			240.2			
1318	Cavco Industries Inc. (Litchfield)	36.58			281.4			
1317	Cavco Industries Inc. (S. 35th Ave.)	10.97			84.4			
1316	Cavco Industries LLC/Durango Plant	25.02			192.5			
1267	Cemex Mesa Plants No #61 & #71	1.25	61.69	4.24	6.6	325.4	22.4	
1310	Century Graphics LLC	11.52	0.06	0.05	88.6	0.4	0.4	*
3297	Chevron USA Inc.	18.73			95.7			
3976	Cholla Custom Cabinets Inc.	13.50	0.10	0.02	103.9	0.7	0.1	
61573	Circle H Sand & Rock	1.05	12.82	2.76	8.0	98.6	21.2	
35819	City of Chandler Landfill	2.86	6.57	57.72	15.9	36.7	328.2	
38731	Clayton Homes-El Mirage	11.36			87.4			
3443	Conoco Phillips Phoenix Terminal	12.56			66.2			
113723	Contractors Landfill & Recycling	0.23	2.80	0.60	1.5	18.2	3.9	
399	Coreslab Structures (Ariz) Inc.	14.76			112.0			
1198	Courier Graphics Corp.	12.42	0.37	0.31	86.0	2.6	2.1	*
4368	Craftsmen in Wood Mfg.	11.58	0.07	0.06	89.1	0.5	0.5	
1389	Daimlerchrysler Arizona Proving Ground	1.02	0.14	0.06	7.1	0.7	0.6	
3744	Desert Sun Fiberglass	21.70			166.9			
130	Dolphin Inc.	6.29	2.27	1.89	53.2	18.8	15.7	*
48771	Eagle Roofing Products	5.01	1.82	1.53	32.1	11.7	9.8	
3305	Earthgrains Baking Companies Inc.	24.71	2.06	1.73	158.5	13.2	11.1	*
26	Empire Machinery Co.	9.03	33.25	22.31	56.3	197.5	134.0	
1505	Executive Door	13.42			103.2			
1488	Farmer's Gin Inc.	0.02	0.60	0.10	0.0	0.0	0.0	
544	Fleetwood Homes of Arizona Inc. #21	14.57			112.1			
27728	Flipchip International LLC	17.81	0.44	0.37	97.9	2.4	2.0	
881	Freescale Semiconductor Inc. (Alma Sch)	48.77	6.92	2.67	268.8	70.5	22.2	
1109	Freescale Semiconductor Inc. (Elliott Rd.)	11.08	3.11	0.05	61.3	21.4	1.4	
73110	Glenn Weinberger Topsoil Inc.	0.01	0.08	0.02	0.0	0.4	0.1	
508	Golden Eagle Manufacturing	14.97	0.03	0.02	115.2	0.2	0.2	
1418	Goodrich Aircraft Interior Products	75.53	0.58	0.28	580.9	1.9	0.0	
699	Hanson Aggregates of AZ (S. 51st Ave.)	5.01	5.64	6.68	38.5	43.4	51.4	
4498	Hanson Aggregates of AZ (W. Ind. Sch.)	1.38	16.90	3.64	10.6	130.0	28.0	
44183	Haulmark Industries Inc.	15.58			119.8			
31565	Henry Products Inc.	62.26	0.55	0.46	480.8	4.2	3.5	*
138	Heritage Shutters Inc.	14.56			112.0			
529	Highland Products Inc.	50.29	1.98	1.66	276.5	15.2	12.8	*
3536	Holsum Bakery Inc.	25.22	2.71	2.28	202.4	20.0	16.8	*
1059	Honeywell Engines Sys & Service	21.52	1.52	1.95	137.6	3.1	6.9	
247	Honeywell Engines Systems Accessories	3.38	10.39	3.18	18.6	57.1	17.5	
355	Honeywell-Engines Systems & Services	44.60	64.78	27.42	280.5	355.9	150.6	
403	Hydro Aluminum North America Inc.	38.69	11.95	11.03	248.0	76.6	70.7	*
777	Insulfoam	90.54	1.63	1.37	534.0	10.4	8.8	*
3966	Intel Corp.-Ocotillo Campus (Fab 12 / 22)	31.08	24.87	20.44	180.8	259.1	138.6	*
732	Jabil Circuit Inc.	21.81			167.8			

* = 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**	
341	L & M Laminates & Marble	45.63			292.5			
96886	Legends Furniture	16.24			199.9			
4360	Litho Tech Inc.	11.37			87.5			
857	Litton Electro-Optical Systems	16.05			103.9			
43063	LSP Arlington Valley LLC	5.66	51.81	58.25	52.9	485.4	539.8	
3300	Luke Air Force Base	34.76	9.37	6.27	260.0	45.2	27.2	*
744	M E Global Inc.	22.35	40.38	53.28	169.9	325.2	360.8	*
1248	Maax Spas Arizona	51.65			556.2			
31261	Madison Granite Supplies	3.07	31.84	20.51	23.7	244.9	157.8	
353	Marlam Industries Inc.	80.87	0.04	0.03	622.0	0.3	0.3	
62	Mastercraft Cabinets Inc.	101.66	0.13	0.11	907.1	0.9	0.8	
3326	Mesa Fully Formed Inc.	41.01			315.5			
1415	Mesa Materials Inc. (Broadway)	5.42	9.52	22.08	50.1	87.9	203.8	
1414	Mesa Materials Inc. (Higley)	3.64	7.02	19.17	33.6	64.8	177.0	
44186	Mesquite Generating Station	8.41	210.54	22.37	50.3	1,255.1	134.0	*
1875	Microchip Technology Inc.	35.40	6.36	4.66	196.8	62.8	31.6	*
226	Monier Lifetile LLC	11.51	0.54	0.45	73.8	3.4	2.9	
34197	National Gypsum Co.	0.98	17.96	14.69	6.4	118.8	94.8	
910	Neltec Inc.	25.52	10.73	2.00	140.2	59.0	11.0	*
73084	New Directions Incorporated	25.42			195.6			
1879	Northwest Regional Landfill	0.68	8.75	2.27	99.6	132.4	133.9	
1331	Oak Canyon Manufacturing Inc.	90.83			5.0	62.9	13.6	
3953	Oakcraft Inc.	88.19	0.14	0.12	698.7			
27925	Oasis Bedroom Co.	15.58			565.3	1.1	0.9	
52382	Ocotillo Power Plant	6.18	97.46	27.74	119.9			
3982	O'Neil Printing Inc.	34.22			56.4	966.4	272.8	
528	Packaging Corporation of America Inc.	6.34	13.88	11.66	263.2			
1344	Palm Harbor Homes Inc.	13.45			48.8	106.8	89.7	
98	Palo Verde Nuclear Generating Station	28.76	82.56	24.55	103.5			
73	Pan-Glo Services	13.25	0.72	0.60	72.9	5.5	4.6	*
419	Parker Hannifin GTFSD	22.09			141.6			
1341	Penn Racquet Sports Inc.	221.40	5.17	4.34	1,703.1	38.8	32.6	*
1014	Phoenix Brick Yard	1.53	10.27	34.60	9.0	56.4	190.1	
562	Phoenix Newspapers Inc.	12.26	0.59	0.22	67.9	16.5	3.2	
1154	Ping Inc.	12.99	0.17	0.14	99.7	0.5	0.5	
148	Presto Casting Co.	10.16	1.19	0.93	78.2	9.1	7.1	
60889	Purcells Western States Tire	6.19	0.16	0.13	66.6	1.2	1.0	
1030	Quebecor World-Phoenix Division	74.19	1.76	39.99	361.5	9.9	225.6	*
44182	Quincy Joist Company	79.47			611.3			
50299	Quintero Area Water System	1.06	13.39	2.89	5.9	74.1	16.0	
537	Red Mountain Mining Inc.	0.69	8.46	1.82	5.3	65.0	14.0	
42956	Redhawk Generating Facility	7.41	145.02	134.65	62.2	1,238.3	1,151.9	
303	Rexam Beverage Can Company	118.93	5.22	4.39	653.5	28.7	24.1	*
63	Rinker Materials (El Mirage)	0.00	0.25	0.06	0.0	1.6	0.4	
260	Rinker Materials (S. 19th Ave.)	1.22	4.90	14.67	9.5	37.5	130.0	
64781	Rinker Materials (S. 59th Ave.)	2.36	29.20	6.31	15.1	187.2	40.5	
213	Rinker Materials (W. Glendale)	7.77	7.44	29.54	57.1	54.6	219.5	
4318	River Ranch Plant #40	0.15			1.2			
759	Rogers Corp./Advanced Circuit Materials	49.76	1.33	7.31	284.3	7.3	40.2	*
1437	Sanmina Phoenix Division	29.25	1.24	1.04	187.5	8.0	6.7	*
3315	Santan Generating Station	14.58	220.66	106.40	118.2	2,054.9	920.8	
266	Schuff Steel Co.	4.97	10.46	2.25	38.2	80.5	17.3	

* = 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	
246	Schult Homes	10.24			79.6			
4175	SFPP LP Phoenix Terminal	325.25	6.64	4.81	1,758.9	36.5	26.4	*
50422	Simula Safety Systems Inc.	36.54	0.08	0.06	234.2	0.5	0.4	
27933	Skunk Creek Landfill	14.13	1.83	0.54	77.7	10.1	2.9	
331	Smurfit Stone Container Corp.	0.88	10.81	2.33	6.8	83.1	17.9	
46277	Southwest Forest Products Inc.	1.59	19.51	4.20	12.2	150.1	32.3	
3316	SRP Agua Fria Generating Station	6.32	352.99	74.15	84.2	5,626.3	1,180.7	
3317	SRP Kyrene Generating Station	1.38	47.07	19.04	11.7	456.0	193.7	
4131	ST Microelectronics	33.99	4.02	3.37	186.8	22.1	18.5	*
1444	Staco Architectural Roof Tile	12.86	0.07	0.06	98.9	0.6	0.5	
582	Stone Creek Inc.	21.41			164.7			
4400	Sumco Southwest Corporation	14.67	11.19	2.39	87.0	68.1	13.1	*
378	Sun Land Materials	0.86	10.57	2.28	6.6	81.3	17.5	
281	Sun State Rock & Materials	0.40	32.09	0.96	2.6	205.7	6.2	
101	Sunland Beef Company	15.13	11.19	9.40	97.7	83.1	69.8	
42102	Suntron Corp.	13.26			102.0			
31643	SW Reg Municipal Solid Waste Landfill	15.09	6.35	1.39	88.6	40.7	8.9	
249	The Boeing Company	28.11	3.17	1.91	216.2	24.2	14.6	
552	Thornwood Furniture Mfg.	75.45			580.4			*
363	Thunderbird Furniture	16.12	0.03	0.03	124.0	0.3	0.2	
56	TPAC A Division of Kiewit Western Co.	0.10	1.77	1.49	0.7	13.6	11.4	
1211	Trendwood Inc. (E. University)	55.09			423.8			
1210	Trendwood Inc. (S. 15th Ave.)	62.21			478.5			
37546	Trenwyth Industries	11.19	0.09	0.07	107.6	0.8	0.7	
169	U-Haul Intl. Technical Center	16.62			106.5			
234	United Dairymen of Arizona	2.09	16.60	26.91	11.1	84.5	142.3	
53	Utility Vault Co.	10.25	2.36	0.51	94.3	18.1	3.9	
827	Valley Industrial Painting	24.71			190.1			
2	Vulcan Materials Co. (115th Ave.)	0.36	10.85	22.90	3.1	83.4	176.1	
90	Vulcan Materials Co. (43rd Ave.)	3.60	5.88	1.39	33.5	54.3	12.8	
344	Vulcan Materials Co. (Indian School Rd.)	0.13			1.4			
174	W R Meadows of AZ Inc.	11.62	0.14	0.11	190.7	1.7	1.5	
1239	Wastequip-AG	14.59			93.5			
36676	Western Milling	0.36	0.96	0.32	2.8	7.4	2.4	
141	Western Organics Inc.	0.30			1.9			
398	Wickenburg Facility	0.46	5.65	1.22	3.5	43.5	9.4	
20706	Wincup Holdings Inc.	104.38	13.24	11.12	642.3	81.5	68.5	*
1382	Woodcase Fine Cabinetry Inc.	19.77			152.1			
	Ozone Nonattainment Area Totals:	**3,769.67**	**2,493.05**	**1,234.11**	**26,566.2**	**22,306.3**	**9,591.0**	

Facilities outside the ozone NAA:

		Annual (tons/yr)			Ozone season day (lbs/day)			
ID #	Business name	VOC	NO_x	CO	VOC	NO_x	CO	
	Gila River Power Station	1.48	353.59	74.50	16.0	3,636.4	766.2	*
	Martori Farms	2.70	0.05	0.04	20.1			
	New Harquahala Generating Co.	18.13	24.10	24.36	99.6	132.4	133.9	
	Paloma Gin Properties LLC		0.08	0.07				
	Other Than NAA Totals:	**22.31**	**377.82**	**98.97**	**135.7**	**3,768.8**	**900.1**	
	Total Point Source Emissions:	**3,791.98**	**2,870.87**	**1,333.08**	**26,701.9**	**26,075.1**	**10,491.0**	

*Source for which rule effectiveness has been applied.

2.4.2 Point source emissions by process type

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

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

CATEGORY		Annual (tons/yr)			Ozone season day (lbs/day)		
SCC Category		**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
101	External Combustion – EGUs	10.18	414.28	92.82	126.7	6,185.7	1,351.3
102	External Combustion – Industrial	30.45	169.62	200.82	199.4	1,046.8	1,203.1
103	External Combustion – Comm./inst.	2.03	26.82	27.99	8.3	118.4	97.9
201	Internal Combustion – EGUs	68.22	1,585.54	497.25	567.8	14,203.0	4,451.9
202	Internal Combustion – Industrial	45.95	422.28	130.54	298.4	2,854.7	866.2
203	Internal Combustion – Comm./inst.	2.57	31.90	6.89	16.1	202.5	43.8
204	Internal Combustion – Engine testing	7.65	61.43	24.42	45.4	346.5	140.1
302	Food/Agriculture	63.01			444.5		
304	Industrial. Proc: Secondary Metal	34.79	37.81	52.02	267.0	306.8	351.0
305	Mineral Products	44.47	64.05	167.51	351.1	495.5	1,249.7
306	Petroleum Industry	5.12			0.0		
307	Ind. Proc: Paper/Wood	10.18			78.7		
308	Ind. Proc: Rubber/Plastic	519.03			3,659.0		
312	Ind. Proc: Misc. Machinery	0.53			4.1		
313	Ind. Proc: Elec. Equipment	105.42	14.58	5.50	600.4	86.8	30.2
330	Industrial Processes, NEC	0.45			2.9		
385	Ind. Proc: Cooling Towers	3.75			26.9		
390	In-Process Fuel Use	0.04			0.2		
399	Ind. Proc: Misc. Mfg	250.90			1,884.1		
401	Organic Solvent Evaporation	180.43			1,220.5		
402	Surface Coating	1,764.24	8.36		13,170.6	45.9	
403	Petroleum Product Storage	6.39	6.64	4.81	47.2	36.5	26.4
404	Petroleum Liquid Storage	412.38			2,250.3		
405	Printing/Publishing	180.47			1,180.5		
406	Transp./Mktg. Petroleum Products	7.92			52.8		
407	Organic Chemical Storage	4.62			25.4		
490	Organic Solvent Evaporation	0.01			0.0		
501	Solid Waste Disposal.: Municipal	29.92	26.31	118.36	168.9	139.2	656.5
502	Solid Waste Disposal.: Comm./Inst.	0.87	1.24	4.14	4.8	6.8	22.8
		3,791.98	**2,870.87**	**1,333.08**	**26,701.9**	**26,075.1**	**10,491.0**
n/a	Emission reduction credits	97.2	9.8	14.3	532.6	53.7	78.4
		3,889.18	**2,880.67**	**1,347.38**	**27,234.5**	**26,128.8**	**10,569.4**

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.

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 MCAQD Rule 240 (Permit Requirements for New Major Sources and Major Modification to Existing Major Sources).

Table 2.5–1 provides a list of emission reduction credits for VOC, NO_x, and CO. Two previously operational facilities maintain emission reduction credits that are still valid for inclusion in this report and the rate of progress plan.

Table 2.5–1. Emission reduction credits.

		Emission reduction credits (tons)		
ID	**Facility**	**VOC**	**NO_x**	**CO**
1151	Freescale Semiconductor, Inc. (formerly Motorola Mesa)	17.1	9.8	14.3
72	Woodstuff Manufacturing	80.1	–	–
	Totals:	**97.2**	**9.8**	**14.3**

2.6 Quality assurance / quality control procedures

2.6.1 Emission survey preparation and data collection

The MCAQD's Emissions Inventory (EI) Unit annually collects point source criteria pollutant emission data from sources in the county. MCAQD 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 monthly workshops from January through April to assist businesses in completing EI forms.

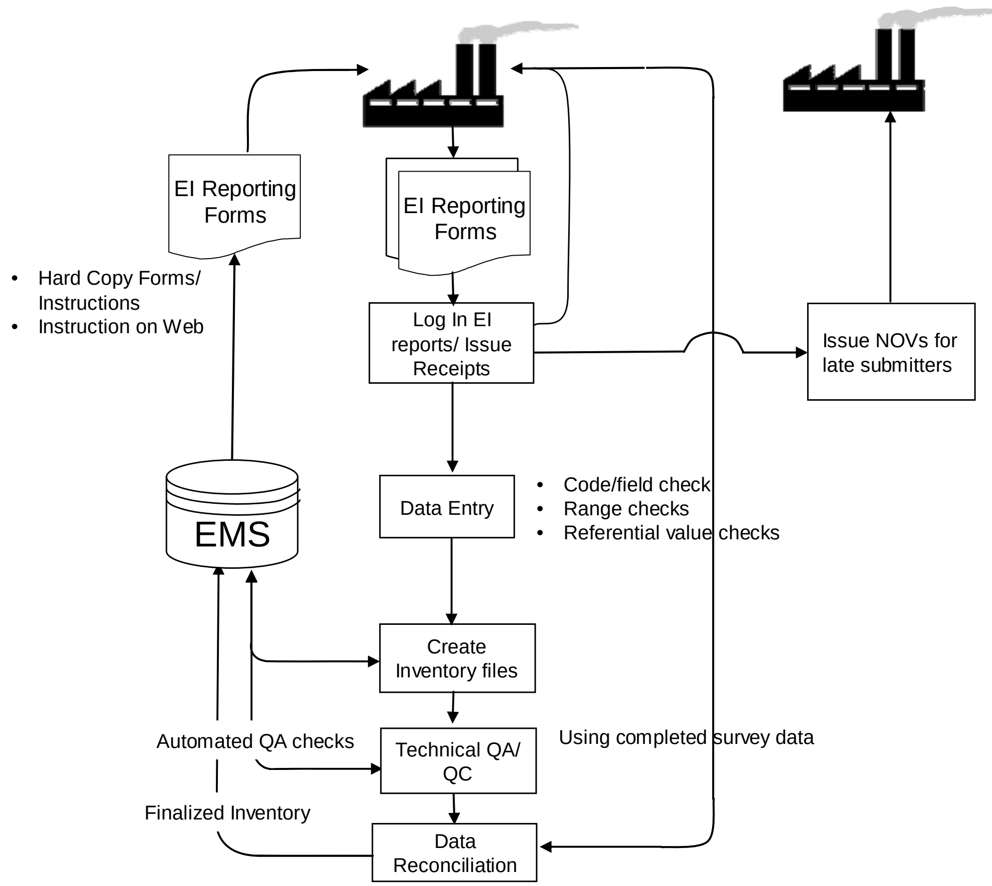
The general data flow for data collection and inventory preparation is shown in Figure 2.6–1.

2.6.2 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.

Figure 2.6–1. Data flow for point source emission inventories.



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.

2.6.3 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 MCAQD for the year 2005 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 2005 annual emissions report.

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

2.7 References

MCAQD, 2007. 2005 Periodic Emission Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area. Maricopa County Air Quality Department, May 2007

US EPA, 1992. Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories. US EPA 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, 2003. 2002 National Emission Inventory (NEI) Preparation Plan (draft). US EPA 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, 2005, Appendix B. Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. US EPA Office of Air Quality Planning and Standards, Research Triangle Park, NC. Draft Rep. Revised Nov. 2005. 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 MCAQD'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. MCAQD 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
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
2312000000	Electrical equipment manufacturing	3.3.6
	State-permitted portable sources	3.3.7
2399000000	Industrial processes not elsewhere classified	3.3.8
	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	Agricultural pesticide application	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
	Waste treatment and disposal	
2601000000	On-site incineration	3.6.1
2610000500	Open burning	3.6.2
2620000000	Landfills	3.6.3
2630000000	Publicly owned treatment works (POTWs)	3.6.4
2660000000	Remediation of leaking underground storage tanks	3.6.5
2650000000	Other industrial waste and disposal	3.6.6
	Miscellaneous area sources:	
2810001000	Wildfires	3.7.1.1
2810005000	Prescribed Fires	3.7.1.2
2810030000	Structure fires	3.7.1.3
2810050000	Vehicle fires	3.7.1.4
2810040000	Engine testing	3.7.1.5
2850000000	Hospitals	3.7.2.1
2810060100	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.

	Sales by end user category (in MMCF/yr)					
Natural gas supplier	**Electric Utilities**	**Industrial**	**Commercial/ Institutional**	**Residential**	**Transport***	**Other***
Southwest Gas	n/a	2,459.27	13,968.02	15,364.45	5,151.97	836.01
City of Mesa	n/a	108.99	1,367.49	1,106.08	8.74	114.58
El Paso	148,506.64	185.58	n/a	n/a	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 2005. 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 2005, 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
	=	4,257.47	×	5.5	÷	2,000
	=	11.71 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) VOC	NO_x	CO	Annual emissions (tons/yr) VOC	NO_x	CO
External	98.44	4,257.47	5.5	100	84	11.71	212.87	178.81
Internal	1.56	67.29	116	2840	399	3.90	95.55	13.42
Totals:	**100.00**	**4,324.16**				**15.61**	**308.43**	**192.24**

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

= 15.61 × 20.73% ÷ (6 × 13) × 2,000

= 83.0 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

= 15.61 × 0.9903

= 15.46 tons VOC/yr

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

Geographic area	Annual emissions (tons/yr) VOC	NO_x	CO	Season-day emissions (lbs/day) VOC	NO_x	CO
Maricopa County	15.61	308.43	192.24	83.0	1,639.6	1,022.0
Ozone NAA	15.46	305.44	190.37	82.2	1,623.7	1,012.0

3.2.2 Industrial fuel oil

Area-source emissions from industrial fuel oil combustion are calculated by a multi-step process which allocates Arizona state-level industrial fuel oil sales as reported by the U.S. Department of Energy, Energy Information Administration (US DOE, 2006b) to Maricopa County.

To derive industrial fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2005 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
	=	84,519 Mgal	–	431 Mgal
	=	84,088 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 (0.70), as determined by data from the US Census Bureau (2006a) 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
	=	84,088 Mgal	×	0.70
	=	58,466.39 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:

Maricopa County 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
	=	58,466.39 Mgal	–	9,928.15 Mgal	–	3,090.77 Mgal
	=	45,447.461 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 in 2005 (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 VOC emissions from external industrial fuel oil combustion	=	External industrial fuel oil sales (Mgal)	×	VOC emission factor for external fuel oil combustion (lb/Mgal)	÷	2,000 lb/ton
	=	35,453.565	×	0.2	÷	2,000
	=	3.55 tons VOC/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	35,453.565	0.2	24	5	3.55	425.44	88.63
Internal	21.99	9,993.897	49.3	604	130	246.35	3,018.16	649.60
Totals:	**100.00**	**45,447.461**				**249.89**	**3,443.60**	**738.24**

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
	= 249.89	× 25.49%	÷ (6 × 13)	× 2,000
	= 1,633.1 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
	= 249.89	× 0.9903
	= 247.47 tons VOC/yr	

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

Geographic area	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Maricopa County	249.89	3,443.60	738.24	1,633.1	22,505.1	4,824.6
Ozone NAA	247.47	3,410.20	731.08	1,617.3	22,286.8	4,777.8

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 2005. Area-source commercial and institutional (C&I) natural gas usage for the county is based on the reported total volume of natural gas sold to 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
	= 16,286.09 MMCF	– 538.85 MMCF
	= 15,747.24 MMCF	

Natural gas is used for both external combustion (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 2005.

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
	=	15,747.24	×	5.5	÷	2,000
	=	42.58 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) VOC	NO_x	CO	Annual emissions (tons/yr) VOC	NO_x	CO
External	98.34	15,485.18	5.5	100	84	42.58	774.26	650.38
Internal	1.66	262.06	116	2840	399	15.20	372.13	52.28
Totals:	**100.00**	**15,747.24**				**57.78**	**1,146.39**	**702.66**

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
	= 57.78	× 19.82%	÷ (6 × 13)	× 2,000
	= 293.7 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
	= 57.78	× 0.9985
	= 57.70 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**
Maricopa County	57.78	1,146.39	702.66	293.7	5,826.5	3,571.2
Ozone NAA	57.70	1,144.67	701.60	293.2	5,817.7	3,565.9

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 U.S. Department of Energy, Energy Information Administration (US DOE, 2006a) to Maricopa County.

To derive commercial/institutional fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2005 are first subtracted from Arizona state-level total C&I fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local clean air act requirements 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
	= 20,645 Mgal	–	0 Mgal
	= 20,645 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 (0.80), as determined by data from the US Census Bureau (2006a) 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
	=	20,645 Mgal	×	0.80
	=	16,532.52 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
	= 16,532.52 Mgal	–	6,092.013 Mgal	–	140.591 Mgal
	= 10,299.912 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 and institutional area sources surveyed in 2005 (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	
	=	6,895.791	×	0.34	÷ 2,000	
	=	1.17 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	6,895.791	0.34	24	5	1.17	82.75	17.24
Internal	33.05	3,404.121	49.3	604	130	83.91	1,028.04	221.27
Totals:	**100.00**	**10,299.912**				**85.08**	**1,110.79**	**238.51**

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
	= 85.08	× 25.59%	÷ (6 × 13)	× 2,000
	= 558.3 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
	= 85.08	×	0.9985
	= 84.96 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**
Maricopa County	85.08	1,110.79	238.51	558.3	7,288.2	1,564.9
Ozone NAA	84.96	1,109.13	238.15	557.4	7,277.2	1,562.6

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
	=	16,470.54	×	5.5	÷	2,000
	=	45.29 tons VOC/yr				

Ozone season-day emissions are calculated by first multiplying reported natural gas usage during the ozone season (2,437.40 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)
	=	2,437.40	×	5.5	÷	(7 × 13)
	=	147.3 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 resident population in the ozone nonattainment area as follows:

Annual emissions from residential natural gas combustion in the NAA	= County annual emissions	×	Percentage of resident population in the NAA
	= 45.29 tons/yr	×	100.52%
	= 45.53 tons VOC/yr		

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

Geographic area	Annual emissions (tons/yr) VOC	NO_x	CO	Season-day emission (lbs/day) VOC	NO_x	CO
Maricopa County	45.29	774.12	329.41	147.3	2,517.8	1,071.4
Ozone NAA	45.53	778.14	331.12	148.1	2,530.8	1,077.0

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, 2001f). Residential wood combustion in the county is estimated by multiplying data on statewide residential wood combustion usage from the US Department of Energy (2006c) by the ratio of county to state households that report use of wood for heating from the US Census Bureau (2006b). The latest available data on residential wood use for household heating from the US Department of Energy is for the calendar year 2003. 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 2003 data is assumed to be representative of 2005 emissions.

Maricopa County residential wood usage (cords/yr) = Arizona residential wood usage (cords/yr) × Ratio of county:state households using wood for heat

= 304,000 × 1,449 / 41,213

= 10,701 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, 2001f). 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

= 10,701 × 79 × 31.57 ÷ 2,000

= 13,344.06 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, 2001f):

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

= 13,344.06 × 229.0 ÷ 2,000

= 1.527.89 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
13,344.06	229.0	2.6	252.6	1,527.89	17.35	1,685.35

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 Department of Commerce (ADOC, 2006) indicated that there was no heating degree days reported during the 2005 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 are calculated by multiplying county totals by the percentage of residential population in the nonattainment area. See Section 1.5.1 for a further discussion of the population data used.

NAA annual emissions from residential wood combustion (tons/yr) = County annual emissions (tons/yr) × Percentage of resident population in the NAA

= 1,527.89 × 100.52%

= 1,535.84 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.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	1,527.89	17.35	1,685.35	0.0	0.0	0.0
Ozone NAA	1,535.84	17.44	1,694.12	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 (2006b):

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 are 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	0.66	0.18	0.0	0.0	0.0
Ozone NAA	0.713	18.0	5.0	0.03	0.66	0.18	0.0	0.0	0.0

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 (2006a) 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 2004 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
32532	Pesticide & Other Agricultural Chemical mfg.	0–19	10
32552	Adhesive mfg.	100–249	175
32591	Printing Ink mfg.	250–499	375
324122	Asphalt Shingle & Coating Materials mfg.	20–99	60
325188	All Other Basic Inorganic Chemical mfg.	100–249	175
325412	Pharmaceutical Preparation mfg.	500–999	750
325510	Paint & Coating mfg.	20–99	60
325611	Soap & Other Detergent mfg.	20–99	60
325991	Custom Compounding of Purchased Resins	100–249	175
325998	All Other Miscellaneous Chemical Product & Preparation mfg.	20–99	60
424690	Other Chemical & Allied Products Merchant Wholesalers	968	968
Total:			**2,868**

Since there were no point sources in this category, area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2005 as follows:

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

$$= \frac{19.96 \text{ tons of VOC/yr}}{1{,}280 \text{ employees}} \times 2{,}868 \text{ employees}$$

$$= 44.71 \text{ tons VOC/yr}$$

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 season-day emissions as follows:

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

$$= \frac{44.71}{5 \times 52} \times 2{,}000$$

$$= 343.9 \text{ lbs VOC/day}$$

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

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

$$= 44.71 \text{ tons/yr} \times 0.9903$$

$$= 44.28 \text{ tons VOC/yr}$$

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	44.71	0.39	0.03	343.9	3.0	0.2
Ozone NAA	44.28	0.38	0.03	340.6	2.9	0.2

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, 2006) 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 Maricopa County Environmental Services Department (MCESD) eating and drinking establishments permit database indicated that 10,238 restaurants operated in Maricopa County in 2005. 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 2005 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	1,481
Fast food	15.35	1,571
Family	3.64	372
Seafood	0.61	62
Steak & barbecue	1.15	118
Unrelated restaurant types e.g., lunchroom, bars,…	64.79	6,633
All restaurants	**100.00**	**10,238**

Using the number of restaurants for each restaurant type, along with the default emission factors and equations from EPA (2006), 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.

Commercial cooking is assumed 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. 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 (101.10%). (See Section 1.5.1 for a discussion of the population data used.) Table 3.3–4 summarizes the annual and season-day emissions from commercial cooking.

Table 3.3–4. Annual and season-day emissions from commercial cooking equipment.

	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	38.94	130.04	214.0	714.5	39.37	131.47	210.0	701.2
Underfired charbroilers	128.53	420.46	706.2	2,310.2	129.95	425.08	693.0	2,267.0
Deep fat fryers	20.08	0.00	110.3	0.0	20.30	0.00	108.3	0.0
Flat griddles	16.92	34.93	92.9	191.9	17.10	35.31	91.2	188.3
Clamshell griddles	0.68	0.00	3.7	0.0	0.68	0.00	3.6	0.0
Totals:	**205.15**	**585.43**	**1,127.2**	**3,216.7**	**207.40**	**591.87**	**1,139.6**	**3,252.0**

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 (2006a) 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 2004 employment, were used. CBP employment data for NAICS code 31181 (bread and bakery product manufacturing) indicated 1,607 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)
	= 1,607	–	236
	= 1,371 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source VOC emissions from bakeries} = \frac{37.52 \text{ tons/yr}}{590} \times 1{,}371 \text{ employees}$$

$$= 87.20 \text{ tons VOC/yr}$$

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 season-day emissions as follows:

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

$$= \frac{87.20 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 670.7 \text{ lbs VOC/day}$$

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. Results are summarized in Table 3.3–5. (See section 1.5.1 for a discussion of the employment data used.)

VOC emissions from area-source bakeries in the ozone NAA (tons/yr)	= Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	= 87.20 tons/yr	×	99.03%
	= 86.35 tons VOC/yr		

Table 3.3–5. Annual and season-day VOC emissions from area-source bakeries.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	87.20	670.7
Ozone NAA	86.35	664.2

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 3.3–6. 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	37.36	4.53	12.21	208.0	24.0	64.4
Ozone NAA	37.36	4.53	12.21	208.0	24.0	64.4

3.3.4 Non-metallic 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 were derived from annual emission reports from permitted facilities. Since all permitted facilities in this category were surveyed in 2005, it was assumed that there were no significant unpermitted sources within Maricopa County. Note that larger operations are treated as point sources, and addressed in Chapter 2. 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 (ADEQ). All state-permitted portable sources are addressed in Section 3.3.7.

Season-day emissions are calculated based on the operating schedule data reported by surveyed facilities. Annual and season-day emissions for the ozone nonattainment area were derived based on the location data of the individual facilities. County permitted portable sources with no location data were assumed to operate within the ozone nonattainment area as a conservative estimate.

Table 3.3–7 summarizes annual and season-day emissions from non-metallic mineral processes in both Maricopa County and the ozone nonattainment area.

Table 3.3–7. 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	0.11	0.6
Ozone NAA	0.11	0.6

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 (2006a) 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 2004 employment were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–8 lists 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)
	=	8,720	–	2,536
	=	6,184 employees		

Table 3.3–8. NAICS codes and employment data for rubber and plastic manufacturing facilities.

NAICS Code	Description	US Census employment data	Value used
322130	Paperboard Mills	0–19	10
323116	Manifold Business Forms Printing		375
325991	Custom Compounding of Purchased Resins	100–249	175
326122	Plastics Pipe & Pipe Fitting Mfg.	250–499	375
32613	Laminated Plastics Plate, Sheet (except Packaging), & Shape Mfg.	0–19	10
32614	Polystyrene Foam Product Mfg.		316
326160	Plastics Bottle Mfg.		161
32619	Other Plastics Product Mfg.		4,117
326212	Tire Retreading	20–99	60
32622	Rubber & Plastics Hoses & Belting Mfg.	20–99	60
326299	All Other Rubber Product Mfg.	100–249	175
327991	Cut Stone & Stone Product Mfg.		411
333415	HVAC Equipment Mfg.	500–999	750
336612	Boat Building	0–19	10
33992	Sporting & Athletic Goods Mfg.		1,212
423930	Recyclable Material Merchant Wholesalers		503
Total:			**8,720**

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source VOC emissions from rubber \& plastic mfg.} = \frac{\text{123.23 tons of VOC/yr}}{\text{1,119 employees}} \times \text{6,184 employees}$$

$$= \text{681.03 tons VOC/yr}$$

Ozone season-day emissions are calculated based on the operating schedule data reported by rubber and plastic 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 season-day emissions as follows:

Season-day VOC emissions from rubber & plastic manufacturing

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

$$= \frac{681.03 \times 25\%}{5 \times 13} \times 2{,}000$$

$$= 5{,}238.7 \text{ lbs VOC/day}$$

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 rubber & plastic mfg. in the ozone NAA (tons/yr)

= Annual Maricopa County emissions × NAA:County ratio of industrial employment

= 681.03 tons/yr × 99.03%

= 674.42 tons VOC/yr

Table 3.3–9 summarizes annual and season-day emissions from chemical manufacturing in both Maricopa County and the ozone nonattainment area.

Table 3.3–9. 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	681.03	5,238.7
Ozone NAA	674.42	5,187.8

3.3.6 Electric equipment manufacturing

Emissions from electric equipment manufacturing were derived from annual emission reports submitted by permitted sources. It was assumed that there were no significant unpermitted sources within Maricopa County. Note that larger operations are treated as point sources, and addressed in Chapter 2.

Annual and 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 either a 5- or 6-day week. As all facilities addressed in this source category are located within the ozone nonattainment area, emission totals for both areas are equal. Annual and season-day emissions are shown in Table 3.3–10.

Table 3.3–10. Annual and season-day emissions from area-source electric equipment manufacturing.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
Maricopa County	87.00	0.01	0.17	478.0	0.1	0.9
Ozone NAA	87.00	0.01	0.17	478.0	0.1	0.9

3.3.7 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. MCAQD requested information from ADEQ for all ADEQ-permitted sources that reported any activity in Maricopa County during 2005. Only annual total emissions for most pollutants were provided, along with information on the facility type, and information on the location of the site(s) during the year. Permits were classified into four major types: asphalt batch, concrete batch, crushing/ screening, and other (including soil remediation, generators, etc.).

Table 3.3–11 summarizes the annual and typical daily emissions for all ADEQ-permitted portable sources that operated within Maricopa County at some point during 2005. Since no precise location data was not available for all permits, all emissions are conservatively assumed to have originated within the ozone nonattainment area, therefore emissions in Maricopa County and the ozone nonattainment area are equal.

Table 3.3–11. Annual and season-day emissions from ADEQ-permitted portable sources.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	55.66	554.60	176.52	647.4	5,377.5	1,357.8
Ozone NAA	55.66	554.60	176.52	647.4	5,377.5	1,357.8

3.3.8 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.

Annual and season-day emissions for the ozone nonattainment area are based upon location of the annual emissions reports. Results are summarized in Table 3.3–12.

Table 3.3–12. 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	22.96	4.58	3.96	151.0	26.5	25.7
Ozone NAA	22.96	4.53	3.95	151.0	26.3	25.6

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 2005 national architectural coating usage from the US Census Bureau (2006c) by the United States population in 2004 (US Census Bureau, 2008).

National per-capita usage (gal/person)	= National architectural coating paint usage (gals)	÷	2004 US population
	= 807,395,000	÷	293,638,158
	= 2.74963 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 2.74963 (gal/person-yr)	×	Maricopa County emission limit for architectural coating (Rule 335) 2.1 (lb/gal)
	=	2.92085	×	2.1
	=	5.77421 lb/person/yr		

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 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	3,780,380	10,914.36	33 %	7	79,159.1
Ozone NAA	3,821,974	11,034.45	33 %	7	80,030.1

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 2004	× EPA emission factor (lbs/person)	÷ 2,000 (lbs/ton)	–	Annual emissions from point sources (tons/yr)[1]
	= 3,780,380	× 1.9	÷ 2,000	–	10.5
	= 3,580.86 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	3,780,380	3,580.86	25 %	5	27,545.1
Ozone NAA	3,821,974	3,620.38	25 %	5	27,849.0

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 2005 national traffic paint usage (US Census Bureau, 2006c) by the US population in 2004 (US Census Bureau, 2008).

Annual per-capita usage (gals/person)	= National traffic paint usage (gals/yr) 2005 ÷	US population 2004
	= 30,799,000	÷ 293,638,158
	= 0.10488 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)
	= 0.10488	×	2.1
	= 0.22025 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 season-day 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	3,780,380	416.34	33 %	5	4,227.5
Ozone NAA	3,821,974	420.92	33 %	5	4,273.8

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 (2006a) 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 2004 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.	340–755	548
337215	Showcase, partition, shelving & locker manufacturing	198–440	319
337920	Blind & shade manufacturing	222–511	367
321911	Wood window & door manufacturing	728	728
321918	Other millwork	334	334
Total:			**2,296**

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)

= 2,296 – 338

= 1,958 employees

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source VOC emissions from factory-finished wood} = \frac{53.02 \text{ tons/yr}}{544 \text{ employees}} \times 1{,}958 \text{ employees}$$

$$= 190.82 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of 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 percentage of industrial employment
	=	190.82 tons/yr	×	99.03%
	=	188.97 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	190.82	1,405.6
Ozone NAA	188.97	1,392.0

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 (2006a) 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 2004 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	1,801	1,801
337121	Upholstered household furniture manufacturing	278–679	479
337122	Non-upholstered wood household furniture manufacturing	2,181–4,651	3,416
337127	Institutional furniture manufacturing	27–66	47
337129	Wood television, radio & sewing machine cabinet mfg.	261–522	392
337211	Wood office furniture manufacturing	74–182	128
811420	Re-upholstery & furniture repair	292	292
Total:			**6,555**

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)
	=	6,555	–	2,170
	=	4,385 employees		

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source VOC from wood furniture coating} = \frac{128.77 \text{ tons/yr}}{633 \text{ employees}} \times 4{,}385 \text{ employees}$$

$$= 892.03 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of 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 percentage of industrial employment
	=	892.03 tons/yr	×	99.03%
	=	883.38 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	892.03	6,870.4
Ozone NAA	883.38	6,803.8

3.4.1.6 Aircraft surface coating

Annual emissions from aircraft surface coating facilities were derived from annual emission reports from permitted sources. It is assumed that all aircraft surface coating facilities were surveyed in 2005 based on a comparison of county-level employment data (US Census Bureau, 2006a) and annual emissions report employment data. 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 are equal.

Table 3.4–8. 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	51.94	378.6
Ozone NAA	51.94	378.6

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 2005
	= 398,975.9 lbs	÷ 33,915 employees
	= 11.764 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 2005	–	Employment at point sources in these SIC codes (from annual emission reports)
	=	105,628	–	42,887
	=	62,741 employees		

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

Total area-source emissions from misc. coating operations	=	per-employee emission factor	×	Total area-source employment in relevant SIC categories
	=	11.764 lbs/employee	×	62,741 employees
	=	738,085 lbs/yr		
	=	369.04 tons VOC/yr		

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of 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 percentage of industrial employment
	=	369.04 tons/yr	×	99.03%
	=	365.46 tons VOC/yr		

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

Table 3.4–9. Annual and season-day VOC emissions from miscellaneous surface coating.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	369.04	2,834.9
Ozone NAA	365.46	2,807.4

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 2005
	=	523,874 lbs	÷	24,946 employees
	=	21.00 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 over-estimate 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 2005	–	Employment at point sources in these SIC codes (from annual emission reports)
	=	116,356	–	53,276
	=	63,080 employees		

Annual emissions are calculated by “scaling up” area-source emissions reported from those facilities surveyed in 2005 as follows:

Total area-source emissions from degreasing operations	=	per-employee emission factor	×	Total area-source employment in relevant SIC categories
	=	21.00 lbs/employee	×	63,080 employees
	=	1,324,680 lbs/yr		
	=	662.35 tons VOC/yr		

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of 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 percentage of industrial employment
	=	662.35 tons/yr	×	99.03%
	=	655.93 tons VOC/yr		

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

Table 3.4–10. Annual and season-day VOC emissions from area-source degreasing.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	662.35	4,528.7
Ozone NAA	655.93	4,484.7

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 the petroleum-based solvents 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). Ozone season-day emissions were calculated based on operating schedule information provided in the facilities' annual emission reports

Since all dry cleaning establishments are located within the ozone nonattainment area, the county and nonattainment area emission totals are the same. Table 3.4–11 summarizes the annual and season-day VOC emissions from dry cleaning.

Table 3.4–11. Annual and season-day VOC emissions from dry cleaning.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	21.19	162.4
Ozone NAA	21.19	162.4

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 (2006a) 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 2004 employment were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.4–12 shows the NAICS codes and employment data used to calculate emissions from graphic arts.

Table 3.4–12. NAICS codes and descriptions for graphic arts.

NAICS Code	Description	US Census employment data	Value used
323*	Printing & related support activities	5,373	5,373
5111*	Newspaper, periodical, book & database publishers	5,563	5,563
Total:			**10,936**

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)
	= 10,936	–	1,416
	= 9,520 employees		

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source VOC emissions from graphic arts} = \frac{41.52 \text{ tons/yr}}{1{,}894 \text{ employees}} \times 9{,}520 \text{ employees}$$

$$= 208.71 \text{ tons VOC/yr}$$

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of 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 percentage of industrial employment
	= 208.71 tons/yr	×	99.03%
	= 206.69 tons VOC/yr		

Table 3.4–13 summarizes annual and season-day emissions from graphic arts in both Maricopa County and the ozone nonattainment area.

Table 3.4–13. Annual and season-day VOC emissions from area-source graphic arts.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	208.71	1,477.9
Ozone NAA	206.69	1,463.5

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 2005
	=	9,106.2 lbs	÷	3,599 employees
	=	2.53 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 2005	–	Employment at point sources in these SIC codes (from annual emission reports)
	=	36,942	–	11,797
	=	25,145 employees		

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

Total area-source emissions from misc. solvent use (tons/yr)	=	per-employee emission factor	×	Total area-source employment in relevant SIC categories
	=	2.53 lbs/employee	×	25,145 employees
	=	63,616.9 lbs/yr		
	=	31.81 tons VOC/yr		

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and season-day emissions for the ozone nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of 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 percentage of industrial employment
	= 31.81 tons/yr	×	99.03%
	= 31.50 tons VOC/yr		

Table 3.4–14 summarizes annual and season-day emissions from area-source miscellaneous industrial solvent use in both Maricopa County and the ozone nonattainment area.

Table 3.4–14. 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	31.81	221.5
Ozone NAA	31.50	219.4

3.4.6 Agricultural pesticide application

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 (AI) and various solvents (which act as carriers for the pest-killing material) referred to as the inert ingredient. Both active and inert ingredients can 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 MCAQD with data on agricultural pesticide usage for 2005, including information on the pesticide use, active ingredient(s), percent active ingredient(s), total chemical applied to the field, application date, application location, and application type (USDA, 2007). VOC emissions from the active ingredients were calculated using the preferred method outlined in EIIP guidance (US EPA, 2001e).

The EIIP guidance states that the preferred method cannot be used for aerial applications because a major factor in losses by aerial application is drift and neither equations nor experimental data are currently available to predict these losses. However, the MCAQD included both ground and aerial applications in emission estimates for agricultural pesticide applications because while some fraction of the applied pesticide may not reach its target area, the volatile portion will still result in VOC emissions.

Emission factors for the active ingredients were determined based on the vapor pressure of the active ingredient (US EPA 2001e, Table 9.4-4). Vapor pressure of the active ingredient was obtained from multiple sources including: EIIP guidance (US EPA 2001e, Table 9.4-2) and material safety data sheets. 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 shown in the example below for Methomyl, the active ingredient contained in the pesticide Lannate SP. Methomyl is a soluble powder and has a vapor pressure of 5×10^{-5}:

Amount of AI Methomyl applied	=	Lbs Lannate SP applied	×	Percent active ingredient (AI)
	=	1,476.04 lbs/yr	×	90%
	=	1,328.44 lbs/yr		

Annual VOC emissions AI Methomyl	=	Amount of AI Methomyl applied	×	Emission factor for active ingredient (lbs VOC/lb AI)
	=	1,328.44 lbs/yr	×	0.35 lbs VOC/lb
	=	464.95 lbs VOC/yr		

VOC emissions from the inert ingredients were calculated using average VOC content of the inert ingredient portion based on formulation type (US EPA 2001e, Table 9.4-3). Annual VOC emissions from the inert ingredient components of pesticides were calculated as shown in this example for Lannate SP:

Amount of inert ingredients of Lannate SP applied (lbs/yr)	=	Lbs Lannate SP applied	×	Percent inert ingredient
	=	1,476.04 lbs/yr	×	10%
	=	147.60 lbs/yr		

Annual VOC emissions from inert ingredients of Lannate SP (lbs/yr)	=	Amount of inert ingredients of Lannate SP applied	×	VOC content of inert portion for soluble powder
	=	147.60 lbs	×	12%
	=	17.71 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 Lannate SP:

Total annual VOC emissions from Lannate SP(lbs/yr)	=	Annual VOC emissions from AI of Methomyl (lbs/yr)	+	Annual VOC emissions from inert ingredients
	=	464.95 lbs	+	17.71 lbs
	=	482.66 lbs VOC/yr		

This procedure was followed for each pesticide that was applied in 2005. Totaling these calculated emissions resulted in 261.74 tons of VOC emissions from agricultural pesticide application in 2005. Ozone season-day emissions were calculated by dividing ozone season emissions by 91 (7 days/wk × 13 wks/ozone season), as follows:

Ozone season-day VOC emissions from agricultural pesticides (lbs/day)	=	Ozone season emissions from agricultural pesticides (lbs)	÷	(7 days/week × 13 weeks/season)
	=	74,493 lbs	÷	91 days/season
	=	818.60 lbs of VOC/day		

Agricultural pesticide usage data for 2005 included the location of the pesticide application to determine emissions from agricultural pesticide applications within the ozone nonattainment area.

Table 3.4–15. Annual and season-day VOC emissions from agricultural pesticide application.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	261.74	818.6
Ozone NAA	69.62	255.3

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 and the ozone nonattainment area (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 3.4–16. Annual and season-day VOC emissions from consumer and commercial products.

	Emission	Maricopa County		Ozone NAA	
Product category	factor (lbs/person)	Annual (tons/yr)	Season day (lbs/day)	Annual (tons/yr)	Season day (lbs/day)
Personal care	2.32	4,385.24	24,028.7	4,433.49	24,293.1
Household	0.79	1,493.25	8,182.2	1,509.68	8,272.2
Automotive aftermarket	1.36	2,570.66	14,085.8	2,598.94	14,240.8
Adhesives/sealants	0.57	1,077.41	5,903.6	1,089.26	5,968.6
FIFRA-Regulated	1.78	3,364.54	18,435.8	3,401.56	18,638.7
Coatings and related	0.95	1,795.68	9,839.3	1,815.44	9,947.6
Miscellaneous	0.07	132.31	725.0	133.77	733.0
Totals:	**7.84**	**14,819.09**	**81,200.5**	**14,982.14**	**82,093.9**

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 2005 state-level asphalt usage data (Asphalt Institute, 2007) to Maricopa County and the ozone nonattainment area by the use of two surrogates: vehicle miles traveled (VMT) and population. Table 3.4–17 lists 2005 vehicle miles traveled (VMT) and population for Arizona, Maricopa County and the ozone NAA.

Table 3.4–17. 2005 vehicle miles traveled (VMT) and population data.

Geographic area	VMT	Total residential population
Arizona	163,825,000 (1)	5,845,250
Maricopa County	82,150,747 (2)	3,524,175
Ozone NAA	84,631,487 (3)	3,542,478

1. ADOT, 2007; 2. MAG, 2007a., 3. MAG, 2007b.

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:

$$\text{2005 county cutback asphalt usage (tons/yr)} = \text{2005 Arizona cutback asphalt usage (tons/yr)} \times \text{2005 county:state VMT ratio}$$

$$= 10{,}972 \times (82{,}150{,}747 \div 163{,}825{,}000)$$

$$= 5{,}502 \text{ tons/yr}$$

Table 3.4–18 details state and county asphalt usage by type and the county:state allocation factor used.

Table 3.4–18. Annual asphalt usage, by type.

Asphalt type	2005 Arizona asphalt usage (tons/yr)	County:state allocation factor (surrogate measure)	County asphalt usage (tons/yr)
Cutback	10,972	50.15% (VMT)	5,501.96
Emulsified	42,448	50.15% (VMT)	21,285.73
Roofing	11,412	60.29% (population)	6,880.44

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:

$$\text{Annual VOC emissions from cutback asphalt in Maricopa County (tons/yr)} = \text{Maricopa County cutback asphalt usage (tons/yr)} \times \text{Emission factor (ton/ton)}$$

$$= 5{,}501.96 \times 0.20$$

$$= 1{,}100.39 \text{ tons VOC/yr}$$

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)
	=	6,880.44 ×	6.2 ÷	2,000
	=	21.33 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)
	= 1,100.39	× 2,000	÷ 365
	= 6,029.5 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 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
	=	1,100.39	× 1.0302
	=	1,133.62 tons VOC/yr	

Table 3.4–19. 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	1,100.39	6,029.5	1,133.62	6,211.6
Emulsified	559.51	3,065.8	576.41	3,158.4
Roofing	21.33	164.1	21.44	164.9
Totals:	**1,681.23**	**9,259.4**	**1,731.47**	**9,534.9**

3.5 Storage and transport

3.5.1 Bulk plants/terminals

Emissions from this source category were calculated from annual emissions inventory reports from all bulk terminals and bulk plants located within the county. It is assumed that there are no unpermitted bulk terminals or bulk plants in Maricopa County. To avoid double-counting, emissions from bulk terminals and bulk plants treated as point sources (totaling 404.50 tons) were subtracted from total emissions to derive total annual emissions from area-source bulk terminals and bulk plants of 26.35 tons/yr. 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 are equal.

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

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	26.35	138.6
Ozone NAA	26.35	138.6

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 16.38 tons) are addressed in Chapter 2. 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 are equal.

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

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	17.10	126.5
Ozone NAA	17.10	126.5

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 (1,568,138,788 gallons [ADOT, 2006]) by emission factors provided in AP-42 Table 5.2-7 (US EPA, 1995b) for each filling technology. Based on annual emissions reports, 98.5% of gasoline is delivered using balanced submerged filling with the remaining 1.5% delivered by submerged filling.

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

= 1,568,138.788 × 98.5% × 0.3

= 463,385 lbs, or 231.69 tons VOC/yr

VOC emissions from submerged filling	= Gas sales (Mgals)	× % delivered by fill technology		× emission factor (lbs/Mgals)
	= 1,568,138.788	× 1.5%		× 7.3
	= 171,711 lbs			
	= 85.86 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; as in this example for submerged filling:

Season-day VOC emissions from balanced submerged fill	= Total seasonal gas sales (Mgals)	× % fill tech.	× emission factor (lbs/MGals)	÷ (days/week × wks/season)
	= 394,827.536	× 98.5%	× 0.3	÷ (6 × 13)
	= 1,495.8 lbs VOC/day			

As a conservative assumption, annual and season-day emissions for the ozone nonattainment area are assumed to be equal to Maricopa County emissions.

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	317.55	2,050.1
Ozone NAA	317.55	2,050.1

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:

$$= \frac{(1{,}568{,}138.788 \text{ Mgals/yr} \times 0.005 \text{ lbs/Mgals} \times 1.25) + (1{,}568{,}138.788 \text{ Mgals/yr} \times 0.055 \text{ lbs/Mgals} \times 1.25)}{2{,}000}$$

= 58.81 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) (394,827,536 gallons (ADOT, 2006)), 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.

As a conservative estimate, all activity was assumed to occur within the nonattainment area; thus annual and season-day emissions estimates for the NAA are equal to county totals.

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	58.81	379.6
Ozone NAA	58.81	379.6

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 (ADOT, 2006) 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).

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

$$= \frac{1{,}568{,}138.788 \text{ Mgal} \times 1.0 \text{ lb/Mgal}}{2{,}000}$$

$$= 784.07 \text{ tons/yr}$$

Ozone season-day VOC emissions are calculated using the same formula as above, using only the gasoline distributed during the ozone season (July–September, 394,827,536 gallons) 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.

As a conservative estimate, all activity was assumed to occur within the nonattainment area; thus annual and season-day emissions estimates for the NAA are equal to county totals.

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	784.07	4,338.8
Ozone NAA	784.07	4,338.8

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 (ADOT, 2006) by a vehicle refueling factor estimated from the MOBILE6 model (MAG, 2004) as follows:

Annual VOC emissions from vehicle refueling (tons/yr)	=	Annual gasoline throughput (gals)	×	MOBILE6 vehicle refueling factor (g/gal)	÷	unit conversion factor
	=	1,568,138,788 gals	×	0.64 g/gal	÷	908,000 grams / ton
	=	1,105.30 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, 394,827,536 gallons) 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.

To be conservative, annual and season-day emissions for the ozone nonattainment area are assumed to be equal to Maricopa County emissions.

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	1,105.30	6,498.6
Ozone NAA	1,105.30	6,498.6

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 2005.

Emissions from on-site incineration were determined from annual emissions reports. It is assumed that all incinerator emissions are accounted for, since all permitted incinerators received reports in 2005. Season-day emissions are based on operating schedules as supplied in the annual emissions reports. All surveyed facilities are located within the ozone nonattainment area, thus total emissions for the county and NAA are equal. Table 3.6-1 summarizes annual and season-day emissions for Maricopa County and the nonattainment area.

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
Maricopa County	0.07	2.54	0.46	0.3	18.0	3.4
Ozone NAA	0.07	2.54	0.46	0.3	18.0	3.4

3.6.2 *Open burning*

Emissions from controlled open burning are regulated by Maricopa County Air Pollution Control Regulations Rule 314 (Open Outdoor Fires and Indoor Fireplaces at Commercial and Institutional Establishments), which requires a burn permit for open burning in Maricopa County. Burn permits are issued primarily for purposes of agricultural ditch bank and fence row 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 2005. A total of 73 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:

$$\text{Total ditchbank/fencerows} = 1{,}504{,}852 \text{ linear ft (reported)} \times \frac{50 \text{ burn permits issued}}{29 \text{ permits with data}} = 2{,}594{,}572 \text{ linear ft}$$

Reported and estimated activity data for each open burning category are summarized in Table 3.6–2. Permits issued for fire fighting training are addressed in Section 3.5.1.2.

Table 3.6–2. 2005 Maricopa County burn permit activity data.

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	1,504,852	29	50	2,594,572
Land clearance	Acres	5	1	7	35
Land clearance	Piles	37	2	7	130
Air curtain	Material Burned	70	7	7	70
Tumbleweeds	Piles	20	3	4	27

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)			
Category	VOC	NO_x	CO	Fuel loading 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 Maricopa County emission inventory and information from MCAQD's open burn program staff:

- 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 0.1 tons/acre, the AP-42 fuel loading factor for tumbleweeds.
- Air curtain destructors burn between 7–10 tons of material per day (MCAQD, 2006).

To calculate the annual amount of material burned on ditch banks and fence rows in Maricopa County, MCAQD 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 from ditchbanks and fence rows

$$= \frac{2{,}594{,}572 \text{ ft length}}{43{,}560 \text{ ft}^2 \text{ / acre}} \times 7 \text{ ft width} \times 3.2 \text{ tons/acre} \times 2 \text{ times/yr}$$

$$= 2{,}668 \text{ tons material burned/yr}$$

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 AP-42 emission factors (listed in Table 3.6–3) for each open burning category. To account for unpermitted illegal outdoor burning, all calculated emissions estimates were increased 2.31 times based on complaints received in 2006 for open or illegal outside burning (169 complaints received; 169 complaints/73 open burn permits = 2.31).

Annual VOC emissions from ditchbank and fence row burning

$$= \text{Total material burned} \times \text{emission factor} \times \text{unit conversion factor}$$

$$= 2{,}668 \text{ tons} \times 9 \text{ lbs/ton} \times 1 \text{ ton / } 2{,}000 \text{ lbs}$$

$$= 12.01 \text{ tons/yr}$$

Total annual VOC emissions including unpermitted burning

$$= \text{Calculated emissions from permit data + unpermitted burning adjustment factor}$$

$$= 12.01 \text{ tons/yr} \times 2.32$$

$$= 27.86 \text{ tons VOC/yr}$$

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 in Maricopa County.

		Annual emissions (tons/yr)		
Category	**Ton-equivalents**	**VOC**	**NO_x**	**CO**
Ditchbank/fencerow	2,668.4	27.86	12.38	263.11
Land clearance	526.4	5.50	2.44	51.90
Air curtain	70.0	0.73	0.32	6.58
Tumbleweeds	2.67	0.00	0.01	0.96
Totals:		**34.09**	**15.16**	**322.54**

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.

Category	Surrogate land use categories	2004 NAA:county land-use ratio	Emissions (tons/yr)		
			VOC	NO_x	CO
Ditchbank/fencerow	Agriculture	64.37 %	17.93	7.97	169.37
Land clearance	Vacant	43.32 %	2.38	1.06	22.48
Air curtain	Agriculture and vacant	47.23 %	0.35	0.15	3.11
Tumbleweeds	Agriculture and vacant	47.23 %	0.00	0.01	0.45
Totals:			**20.66**	**9.19**	**195.41**

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:

Seasonal adjustment factor = # of permits issued July–Sept. for the category / Total # of permits issued in 2005 for the category

E.g., Seasonal adjustment factor for ditchbank/fencerow burning = 11 permits issued during July–Sept. for ditchbank/fencerow burning / 50 total permits issued in 2005 for ditchbank/fencerow burning

= 22.00%

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

Ozone season-day VOC emissions (lbs/day) = (annual VOC emissions) × (seasonal adjustment factor) / (# of burn days/week) × (# of season weeks/yr)

Season-day VOC emissions from ditchbank burning = 55,720 lbs × 0.22 / 5 days/wk × 13 wks/yr

= 188.59 lbs VOC/day

Season-day emissions for the ozone nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the nonattainment area by the Maricopa County season-day emissions. (See Section 1.5.2 for a discussion of the land-use data used.) Table 3.6–6 summarizes the 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.

Category	Maricopa County			Ozone nonattainment area		
	VOC	NO_x	CO	VOC	NO_x	CO
Ditchbank/fencerow	188.6	83.8	1,781.0	121.4	54.0	1,146.5
Land clearance	0.0	0.0	0.0	0.0	0.0	0.0
Air curtain	3.2	1.4	28.9	1.5	0.7	13.7
Tumbleweeds	0.0	0.0	0.0	0.0	0.0	0.0
Totals:	**191.8**	**85.2**	**1,809.9**	**122.9**	**54.6**	**1,160.2**

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. Five MSW landfills (Butterfield Station, City of Chandler Landfill, Northwest Regional Landfill, Skunk Creek Landfill and Southwest Regional Municipal Solid Waste Landfill) 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 emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	6.81	6.50	8.42	37.0	35.5	46.2
Ozone NAA	6.81	6.50	8.42	37.0	35.5	46.2

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, 2001h) 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 (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	3,780,380	8.9	614.03	4,723.3
Ozone NAA	3,821,974	8.9	620.78	4,775.3

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 56 LUST opened in Maricopa County in 2005 (ADEQ, 2007). Data were not available on the number or date of remediations that occurred in 2005; therefore, it was conservatively assumed that all 56 LUST were remediated in 2005 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:

$$\text{Annual VOC emissions from LUST remediations} = \frac{28 \text{ lbs VOC}}{\text{day}} \times 56 \text{ remediations} \times \frac{5 \text{ days}}{\text{remediation}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}}$$

$$= 3.92 \text{ tons/yr}$$

Ozone season-day emissions were calculated by dividing annual values by 65 (5 days/wk × 13 wks/ozone season). To be conservative, it was assumed that all gasoline retail outlets were located within the ozone NAA and therefore, annual and season-day emissions for the ozone nonattainment area were assumed to be equal to the Maricopa County totals.

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	3.92	120.6
Ozone NAA	3.92	120.6

3.6.6 Other industrial waste disposal

Annual area-source emissions from other industrial waste disposal were derived from annual emissions reports from permitted facilities. Other 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 emissions reports. Season-day emissions are based on operating schedules as supplied in the annual emissions reports. All surveyed facilities are located within the ozone nonattainment area, thus total emissions for the county and NAA are equal. Table 3.6-10 summarizes annual and season-day emissions for Maricopa County and the nonattainment area.

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

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
Maricopa County	10.56	4.15	14.57	58.2	22.8	80.1
Ozone NAA	10.56	4.15	14.57	58.2	22.8	80.1

3.7 Miscellaneous area sources

3.7.1 Other combustion

3.7.1.1 Wildfires

Federal and state records of individual vegetation fire events were collected from the Arizona State Land Department WildCAD database (ASLD, 2006a) and the United States Geological Survey GeoMAC Wildland Fire Support database (USGS, 2006). Only vegetation fires with reported acreage were used to estimate emissions from wildfires. Seventy-six fires occurred within the ozone nonattainment area, resulting in nearly 205,000 acres burned. The largest fire within the ozone nonattainment area was the Cave Creek Complex fire which occurred in July 2005 and resulted in over 96,000 acres burned.

Fire activity records in the two databases were culled for duplicates by comparing incident names and incident dates. The acreage for fires located near the Maricopa County border where reviewed by Arizona State Land Department (ASLD) staff to ensure that only acres burned within Maricopa County were included in emission estimates. ASLD staff also reviewed acreage estimates for all fires with a discrepancy greater than 500 acres between data reported by ASLD and USGS. When fuel type data was missing from state and federal records, fuel type was obtained from Incident Status Summary, Form ICS-209 (USFS, 2006a). In the event that fire event-specific fuel type were not contained in federal or state data nor in the ICS-209 forms, then National Fire Danger Rating System (NFDRS) model descriptions of “sagebrush grass” or “California chaparral” were assigned based on guidance from Arizona State Land Department (ASLD, 2006b).

NFDRS model descriptions were assigned to each fire event based on the fuel type and then corresponding fuel loadings were assigned (WGA/WRAP, 2005). Estimates of the material burned were derived by multiplying the number of acres burned by the assigned fuel loading factor.

Table 3.7–1. Assigned NFDRS model categories, fuel loading factors, and material burned.

NFDRS Model Description	Fuel Load (tons/acre)	Attribute	Ozone NAA	Maricopa County
California Chaparral	19.5	acres burned	187,364	187,864
		material burned (tons)	3,653,600	3,663,350
Intermediate Brush	15	acres burned	3,088	81,446
		material burned (tons)	46,320	1,221,690
Sagebrush Grass	4.5	acres burned	24,178	34,163
		material burned (tons)	108,799	153,736
Western Grasses (annual)	0.5	acres burned	7,935	12,447
		material burned (tons)	3,968	6,224
Total acres burned			204,950	315,921
Total material burned (tons)			3,747,112	5,044,999

Emission factors were obtained from the Western Regional Air Partnership's (WRAP) 2002 Fire Emission Inventory (WGA/WRAP, 2005). Emission factors are listed below in Table 3.7–2.

Table 3.7–2. Summary of emission factors for prescribed fire (lb/ton).

Category	VOC	NO_x	CO
Prescribed fire (Non-Piled)	13.6	6.2	289

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

Annual VOC emissions from wildfires in Maricopa County

$$= \frac{\text{material burned} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{5{,}044{,}999 \text{ tons of material burned} \times 13.60 \text{ lbs VOC/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 34{,}306 \text{ tons VOC/yr}$$

Fire activity records included fire locations in latitude and longitude. This data was used to determine the number of acres burned inside of the nonattainment area. Estimates of the material burned were derived by multiplying the number of acres burned within the nonattainment area by the assigned fuel loading factor. Annual emissions from wildfires within the nonattainment area were then calculated by multiplying the material burned by the appropriate emission factor.

Annual VOC emissions from wildfires within the ozone NAA

$$= \frac{\text{material burned within the ozone NAA} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{3{,}747{,}112 \text{ tons of material burned} \times 13.6 \text{ lbs VOC/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 25{,}480.36 \text{ tons VOC/yr}$$

Table 3.7–3. Annual emissions from wildfires (tons/yr).

Geographic area	Material Burned (tons)	Annual emissions (tons/yr)		
		VOC	NO_x	CO
Maricopa County	5,044,999	34,305.99	15,639.50	729,002.36
Ozone NAA	3,747,112	25,480.36	11,616.05	541,457.70

Season-day emissions were estimated by dividing ozone season emissions by the number of ozone season burn days. In 2005, ninety-one burn days occurred during the ozone season.

Season day VOC emissions from wildfires in Maricopa County

$$= \frac{\text{material burned during ozone season (tons)} \times \text{VOC emission factor (lbs/ton)}}{\text{number of ozone season burn days in 2005}}$$

$$= \frac{1{,}540{,}444 \times 13.6 \text{ lbs VOC/day}}{91 \text{ days/yr}}$$

$$= 230{,}220 \text{ lbs VOC/day}$$

Table 3.7–4. Season-day emissions from wildfires (lbs/day).

Geographic area	Number of Burn Days	Season-day emissions (lbs/day)		
		VOC	NO_x	CO
Maricopa County	298	230,220.1	104,953.3	4,892,178.0
Ozone NAA	91	221,532.3	100,992.6	4,707,560.5

3.7.1.2 Prescribed fires

Prescribed fires data were obtained from the United States Forest Service (USFS, 2006b). The United States Forest Service reported that one prescribed fire occurred in Maricopa County in 2005. Three acres of piled fuels were burned in the Tonto National Forest on October 21, 2005. The prescribed fire occurred within the ozone nonattainment area.

Prescribed fire emission factors were obtained from the Western Regional Air Partnership's (WRAP) 2002 Fire Emission Inventory (WGA/WRAP, 2005). The United States Forest Service estimated the fuel loading. Both are listed in Table 3.7–5. Estimates of the material burned in are derived by multiplying the number of acres burned by the appropriate fuel loading factor.

Table 3.7–5. Emission and fuel loading factors for prescribed fires.

Type of fire	Number of acres burned	Fuel loading factor (tons/acre)	Emission factors (lbs/ton burned)		
			VOC	NO_x	CO
Prescribed fire (piled fuels)	3	5.0	6.3	6.2	74.3

Annual emissions from prescribed fires in Maricopa County were calculated as follows.

Annual VOC emissions from prescribed fires in Maricopa County

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

$$= \frac{3 \text{ acres burned} \times 5.0 \text{ tons/acre} \times 6.3 \text{ lbs/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 0.05 \text{ tons VOC/yr}$$

Because only one prescribe fire occurred in 2005 within the Tonto National Forest, which is located inside of the ozone nonattainment area, emissions from prescribed fires within the nonattainment area are equal to annual emissions for Maricopa County.

Because the prescribed fire occurred on October 21, 2005, and not during the ozone season, season-day emissions from prescribed fires for Maricopa County and the ozone nonattainment area were determined to be zero.

Table 3.7–6. Annual and season-day emissions from prescribed fires.

Geographic area	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Maricopa County	0.05	0.05	0.56	0.0	0.0	0.0
Ozone NAA	0.05	0.05	0.56	0.0	0.0	0.0

3.7.1.3 Structure fires

2005 structure fire data were obtained by surveying fire departments in Maricopa County and by querying Maricopa County's burn permit data base. Approximately 50 percent of the fire departments surveyed responded to the survey. Because actual fire data was only collected for a portion of the fire departments in Maricopa County, the number of structure fires reported were scaled up to the entire inventory area based on population. The most recent population estimates for Maricopa County were used to scale up the number of structure fires (DES, 2006). Five open burn permits were issued in 2005 for fire training; these were included in the total number of estimated structure fires for 2005. It was estimated that 3,628 structure fires occurred in Maricopa County in 2005.

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, 2001g). Tons of material burned were estimated as follows:

Material burned in structure fires (tons/yr)	= 3,628 fires	× 1.15 tons/fire
	= 4,171.77 tons material burned/yr	

Table 3.7–7. Estimated material burned, emission 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
3,628	1.15	4,171.77	11	1.4	60

Annual emissions were then calculated by multiplying the amount of material burned by the emission factors listed in Table 3.7–7 (from US EPA, 2001g), as follows:

Annual VOC emissions from structure fires Maricopa County	=	Quantity of material burned × emission factor × unit conversion factor
	=	4,171.77 tons × 11 lbs/ton × (1 ton/2,000 lbs.)
	=	22.94 tons VOC/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 nonattainment area (100.52%), as shown in the example below. See Section 1.5.1 for a discussion of the population data used.

Annual VOC emissions within the ozone NAA	=	Annual VOC emissions for Maricopa County	×	Percentage residential population within the NAA
	=	22.94 tons/yr	×	100.52%
	=	23.06 tons VOC/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, 2001g). 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 emissions for Maricopa County were derived using the following formula:

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

$= \frac{45{,}880 \times 22.3\%}{91}$

= 112.4 lbs VOC/day

Table 3.7–8. Annual and season-day emissions from structure fires.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	22.94	2.92	125.15	112.5	14.3	613.4
Ozone NAA	23.06	2.94	125.80	113.0	14.4	616.6

3.7.1.4 Vehicle fires

2005 vehicle fire data were obtained by surveying fire departments in Maricopa County. Approximately 50 percent of the fire departments surveyed responded to the survey. Because actual fire data was only collected for a portion of the fire departments in Maricopa County, the number of vehicle fires reported were scaled up to the entire inventory area based on population. The most recent population estimates for Maricopa County were used to scale up the number of vehicle fires (DES, 2006). It was estimated that 2,113 vehicle fires occurred in Maricopa County in 2005.

Annual emissions from vehicle fires are calculated by first multiplying the number of vehicle fires by a fuel loading factor per vehicle fire to estimate the annual amount of material burned in vehicle fires (US EPA, 2000b). The amount of annual material burned in vehicle fires is then multiplied by emission factors for open burning of automobile components from AP-42 as listed in table 3.7–9 (US EPA, 1992).

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

= 2,113 × 0.25 tons/vehicle × 100 lbs/ton × (1 ton / 2,000 lbs)

= 26.41 tons VOC/yr

Table 3.7–9. 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	Emission factors (lbs/ton) NO_x	Emission factors (lbs/ton) CO
2,113	0.25	528.25	32	4	125

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 (100.52%). See Section 1.5.1 for a discussion of the population data used.

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

= 8.45 tons/yr × 100.52%

= 8.49 tons/yr

It is 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. The results are shown in Table 3.7–10 below.

Table 3.7–10. 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**
Maricopa County	8.45	1.06	33.02	46.3	5.8	180.9
Ozone NAA	8.50	1.06	33.19	46.6	5.8	181.9

3.7.1.5 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. Results are shown in Table 3.7–11.

Table 3.7–11. 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**
Maricopa County	0.48	4.61	1.41	1.3	34.1	8.7
Ozone NAA	0.48	4.61	1.41	1.3	34.1	8.7

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 (2006a) 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 2004 employment, were used. CBP employment data for NAICS code 662110 (general medical and surgical hospitals) indicated 42,059 employees in this industry in Maricopa County.

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2005 as follows:

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

Area-source VOC emissions from hospitals = $\frac{23.99 \text{ tons/yr}}{18{,}850 \text{ employees}}$ × 42,059 employees

= 53.52 tons VOC/yr

Ozone season-day emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. 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 employment data used.)

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

= 53.52 tons/yr × 100.11%

= 54.11 tons VOC/yr

Table 3.7–12 summarizes annual and season-day emissions from hospitals in both Maricopa County and the ozone nonattainment area.

Table 3.7–12. Annual and season-day VOC emissions from hospitals.

Geographic area	Annual emissions (tons/yr)	Season-day emissions (lbs/day)
Maricopa County	53.52	308.2
Ozone NAA	54.11	311.6

3.7.2.2 Crematories

Emissions from human and animal crematories were calculated from annual emissions inventory reports from all crematories located within the county. It is assumed that there are no unpermitted crematories in 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 crematories are equal.

Table 3.7–13. Annual and season-day emissions from crematories.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	VOC	NO_x	CO	VOC	NO_x	CO
Maricopa County	0.28	11.45	0.63	2.1	88.0	4.8
Ozone NAA	0.28	11.45	0.63	2.1	88.0	4.8

3.7.3 Accidental releases

As part of its air quality permit compliance program, MCAQD 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 0.03 tons of VOC for the year 2005.

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 3.7–14.

Table 3.7–14. Annual and season-day VOC emissions from accidental releases.

Geographic area	Annual emissions (tons/yr)	Season-day emission (lbs/day)
Maricopa County	0.03	0.2
Ozone NAA	0.03	0.2

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	15.61	308.43	192.24	83.0	1,639.6	1,022.0
Industrial fuel oil	249.89	3,443.60	738.24	1,633.1	22,505.1	4,824.6
Commercial/institutional natural gas	57.78	1,146.39	702.66	293.7	5,826.5	3,571.2
Commercial/institutional fuel oil	85.08	1,110.79	238.51	558.3	7,288.2	1,564.9
Residential natural gas	45.29	774.12	329.41	147.3	2,517.8	1,071.4
Residential wood	1,527.89	17.35	1,685.35	0.0	0.0	0.0
Residential fuel oil	0.03	0.66	0.18	0.0	0.0	0.0
Total, all fuel combustion:	**1,981.59**	**6,801.33**	**3,886.59**	**2,715.4**	**39,777.1**	**12,054.1**
Industrial Processes:						
Chemical manufacturing	44.71	0.39	0.03	343.9	3.0	0.2
Commercial cooking	205.15		585.43	1,127.2		3,216.7
Bakeries	87.20			670.7		
Secondary metal production	37.36	4.53	12.21	208.0	24.0	64.4
Mineral processes	0.11			0.6		
Rubber/plastic product mfg.	681.03			5,238.7		
Electrical equipment mfg.	87.00	0.01	0.17	478.0	0.1	0.9
State-permitted portable sources	55.66	554.60	176.52	647.4	5,377.5	1,357.8
Industrial processes, NEC	22.96	4.58	3.96	151.0	26.5	25.7
Total, all industrial processes:	1,221.17	564.11	778.32	8,865.6	5,431.1	4,665.7
Solvent Use:						
Surface Coating:						
–Architectural coatings	10,914.36			79,159.1		
–Auto refinishing	3,580.86			27,545.1		
–Traffic markings	416.34			4,227.5		
–Factory-finished wood	190.82			1,405.6		
–Wood furniture	892.03			6,870.4		
–Aircraft	51.94			378.6		
–Misc. surface coating	369.04			2,834.9		
Total, all surface coating:	**16,415.40**			**122,421.2**		

Table 3.8–1. Summary of annual and season-day emissions from all area sources in Maricopa County (continued).

Category	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Degreasing	662.35			4,528.7		
Dry cleaning	21.19			162.4		
Graphics arts	208.71			1,477.9		
Misc. industrial solvent use	31.81			221.5		
Agricultural pesticides	261.74			818.6		
Consumer/ commercial solvent use	14,819.09			81,200.5		
Asphalt application	1,681.23			9,259.4		
Total, all solvent use:	**34,101.52**			**220,090.2**		
Storage/Transport:						
Bulk plants and terminals	26.35			138.6		
VOL storage/transport	17.10			126.5		
Fuel delivery	317.55			2,050.1		
Trucks in transit	58.81			379.6		
Station losses	784.07			4,338.8		
Vehicle refueling	1,105.30			6,498.6		
Total, all storage/transport:	**2,309.17**			**13,532.1**		
Waste Treatment/Disposal:						
On-site incineration	0.07	2.54	0.46	0.3	18.0	3.4
Open burning	34.09	15.16	322.54	191.8	85.2	1,809.9
Landfills	6.81	6.50	8.42	37.0	35.5	46.2
Publicly owned treatment works	614.03			4,723.3		
Leaking underground storage tanks	3.92			120.6		
Other waste treatment/disposal	10.56	4.15	14.57	58.2	22.8	80.1
All waste treatment/disposal:	**669.48**	**28.35**	**346.00**	**5,131.3**	**161.5**	**1,939.6**
Miscellaneous Area Sources:						
Wildfires	34,305.99	15,639.50	729,002.36	230,220.1	104,953.3	4,892,178.0
Prescribed fires	0.05	0.05	0.56	0.0	0.0	0.0
Structure fires	22.94	2.92	125.15	112.5	14.3	613.4
Vehicle fires	8.45	1.06	33.02	46.3	5.8	180.9
Engine testing	0.48	4.61	1.41	1.3	34.1	8.7
Hospitals	53.52			308.2		
Crematories	0.28	11.45	0.63	2.1	88.0	4.8
Accidental releases	0.03			0.2		
Total, all miscellaneous sources:	**34,391.76**	**15,659.58**	**729,163.13**	**230,690.8**	**105,095.5**	**4,892,985.9**
Total, all area sources:	**74,674.69**	**23,053.36**	**734,174.04**	**481,025.3**	**150,465.3**	**4,911,645.3**

Table 3.8–2. Summary of annual and season-day emissions from all area sources within the ozone NAA.

Category	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
	VOC	NO_x	CO	VOC	NO_x	CO
Fuel Combustion:						
Industrial natural gas	15.46	305.44	190.37	82.2	1,623.7	1,012.0
Industrial fuel oil	247.47	3,410.20	731.08	1,617.3	22,286.8	4,777.8
Commercial/institutional natural gas	57.70	1,144.67	701.60	293.2	5,817.7	3,565.9
Commercial/institutional fuel oil	84.96	1,109.13	238.15	557.4	7,277.2	1,562.6
Residential natural gas	45.53	778.14	331.12	148.1	2,530.8	1,077.0
Residential wood	1,535.84	17.44	1,694.12	0.0	0.0	0.0
Residential fuel oil	0.03	0.66	0.18	0.0	0.0	0.0
Total, all fuel combustion:	**1,986.98**	**6,765.66**	**3,886.63**	**2,698.2**	**39,536.4**	**11,995.3**
Industrial Processes:						
Chemical manufacturing	44.28	0.38	0.03	340.6	2.9	0.2
Commercial cooking	207.40		591.87	1,139.6		3,252.0
Bakeries	86.35			664.2		
Secondary metal production	37.36	4.53	12.21	208.0	24.0	64.4
Mineral processes	0.11			0.6		
Rubber/plastic product mfg.	674.42			5,187.8		
Electrical equipment mfg.	87.00	0.01	0.17	478.0	0.1	0.9
State-permitted portable sources	55.66	554.6	176.52	647.4	5,377.5	1,357.8
Industrial processes, NEC	22.96	4.53	3.95	151.0	26.3	25.6
Total, all industrial processes:	**1,215.54**	**564.05**	**784.75**	**8,817.3**	**5,430.8**	**4,701.0**
Solvent Use:						
Surface Coating:						
–Architectural coatings	11,034.45			80,030.1		
–Auto refinishing	3,620.38			27,849.0		
–Traffic markings	420.92			4,273.8		
– Factory-finished wood	188.97			1,392.0		
–Wood furniture	883.38			6,803.8		
–Aircraft	51.94			378.6		
–Misc. surface coating	365.46			2,807.4		
Total, all surface coating:	**16,565.50**			**123,534.6**		
Degreasing	655.93			4,484.7		
Dry cleaning	21.19			162.4		
Graphics arts	206.69			1,463.5		
Misc. industrial solvent use	31.50			219.4		
Agricultural pesticides	69.62			255.3		
Consumer/ commercial solvent use	14,982.14			82,093.9		
Asphalt application	1,731.47			9,534.9		
Total, all solvent use:	**34,264.03**			**221,748.8**		
Storage/Transport:						
Bulk plants and terminals	26.25			138.6		
VOL storage/transport	17.10			126.5		
Fuel delivery	317.55			2,050.1		
Trucks in transit	58.81			379.6		
Station losses	784.07			4,338.8		
Vehicle refueling	1,105.30			6,498.6		
Total, all storage/transport:	**2,309.17**			**13,532.1**		

Table 3.8–2. Summary of annual and season-day emissions from all area sources within the ozone NAA (continued).

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Waste Treatment/Disposal:						
On-site incineration	0.07	2.54	0.46	0.3	18.0	3.4
Open burning	20.66	9.19	195.41	122.9	54.6	1,160.2
Landfills	6.81	6.50	8.42	37.0	35.5	46.2
Publicly owned treatment works	620.78			4,775.3		
Leaking underground storage tanks	3.92			120.6		
Other waste treatment/disposal	10.56	4.15	14.57	58.2	22.8	80.1
All waste treatment/disposal:	**662.81**	**22.38**	**218.87**	**5,114.3**	**130.9**	**1,289.8**
Miscellaneous Area Sources:						
Wildfires	25,480.36	11,616.05	541,457.70	221,532.3	100,992.6	4,707,560.5
Prescribed fires	0.05	0.05	0.56	0.0	0.0	0.0
Structure fires	23.06	2.94	125.80	113.0	14.4	616.6
Vehicle fires	8.50	1.06	33.19	46.6	5.8	181.9
Engine testing	0.48	4.61	1.41	1.3	34.1	8.7
Hospitals	54.11			311.6		
Crematories	0.28	11.45	0.63	2.1	88.0	4.8
Accidental releases	0.03			0.2		
Total, all miscellaneous sources:	**25,566.88**	**11,636.15**	**541,619.29**	**222,007.1**	**101,135.0**	**4,708,372.4**
Total, all area sources:	**66,005.41**	**18,988.24**	**546,509.54**	**473,917.9**	**146,233.0**	**4,726,358.5**

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 2005 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 2002 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 2005 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 (not present in Maricopa County);
- 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 (not present in Maricopa County);
- Aircraft, such as jet and piston engines; and
- Locomotives, such as switching and line haul trains.

Emission calculations for all nonroad mobile sources except aircraft, airport ground support equipment and locomotives are derived from EPA's NONROAD2005 model (Core version 2005a, Feb. 2006). Aircraft and airport ground support equipment emission calculations were derived from individual surveys of county airports. Locomotive emission calculations were derived from surveys of the 3 railroad companies that have operations in the county (Burlington Northern Santa Fe, Union Pacific and Amtrak).

County specific temperature and fuel-related inputs are required for the operation of the NONROAD2005 model. Monthly temperature and fuel data were provided by the Arizona State Weights and Measures Department. The following table lists the local county inputs used:

Table 4.1–1. NONROAD2005 model county temperature and fuel-related inputs.

Month	Max (°F)	Min (°F)	Average (°F)	Fuel RVP (psi)	Diesel Sulfur (ppm)	Gasoline Sulfur (ppm)
January	81	41	57.8	9	354	39
February	72	46	59.2	9	318	43
March	88	46	63.9	9	303	29
April	96	53	72.3	8	301	39
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
September	108	70	89.6	7	314	37
October	101	58	78.3	8	339	30
November	90	40	66.3	9	364	34
December	78	35	56.8	9	389	30

Note: All other required temperature and fuel-related inputs not listed assumed NONROAD2005 default values.

The US EPA recommends adjusting default NONROAD2005 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. The NONROAD2005 model defaults were adjusted in the following manner:

- Equipment population numbers and activity levels for commercial lawn and garden equipment were adjusted based on 2003 survey results of the commercial lawn and garden industry performed by ENVIRON as part of an inventory developed to study the impact of visibility impairing pollutants (ENVIRON *et al.,* 2003). 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.

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 NONROAD2005 model come from EPA recommendations on weekday and weekend day activity levels for each nonroad equipment category (US EPA, 1999). Table 4.1–2 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 4.1–2. 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 NONROAD2005 model, as discussed above. 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 (223,627 acres) to agricultural land inside the county (465,833 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
	= 53.31 tons	×	64.37%
	= 34.32 tons VOC /yr		

County season-day emissions were calculated by multiplying ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for agricultural equipment listed in Table 4.1–2, and dividing the product by the number of weeks (13) in the ozone season (US EPA, 1999), as follows:

Maricopa County VOC season-day emissions (lbs/day)	= Ozone season VOC emissions (tons/season)	× 2,000 (lb/ton)	×	daily activity allocation factor for agricultural equipment expressed as (week/day)	÷ 13 (weeks/season)
	= 17.67	× 2,000	×	0.166667	÷ 13
	= 453.1 lbs/day				

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
	= 453.1 lbs/day	×	64.37%
	= 291.7 lbs/day		

Table 4.2–1. Annual and season-day emissions from agricultural equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	53.31	386.34	417.85	453.1	3,226.3	3,707.9
Ozone NAA	34.32	248.69	268.97	291.7	2,076.8	2,386.8

4.3 Airport ground support equipment

Annual emissions from airport ground support equipment (GSE) were calculated based on the MAG Airport Emission Model. Activity data on aircraft operations was obtained through the Federal Aviation Administration website for eight towered airports in Maricopa County. Since all eight towered airports are in the ozone nonattainment area, NAA emission estimates are equal to Maricopa County totals.

Table 4.3–1. Annual and season-day emissions from airport ground support equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Ozone NAA	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0

4.4 Commercial equipment

Annual emissions from commercial equipment in Maricopa County were calculated using EPA's NONROAD2005 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.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for commercial equipment (0.1666667) listed in Table 4.1–2, 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 4.4–1. Annual and season-day emissions from commercial equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	2,339.70	1,449.72	54,941.52	17,907.0	8,553.8	410,503.5
Ozone NAA	2,331.28	1,444.50	54,743.73	17,842.5	8,523.0	409,025.7

4.5 Construction and mining equipment

Annual emissions from construction and mining equipment in Maricopa County were calculated using EPA's NONROAD2005 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.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for construction/mining equipment (0.1666667) listed in Table 4.1–2, 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 4.5–1. Annual and season-day emissions from construction and mining equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	2,690.85	16,016.62	23,667.21	18,840.1	108,785.6	177,261.9
Ozone NAA	2,720.45	16,192.81	23,927.55	19,047.3	109,982.3	179,211.8

4.6 Industrial equipment

Annual emissions from industrial equipment in Maricopa County were calculated using EPA's NONROAD2005 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.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for industrial equipment (0.1666667) listed in Table 4.1–2, 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 4.6–1. Annual and season-day emissions from industrial equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	772.17	3,316.67	13,597.40	5,035.6	21,109.0	90,844.8
Ozone NAA	769.39	3,304.73	13,548.45	5,017.5	21,033.0	90,517.8

4.7 Lawn and garden equipment

Annual emissions from lawn and garden equipment in Maricopa County were calculated using EPA's NONROAD2005 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 population in the nonattainment area to Maricopa County-level totals, since housing units was not available, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 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 4.1–2, 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 4.7–1. Annual and season-day emissions from lawn and garden equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	6,586.38	843.10	101,879.34	74,053.0	6,409.9	1,085,431.7
Ozone NAA	6,658.83	852.37	103,000.01	74,867.6	6,480.4	1,097,371.4

4.8 Pleasure craft

Annual emissions from pleasure craft equipment in Maricopa County were calculated using EPA's NONROAD2005 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.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for pleasure craft (0.350000) listed in Table 4.1–2, 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 4.8–1. Annual and season-day emissions from pleasure craft equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Ozone NAA	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6

4.9 Railway maintenance equipment

Annual emissions from railway maintenance equipment in Maricopa County were calculated using EPA's NONROAD2005 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.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for railway maintenance equipment (0.1800000) listed in Table 4.1–2, 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 4.9–1. Annual and season-day emissions from railway maintenance equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	2.32	9.27	28.38	16.8	63.9	221.4
Ozone NAA	2.35	9.37	28.69	17.0	64.6	223.8

4.10 Recreational equipment

Annual emissions from recreational equipment in Maricopa County were calculated using EPA's NONROAD2005 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.

County season-day emissions were calculated by multiplying Maricopa County ozone season emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for recreational equipment (0.2222222) listed in Table 4.1–2, 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 4.10–1. Annual and season-day emissions from recreational equipment.

	Annual emissions (tons/yr)			Season-day emission (lbs/day)		
Geographic area	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Maricopa County	1,416.44	59.99	10,675.34	16,532.4	535.5	135,733.8
Ozone NAA	911.28	38.59	6,868.11	10,636.3	344.5	87,326.0

4.11 Aircraft

A survey of 17 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 (Gila Bend Municipal Airport, Gila Bend Air Force Auxiliary Field and Wickenburg Municipal Airport) are outside of the nonattainment area.

For airports that provided complete survey data, the FAA's latest airport Emissions and Dispersion Modeling Software (EDMS 4.5) 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 taxi-in and taxi-out times.

For those airports that provided only partial data, the EDMS model could not be used to calculate emissions for that specific airport. Instead, emission factors from similar airports that provided complete information was used. Examples of missing data were detailed fleet mix data or unknown idle times. For airports that did not respond to the survey, LTO figures, taxi-in/taxi-out times and aircraft types were derived from online databases that provide detailed aeronautical information on airports at http://www.transtats.bts.gov, http:// www.apo.data.faa.gov and http://www.airnav.com.

The following provides an example of how aircraft emissions were calculated using the FAA's EDMS modeling software for Skyranch at Carefree, a small, general-aviation only airport that has an ordinance mandate that the airport can only accept aircraft that weigh 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 a composite emission factor for an airport based on the most common type of aircraft using that facility and then that composite emission factor was applied to the actual reported activity for the airport. 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, Comanche, 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 1000 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. Table 4.11–1 summarizes the activity level for each aircraft category for each airport surveyed as well as the emission factor for each pollutant.

Table 4.11–1. 2005 airport activity data, emission calculation methods, and emission factors.

Airport name	Activity category	2005 LTOs	Lbs/LTO VOC	Lbs/LTO NO_x	Lbs/LTO CO
Arizona Army National Guard [2]	ML	1,080	2.899	2.251	3.458
Buckeye Municipal Airport [2]	GA	21,457	2.008	1.412	8.567
Chandler Municipal Airport [4]	AT	1,370	2.137	2.036	14.437
	GA	116,158	2.008	1.412	8.567
	ML	28	9.841	4.243	27.098
Falcon Field [2]	AC	24	1.275	26.34	6.208
	AT	4,098	2.137	2.036	14.437
	GA	128,835	0.617	1.214	4.564
	ML	2,136	9.841	4.243	27.098
Gila Bend Air Force Auxiliary Field [1,2]	ML	31,003	0.465	4.174	4.82
Gila Bend Municipal Airport [1,3]	GA	6,935	0.617	1.214	4.564
Glendale Municipal Airport [4]	AT	935	2.137	2.036	14.437
	GA	65,438	0.617	1.214	4.564
	ML	62	9.841	4.243	27.098
Luke Air Force Base [2]	ML	59,500	6.424	14.327	26.727
Phoenix Deer Valley Airport [4]	AT	2,293	2.137	2.036	14.437
	GA	186,231	0.617	1.214	4.564
	ML	30	9.841	4.243	27.098
Phoenix Goodyear Airport [4]	AC	172	1.275	26.34	6.208
	AT	1,893	2.137	2.036	14.437
	GA	46,440	0.617	1.214	4.564
	ML	2,005	9.841	4.243	27.098
Phoenix Sky Harbor Int'l. [4]	AC	204,856	5.431	16.889	23.897
	AT	48,118	2.174	5.494	14.862
	GA	20,670	2.008	1.412	8.567
	ML	1,447	27.986	35.936	59.645
Pleasant Valley Airport [2]	GA	14,096	0.045	0.354	0.724
Scottsdale Airport [2]	AT	5,903	2.137	2.036	14.437
	GA	100,164	2.008	1.412	8.567
	ML	155	9.841	4.243	27.098
Skyranch at Carefree [2]	GA	2,248	0.278	0.046	18.171
Stellar Airpark [2]	GA	19,528	0.617	1.214	4.564
Wickenburg Municipal Airport[1]	AT	485	2.137	2.036	14.437
	GA	23,059	0.617	1.214	4.564
	ML	728	9.841	4.243	27.098
Williams Gateway Airport [4]	AC	450	1.275	26.34	6.208
	AT	3,874	2.137	2.036	14.437
	GA	128,310	0.617	1.214	4.564
	ML	5,689	40.954	19.82	75.111

1. Airport is outside the nonattainment area.
2. Data reported from source.
3. No data reported from source. Data derived from http://www.airnav.com
4. No data reported from source. Data derived from http://www.apo.data.faa.gov/main/atads.asp

For example, the model run with the 12 aircraft types resulted in total NO_x emissions of 0.277 tons (assuming each of the 12 aircraft types had 1000 LTOs each during the period).

Composite NO_x emission factor (lb/LTO) $= \Sigma$ modeled NO_x emissions (tons/yr) × 1 yr / 12,000 LTOs × 2,000 lb/ton

$= 0.046$ lb NO_x /LTO

This composite emission factor was then multiplied by the actual number of LTOs at the airport to derive an annual NO_x emissions total:

NO_x emissions (lb/ yr) = 2,248 LTO/yr × 0.046 lb NO_x /LTO
= 103.4 lb NO_x /yr

Table 4.11–2 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 (17,578 + 17,784 + 16,882 ÷ 204,856 = 25%).

Table 4.11–2. Annual and ozone season-day emissions by airport and aircraft type.

Facility	Category[1]	Tons/yr VOC	Tons/yr NO_x	Tons/yr CO	Lbs/day VOC	Lbs/day NO_x	Lbs/day CO
Arizona Army Natl. Guard	ML	1.57	1.22	1.87	8.6	6.7	10.3
Buckeye Municipal Airport	GA	21.54	15.15	91.91	118.4	83.2	505.0
Chandler Municipal Airport	AT	1.46	1.39	9.89	8.0	7.7	54.3
	GA	116.62	82.01	497.56	640.8	450.6	2,733.9
	ML	0.14	0.06	0.38	0.8	0.3	2.1
Falcon Field	AC	0.02	0.32	0.07	0.1	1.7	0.4
	AT	4.38	4.17	29.58	24.1	22.9	162.5
	GA	39.75	78.20	294.00	218.4	429.7	1,615.4
	ML	10.51	4.53	28.94	57.7	24.9	159.0
Glendale Municipal Airport	AT	1.00	0.95	6.75	5.5	5.2	37.1
	GA	20.19	39.72	149.33	110.9	218.2	820.5
	ML	0.31	0.13	0.84	1.7	0.7	4.6
Luke Air Force Base	ML	191.11	426.23	795.13	1,050.1	2,341.9	4,368.8
Phoenix Deer Valley Airport.	AT	2.45	2.33	16.55	13.5	12.8	90.9
	GA	57.45	113.04	424.98	315.7	621.1	2,335.1
	ML	0.15	0.06	0.41	0.8	0.3	2.2
Phoenix Goodyear Airport	AC	0.11	2.27	0.53	0.6	12.4	2.9
	AT	2.02	1.93	13.66	11.1	10.6	75.1
	GA	14.33	28.19	105.98	78.7	154.9	582.3
	ML	9.87	4.25	27.17	54.2	23.4	149.3
Phoenix Sky Harbor Int'l.	AC	556.29	1,729.91	2,447.72	3,056.5	9,505.0	13,449.0
	AT	52.30	132.18	357.56	287.4	726.3	1,964.6
	GA	20.75	14.59	88.54	114.0	80.2	486.5
	ML	20.25	26.00	43.15	111.3	142.9	237.1
Pleasant Valley Airport	GA	0.32	2.49	5.10	1.7	13.7	28.0
Scottsdale Airport	AT	6.31	6.01	42.61	34.7	33.0	234.1
	GA	100.56	70.72	429.05	552.6	388.5	2,357.4
	ML	0.76	0.33	2.10	4.2	1.8	11.5
Skyranch at Carefree	GA	0.31	0.05	20.42	1.7	0.3	112.2
Stellar Airpark	GA	6.02	11.85	44.56	33.1	65.1	244.9
Williams Gateway Airport	AC	0.29	5.93	1.40	1.6	32.6	7.7
	AT	4.14	3.94	27.96	22.7	21.7	153.7
	GA	39.58	77.88	292.80	217.5	427.9	1,608.8
	ML	116.49	56.38	213.65	640.1	309.8	1,173.9
Ozone nonattainment area totals:		1,419.35	2,944.42	6,512.18	7,798.6	16,178.1	35,781.2

1. AC = air carrier, GA = general aviation, AT = air taxi, ML = military.

Table 4.11–2 (continued). Annual and ozone season-day emissions, by airport and aircraft type.

Airports outside the nonattainment area:							
Gila Bend AF Auxiliary Field	ML	7.21	64.70	74.72	39.6	355.5	410.5
Gila Bend Municipal Airport	GA	2.14	4.21	15.83	11.8	23.1	87.0
Wickenburg Municipal Airport	AT	0.52	0.49	3.50	2.8	2.7	19.2
	GA	7.11	14.00	52.62	39.1	76.9	289.1
	ML	3.58	1.54	9.86	19.7	8.5	54.2
Maricopa County totals:		1,439.91	3,029.37	6,668.71	7,911.6	16,644.9	36,641.3

1. AC = air carrier, GA = general aviation, AT = air taxi, ML = military.

4.12 Locomotives

Annual emissions from locomotives were calculated based on diesel fuel usage provided by Burlington Northern/Santa Fe Railway (BNSF), Union Pacific Railway (UP) and Amtrak. Railway operations from these companies fall into two categories: Class I haul lines and yard/switching operations. Annual emissions from Class I haul operations and yard/switching operations were calculated by multiplying diesel fuel usage by the emission factors listed in Table 4.12–1 (US EPA, 1997).

Table 4.12–1. Emission factors for locomotives.

	Emission factors (lbs/gal diesel)		
Activity type	**VOC**	**NO_x**	**CO**
Class I haul line	0.022	0.595	0.059
Yard/switch operations	0.046	0.798	0.084

The example below illustrates how emissions were calculated for each locomotive activity type. Fuel use reported by railroads, and emission totals are summarized in Table 4.12–2.

VOC emissions from UP Class I haul lines	= Diesel fuel used (gals)	×	EPA emission factor (lbs/gal) for VOC	÷ 2,000 lbs/ton
	= 7,598,448 gallons	×	0.022 lbs/gal	÷ 2,000 lbs/ton
	= 83.58 tons VOC/yr			

Table 4.12–2. Fuel use and annual emissions from locomotives in Maricopa County.

	Diesel fuel	Annual emissions (tons/yr)		
Locomotive type	**used (gals)**	**VOC**	**NO_x**	**CO**
BNSF Class I haul line	1,089,969	11.99	324.27	32.15
UP Class I haul line	7,598,448	83.58	2,260.54	224.15
BNSF yard/switch operations	500,000	11.50	199.50	21.00
UP yard/switch operations	415,740	9.56	165.88	17.46
Amtrak	17,000	0.19	5.06	0.50
Totals:	**9,621,157**	**116.82**	**2,955.24**	**295.27**

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. Results are shown in Table 4.12–3.

Table 4.12–3. Annual emissions (in tons/yr) from locomotives in the ozone NAA.

Locomotive type	Track in nonattainment area (%)	Annual emissions (tons/yr) VOC	NO_x	CO
BNSF Class I haul line	60.65%	7.27	196.67	19.50
UP Class I haul line	60.65%	50.69	1,371.02	135.95
BNSF yard/switch operations	100.00%	11.50	199.50	21.00
UP yard/switch operations	100.00%	9.56	165.88	17.46
Amtrak	6.98%	0.01	0.35	0.04
Totals:		**79.04**	**1,933.42**	**193.95**

Ozone season-day emissions for both the county (shown in Table 4.12–4) and the ozone nonattainment area (Table 4.12–5) 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)	× 2,000 lbs/ton	÷ 365 days
	= 95.57 tons VOC/yr	× 2,000 lbs/ton	÷ 365 days
	= 523.7 lbs VOC/day		

Table 4.12–4. Season-day emissions (in lbs/day) from locomotives in Maricopa County and the ozone NAA.

Locomotive type	Maricopa County VOC	NO_x	CO	Ozone nonattainment area VOC	NO_x	CO
BNSF Class I haul line	65.7	1,776.8	176.2	39.8	1,077.6	106.9
UP Class I haul line	458.0	12,386.5	1,228.2	277.8	7,512.4	744.9
BNSF yard/switch operations	63.0	1,093.2	115.1	63.0	1,093.2	115.1
UP yard/switch operations	52.4	908.9	95.7	52.4	908.9	95.7
Amtrak	1.0	27.7	2.7	0.1	1.9	0.2
Totals:	**640.1**	**16,193.1**	**1,617.9**	**433.1**	**10,594.1**	**1,062.7**

4.13 Summary of all nonroad mobile source emissions

Table 4.13–1 summarizes annual and daily emissions of VOC, NO_x, and CO from nonroad mobile sources in Maricopa County respectively. Table 4.13–2 shows annual and season-day emissions for these pollutants for the ozone nonattainment area.

Table 4.13–1. Annual and season-day emissions from nonroad mobile sources in Maricopa County.

Category	Annual emissions (tons/yr) VOC	NO_x	CO	Season-day emissions (lbs/day) VOC	NO_x	CO
Agricultural	53.31	386.34	417.85	453.1	3,226.3	3,707.9
Airport ground support	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Commercial	2,339.70	1,449.72	54,941.52	17,907.0	8,553.8	410,503.5
Construction & mining	2,690.85	16,016.62	23,667.21	18,840.1	108,785.6	177,261.9
Industrial	772.17	3,316.67	13,597.40	5,035.6	21,109.0	90,844.8
Lawn & garden	6,586.38	843.10	101,879.34	74,053.0	6,409.9	1,085,431.7
Pleasure craft	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Railway maintenance	2.32	9.27	28.38	16.8	63.9	221.4
Recreational	1,416.44	59.99	10,675.34	16,532.4	535.5	135,733.8
Aircraft	1,439.91	3,029.37	6,668.71	7,911.6	16,644.9	36,641.3
Locomotives	116.82	2,955.24	295.27	640.1	16,193.1	1,617.9
Totals:	**16,364.68**	**28,604.72**	**219,864.25**	**159,436.9**	**185,432.6**	**2,014,685.9**

Table 4.13–2. Annual and season-day emissions from nonroad mobile sources in the ozone NAA.

	Annual emissions (tons/yr)			Season-day emissions (lbs/day)		
Category	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Agricultural	34.32	248.69	268.97	291.7	2,076.8	2,386.8
Airport ground support	137.28	467.82	5,944.39	752.2	2,563.4	32,572.0
Commercial	2,331.28	1,444.50	54,743.73	17,842.5	8,523.0	409,025.7
Construction & mining	2,720.45	16,192.81	23,927.55	19,047.3	109,982.3	179,211.8
Industrial	769.39	3,304.73	13,548.45	5,017.5	21,033.0	90,517.8
Lawn & garden	6,658.83	852.37	103,000.01	74,867.6	6,480.4	1,097,371.4
Pleasure craft	809.50	70.58	1,748.83	17,294.9	1,347.2	40,149.6
Railway maintenance	2.35	9.37	28.69	17.0	64.6	223.8
Recreational	911.28	38.59	6,868.11	10,636.3	344.5	87,326.0
Aircraft	1,419.35	2,944.42	6,512.18	7,798.6	16,178.1	35,781.2
Locomotives	79.04	1,933.42	193.95	433.1	10,594.1	1,062.7
Totals:	**15,873.05**	**27,507.30**	**216,784.87**	**153,998.8**	**179,187.3**	**1,975,628.9**

4.14 Quality assurance procedures

Established procedures were used to check, and correct when necessary, the nonroad 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.

4.15 References

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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 2005 periodic ozone precursor emissions inventory for the eight-hour ozone Nonattainment Area (NAA) and for Maricopa County. Emission estimates were developed for both an ozone season-day and an annual total for 2005.

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; LDGT12) and over 6000 pounds (LDGT3/LDGT4; LDGT34), 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, which is 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 calculated emission factors were multiplied by the estimates of vehicle miles of travel (VMT) to generate emission estimates for onroad mobile sources.

The main references for preparing the onroad mobile source emissions inventory were as follows:

Emission Inventory Requirements for Carbon Monoxide State Implementation Plans, EPA-450/4-91-011 (US EPA, 1991).
Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81-026d (US EPA, 1992a).
Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation (US EPA, 2002).
User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010 (US EPA, 2003).

5.2 Vehicle miles of travel (VMT) estimation

MAG prepared 2005 VMT estimates for the eight-hour ozone NAA and Maricopa County. The source of data for these estimates is the 2005 Highway Performance Monitoring System (HPMS) data from the Arizona Department of Transportation (ADOT) (http://tpd.azdot.gov/data/reports/vmt2005.php) and the 2005 traffic assignment prepared by MAG using the EMME/2 travel demand model.

ADOT only prepares HPMS data for Maricopa County and the PM_{10} NAA. MAG derived the 2005 VMT for the eight-hour ozone NAA from the 2005 HPMS VMT for the PM_{10} NAA and the 2005 MAG EMME/2 traffic assignment. The output of the traffic assignment was evaluated using GIS to obtain the traffic assignment VMT for the PM-10 NAA and the eight-hour ozone NAA. The 2005 VMT for the eight-hour ozone NAA was obtained by multiplying the 2005 HPMS VMT for the PM-10 NAA by the ratio of those traffic assignment VMTs (the eight-hour ozone NAA to the PM-10 NAA). The calculation details are presented as follows:

2005 HPMS VMT for the
PM_{10} NAA ($HPMS_{PM10}$) = 83,013,000 miles/day

2005 traffic assignment VMT
for the PM_{10} NAA ($EMME2_{PM10}$) = 86,054,855 miles/day

2005 traffic assignment VMT for
the eight-hour ozone NAA ($EMME2_{O3}$) = 87,644,885 miles/day

$$\text{2005 VMT for the eight-hour ozone NAA} = HPMS_{PM10} \times \frac{EMME2_{O3}}{EMME2_{PM10}}$$

$$= 83{,}013{,}000 \text{ miles/day} \times \frac{87{,}644{,}885}{86{,}054{,}855}$$

$$= 84{,}546{,}826 \text{ miles/day}$$

The distribution of VMT by facility type for the eight-hour ozone NAA and Maricopa County was obtained by multiplying the VMT fraction from the 2002 HPMS by functional system (ADOT, 2003), which was provided by Michael Wade of ADOT in 2004, by the 2005 HPMS VMT for Maricopa County and the estimated 2005 VMT for the eight-hour ozone NAA. The VMT estimates by facility type for the eight-hour ozone NAA and Maricopa County are shown in Table 5.2-1.

Table 5.2–1. 2005 daily VMT by facility type (annual average daily traffic).

Facility Type	Eight-hour ozone NAA (miles/day)	Maricopa County (miles/day)
Rural Interstate	3,304,702	3,333,633
Rural Other Principal Arterial	1,885,611	1,902,118
Rural Minor Arterial	883,629	891,364
Rural Major Collector	2,569,302	2,591,796
Rural Minor Collector	293,011	295,576
Rural Local	587,171	592,311
Urban Interstate	11,406,738	11,506,599
Urban Other Freeway/Expressway	15,858,203	15,997,036
Urban Other Principal Arterial	20,129,266	20,305,490
Urban Minor Arterial	12,009,995	12,115,138
Urban Collector	7,171,295	7,234,077
Urban Local	8,447,903	8,521,861
Total	**84,546,826**	**85,287,000**

5.3 Speed estimation

The average daily vehicle speeds were developed from several sources representing the latest planning assumptions for 2005. To develop speed estimates for all facility types, except local roadways, speeds were extracted from the latest 2005 travel demand model run provided by the MAG Transportation Group in July 2006. As for the speed of local roadways, MOBILE6.2 assumes a speed of 12.9 miles per hour for local roadways. Table 5.3-1 presents average daily speeds used in the MOBILE6.2 runs.

Table 5.3–1. Average daily speeds for the 2005 periodic emissions inventory.

HPMS Facility Type	Average Daily Speed (mph)
Rural Principal Arterial – Interstate	58.0
Rural Principal Arterial – Other	29.4
Rural Minor Arterial	29.4
Rural Major Collector	26.9
Rural Minor Collector	26.9
Rural Local	12.9
Urban Principal Arterial – Interstate	50.1
Urban Freeway and Expressway	49.3
Urban Principal Arterial – Other	28.8
Urban Minor Arterial	28.8
Urban Collector	22.1
Urban Local	12.9

5.4 Monthly VMT factors

In the development of annual emissions totals for this inventory, emission factor estimates were prepared separately 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. Average daily VMT adjustment factors were developed from the 1998 MAG Regional Congestion Study (MAG, 2000) and these adjustment factors for each month are presented in Table 5.4–1. Similarly, the conversion of annual average day traffic to the three months of the peak ozone season utilized the monthly VMT factors listed below.

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 one percent less traffic than an average day.

Table 5.4–1. Average daily VMT adjustment factors by month.

Month	Average daily VMT estimate factor	Month	Average daily VMT estimate factor
January	0.98	July	0.96
February	1.03	August	0.96
March	1.04	September	0.98
April	1.04	October	1.02
May	0.99	November	1.00
June	0.99	December	1.02

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 2002 periodic ozone precursors inventory, the three consecutive months selected were July through September, 2005, in accordance with EPA guidance (US EPA, 1991). Average daily VMTs during the 2005 peak ozone season for the eight-hour ozone NAA and Maricopa County are presented in Table 5.4-2.

5.5 Emission factor estimation

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 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 Ieesuck Jung (602-254-6300).

In order to calculate vehicle emission factors for 2005 annual average day and peak ozone season, two MOBILE6.2 runs reflecting vehicles registered locally (subject to the I/M program) and those not registered locally (not participating in the I/M program) were executed using month specific fuel and temperature data for each month of the year and during the three-month period of July through September, respectively.

Table 5.4–2. Average daily VMT during 2005 peak ozone season for the eight-hour ozone NAA and Maricopa County (July–September 2005).

Facility Type	Eight-hour ozone NAA (miles/day)	Maricopa County (miles/day)
Rural Interstate	3,198,388	3,226,389
Rural Other Principal Arterial	1,824,950	1,840,926
Rural Minor Arterial	855,202	862,689
Rural Major Collector	2,486,647	2,508,416
Rural Minor Collector	283,584	286,067
Rural Local	568,281	573,256
Urban Interstate	11,039,777	11,136,426
Urban Other Freeway/Expressway	15,348,037	15,482,403
Urban Other Principal Arterial	19,481,697	19,652,252
Urban Minor Arterial	11,623,627	11,725,388
Urban Collector	6,940,591	7,001,353
Urban Local	8,176,130	8,247,708
Total	**81,826,911**	**82,543,273**

5.5.1 Emission factor model

The emission factors estimated from the MOBILE6.2 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 (I/M) Program. It is important to note that participation in the I/M program is required for all vehicles registered in the NAA, 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 91.6 percent of the vehicles operating within the NAA participate in the I/M program. The remaining 8.4 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 2007 Eight-Hour Ozone Plan for the Maricopa County Nonattainment Area (MAG, 2007). In the absence of any additional data, this percentage split is assumed to apply directly to VMT as well.

5.5.2 MOBILE6.2 inputs

In order to accurately reflect the state of the I/M program in the modeling area, several MOBILE6.2 runs were performed and the emission factors from those runs were weighted together. The specific model run inputs to the MOBILE6.2 model are described in Appendix 5.

5.5.3 MOBILE6.2 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 twelve facility types. The emission factors generated for 2005 are presented in Appendix 5. These values were subsequently used in developing emission estimates.

5.5.4 MOBILE6.2 emission estimates

MOBILE6.2 was used to generate onroad emission factors and a VMT mix by vehicle class and facility type. Daily VMTs (DVMTs) for an annual average day (Table 5.2–1) and for the peak ozone season (Table 5.4–2) were then multiplied by the VMT mix by vehicle class and the appropriate ozone precursor emission factor (Appendix 5) to estimate emissions. VMT mix refers to the fraction of total onroad vehicle miles of travel by a particular vehicle type.

Tables 5.5–1 and 5.5-2 show the calculated annual and ozone season-day VOC, NO_x, and CO emissions by facility type and vehicle class in the eight-hour ozone NAA and Maricopa County, respectively.

Table 5.5–1. Annual and ozone season-day onroad mobile source emissions by facility type and vehicle class in the eight-hour ozone NAA.

Facility Type	Vehicle Class	SCC	Annual (tons/year)			Ozone season day (lbs/day)		
			VOC	NO_x	CO	VOC	NO_x	CO
Rural Interstate	LDGV	2201001110	453.5	419.4	6,288.3	2,377.0	2,374.9	34,484.0
	LDGT12	2201020110	416.7	439.3	6,011.5	2,172.4	24,339.8	31,728.7
	LDGT34	2201040110	183.0	220.0	2,556.5	968.2	1,210.2	13,506.1
	HDGV	2201070110	40.7	236.4	450.6	221.2	1,242.2	2,773.0
	MC	2201080110	26.4	10.2	132.5	138.1	49.7	892.7
	LDDV	2230001110	0.6	2.3	1.8	3.4	12.2	9.1
	LDDT	2230060110	1.8	5.2	3.4	9.8	28.0	18.6
	HDDV	2230070110	40.7	2,037.2	250.8	214.8	10,806.8	1,311.3
Rural Other Principal Arterial	LDGV	2201001130	303.9	225.2	2,655.0	1,543.3	1,303.8	13,638.1
	LDGT12	2201020130	275.5	230.7	2,667.9	1,434.5	1,289.2	13,339.4
	LDGT34	2201040130	122.0	117.6	1,139.0	646.3	652.1	5,764.7
	HDGV	2201070130	32.8	108.4	240.7	174.7	569.7	1,481.0
	MC	2201080130	14.6	4.1	55.2	76.6	20.1	368.4
	LDDV	2230001130	0.5	0.8	1.1	2.4	4.3	5.6
	LDDT	2230060130	1.3	1.8	2.1	7.0	9.8	11.4
	HDDV	2230070130	36.3	647.5	167.4	191.4	3,433.5	875.7
Rural Minor Arterial	LDGV	2201001150	142.4	105.5	1,244.2	723.3	611.0	6,391.1
	LDGT12	2201020150	129.1	108.1	1,250.3	672.2	604.1	6,251.1
	LDGT34	2201040150	57.1	55.1	533.7	302.9	305.6	2,701.4
	HDGV	2201070150	15.3	50.8	112.8	81.9	266.9	694.0
	MC	2201080150	6.8	1.9	25.9	35.9	9.4	172.7
	LDDV	2230001150	0.2	0.4	0.5	1.1	2.0	2.6
	LDDT	2230060150	0.6	0.9	1.0	3.3	4.6	5.3
	HDDV	2230070150	17.0	303.4	78.5	89.7	1,609.0	410.4
Rural Major Collector	LDGV	2201001170	425.9	314.8	3,626.9	2,156.6	1,827.6	18,583.2
	LDGT12	2201020170	384.4	320.6	3,638.3	2,001.4	1,793.3	18,117.1
	LDGT34	2201040170	170.4	163.3	1,555.5	903.1	906.4	7,845.0
	HDGV	2201070170	47.6	144.9	359.3	253.5	761.1	2,211.3
	MC	2201080170	20.3	5.5	80.9	106.9	27.0	540.9
	LDDV	2230001170	0.7	1.1	1.5	3.4	5.9	7.9
	LDDT	2230060170	1.8	2.5	3.0	9.9	13.6	16.2
	HDDV	2230070170	53.2	900.2	250.2	281.1	4,773.1	1,309.0
Rural Minor Collector	LDGV	2201001190	48.6	35.9	413.7	246.0	208.4	2,119.3
	LDGT12	2201020190	43.8	36.6	415.0	228.2	204.5	2,066.1
	LDGT34	2201040190	19.4	18.6	177.4	102.9	103.3	894.7
	HDGV	2201070190	5.4	16.5	41.0	28.9	86.8	252.2
	MC	2201080190	2.3	0.6	9.2	12.2	3.1	61.6
	LDDV	2230001190	0.1	0.1	0.2	0.4	0.7	0.9
	LDDT	2230060190	0.2	0.3	0.3	1.1	1.6	1.8
	HDDV	2230070190	6.1	102.6	28.6	32.1	544.4	149.2
Rural Local	LDGV	2201001210	136.9	93.7	956.3	648.6	557.1	4,941.9
	LDGT12	2201020210	120.2	90.9	929.9	615.8	512.6	4,595.3
	LDGT34	2201040210	53.6	46.0	403.9	281.0	256.9	2,023.3
	HDGV	2201070210	19.2	29.4	172.8	99.1	154.2	1,063.4
	MC	2201080210	5.8	1.1	33.9	31.0	5.3	229.9
	LDDV	2230001210	0.2	0.3	0.5	1.1	1.7	2.7
	LDDT	2230060210	0.6	0.7	1.0	3.2	4.0	5.5
	HDDV	2230070210	20.3	264.5	116.4	107.4	1,403.8	608.6

Table 5.5–1. Annual and ozone season-day onroad mobile source emissions by facility type and vehicle class in the eight-hour ozone NAA (continued).

Facility Type	Vehicle Class	SCC	Annual (tons/year)			Ozone season day (lbs/day)		
			VOC	NO_x	CO	VOC	NO_x	CO
Urban Interstate	LDGV	2201001230	1,614.9	1,403.7	20,137.1	8,425.4	7,965.3	108,883.7
	LDGT12	2201020230	1,485.7	1,466.9	19,424.8	7,721.2	8,104.1	101,212.6
	LDGT34	2201040230	654.4	738.6	8,255.2	3,455.2	4,046.5	43,166.2
	HDGV	2201070230	146.0	769.8	1,219.3	792.1	3,999.1	7,504.0
	MC	2201080230	81.1	30.0	242.3	422.6	138.6	1,594.9
	LDDV	2230001230	2.3	6.1	5.8	11.8	31.3	29.9
	LDDT	2230060230	6.4	13.5	11.2	34.5	71.8	60.8
	HDDV	2230070230	146.3	5,458.7	754.2	772.9	28,555.2	3,945.8
Urban Other Freeway and Expressway	LDGV	2201001250	2,254.1	1,945.2	27,773.3	11,756.0	11,046.2	149,927.0
	LDGT12	2201020250	2,073.3	2,032.3	26,812.8	10,772.1	11,226.4	139,523.3
	LDGT34	2201040250	913.3	1,024.2	11,397.2	4,822.0	5,611.8	59,526.2
	HDGV	2201070250	204.4	1,063.5	1,668.6	1,107.3	5,525.5	10,266.1
	MC	2201080250	112.7	41.0	336.8	587.4	189.4	2,217.3
	LDDV	2230001250	3.2	8.3	8.0	16.5	42.5	41.5
	LDDT	2230060250	8.9	18.4	15.6	48.1	97.5	84.3
	HDDV	2230070250	204.9	7,436.3	1,041.4	1,080.8	38,896.8	5,447.9
Urban Other Principal Arterial	LDGV	2201001270	3,265.1	2,418.2	28,359.4	16,571.9	14,062.9	145,600.1
	LDGT12	2201020270	2,957.0	2,474.2	28,482.5	15,394.6	13,768.6	142,272.1
	LDGT34	2201040270	1,309.6	1,260.3	12,166.0	6,938.6	6,968.3	61,510.3
	HDGV	2201070270	354.9	1,152.7	2,624.2	1,892.6	5,988.9	16,151.1
	MC	2201080270	157.0	44.1	599.3	822.0	205.4	4,001.5
	LDDV	2230001270	5.0	8.8	11.6	25.8	45.4	60.2
	LDDT	2230060270	14.0	19.6	22.9	75.6	103.8	122.8
	HDDV	2230070270	393.8	6,943.8	1,825.7	2,079.8	36,341.7	9,551.6
Urban Minor Arterial	LDGV	2201001290	1,948.1	1,442.8	16,920.5	9,887.5	8,390.6	86,871.3
	LDGT12	2201020290	1,764.3	1,476.2	16,993.9	9,185.1	8,215.0	84,885.8
	LDGT34	2201040290	781.4	751.9	7,258.8	4,139.9	4,157.6	36,699.7
	LDDT	2201070290	211.8	687.8	1,565.8	1,129.2	3,573.2	9,636.4
	HDDV	2201080290	93.6	26.4	357.5	490.4	122.6	2,387.5
	LDDV	2230001290	3.0	5.3	6.9	15.3	27.1	35.9
	LDDT	2230060290	8.3	11.7	13.6	45.1	61.9	73.3
	HDDV	2230070290	234.9	4,142.9	1,089.3	1,240.9	21,683.0	5,699.0
Urban Collector	LDGV	2201001310	1,274.3	934.0	10,305.6	6,424.5	5,496.2	52,644.8
	LDGT12	2201020310	1,140.8	938.7	10,271.7	5,941.9	5,245.6	50,786.8
	LDGT34	2201040310	506.9	477.3	4,407.8	2,689.4	2,647.3	22,089.1
	HDGV	2201070310	153.8	388.6	1,237.1	818.3	2,018.8	7,611.5
	MC	2201080310	59.9	14.6	263.8	314.8	68.1	1,773.6
	LDDV	2230001310	2.0	3.4	4.8	10.4	17.3	24.6
	LDDT	2230060310	5.7	7.5	9.3	30.6	39.8	50.3
	HDDV	2230070310	174.2	2,661.9	858.4	919.4	13,936.0	4,490.9
Urban Local	LDGV	2201001330	1,970.5	1,348.2	13,758.2	9,331.8	8,107.5	71,101.3
	LDGT12	2201020330	1,728.8	1,307.8	13,380.0	8,860.1	7,364.5	66,114.3
	LDGT34	2201040330	771.3	661.6	5,810.7	4,042.8	3,690.6	29,111.0
	HDGV	2201070330	276.8	422.3	2,486.5	1,425.9	2,193.8	15,300.4
	MC	2201080330	84.1	15.8	487.1	445.0	73.8	3,307.4
	LDDV	2230001330	3.0	4.8	7.5	15.3	24.9	38.9
	LDDT	2230060330	8.4	10.7	14.9	45.5	56.9	80.0
	HDDV	2230070330	292.7	3,805.8	1,673.9	1,545.3	19,936.5	8,756.6

Table 5.5–2. Annual and ozone season-day onroad mobile source emissions by facility type.

Facility Type	Vehicle Class	SCC	Annual (tons/year)			Ozone season day (lbs/day)		
			VOC	NO_x	CO	VOC	NO_x	CO
Rural Interstate	LDGV	2201001110	457.5	423.1	6,343.4	2,397.7	2,387.3	34,789.9
	LDGT12	2201020110	420.3	443.1	6,064.2	2,191.4	2,444.2	32,006.5
	LDGT34	2201040110	184.7	221.9	2,578.9	976.7	1,212.9	13,624.3
	HDGV	2201070110	41.0	238.5	454.5	223.2	1,239.3	2,797.2
	MC	2201080110	26.6	10.3	133.7	139.3	47.7	900.5
	LDDV	2230001110	0.7	2.4	1.8	3.4	12.1	9.2
	LDDT	2230060110	1.8	5.3	3.5	9.9	27.9	18.8
	HDDV	2230070110	41.0	2,055.0	252.9	216.7	10,760.2	1,323.0
Rural Other Principal Arterial	LDGV	2201001130	306.5	227.2	2,678.3	1,556.9	1,320.9	13,757.6
	LDGT12	2201020130	277.9	232.8	2,691.3	1,447.1	1,294.8	13,456.2
	LDGT34	2201040130	123.1	118.6	1,149.0	652.0	655.4	5,815.2
	HDGV	2201070130	33.1	109.4	242.8	176.3	568.4	1,494.0
	MC	2201080130	14.8	4.2	55.7	77.3	19.4	371.7
	LDDV	2230001130	0.5	0.8	1.1	2.4	4.3	5.6
	LDDT	2230060130	1.3	1.8	2.1	7.1	9.8	11.5
	HDDV	2230070130	36.6	653.2	168.9	193.1	3,418.7	883.4
Rural Minor Arterial	LDGV	2201001150	143.7	106.5	1,255.1	729.6	619.0	6447.0
	LDGT12	2201020150	130.2	109.1	1,261.2	678.1	606.8	6305.8
	LDGT34	2201040150	57.7	55.6	538.4	305.5	307.2	2725.1
	HDGV	2201070150	15.5	51.3	113.8	82.6	266.4	700.1
	MC	2201080150	6.9	2.0	26.1	36.2	9.1	174.2
	LDDV	2230001150	0.2	0.4	0.5	1.1	2.0	2.6
	LDDT	2230060150	0.6	0.9	1.0	3.3	4.6	5.4
	HDDV	2230070150	17.1	306.1	79.1	90.5	1602.1	414.0
Rural Major Collector	LDGV	2201001170	429.6	317.6	3,658.6	2,175.5	1,852.9	18,745.9
	LDGT12	2201020170	387.8	323.4	3,670.1	2,018.9	1,801.5	18,275.8
	LDGT34	2201040170	171.8	164.7	1,569.1	911.0	911.1	7,913.7
	HDGV	2201070170	48.0	146.2	362.5	255.7	759.5	2,230.6
	MC	2201080170	20.6	5.6	81.6	107.9	25.9	545.7
	LDDV	2230001170	0.7	1.2	1.6	3.4	5.9	8.0
	LDDT	2230060170	1.9	2.6	3.0	10.1	13.6	16.4
	HDDV	2230070170	53.7	908.0	252.4	283.7	4,752.5	1,320.5
Rural Minor Collector	LDGV	2201001190	49.0	36.2	417.2	248.1	211.3	2,137.8
	LDGT12	2201020190	44.2	36.9	418.5	230.2	205.4	2,084.2
	LDGT34	2201040190	19.6	18.8	178.9	103.9	103.9	902.5
	HDGV	2201070190	5.5	16.7	41.3	29.2	86.6	254.4
	MC	2201080190	2.3	0.6	9.3	12.3	3.0	62.2
	LDDV	2230001190	0.1	0.1	0.2	0.4	0.7	0.9
	LDDT	2230060190	0.2	0.3	0.3	1.1	1.5	1.9
	HDDV	2230070190	6.1	103.6	28.8	32.3	542.0	150.3
Rural Local	LDGV	2201001210	138.2	94.5	964.6	654.3	568.4	4,985.2
	LDGT12	2201020210	121.2	91.7	938.1	621.2	516.4	4,635.5
	LDGT34	2201040210	54.1	46.4	407.4	283.5	258.8	2,041.1
	HDGV	2201070210	19.4	29.6	174.3	10.0	153.8	1,072.8
	MC	2201080210	5.9	1.1	34.2	31.2	5.2	231.9
	LDDV	2230001210	0.2	0.3	0.5	1.1	1.7	2.7
	LDDT	2230060210	0.6	0.8	1.0	3.2	4.0	5.6
	HDDV	2230070210	20.5	266.8	117.4	108.4	1,397.8	614.0

Table 5.5–2. Annual and ozone season-day onroad mobile source emissions by facility type and vehicle class in Maricopa County (continued).

Facility Type	Vehicle Class	SCC	Annual (tons/year)			Ozone season day (lbs/day)		
			VOC	NO_x	CO	VOC	NO_x	CO
Urban Interstate	LDGV	2201001230	1,629.0	1,416.0	20,313.3	8,499.1	8,035.0	109,836.9
	LDGT12	2201020230	1,498.7	1,479.7	19,594.8	7,788.9	8,175.1	102,098.7
	LDGT34	2201040230	660.1	745.1	8,327.4	3,485.4	4,081.9	43,544.0
	HDGV	2201070230	147.3	776.5	1,229.9	799.1	4,034.1	7,569.7
	MC	2201080230	81.8	30.2	244.4	426.3	139.8	1,608.9
	LDDV	2230001230	2.3	6.2	5.8	11.9	31.6	30.2
	LDDT	2230060230	6.4	13.7	11.4	34.7	72.4	61.3
	HDDV	2230070230	147.7	5,506.5	760.8	779.7	28,805.2	3,980.3
Urban Other Freeway and Expressway	LDGV	2201001250	2,273.8	1,962.2	28,016.4	11,858.9	11,142.8	151,239.5
	LDGT12	2201020250	2,091.4	2,050.1	27,047.5	10,866.4	11,324.6	140,744.7
	LDGT34	2201040250	921.3	1,033.1	11,496.9	4,864.1	5,661.0	6,0047.4
	HDGV	2201070250	206.2	1,072.9	1,683.3	1,117.0	5,573.9	1,0355.9
	MC	2201080250	113.7	41.3	339.7	592.6	191.1	2,236.7
	LDDV	2230001250	3.2	8.4	8.1	16.7	42.9	41.8
	LDDT	2230060250	9.0	18.6	15.8	48.5	98.4	85.1
	HDDV	2230070250	206.6	7,501.4	1,050.5	1,090.3	39,237.3	5,495.6
Urban Other Principal Arterial	LDGV	2201001270	3,293.6	2,439.3	28,607.8	16,716.9	14,186.0	146,874.8
	LDGT12	2201020270	2,982.9	2,495.9	28,731.9	15,529.4	13,889.2	143,517.7
	LDGT34	2201040270	1,321.1	1,271.3	12,272.6	6,999.4	7,029.3	62,048.8
	HDGV	2201070270	358.1	1,162.8	2,647.2	1,909.2	6,041.3	16,292.5
	MC	2201080270	158.3	44.5	604.5	829.2	207.2	4,036.5
	LDDV	2230001270	5.0	8.9	11.8	26.0	45.8	60.7
	LDDT	2230060270	14.1	19.8	23.0	76.2	104.8	123.9
	HDDV	2230070270	397.3	7,004.5	1,841.7	2,097.9	36,659.8	9,635.3
Urban Minor Arterial	LDGV	2201001290	1,965.1	1,455.4	17,068.6	9,974.0	8,464.0	87,631.9
	LDGT12	2201020290	1,779.7	1,489.2	17,142.7	9,265.5	8,286.9	85,628.9
	LDGT34	2201040290	788.2	758.5	7,322.3	4,176.1	4,194.0	37,021.0
	HDGV	2201070290	213.6	693.8	1,579.5	1,139.1	3,604.5	9,720.8
	MC	2201080290	94.5	26.6	360.7	494.7	123.6	2,408.4
	LDDV	2230001290	3.0	5.3	7.0	15.5	27.3	36.2
	LDDT	2230060290	8.4	11.8	13.7	45.5	62.5	73.9
	HDDV	2230070290	237.0	4,179.2	1,098.8	1,251.7	21,872.9	5,748.8
Urban Collector	LDGV	2201001310	1,285.4	942.2	10,395.7	6,480.7	5,544.4	53,105.7
	LDGT12	2201020310	1,150.8	946.9	10,361.6	5,994.0	5,291.6	51,231.4
	LDGT34	2201040310	511.3	481.5	4,446.4	2,712.9	2,670.5	22,282.5
	HDGV	2201070310	155.1	392.0	1,247.9	825.4	2,036.5	7,678.2
	MC	2201080310	60.4	14.7	266.2	317.6	68.6	1,789.1
	LDDV	2230001310	2.0	3.4	4.8	10.5	17.5	24.8
	LDDT	2230060310	5.7	7.6	9.4	30.9	40.2	50.7
	HDDV	2230070310	175.7	2,685.2	865.9	927.5	14,058.0	4,530.2
Urban Local	LDGV	2201001330	1,987.8	1,360.0	13,878.7	9,413.5	8,178.5	71,723.7
	LDGT12	2201020330	1,743.9	1,319.2	13,497.2	8,937.6	7,429.0	66,693.1
	LDGT34	2201040330	778.0	667.5	5,861.7	4,078.2	3,722.9	29,365.8
	HDGV	2201070330	279.3	426.0	2,508.2	1,438.4	2,213.1	15,434.4
	MC	2201080330	84.9	16.0	491.3	448.9	74.5	3,336.4
	LDDV	2230001330	3.0	4.9	7.6	15.5	25.0	39.2
	LDDT	2230060330	8.5	10.8	15.1	45.9	57.4	80.7
	HDDV	2230070330	295.2	3,839.2	1,688.6	1,558.9	20,111.1	8,833.3

5.6 Summary of ozone precursor emissions from onroad mobile sources

Tables 5.6–1 and 5.6–2 show the calculated onroad emissions for annual and ozone season-day onroad mobile source emissions by facility type in the eight-hour ozone NAA and Maricopa County, respectively.

Table 5.6–1. Annual and ozone season-day onroad mobile source emissions by facility type in the eight-hour ozone NAA.

		Annual (tons/year)			Ozone season day (lbs/day)		
	Facility Type	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Rural	Interstate	1,163.1	3,370.0	15,695.5	6,104.9	18,163.7	84,723.8
Rural	Other Principal Arterial	786.9	1,336.2	6,928.4	4,076.3	7,282.5	35,484.5
Rural	Minor Arterial	368.6	626.2	3,246.8	1,910.3	3,412.6	16,628.6
Rural	Major Collector	1,104.3	1,853.0	9,515.6	5,715.9	10,108.0	48,630.7
Rural	Minor Collector	126.0	211.3	1,085.3	651.8	1,152.7	5,545.8
Rural	Local	356.9	526.6	2,614.7	1,787.3	2,895.6	13,470.6
Urban	Interstate	4,137.2	9,887.3	50,049.9	21,635.7	52,911.8	266,397.8
Urban	Other Principal Arterial	5,774.7	13,569.2	69,053.7	30,190.3	72,636.1	367,033.6
Urban	Minor Arterial	8,456.4	14,321.7	74,091.7	43,800.8	77,485.0	379,269.7
Urban	Major Collector	5,045.4	8,545.0	44,206.3	26,133.4	46,230.9	226,288.9
Urban	Minor Collector	3,317.6	5,426.1	27,358.5	17,149.3	29,469.2	139,471.6
Urban	Local	5,135.6	7,577.1	37,619.0	25,711.8	414,48.5	193,809.9
	Totals	**35,773.1**	**67,249.7**	**341,465.4**	**184,867.9**	**363,196.8**	**1,776,755.6**

Table 5.6–2. Annual and ozone season-day onroad mobile source emissions by facility type in Maricopa County.

		Annual (tons/year)			Ozone season day (lbs/day)		
	Facility Type	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Rural	Interstate	1,173.6	3,399.6	15,832.9	6,158.3	18,131.6	85,465.4
Rural	Other Principal Arterial	793.8	1,348.0	6,989.2	4,112.2	7,291.7	35,795.2
Rural	Minor Arterial	371.9	631.9	3,275.2	1,926.9	3,417.2	16,774.2
Rural	Major Collector	1,114.1	1,869.3	9,598.9	5,766.2	10,122.9	49,056.6
Rural	Minor Collector	127.0	213.2	1,094.5	657.5	1,154.4	5,594.5
Rural	Local	360.1	531.2	2,637.5	1,802.9	2,906.1	13,588.8
Urban	Interstate	4,173.3	9,973.9	50,487.8	21,825.1	53,375.1	268,730.0
Urban	Other Principal Arterial	5,825.2	13,688.0	69,658.2	30,454.5	73,272.0	370,246.7
Urban	Minor Arterial	8,530.4	14,447.0	74,740.5	44,184.2	78,163.4	382,590.2
Urban	Major Collector	5,089.5	8,619.8	44,593.3	26,362.1	46,635.7	228,269.9
Urban	Minor Collector	3,346.4	5,473.5	27,597.9	17,299.5	29,727.3	140,692.6
Urban	Local	5,180.6	7,643.6	37,948.4	25,936.9	41,811.5	195,506.6
	Totals	**36,085.9**	**67,839.0**	**344,454.3**	**186,486.3**	**366,008.9**	**1,792,310.7**

Tables 5.6-3 and 5.6-4 present the same emissions by vehicle class in the eight-hour ozone NAA and Maricopa County, respectively.

Table 5.6-5 summarizes the annual and ozone season-day emissions for the pollutants VOC, NO_x, and CO from all onroad mobile sources in the eight-hour ozone NAA and Maricopa County.

Table 5.6–3. Annual and ozone season-day onroad mobile source emissions by vehicle class in the eight-hour ozone NAA.

	Annual (tons/year)			Ozone season day (lbs/day)		
Vehicle Class	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
LDGV	13,838.3	10,686.6	132,438.4	70,091.7	61,951.4	695,185.8
LDGT12	12,519.5	10,922.3	130,278.7	64,999.6	60,767.7	660,892.5
LDGT34	5,542.4	5,534.5	55,661.8	29,292.4	30,556.5	284,837.8
HDGV	1,508.8	5,071.2	12,178.8	8,024.7	26,380.2	74,944.5
MC	664.6	195.3	2,624.3	3,483.0	912.5	17,548.4
LDDV	20.8	41.8	50.3	107.0	215.3	259.8
LDDT	58.1	93.0	98.4	313.7	493.4	530.4
HDDV	1,620.5	34,704.8	8,134.7	8,555.7	181,919.8	42,556.5
Totals	**35,773.1**	**67,249.7**	**341,465.4**	**184,867.9**	**363,196.8**	**1,776,755.6**

Table 5.6–4. Annual and ozone season-day onroad mobile source emissions by vehicle class in Maricopa County.

	Annual (tons/year)			Ozone season day (lbs/day)		
Vehicle Class	**VOC**	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
LDGV	13,959.2	10,780.2	133,597.7	70,705.2	62,510.5	701,271.9
LDGT12	12,629.0	11,018.0	131,419.1	65,568.7	61,265.5	666,678.5
LDGT34	5,591.0	5,583.0	56,149.0	29,548.7	30,808.9	287,331.4
HDGV	1,522.1	5,115.7	12,285.2	8,095.2	26,577.4	75,600.6
MC	670.7	197.1	2,647.4	3,513.5	915.1	17,702.2
LDDV	20.9	42.3	50.8	107.9	216.8	261.9
LDDT	58.5	94.0	99.3	316.4	497.1	535.2
HDDV	1,634.5	35,008.7	8,205.8	8,630.7	183,217.6	42,929.0
Totals	**36,085.9**	**67,839.0**	**344,454.3**	**186,486.3**	**366,008.9**	**1,792,310.7**

Table 5.6–5. Summarized 2005 onroad mobile source emissions.

	Annual (tons/year)			Ozone season day (lbs/day)		
	VOC	**NO_x**	**CO**	**VOC**	**NO_x**	**CO**
Eight-hour Ozone NAA	35,773.1	67,249.7	341,465.4	184,867.9	363,196.8	1,776,755.
Maricopa County	36,085.9	67,839.0	344,454.3	186,486.3	366,008.9	1,792,310.

5.7 Quality assurance

5.7.1 VMT estimates

Normal quality assurance procedures, including automated and manual consistency checks, were conducted by MAG in developing the 2005 EMME/2 traffic assignment used to generate the VMT data. The VMT estimates using the MAG travel demand model have been validated against more than 3,000 traffic counts collected in 2005–2006, as well as Highway Performance Monitoring System data submitted annually by ADOT to the Federal Highway Administration.

5.7.2 Emission factor estimates

The quality assurance process performed on the MOBILE6.2 analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, all calculations were checked by an independent reviewer. Any errors found were corrected and the changes were then rechecked by the reviewer.

5.7.3 *Quality review of the 2005 periodic ozone precursor emissions inventory*

The draft onroad mobile source portion of the 2005 periodic ozone precursor emissions inventory was reviewed using published EPA quality review guidelines for base year emission inventories (US EPA, 1992b). The procedure review (Levels I, II, and III) included checks for completeness, consistency, and the correct use of appropriate procedures.

Additionally, the onroad mobile source emissions and annual average daily traffic VMT of the 2005 periodic emissions inventory for ozone precursors were compared with those of the 2002 periodic emissions inventory for ozone precursors for Maricopa County (MCAQD, 2004) as shown in Table 5.7–1.

While the VMT increases over time, the modeled onroad NO_x and CO emissions decrease because of the implementation of control measures designed to reduce onroad emissions of NO_x and CO, such as I/M program, cleaner gasoline, cleaner vehicle technologies, etc. It is also important to note that the 2005 baseline emissions in the periodic inventories may not match those in the Eight-Hour Ozone Maintenance Plan because of factors such as use of HPMS VMT vs. link-level VMT estimates from the MAG travel demand models, average daily speeds vs. hourly speeds, monthly/ozone season vs. episode day hourly temperatures, etc.

Table 5.7–1. Comparison of annual and ozone season-day onroad mobile source emissions and annual average daily traffic VMT in Maricopa County.

	Annual (tons/year)			Ozone season day (lbs/day)			Annual average daily traffic
Year	VOC	NO_x	CO	VOC	NO_x	CO	VMT (miles/day)
2002	31,960	79,572	352,821	180,380	437,741	2,023,444	73,579,000
2005	36,086	67,839	344,454	186,486	366,009	1,792,311	85,287,000

5.8 References

ADOT, 2003. 2002 Maricopa County Estimates of Daily Vehicle Travel by Highway Functional Classification & Non-Attainment Area, Submitted to Federal Highway Administration in October 2003.

MAG, 2000. 1998 MAG Regional Congestion Study, Traffic Research & Analysis, Inc. et al. for MAG, September 2000.

MAG, 2007. 2007 MAG Eight-Hour Ozone Plan for the Maricopa County Nonattainment Area.

MCAQD, 2004. 2002 Periodic Emissions Inventory for Ozone Precursors, June 2004.

US EPA, 1991. Emission Inventory Requirements for Carbon Monoxide State Implementation Plans, EPA-450/4-91-011, March 1991.

US EPA, 1992a. Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81-026d (Revised), 1992.

US EPA, 1992b. Quality Review Guidelines for 1990 Base Year Emission Inventories, EPA454/R-92-007, July 1992.

US EPA, 2002. Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, January 2002

US EPA, 2003. User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010, August 2003.

6. Biogenic Sources

6.1 Introduction and scope

Biogenic emissions have been estimated for the 2005 Periodic Emissions Inventory for Ozone Precursors in Maricopa County. In addition, estimates were made for the approximately 5,000 square-miles of the eight-hour ozone nonattainment area. The biogenic emissions were estimated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN). MEGAN is a state-of-the-art biogenic emissions model, developed by Dr. Alex Guenther at NCAR and ENVIRON International Corporation (Guenther, 2006a and 2006b). MAG contracted with ENVIRON and Dr. Guenther in 2005 to develop a reliable and accurate biogenic emissions model. Dr. Guenther conducted field studies in June 2006 to measure the emission rates of dominant plant species in Maricopa County. Dr. Guenther also collected data on desert plant emission rates in Clark County, Nevada in 2006. Due to the incorporation of updated emission rates that are more characteristic of plants growing in the southwest deserts, the MEGAN estimates represent a substantial improvement over previous biogenic emission estimates for Maricopa County. Emissions estimates for volatile organic compounds (VOCs), carbon monoxide (CO), and nitrogen oxides (NO_x) are included in this biogenic source emissions inventory.

6.2 MEGAN input files

To calculate biogenic emissions using MEGAN, seven gridded input files were prepared:

- User domain file: this file describes the user’s domain such as the number of grid cells, grid cell size, and latitude and longitude coordinates of each grid cell
- Solar radiation and temperature file
- Monthly Leaf Area Index (LAI) file
- Plant Functional Type (PFT) file
- Emission Factor (EF) file
- Wind speed and humidity
- Soil moisture

MEGAN requires that all input data be provided for the grid cells defined in the user domain file. Gridded meteorological data (e.g., temperature, solar radiation, wind speed, humidity, and soil moisture) generated by the Penn State/NCAR Mesoscale Meteorological Model 5 (MM5) were employed, which were provided to MAG by ENVIRON for the MAG Eight-Hour Ozone Plan (MAG, 2007). The MM5 meteorological data were reformatted for MEGAN input. The LAI, PFT, and EF data files developed and updated by Dr. Guenther for Maricopa County were extracted from the MEGAN database using the MEGAN driving variables processor (ENVIRON, 2006).

The species specific biogenic emission rates identified in the 2006 field study were incorporated with the vegetation distributions in Maricopa County to derive the landscape average emission rates for each grid cell in the 4-km domain. Table 6.2-1 summarizes the average VOC emission rates for the land use categories in the 4-km domain (ENVIRON, 2006). Updated land use and land cover data from different sources were employed in the development of the vegetation distribution, PFT, and LAI databases. The average emission rate represents the net above-canopy emission rate expected at standard conditions (e.g. air temperature of 30°C, photosynthetic photon flux density of 1500 μmol/m2/s, humidity of 14 g/kg, wind speed of 3 m/s, and LAI of 5). The standard emission rate was adjusted by the emission activity factor that describes its variation due to physiological and phenological processes. The input data of meteorology and LAI were used in the calculation of the emission activity factor. For details, please refer to Guenther, et al. (2006).

Table 6.2–1. The average VOC emission rates for the land use categories in the 4-km domain.

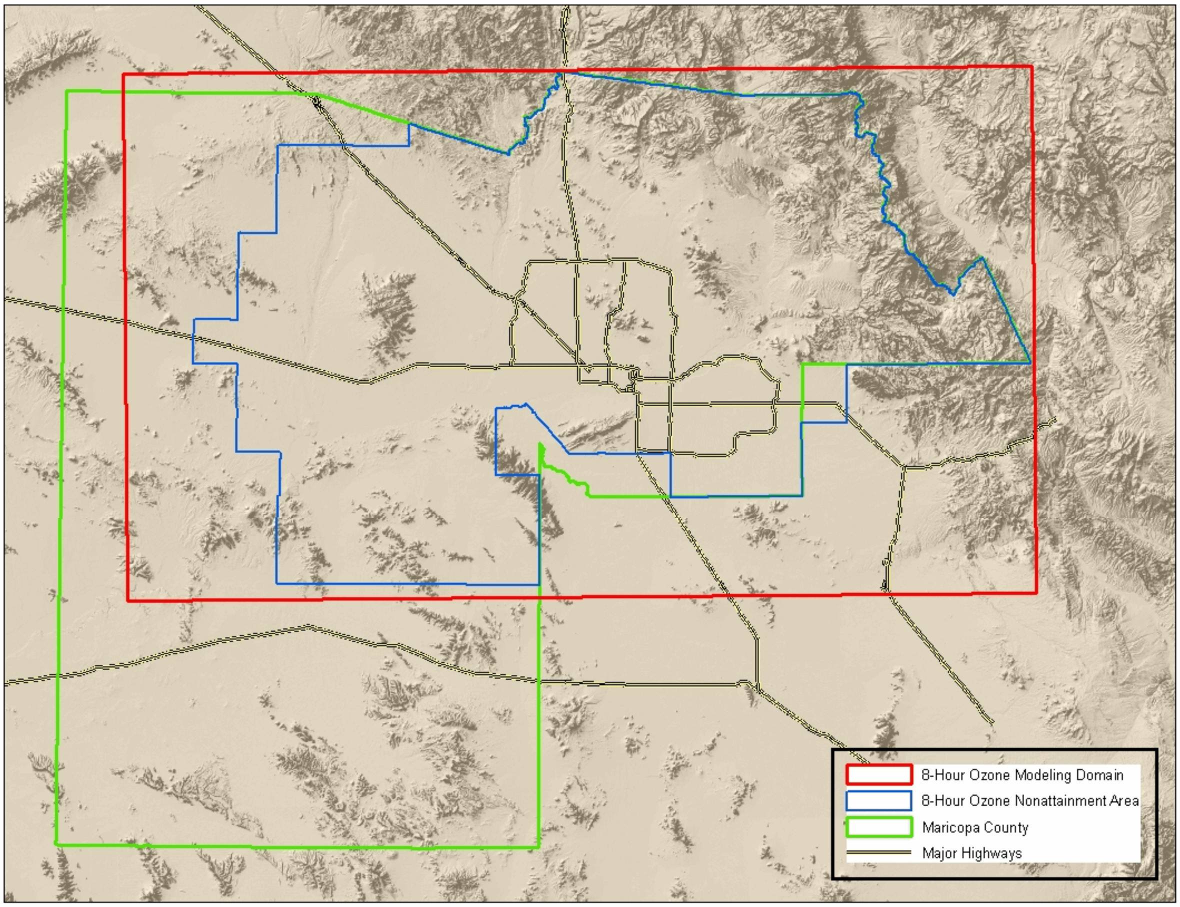
MEGAN Land Use	Land Use Subcategory	Area* in 4-km Domain		Average Emission Rate (μg/m²/hr)
		km2	**acres**	
Urban	Residential	1,875	463,313	162
	Developing & Other Residential	321	79,319	39
	Commercial	690	170,499	157
	Parks/golf/commercial	289	71,412	62
	Transportation	884	218,436	162
	Total	**4,059**	**1,002,979**	
Agriculture	Agriculture (Maricopa + Pinal)	1,291	319,006	175
	Total	**1,291**	**319,006**	
Wildlands	Pine	116	28,664	381
	Pine/Oak/Pinyon	38	9,390	636
	Madrean Oak	89	21,992	658
	Cypress	12	2,965	186
	Riparian/Wetland	358	88,462	958
	Interior Chaparral	2,391	590,816	969
	Pinyon-Juniper	869	214,730	2,131
	Basin Grassland	5	1,236	250
	Creosote-Bursage	6,889	1,702,272	67
	Palo verde-Mixed Cacti-Scrub	14,852	3,669,929	331
	Semi-desert Mixed Grass	47	11,614	503
	Water	346	85,497	248
	Other urban	2,140	528,794	225
	Barren	3	741	232
	Total	**28,155**	**6,957,101**	

* The area for each land use category is approximate.

6.3 Emission estimation

Since MM5 meteorological data for all days in 2005 were not available, emission estimates from MEGAN for May 31 to June 7, 2002 for the MAG eight-hour ozone modeling area were employed to derive the 2005 ozone season daily average VOC, NO_x, and CO emissions for the eight-hour ozone nonattainment area and Maricopa County. Maricopa County and the eight-hour ozone nonattainment and modeling areas are delineated in Figure 6.3–1.

Figure 6.3–1. Boundaries of the eight-hour ozone modeling domain, eight-hour ozone nonattainment area, and Maricopa County.



The daily average emissions for the eight-hour ozone nonattainment area and Maricopa County were extracted from emissions for the eight-hour ozone modeling area using GIS. The extracted daily emissions for May 31 to June 7, 2002 for the Maricopa County portion of the eight-hour ozone modeling area and nonattainment area are provided in Tables 6.3-1 and 6.3-2, respectively. However, the emissions developed for the eight-hour ozone modeling area do not cover the 7,295 square kilometers of the western and southern parts of Maricopa County outside of the modeling area. To obtain emissions for all of Maricopa County, emissions per square kilometer were calculated using MEGAN emission estimates for a 1,600 square kilometer area in the southwest corner of the eight-hour ozone modeling area. This relatively remote and largely unpopulated area was assumed to be representative of vegetation in the portion of Maricopa County that was not modeled for the eight-hour ozone attainment plan. The average emissions per square kilometer for the 1,600 square kilometer area given in Table 6.3-3 were multiplied by 7,295 square kilometers to obtain the biogenic emissions in Maricopa County outside of the eight-hour ozone modeling area. The result was added to the ozone precursor emissions estimated for the eight-hour ozone modeling area within Maricopa County (Table 6.3-1) to obtain total biogenic ozone precursor emissions for the whole Maricopa County.

Table 6.3–1. Daily biogenic emissions in the eight-hour ozone modeling area in Maricopa County.

Date	VOC		NO_x		CO	
	kg/day	lb/day	kg/day	lb/day	kg/day	lb/day
5/31/2002	309,523	682,374	6,414	14,140	42,687	94,108
6/1/2002	278,847	614,746	5,921	13,053	39,253	86,537
6/2/2002	228,687	504,163	5,197	11,457	32,372	71,367
6/3/2002	196,524	433,257	4,742	10,454	28,318	62,430
6/4/2002	207,750	458,006	4,926	10,859	29,778	65,649
6/5/2002	257,443	567,559	5,655	12,467	36,357	80,153
6/6/2002	309,992	683,408	6,536	14,409	43,243	95,334
6/7/2002	299,573	660,439	6,182	13,629	41,942	92,465
Average	**261,042**	**575,493**	**5,697**	**12,560**	**36,744**	**81,006**

Table 6.3–2. Daily biogenic emissions in the eight-hour ozone nonattainment area.

Date	VOC		NO_x		CO	
	kg/day	lb/day	kg/day	lb/day	kg/day	lb/day
5/31/2002	268,009	590,853	5,084	11,208	35,722	78,753
6/1/2002	241,200	531,750	4,702	10,366	32,773	72,251
6/2/2002	198,160	436,864	4,127	9,098	27,076	59,691
6/3/2002	169,941	374,652	3,761	8,292	23,646	52,129
6/4/2002	179,182	395,025	3,913	8,627	24,814	54,705
6/5/2002	222,363	490,222	4,495	9,910	30,325	66,855
6/6/2002	267,560	589,863	5,191	11,444	36,056	79,489
6/7/2002	259,420	571,917	4,921	10,849	35,070	77,315
Average	**225,729**	**497,640**	**4,524**	**9,974**	**30,685**	**67,648**

Table 6.3–3. Average emissions per square kilometer for the 1,600 square-kilometer area in the southwest corner of the eight-hour ozone modeling area.

VOC		NO_x		CO	
kg/day	lb/day	kg/day	lb/day	kg/day	lb/day
268,009	590,853	5,084	11,208	35,722	78,753

6.4 Summary of biogenic source emissions

Ozone season-day and annual biogenic emissions for Maricopa County and the eight-hour ozone nonattainment area are summarized in Tables 6.4–1 and 6.4-2. The annual emissions were scaled up from the ozone season-day emissions multiplied by 365 days. It is noted that this is a conservative estimate, since biogenic emissions are higher during the ozone season than in winter. However, the available data does not permit MAG to perform a whole year of modeling.

Table 6.4–1. Ozone season-day biogenic emissions.

	VOC		NO_x		CO	
Geographic area	**kg/day**	**lb/day**	**kg/day**	**lb/day**	**kg/day**	**lb/day**
Maricopa County	329,414	726,221.8	8,254	18,196.4	48,610	107,165.1
Ozone NAA	225,729	497,639.7	4,524	9,974.1	30,685	67,648.3

Table 6.4–2. Annual biogenic emissions.

	VOC		NO_x		CO	
Geographic area	**tonnes*/yr**	**tons*/yr**	**tonnes/yr**	**tons/yr**	**tonnes/yr**	**tons/yr**
Maricopa County	120,236	132,535.47	3,013	3,320.83	17,743	19,557.63
Ozone NAA	82,391	90,819.25	1,651	1,820.27	11,200	12,345.81

* “tonne” denotes metric ton; “ton” denotes short (English) ton.

6.5 References

ENVIRON International Corp., 2006. Final Report, Maricopa Association of Governments 2006 Biogenics Study.

Guenther, A., 2006a. User’s Guide to Processing Driving Variables for Model of Emissions of Gases and Aerosols from Nature (MEGAN).

Guenther, A., 2006b. User’s Guide to the Model of Emissions of Gases and Aerosols from Nature (MEGAN) Version MEGAN-VBA-2.0.

Guenther, A., T. Karl, P. Harley, C. Wiedinmyer, P. I. Palmer, and C. Geron, 2006. Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature), Atmos. Chem. Phys., 6, 1-30.

Maricopa Association of Governments, 2007. Eight-Hour Ozone Plan for the Maricopa Nonattainment Area.

Appendix 2.1

Instructions for Reporting 2005 Annual Air Pollution Emissions

MARICOPA COUNTY
AIR QUALITY DEPARTMENT

INSTRUCTIONS

FOR REPORTING 2005

ANNUAL AIR POLLUTION EMISSIONS

February 2006

Emissions Inventory Unit
1001 North Central Avenue, Suite 400
Phoenix, Arizona 85004
(602) 506-6790
(602) 506-6985 (Fax)

Copies of this document, related forms
and other reference materials are available online at our web site:
www.maricopa.gov/aq/ei.aspx

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WHAT'S NEW FOR 2005?

Emissions reporting requirements:

- The US EPA has recently designated the chemical **t-butyl acetate** (CAS number 540-88-5) as a VOC for record-keeping and emissions reporting requirements, but not for emission limitations or content requirements. If you use this chemical at your facility, see the box on page 3 for specific reporting instructions.

- It is **critical** to the accuracy of your report to use the emission calculation method that best represents **actual** emissions from your facility. Page 4 of these instructions now includes details on the preferred emission calculation methods. Please double check your emissions calculations to make sure the best method is employed.

Reporting forms:

- Some **pre-printed information** on your report may be different from last year's version. Please review the enclosed forms carefully, and verify all pre-printed information.

- Many of our reporting forms **have changed** recently. If you use your own forms, or a computerized reproduction of our forms, the forms used ***MUST*** conform to the current information requirements and **FORMAT** as supplied on our preprinted forms. "Homemade" reporting forms that vary significantly from the preprinted forms sent to you will ***not*** be accepted.

Miscellaneous:

- **EPA emission factors** for certain activities at sand and gravel facilities have been revised. The new emission factors appear on applicable pre-printed general process forms and are also listed on our revised Sand & Gravel Helpsheet available at: **www.maricopa.gov/aq/ei.aspx**

- In accordance with Maricopa County Air Pollution Control Rule 280 (Fees), the 2005 annual emission fee (for Title V sources only) is $13.65/ton.

I. INTRODUCTION

An annual emissions inventory is a document 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 with its own air quality permit.

Follow these steps to complete your 2005 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 permitted sources, the packet you received from us contains the necessary pre-printed forms based on your site's most recent emissions inventory.

1. **Business Form**: Contains general contact information about the permitted site. This form is required for all businesses.
2. **Stack Form**: Only required if your business location annually emits over 10 tons of a single pollutant (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 9 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 Form or Data Certification/Fee Calculation Form**: Only sources with a **Title V** permit are required to pay a fee for their emissions and need to use the Data Certification/Fee Calculation Form. All other sources use the Data Certification Form.

STEP 2: Complete the applicable forms. 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. Detailed information on how to complete the most common forms is included in this document. The packet you received 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 Form (or Data Certification/Fee Calculation Form for Title V sources) is ***signed*** by a company representative. ***Include your air quality permit number on all correspondence and applicable 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 Air Quality Department
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 volatile organic compound (VOC)**
NH_x	=	Ammonia and 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, Sections 200.69 and 200.110 for a full definition.)

NEW FOR 2005: EPA has redesignated the chemical **t-butyl acetate (CAS Number 540-88-5)** as a VOC for record-keeping requirements and emissions reporting, but not for emission limitations or content requirements. An anticipated revision to County Rule 100, Section 200.69 (tentatively scheduled for adoption in March 2006) will incorporate this change as follows:

"The following compound(s) are VOC for purposes of all recordkeeping, emissions reporting, photochemical dispersion modeling and inventory requirements which apply to VOC and shall be uniquely identified in emission reports, but are not VOC for purposes of VOC emissions limitations or VOC content requirements: t-butyl acetate (540-88-5)."

Therefore, if your facility uses t-butyl acetate, it is necessary to report t-butyl acetate as a separate material on the evaporative process form, not as part of a grouped material (e.g., solvents, thinners, activators, etc.). T-butyl acetate will continue to be identified as a VOC on your emission report and count towards any applicable emission fees.

** ***HAP&NON:*** Usage of certain materials that are: (1) a Hazardous Air Pollutant (HAP) **and** (2) **not** also a VOC (that is, not also an ozone precursor) 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 for HAP emissions.

The most common materials categorized as "HAP&NON" include:

- methylene chloride (dichloromethane)
- perchloroethylene
- 111-trichloroethane (111-TCA or methyl chloroform)
- hydrochloric acid
- hydrofluoric acid

NOTE: HAPs that are also considered volatile organic compounds are reported as VOC.

EMISSION CALCULATION METHOD HIERARCHY:

When preparing emission information for your report, the most accurate method for calculating **actual** emissions must be used. The hierarchy listed below outlines the preferred methods for calculating emission estimates. (The hierarchy listed below will be incorporated into an anticipated July 2006 revision of Rule 280 of Maricopa County's Air Pollution Control Rules and Regulations).

(1) Whenever available, emissions estimates should be calculated from continuous emissions monitors certified under 40 CFR Part 75, Subpart C, or data quality assured pursuant to Appendix F of 40 CFR, Part 60.

(2) When sufficient data obtained using the methods described in paragraph 1 is not available, emissions estimates should be calculated from source performance tests conducted pursuant to Rule 270 in Maricopa County's Air Pollution Control Rules and Regulations.

(3) When sufficient data obtained using the methods described in paragraphs 1 or 2 is not available, emissions estimates should be calculated from material balance using engineering knowledge of the process.

(4) When sufficient data obtained using the methods described in paragraphs 1 through 3 is not available, emissions estimates shall be calculated using emissions factors from EPA Publication No. AP-42 "Compilation of Air Pollutant Emission Factors," Volume I: Stationary Point and Area Sources.

(5) When sufficient data obtained using the methods described in paragraphs 1 through 4 is not available, emissions estimates should be calculated by equivalent methods supported by back-up documentation that will substantiate the chosen method.

III. 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 deemed confidential, the following steps must be followed:

- 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.
- 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.

IV. 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 Permit Engineering Division at (602) 506-6464 to accomplish this.

<u>WHAT IS A PROCESS</u>? A ***process*** is a business activity at your location that emits one or more of the pollutants listed on page 3, 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.

<u>PROCESSES AND MATERIALS THAT DO ***NOT*** HAVE TO BE REPORTED</u>:

- Welding.
- Acetone usage.
- Fuel use for forklifts or other vehicles. (NOTE: Fuel use in ***non-vehicle*** engines ***is*** reportable.)
- Soil remediation activities. (Note: Other periodic reporting requirements may exist; consult your permit.)
- Storage emissions from fuels or organic chemicals in any tank with a capacity of 250 gallons or less.
- 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, with throughput < 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.

<u>GROUPING MATERIALS AND/OR EQUIPMENT UNDER ONE PROCESS ID</u>:
You can group together under one process ID:

- All internal combustion engines ***less than 600 hp*** if they burn the same fuel and have similar operating schedules.
- All external combustion equipment (boilers, heaters) with a capacity of ***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 dissimilar materials together, such as thinners and paints. Attach documentation (see example, p. 20) showing how the grouped emission factor was determined.
- All underground tanks with the same fuel and same type of vapor recovery system.

<u>ASSIGNING IDENTIFICATION NUMBERS (IDs)</u>:
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 each General Process form and for each material reported on the Evaporative Process Forms.

These numbers are usually assigned by the person who prepares the original report. If you are adding a new item 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 each year. If that item is no longer reportable, return the preprinted form with a brief explanation. Do not use that ID number again.

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 site at *www.maricopa.gov/aq/ei.aspx* or call (602) 506-6790.

- Bakeries
- Concrete Batch Plants
- Fuel Storage and Handling
- Incinerators and Crematories
- Lg. Aboveground Storage Tanks
- Natural Gas Boilers/Heaters
- Polyester Resin
- Printing Plants
- Roofing Asphalt
- Sand and Gravel Plants
- Using EPA's TANKS 4.09d Program
- Vehicle Refinishing
- 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: MMCF = 1,000,000 cubic feet
M = 1,000 Example: MGAL = 1,000 gallons

ADDITIONAL RESOURCES AND ASSISTANCE:
The Maricopa County Emissions Inventory web site at *www.maricopa.gov/aq/ei.aspx* contains additional reference materials, such as:

- blank copies of most emissions reporting forms.
- 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.

V. INSTRUCTIONS AND EXAMPLES FOR COMPLETING EMISSIONS REPORTING 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 Permit Engineering Division 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 ***at this business location***.

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. (Consult our website, at *www.maricopa.gov/aq/ei.aspx*, for a link to a full list of NAICS codes.)

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 **stationary** 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 individual pollutant. 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. Include lat/long coordinates of stack (in decimal degrees)
1	***W***	***30*** ft	***90*** °F		***20,000***	***36***			***paint booth Lat: N33.531873 Long: W112.261331***
2	***V***	***14*** ft	***200*** °F		***19,186***	***40***			***thermal oxidizer, Bldg. 2 Lat: N33.5325 Long: W112.26136***

* 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 6.) 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, in degrees Fahrenheit. ***DO NOT*** report "ambient".

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.

7 Stack Name/Description and Lat/Long Coordinates: Provide a brief text description of the stack along with the latitude and longitude coordinates of the stack (in decimal degrees).

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 6.) 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 *www.maricopa.gov/aq/ei.aspx* 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 used for your site (see page 9) ***and*** the control device is vented through that identified stack. This is the ID number shown in column 1 of the Stack Form. 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 13 and 14.)

1 Process ID: A number (up to three digits) that is preprinted or you assign. (See "Assigning Identification Numbers" on page 6.) This Process ID number can not be used for any other process at this location.

2 Process Type/Description: Brief details on the type of activity that is occurring.

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 9) ***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 the section "Other Resources" on our web site, 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 activity occurred in January, February and December 2005. The total for all four seasons must equal 100%.

7 Normal Operating Schedule and
8 Typical Hours of Operation: These reflect the normal daily, weekly, and annual operating parameters of ***this process*** during 2005.

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 "natural gas", "hours of operation," "vehicle miles traveled," or "acres."

10 Used, Produced or Existing: Indicate whether calculated emissions are based on a material type or fuel *used* (an input, such as "paint" or "natural gas"), or an *output* (such as "sawdust produced" or "finished product"). Use "Existing" if the parameter reported on line 9 is not directly used or produced in the process (such as "vehicle miles traveled" or "acres").

11 Annual Amount: The annual amount (a number) of material that was used, fuel combusted, product produced, hours of operation, vehicle miles traveled, or acres.

12 Fuel Sulfur Content (in percent): For processes that involve the combustion of oil or diesel fuels, report the sulfur content of the fuel as a decimal value. Example: 0.05 % (= 500 ppm)

13 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.

14 Unit Conversion Factor: You must provide this if you use an emission factor with an emission factor unit (see item 17 below) that is ***not*** the same as the unit of measure (from line 13). This is the standard number you would multiply your amount (line 11) by to convert it to the units of the emission factor. See page 7 for a list of commonly used conversion factors.

General Process Form Instructions (continued)

15 Pollutant: See page 3 for a list of pollutants that need to be reported.

16 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 in an attachment.

17 Emission Factor (EF) Units: Enter the appropriate Emission Factor Units in pounds (lb) per unit; e.g., lb/ton, lb/MMCF, lb/gal.

18 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 #25 below). Indicate "NO" if: 1) there is no emission control device, or 2) the emission factor represents emission rates **before** controls. A "NO" response requires the use of Formula B (see #25 below).

19 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 continuous emissions monitors (CEM) data or 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 the CEM or the test results. Report "1" in this column for CEM data or "4" for performance test data.

20 through 24: Leave blank if there is no control device.

20 Capture % Efficiency: The percent of the pollutant that is captured and sent to the primary control device in this process. Be sure to list capture efficiency separately for ***each*** pollutant affected.

21 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.

22 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.

23 Control Device(s) % Efficiency: Enter the total control efficiency of the control device(s). Be sure to list control device efficiency separately for ***each*** pollutant affected. If you report control device efficiency, you must ***also*** show capture efficiency in column 20.

24 Efficiency Reference Code: Enter the code (1 through 6) that best describes how you determined the ***control device efficiency***. A list of possible codes is included at the bottom of the form.

25 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 25 = line 11 × line 14 × column 16

B. *Emissions after control:*
Column 25 = line 11 × line 14 × column 16 × (1 – [column 20 × column 23])

Use the decimal equivalent for columns 20 and 23. Example: 96.123% = 0.96123

General Process Form **2005** **EXAMPLE: Internal Combustion** Permit number(s) V99999

Place an X in any gray cell to mark data requested to be held confidential. See page 5 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)

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 Weeks/Year 52

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- [X] Used (input) or [ ] Produced (output) or [ ] Existing (e.g. VMT, acres)

11- Annual Amount: *(a number)* 16,250 12- Fuel Sulfur Content (in percent) 0.05 %

13- Unit of Measure: *(for example: tons, gallons, million cu ft, acres, units produced, etc.)* GALLONS

14- 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					
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
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
- **8** = Site-Specific Emission Factor
- **9** = Vendor Emission Factor
- **10** = Trade Group Emission Factor

**** 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: Unpaved Road Travel

Permit number(s) V99999

Place an X in any gray cell to mark data requested to be held confidential. See page 5 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 Weeks/Year 52

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) or ☒ Existing (e.g. VMT, acres)

11- Annual Amount: *(a number)* 7,500

12- Fuel Sulfur Content (in percent) ___ %

13- Unit of Measure: *(for example: tons, gallons, million cu ft, acres, units produced, etc.)* VMT

14- Unit Conversion Factor *(if needed to convert Unit of Measure to correlate with emission factor units)*

	Emission Factor (EF) Information				Control Device Information					
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
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. 25 are calculated as follows: (line 11 × col. 16) × (1 – [col. 20 × col. 23])

*** 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
- **8** = Site-Specific Emission Factor
- **9** = Vendor Emission Factor
- **10** = Trade Group Emission Factor

**** 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 1–5 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).

Data fields: (See sample forms on pages 17 and 18.)

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/aq/ei.aspx* 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 the total annual activity occurred during January, February and December 2005. 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, time of day and weeks per year when ***this process*** occurred during the calendar year.

6 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 6 of these instructions for more explanation of ID numbers and for exclusions and guidance on grouping materials.

7 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 9) ***and*** the process has a stack.

8 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).

9 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).

10 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.

11 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 9. 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.

12 Pounds of pollutant sent off-site: Required only if you wish to take credit for reduced emissions because waste of this material is 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 12 ***must*** equal the number of pounds reported on the Off-Site Recycling/Disposal Form(s) for the same Process ID number.

13 and 14: Leave these fields blank if there is no control device present.

13 Capture % Efficiency: The percent of the pollutant from this process that is captured and sent to the control device.

14 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.

15 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 15 is calculated as follows:

Emissions without off-site recycling/disposal or controls:
Column 15 = column 9 × column 11

Emissions with off-site recycling/disposal:
Column 15 = (column 9 × column 11) – column 12

*Emissions with off-site recycling/disposal **and** controls:*
Column 15 = ([column 9 × column 11] – column 12) × (1 – [column 13 × column 14])

Use the decimal equivalent for columns 13 and 14. Example: 96.123% = 0.96123

EXAMPLE: Coating and Painting

Evaporative Process Form **2005** Permit number(s) V99999

Place an X in any gray cell to mark data requested to be held confidential. See page 5 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* Weeks/Year *52*

5- Typical Hours of Operation *(military time)* Start *0800* End *1700*

6	7	8	9		10	11		12	13	14			15
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 6455-06	95	gl	VOC	4.7	gal		%		%		447
801	1	lacq thinner	120	gl	VOC	7.1	gal		%		%		852
802	1	Paint red 4039-03	940	gl	VOC	4.2	gal		%		%		3,948
803	1	paint thinner	707	gl	VOC	7.0	gal		%		%		4,949
804	1	powder paint 8730-11	20,200	lb	VOC	0.001	lb		%		%		20
									%		%		

Note: Do NOT change pre-printed Process ID numbers. See page 6 of these 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. 15 are calculated as follows: **([col. 9 × col. 11] – col. 12) × (1 – [col. 13 × col. 14])**

**** 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 **2005**

Permit number(s) ___V99999___

Place an X in any gray cell to mark data requested to be held confidential. See page 5 for requirements for information to be deemed confidential.

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 ***8*** Days/Week ***5*** Hours/Year ***2080*** Weeks/Year ***52***

5- Typical Hours of Operation *(military time)* Start ***1300*** End ***1700***

6	7	8	9		10	11		12	13	14			15
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	569	%		%		727
7		xyz stripper	1300	gl	VOC	3.3	gl	1,884	%		%		2,406
8		cleaning solvents	358	gl	VOC	6.4	gl	1,006	%		%		1,285
9		generoclean	2258	gl	VOC	6.8	gl	6,741	%		%		8,613
									%		%		

Note: Do NOT change pre-printed Process ID numbers. See page 6 of these 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 12 is calculated on the example Off-Site Recycling/Disposal Form on the next page.

EXAMPLE

Off-Site Recycling/Disposal Form 2005

Permit number(s) ***V99999***

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/aq/ei.aspx.

Provide one off-site recycling/disposal form for each waste stream at your business location. A waste stream is the waste from one or more processes mixed together to make one waste product before it is taken off site for recycling, disposal or combustion.

1) Assign a unique two-digit ID number to identify the waste stream that will be described below. ***01***
(Start with ID# 01 for first waste stream. Make copies of a blank Off-Site Recycling/Disposal form and use 02 for second, etc.)

Check one:

☐ pounds
☒ gallons

2) What was the quantity of this waste stream in 2005? 2,400
Indicate whether this quantity is reported in pounds or gallons. Keep waste disposal company manifests as proof that this amount of waste was taken off-site.

3) What was the **average** pollutant content of the waste stream? NOTE: Report in the same units (pounds or gallons) as used in line 2.

VOC ***4.25*** lbs/unit HAP&NON ______ lbs/ unit NHx ______ lbs/ unit

NOTE: 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 or other contaminants in the waste stream. The estimated pollutant content of the waste is usually between 50% and 95% of the new product. This example estimates an average VOC content (on line 3) to be 75% of the original VOC content of 5.67 lbs/gal., to account for evaporation and contaminants. See page 20 to calculate a weighted average.

4) Calculate the **total** annual pollutant content of the waste in this waste stream.
(volume of 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: In this example, the amount each process material contributed to total pollutants in the waste stream (Line 4) is based on the percentage, by weight, of each material that contributed to the waste stream. (e.g. Process ID #6 contributed 5.6%, therefore 5.6% × 10,200 lbs/yr = 569 lbs. See example on page 20.)

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 12 on the Evaporative Process Form.

Process ID	Annual VOC (lbs)	Annual HAP&NON (lbs)	Annual NHx (lbs)
6 Contributed about	***569*** lbs	lbs	lbs
7 Contributed about	***1,884*** lbs	lbs	lbs
8 Contributed about	***1,006*** lbs	lbs	lbs
9 Contributed about	***6,741*** lbs	lbs	lbs

EXAMPLE: Documentation of Emission Factor Calculations

Identify the process ID number(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 ***V99999***

Emission factors derived from source test performed 12/2/00 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

Weighted average sample calculation

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: 23,231 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 6.

Process ID #	Material Type	2005 Usage	Units	VOC (lbs/unit)	VOC Emissions (= Usage × VOC content)	Percent contributed to waste stream
6	*gun cleaner*	*180*	*gal*	*7.2*	*1,296 lbs.*	*5.6 %*
7	*xyz stripper*	*1,300*	*gal*	*3.3*	*4,290 lbs.*	*18.5 %*
8	*cleaning solvent*	*358*	*gal*	*6.4*	*2,291 lbs.*	*9.9 %*
9	*generoclean solvent*	*2,258*	*gal*	*6.8*	*15,354 lbs.*	*66.1 %*
	Totals:	***4,096***	***gal***		***23,231 lbs.***	*100.0 %*

Average VOC content:	***23,231 lbs. / 4,096 gals***	**=**	***5.67 lb/gal***

EXAMPLE (for all sources except Title V sources)

Data Certification Form 2005

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".

NOTE: "Accidental Releases" reported in column 2 should include all excess emissions reported to the Department under Rule 140, Section 500.

Summary of 2005 Annual Emissions:	**(1) Totals from Process Forms**	**(2) + Accidental Releases**	**(3) = TOTAL 2005 Emissions**
CO	***2,113***	***0***	***2,113***
NH_x	***0***	***0***	***0***
Lead	***0***	***0***	***0***
HAP&NON	***0***	***0***	***0***
VOC	***24,220***	***0***	***24,220***
NO_x	***9,815***	***0***	***9,815***
SO_x	***645***	***0***	***645***
PM_{10}	***7,891***	***0***	***7,891***

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:

- Complete the Confidentiality Statement below.
- Sign and date this form below where indicated.
- Send the **original** copy of your completed forms: Maricopa County Air Quality Department, Emissions Inventory Unit, 1001 N. 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

How to calculate an emission fee (for Title V sources only):

1. For each pollutant listed on the "Data Certification/Fee Calculation" form, total up all emissions recorded on your General Process and Evaporative Process Forms. Enter these numbers in column 1, "Totals from Process Forms."

NOTE: While most processes that generate PM_{10} should be reported on line 5 of the Data Certification/Fee Calculation form, "[f]ugitive emissions of PM_{10} from activities other than crushing, belt transfers, screening, or stacking" (County Rule 280, § 305.2d) are NOT subject to annual emission fees. The most common occurrences of these PM_{10}-producing activities that are NON-billable are listed below:

SCC codes and description of PM_{10}-producing processes that are NOT subject to emission fees

SCC	Major Category	Subcategory	Facility / Process Type	Process Description
30200814	Industrial Processes	Food and Agriculture	Feed Manufacture	Storage
30400737	Industrial Processes	Secondary Metal Production	Steel Foundries	Raw Material Silo
30500120	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Storage Bins: Ferric Chloride
30500121	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Storage Bins: Mineral Stabilizer
30500134	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Blown Saturant Storage
30500135	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Blown Coating Storage
30500141	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Granules Storage
30500143	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Mineral Dust Storage
30500203	Industrial Processes	Mineral Products	Asphalt Concrete	Storage Piles
30500212	Industrial Processes	Mineral Products	Asphalt Concrete	Heated Asphalt Storage Tanks
30500213	Industrial Processes	Mineral Products	Asphalt Concrete	Storage Silo
30500290	Industrial Processes	Mineral Products	Asphalt Concrete	Haul Roads: General
30500303	Industrial Processes	Mineral Products	Brick Manufacture	Storage of Raw Materials
30500608	Industrial Processes	Mineral Products	Cement Manufacturing (Dry Process)	Raw Material Piles
30500708	Industrial Processes	Mineral Products	Cement Manufacturing (Wet Process)	Raw Material Piles
30501710	Industrial Processes	Mineral Products	Mineral Wool	Storage of Oils and Binders
30502007	Industrial Processes	Mineral Products	Stone Quarrying - Processing	Open Storage
30502011	Industrial Processes	Mineral Products	Stone Quarrying - Processing	Hauling
30502504	Industrial Processes	Mineral Products	Construction Sand and Gravel	Hauling
30502507	Industrial Processes	Mineral Products	Construction Sand and Gravel	Storage Piles
30502760	Industrial Processes	Mineral Products	Industrial Sand and Gravel	Sand Handling, Transfer, & Storage
30531090	Industrial Processes	Mineral Products	Coal Mining, Cleaning, Material Handling	Haul Roads: General
30532007	Industrial Processes	Mineral Products	Stone Quarrying - Processing	Open Storage
30704002	Industrial Processes	Pulp and Paper & Wood Pdts.	Bulk Handling and Storage - Wood/Bark	Stockpiles
31100199	Industrial Processes	Building Construction	Construction: Building Contractors	Other Not Classified
31100299	Industrial Processes	Building Construction	Demolitions/Special Trade Contracts	Other Construction/Demolition
50100401	Waste Disposal	Solid Waste Disposal	Landfill Dump	Unpaved Road Traffic
50100402	Waste Disposal	Solid Waste Disposal	Landfill Dump	Fugitive Emissions
50100403	Waste Disposal	Solid Waste Disposal	Landfill Dump	Area Method
50100404	Waste Disposal	Solid Waste Disposal	Landfill Dump	Trench Method
50100405	Waste Disposal	Solid Waste Disposal	Landfill Dump	Ramp Method

2. Report any accidental releases in column 2. Add columns 1 and 2 together for each pollutant, and enter the sum in column 3. Sum lines 1 through 5 together, and enter the total on line 6.

3. Divide your facility's total billable emissions (on line 6) by 2000 to convert pounds into tons. **Round to the nearest ton.** Enter this value on line 7. Multiply this number by **$13.65**, and enter the result on line 8. This is your 2005 emission fee.

EXAMPLE (for Title V sources only)

Data Certification/Fee Calculation Form **2005** Permit number **V99999**

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 2005 Annual Emissions:	**(1) Totals from Process Forms**	**(2) + Accidental Releases**	**(3) = TOTAL 2005 Emissions**
	CO	*2,113*	*0*	*2,113*
	NH_x	*0*	*0*	*0*
	Lead	*0*	*0*	*0*
	PM_{10} (non-billable; see page 22)	*7,200*	*0*	*7,200*
	Emissions fees are based on your emissions of the following pollutants ONLY:			
1	HAP&NON	*0*	*0*	*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} (billable; see page 22)	*691*	*0*	*691*
6	**Add "TOTAL" column from lines 1 through 5 ONLY:**			*35,371* lbs.
7	Divide the total on line 6 by 2000 (pounds per ton) to get tons, and round the number to the nearest ton. (Drop any decimal of .499 or less. Increase to the next whole number any decimal of .500 or more.) Enter the resulting WHOLE NUMBER here.			*18* TONS
8	Multiply line 7 (a WHOLE number) by **$ 13.65**. This is your **2005 ANNUAL EMISSION FEE**.			$ *245.70*

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:

- Include a check (made payable to Maricopa County Air Quality Department) 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 Air Quality Department, Emissions Inventory Unit, 1001 N. 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

Calculating Rule Effectiveness for Controlled (Title V and non-Title V) Point Source Processes

A. Most important factors (2 criteria, each assigned weighting of 20% of total):

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Monitoring	94%	100%	97%	Source specific monitoring used for compliance purposes, and monitoring records filed with regulatory agency at least every 4 months.			
	87%	93%	90%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency every 6 to 9 months.	20%	90%	18.0%
	81%	86%	84%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency each year.			
	70%	80%	75%	General guidance exists for source specific enhanced monitoring, and monitoring records required but aren't submitted to regulatory agency.			
		< 70%	35%	No requirements for any type of monitoring.			

Compliance History	94%	100%	97%	The facility has been in compliance for the past eight quarters.		18 of 39 facilities	9.0%
	87%	93%	90%	The facility is believed to have been in compliance for the past eight quarters, although inspection frequency is such that this can't be positively confirmed.		5 of 39 facilities	2.3%
	81%	86%	84%	On schedule; the facility is meeting its compliance schedule.			
	70%	80%	75%	In Violation; facility is in violation of emissions and/or procedural requirements.		7 of 39 facilities	2.7%
		< 70%	35%	High Priority Violator (HPV): the facility is in significant violation of one or more applicable requirement of the CAA.		9 of 39 facilities	1.6%
					20%	Sum:	**15.6%**

B. Other important factors (4 criteria, each assigned weighting of 6% of total):

Type of Inspection	94%	100%	97%	Inspections involve compliance test methods with a high degree of accuracy, such as stack testing or other types of precise emissions measurement.	6%	97%	5.8%
	87%	93%	90%	Inspections involve detailed review of process parameters & inspection of control equipment.			
	81%	86%	84%	Inspections involve review of process and inspection of control equipment.			
	70%	80%	75%	Inspections generally consist of only a records review.			
		< 70%	35%	Inspections most likely consist of visual inspection (e.g., opacity), or drive by.			

Operation & Maintenance	94%	100%	97%	Control equipment operators follow and sign daily O&M instructions.			
	87%	93%	90%	Control equipment operators follow daily O&M instructions.	6%	90%	5.4%
	81%	86%	84%	Control equipment operators follow daily or weekly O&M instructions.			
	70%	80%	75%	O&M requirements exist, but on no specific schedule.			
		< 70%	35%	No specific O&M requirements.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Unannounced Inspections	94%	100%	97%	Routinely conducted.	6%	97%	5.8%
	87%	93%	90%	Sometimes done.			
	81%	86%	84%	Done, but infrequently.			
	70%	80%	75%	Rarely done.			
		< 70%	35%	Never done.			

Enforcement Penalties	94%	100%	97%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.	6%	97%	5.82%
	87%	93%	90%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	81%	86%	84%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	70%	80%	75%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
		< 70%	35%	Agency does not have sufficient authority to impose punitive measures towards violators.			

C. Other factors (9 criteria, each assigned weighting of 4% of total):

Compliance Certifications	94%	100%	97%	Source subject to Title V or other type of compliance certification.	4%	97%	3.88%
	87%	93%	90%	Source subject to Title V or other type of compliance certification.			
	81%	86%	84%	Source not subject to any type of compliance certification.			
	70%	80%	75%	Source not subject to any type of compliance certification.			
		< 70%	35%	Source not subject to any type of compliance certification.			

Inspection Frequency	94%	100%	97%	Source(s) are inspected once every 2 years or more frequently.	4%	97%	3.88%
	87%	93%	90%	Source(s) inspected every 3 years or more frequently.			
	81%	86%	84%	Source(s) inspected every 5 years or more frequently.			
	70%	80%	75%	Inspection of source(s) infrequent. > every 5 years.			
		< 70%	35%	Inspections rarely, if ever, performed.			

EPA HPV Enforcement	94%	100%	97%	Agency has sufficient resources to implement EPA's 12/22/98 HPV policy.	4%	97%	3.88%
	87%	93%	90%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	81%	86%	84%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	70%	80%	75%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy more often than not.			
		< 70%	35%	Resource constraints prohibit agency from implementing EPA's 12/22/98 HPV policy in most instances.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Operator Training	94%	100%	97%	Control equipment operators complete a formal training program on use of the equipment, and such program is kept up to date and has been reviewed by the regulatory agency.			
	87%	93%	90%	Control equipment operators complete formal training program, and such program is kept up to date and available for review by the regulatory agency upon request.			
	81%	86%	84%	Control equipment operators complete some amount of formal training.	4%	84%	3.36%
	70%	0.8	75%	Control equipment operators receive only on the job training .			
		< 70%	35%	Control equipment operators receive no specific training.			

Media Publicity	94%	100%	97%	Media publicity of enforcement actions.	4%	97%	3.88%
	87%	93%	90%	Media publicity of enforcement actions.			
	81%	86%	84%	Media publicity of enforcement actions.			
	70%	80%	75%	Media publicity of enforcement actions.			
		< 70%	35%	No media publicity of enforcement actions.			

Regulatory Workshops	94%	100%	97%	Regulatory workshops are available annually, and/or the implementing agency mails regulatory information packages each year.	4%	97%	3.88%
	87%	93%	90%	Regulatory workshop are available every 1-2 years, and/or the implementing agency mails regulatory information packages every 1-2 years.			
	81%	86%	84%	Regulatory workshop are available every 2-3 years, and/or the implementing agency mails regulatory information packages once every 2-3 years.			
	70%	80%	75%	Regulatory workshop not routinely available, but implementing agency mails regulatory information packages out about once every 2-3 years.			
		< 70%	35%	Regulatory workshops not routinely available. implementing agency mails regulatory information packages infrequently, if ever.			

Inspector Training	94%	100%	97%	Inspectors must undergo 2 weeks of comprehensive basic training, and 1 to 2 weeks of source specific training, and such training is updated each year.			
	87%	93%	90%	Inspectors must undergo 1 to 2 weeks of basic training and 1 week of source specific training, and such training is updated every 1-2 years.	4%	90%	3.60%
	81%	86%	84%	Inspectors must undergo 1 to 2 weeks of basic training and 3 to 5 days of source specific training, and such training is updated every 1-2 years.			
	70%	80%	75%	Inspectors must undergo 1 to 2 weeks of basic training and 1 to 3 days of source specific training, and such training is updated every 1-2 years.			
		< 70%	35%	Inspectors must undergo less than 5 days of basic training less than 3 days of source specific training, and such training is updated only every 2 years or less frequently.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Testing Guidelines	94%	100%	97%	Specific guidelines and schedule for testing and test methods exist.	4%	97%	3.88%
	87%	93%	90%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	81%	86%	84%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	70%	80%	75%	Specific guidelines on testing and test methods, but no schedule for testing.			
		< 70%	35%	Only general guidance on testing, or no mention of testing requirements.			

Follow-up Inspections	94%	100%	97%	Follow-up inspections always or almost always done (90 % of the time or more).	4%	97%	3.88%
	87%	93%	90%	Follow-up inspections usually done (approximately 75% of the time).			
	81%	86%	84%	Follow-up inspections sometimes done (approximately 50% of the time).			
	70%	80%	75%	Follow-up inspections infrequently done (approximately 25% of the time).			
		< 70%	35%	Follow-up inspections rarely or never done (10% of the time or less)			
							90.55%

A. Most important factors (2 criteria, each assigned weighting of 20% of total):

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Monitoring	94%	100%	97%	Source specific monitoring used for compliance purposes, and monitoring records filed with regulatory agency at least every 4 months.			
	87%	93%	90%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency every 6 to 9 months.			
	81%	86%	84%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency each year.			
	70%	80%	75%	General guidance exists for source specific enhanced monitoring, and monitoring records required but aren't submitted to regulatory agency.	20%	75%	15.0%
		< 70%	35%	No requirements for any type of monitoring.			

Compliance History	94%	100%	97%	The facility has been in compliance for the past eight quarters.		182 of 748 facilities	4.7%
	87%	93%	90%	The facility is believed to have been in compliance for the past eight quarters, although inspection frequency is such that this can't be positively confirmed.		404 of 748 facilities	9.7%
	81%	86%	84%	On schedule; the facility is meeting its compliance schedule.			
	70%	80%	75%	In Violation; facility is in violation of emissions and/or procedural requirements.		156 of 748 facilities	3.1%
		< 70%	35%	High Priority Violator (HPV): the facility is in significant violation of one or more applicable requirement of the CAA.		6 of 748 facilities	0.1%
						Sum:	**17.6%**

B Other important factors (4 criteria, each assigned weighting of 6% of total):

Type of Inspection	94%	100%	97%	Inspections involve compliance test methods with a high degree of accuracy, such as stack testing or other types of precise emissions measurement.			
	87%	93%	90%	Inspections involve detailed review of process parameters & inspection of control equipment.	6%	90%	5.4%
	81%	86%	84%	Inspections involve review of process and inspection of control equipment.			
	70%	80%	75%	Inspections generally consist of only a records review.			
		< 70%	35%	Inspections most likely consist of visual inspection (e.g., opacity), or drive by.			

Operation & Maintenance	94%	100%	97%	Control equipment operators follow and sign daily O&M instructions.			
	87%	93%	90%	Control equipment operators follow daily O&M instructions.	6%	90%	5.4%
	81%	86%	84%	Control equipment operators follow daily or weekly O&M instructions.			
	70%	80%	75%	O&M requirements exist, but on no specific schedule.			
		< 70%	35%	No specific O&M requirements.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Unannounced Inspections	94%	100%	97%	Routinely conducted.	6%	97%	5.8%
	87%	93%	90%	Sometimes done.			
	81%	86%	84%	Done, but infrequently.			
	70%	80%	75%	Rarely done.			
		< 70%	35%	Never done.			

Enforcement Penalties	94%	100%	97%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.	6%	97%	5.82%
	87%	93%	90%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	81%	86%	84%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	70%	80%	75%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
		< 70%	35%	Agency does not have sufficient authority to impose punitive measures towards violators.			

C. Other factors (9 criteria, each assigned weighting of 4% of total):

Compliance Certifications	94%	100%	97%	Source subject to Title V or other type of compliance certification.			
	87%	93%	90%	Source subject to Title V or other type of compliance certification.			
	81%	86%	84%	Source not subject to any type of compliance certification.			
	70%	80%	75%	Source not subject to any type of compliance certification.	4%	75%	3.00%
		< 70%	35%	Source not subject to any type of compliance certification.			

Inspection Frequency	94%	100%	97%	Source(s) are inspected once every 2 years or more frequently.	4%	97%	3.88%
	87%	93%	90%	Source(s) inspected every 3 years or more frequently.			
	81%	86%	84%	Source(s) inspected every 5 years or more frequently.			
	70%	80%	75%	Inspection of source(s) infrequent. > every 5 years.			
		< 70%	35%	Inspections rarely, if ever, performed.			

EPA HPV Enforcement	94%	100%	97%	Agency has sufficient resources to implement EPA's 12/22/98 HPV policy.	4%	97%	3.88%
	87%	93%	90%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	81%	86%	84%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	70%	80%	75%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy more often than not.			
		< 70%	35%	Resource constraints prohibit agency from implementing EPA's 12/22/98 HPV policy in most instances.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Operator Training	94%	100%	97%	Control equipment operators complete a formal training program on use of the equipment, and such program is kept up to date and has been reviewed by the regulatory agency.			
	87%	93%	90%	Control equipment operators complete formal training program, and such program is kept up to date and available for review by the regulatory agency upon request.			
	81%	86%	84%	Control equipment operators complete some amount of formal training.			
	70%	80%	75%	Control equipment operators receive only on the job training .	4%	75%	3.00%
		< 70%	35%	Control equipment operators receive no specific training.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Media Publicity	94%	100%	97%	Media publicity of enforcement actions.	4%	97%	3.88%
	87%	93%	90%	Media publicity of enforcement actions.			
	81%	86%	84%	Media publicity of enforcement actions.			
	70%	80%	75%	Media publicity of enforcement actions.			
		< 70%	35%	No media publicity of enforcement actions.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Regulatory Workshops	94%	100%	97%	Regulatory workshops are available annually, and/or the implementing agency mails regulatory information packages each year.	4%	97%	3.88%
	87%	93%	90%	Regulatory workshop are available every 1-2 years, and/or the implementing agency mails regulatory information packages every 1-2 years.			
	81%	86%	84%	Regulatory workshop are available every 2-3 years, and/or the implementing agency mails regulatory information packages once every 2-3 years.			
	70%	80%	75%	Regulatory workshop not routinely available, but implementing agency mails regulatory information packages out about once every 2-3 years.			
		< 70%	35%	Regulatory workshops not routinely available. implementing agency mails regulatory information packages infrequently, if ever.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Inspector Training	94%	100%	97%	Inspectors must undergo 2 weeks of comprehensive basic training, and 1 to 2 weeks of source specific training, and such training is updated each year.			
	87%	93%	90%	Inspectors must undergo 1 to 2 weeks of basic training and 1 week of source specific training, and such training is updated every 1-2 years.	4%	90%	3.60%
	81%	86%	84%	Inspectors must undergo 1 to 2 weeks of basic training and 3 to 5 days of source specific training, and such training is updated every 1-2 years.			
	70%	80%	75%	Inspectors must undergo 1 to 2 weeks of basic training and 1 to 3 days of source specific training, and such training is updated every 1-2 years.			
		< 70%	35%	Inspectors must undergo less than 5 days of basic training less than 3 days of source specific training, and such training is updated only every 2 years or less frequently.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Testing Guidelines	94%	100%	97%	Specific guidelines and schedule for testing and test methods exist.	4%	97%	3.88%
	87%	93%	90%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	81%	86%	84%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	70%	80%	75%	Specific guidelines on testing and test methods, but no schedule for testing.			
		< 70%	35%	Only general guidance on testing, or no mention of testing requirements.			

Follow-up Inspections	94%	100%	97%	Follow-up inspections always or almost always done (90 % of the time or more).	4%	97%	3.88%
	87%	93%	90%	Follow-up inspections usually done (approximately 75% of the time).			
	81%	86%	84%	Follow-up inspections sometimes done (approximately 50% of the time).			
	70%	80%	75%	Follow-up inspections infrequently done (approximately 25% of the time).			
		< 70%	35%	Follow-up inspections rarely or never done (10% of the time or less)			
							87.95%

Appendix 5

MOBILE6.2 Inputs, Outputs, and Emission Factors

In order to calculate vehicle emission factors for the 2005 annual average day and peak ozone season, two MOBILE6.2 runs were performed for each month as follows: I/M program in place and 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 facility type are characterized by average speed and the roadway scenario in the input file. The MOBILE6.2 emission factors produced by the runs were subsequently weighted together using the appropriate proportions as described in Section 5.5 Emission Factor Estimation.

MOBILE6.2 Input

```
MOBILE6 INPUT FILE : RUN DATA
NO 2007 HDDV RULE  :
STAGE II REFUELING :
94 1 80.77 80.77 I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
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 CUTPNT05.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 REG DIST           : 02reg05.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032
0.0097 0.0162 0.0241 0.0510 0.0706
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0126 0.0126 0.0126 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
0.0126 0.0126 0.0126 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
0.1998 0.1998 0.1998 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
0.6774 0.6774 0.6774 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
0.8606 0.8606 0.8606 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
0.4647 0.4647 0.4647 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
0.6300 0.6300 0.6300 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
0.8563 0.8563 0.8563 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
0.9992 0.9992 0.9992 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
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 0.9585 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 ** Rural: Principal Arterial - Interstate
SCENARIO RECORD    : I/M Rural Principal Arterial - Interstate, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 58.0 Freeway
VMT BY FACILITY    : allfwy.def
FUEL PROGRAM       : 2 S ** Rural: Principal Arterial - Other
SCENARIO RECORD    : I/M Rural Principal Arterial - Other, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
```

```
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 29.4 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Rural: Minor Arterial
SCENARIO RECORD    : I/M Rural Minor Arterial, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 29.4 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Rural: Major Collector
SCENARIO RECORD    : I/M Rural Major Collector, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 26.9 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Rural: Minor Collector
SCENARIO RECORD    : I/M Rural Minor Collector, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 26.9 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Rural: Local
SCENARIO RECORD    : I/M Rural Local, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 12.9 Arterial
VMT BY FACILITY    : allloc.def
FUEL PROGRAM       : 2 S ** Urban: Principal Arterial - Interstate
SCENARIO RECORD    : I/M Urban Principal Arterial - Interstate, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 50.1 Freeway
VMT BY FACILITY    : allfwy.def
FUEL PROGRAM       : 2 S ** Urban: Freeways & Expressways
SCENARIO RECORD    : I/M Urban Freeways & Expressways, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 49.3 Freeway
VMT BY FACILITY    : allfwy.def
FUEL PROGRAM       : 2 S ** Urban: Principal Arterial - Other
SCENARIO RECORD    : I/M Urban Principal Arterial - Other, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 28.8 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Urban: Minor Arterial
SCENARIO RECORD    : I/M Urban Minor Arterial, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 28.8 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Urban: Collector
SCENARIO RECORD    : I/M Urban Collector, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 22.1 Arterial
VMT BY FACILITY    : allart.def
FUEL PROGRAM       : 2 S ** Urban: Local
SCENARIO RECORD    : I/M Urban Local, July 2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 79. 116.
FUEL RVP           : 7.0
AVERAGE SPEED      : 12.9 Arterial
VMT BY FACILITY    : allloc.def
FUEL PROGRAM       : 2 S END OF RUN
```

MOBILE6.2 Output

```
*****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                               *
* Input file: I507.IN (file 1, run 1).                                     *
*****************************************************************************
  M621 Comment:
                Results Reflect NO 2007 Heavy Duty Vehicle Emissions Reductions
  M601 Comment:
               User has enabled STAGE II REFUELING. * Reading non-default I/M CUTPOINTS from the following external
* data file: CUTPNT05.D                                                                           * Reading Registration Distributions
from the following external
* data file: 02REG05.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)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M614 Comment:
               User supplied diesel sale fractions.

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Rural Principal Arterial - Interstate (PM10), July 2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M582 Warning:
            The user supplied freeway average speed of 58.0
            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
*** 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:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4132	0.3281	0.1227		0.0357	0.0008	0.0021	0.0926	0.0048	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.832	0.953	1.133	1.002	0.910	0.597	0.662	0.329	4.23	0.881
Composite CO :	11.99	13.77	15.68	14.29	11.39	1.622	1.259	2.009	28.94	12.136
Composite NOX :	0.812	1.045	1.390	1.139	4.893	2.132	1.865	16.339	1.34	2.549

```
* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Rural Principal Arterial - Other (PM10), July 2005
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 29.4
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                      Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
```

```
            Fuel Sulfur Content:   90. ppm              Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  Yes
               Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV       MC   All Veh
              GVWR:              <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
  ------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.944     1.103     1.326     1.163     1.253     0.742     0.829     0.514      4.12     1.029
     Composite CO  :      8.22     10.04     11.62     10.47     10.66     1.735     1.349     2.351     20.89     8.820
     Composite NOX :      0.793     0.972     1.320     1.067     3.933     1.315     1.147     9.098      0.96     1.799
  ------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Rural Minor Arterial (PM10), July 2005
* File 1, Run 1, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
           The user supplied arterial average speed of 29.4
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
             there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
            Minimum Temperature:  79.0 (F)
            Maximum Temperature: 116.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:   90. ppm              Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  Yes
               Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV       MC   All Veh
              GVWR:              <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
  ------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.944     1.103     1.326     1.163     1.253     0.742     0.829     0.514      4.12     1.029
     Composite CO  :      8.22     10.04     11.62     10.47     10.66     1.735     1.349     2.351     20.89     8.820
     Composite NOX :      0.793     0.972     1.320     1.067     3.933     1.315     1.147     9.098      0.96     1.799
  ------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Rural Major Collector (PM10), July 2005
* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
           The user supplied arterial average speed of 26.9
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
             there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
            Minimum Temperature:  79.0 (F)
            Maximum Temperature: 116.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:   90. ppm              Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  Yes
               Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV       MC   All Veh
              GVWR:              <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
  ------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.968     1.129     1.360     1.192     1.332     0.773     0.866     0.554      4.21     1.059
     Composite CO  :      8.21     10.00     11.59     10.43     11.68     1.811     1.409     2.579     22.52     8.863
     Composite NOX :      0.817     0.993     1.347     1.090     3.857     1.341     1.170     9.282      0.94     1.834
  ------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Rural Minor Collector (PM10), July 2005
* File 1, Run 1, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
           The user supplied arterial average speed of 26.9
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
             there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
            Minimum Temperature:  79.0 (F)
            Maximum Temperature: 116.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:   90. ppm              Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  Yes
               Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
```

```
    HDDV       MC   All Veh
             GVWR:              <6000    >6000    (All)
                    ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:   0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 ------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.968     1.129     1.360     1.192     1.332     0.773     0.866     0.554      4.21     1.059
    Composite CO  :      8.21     10.00     11.59     10.43     11.68     1.811     1.409     2.579     22.52     8.863
    Composite NOX :     0.817     0.993     1.347     1.090     3.857     1.341     1.170     9.282      0.94     1.834
 ------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Rural Local (PM10), July 2005
* File 1, Run 1, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
            The user supplied arterial average speed of 12.9
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLLOC.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
    HDDV       MC   All Veh
             GVWR:              <6000    >6000    (All)
                    ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:   0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 ------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :     1.267     1.521     1.852     1.611     2.259     1.064     1.202     0.926      5.31     1.445
    Composite CO  :      9.50     10.99     12.97     11.53     24.59     2.698     2.114     5.247     42.02    10.696
    Composite NOX :     1.105     1.249     1.678     1.366     3.418     1.721     1.504    11.946      0.82     2.309
 ------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Urban Principal Arterial - Interstate (PM10), July 2005
* File 1, Run 1, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M582 Warning:
            The user supplied freeway average speed of 50.1
            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
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
    HDDV       MC   All Veh
             GVWR:              <6000    >6000    (All)
                    ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:   0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 ------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.854     0.981     1.171     1.032     0.944     0.608     0.674     0.343      3.76     0.904
    Composite CO  :     10.95     12.70     14.49     13.19      8.93     1.536     1.190     1.751     14.90    11.023
    Composite NOX :     0.793     1.013     1.356     1.106     4.614     1.608     1.405    12.672      1.14     2.174
 ------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Urban Freeways & Expressways (PM10), July 2005
* File 1, Run 1, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M582 Warning:
            The user supplied freeway average speed of 49.3
            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
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
    HDDV       MC   All Veh
             GVWR:              <6000    >6000    (All)
                    ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:   0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
```

```
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.857     0.984     1.176     1.036     0.949    0.610     0.677     0.345      3.76     0.907
     Composite CO  :     10.84     12.59     14.37     13.07      8.79     1.532     1.187     1.739     14.90    10.922
     Composite NOX :      0.791     1.010     1.353     1.103     4.586    1.572     1.373    12.416      1.12     2.147
 -------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Urban Principal Arterial - Other (PM10), July 2005
* File 1, Run 1, Scenario 9.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
            The user supplied arterial average speed of 28.8
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                           Month:  July
                        Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV        MC   All Veh
               GVWR:              <6000     >6000     (All)
                          ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.950     1.109     1.334     1.170     1.271    0.749     0.838     0.523      4.14     1.036
     Composite CO  :      8.22     10.03     11.61     10.46     10.89     1.752     1.362     2.402     21.25     8.830
     Composite NOX :      0.798     0.977     1.326     1.072     3.916    1.321     1.152     9.139      0.96     1.807
 -------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Urban Minor Arterial (PM10), July 2005
* File 1, Run 1, Scenario 10.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
            The user supplied arterial average speed of 28.8
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                           Month:  July
                        Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV        MC   All Veh
               GVWR:              <6000     >6000     (All)
                          ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.950     1.109     1.334     1.170     1.271    0.749     0.838     0.523      4.14     1.036
     Composite CO  :      8.22     10.03     11.61     10.46     10.89     1.752     1.362     2.402     21.25     8.830
     Composite NOX :      0.798     0.977     1.326     1.072     3.916    1.321     1.152     9.139      0.96     1.807
 -------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Urban Collector (PM10), July 2005
* File 1, Run 1, Scenario 11.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
            The user supplied arterial average speed of 22.1
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLART.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                       Calendar Year:  2005
                           Month:  July
                        Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm               Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV        MC   All Veh
               GVWR:              <6000     >6000     (All)
                          ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.033     1.201     1.451     1.269     1.537    0.848     0.952     0.649      4.44     1.138
     Composite CO  :      8.32     10.01     11.66     10.46     14.41     2.008     1.565     3.170     26.48     9.092
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    Composite NOX :      0.878     1.046     1.415     1.146     3.705    1.420     1.240     9.837      0.89     1.931
  -----------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Urban Local (PM10), July 2005
* File 1, Run 1, Scenario 12.
* # # # # # # # # # # # # # # # # # # # # # # # # #   M583 Warning:
            The user supplied arterial average speed of 12.9
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types. * Reading Hourly Roadway VMT distribution from the following
external
* data file: ALLLOC.DEF   Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b                      Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  79.0 (F)
              Maximum Temperature: 116.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm              Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  Yes
                 Reformulated Gas:  Yes       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT
     HDDV        MC   All Veh
             GVWR:             <6000     >6000     (All)
                    ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
  -----------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :      1.267     1.521     1.852     1.611     2.259    1.064     1.202     0.926      5.31     1.445
    Composite CO  :      9.50     10.99     12.97     11.53     24.59    2.698     2.114     5.247     42.02    10.696
    Composite NOX :      1.105     1.249     1.678     1.366     3.418    1.721     1.504    11.946      0.82     2.309
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MOBILE6.2 Emission Factors January 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.789	0.967	1.007	0.731	0.572	0.598	0.316	3.470
	CO	11.535	14.893	15.149	6.845	1.576	1.151	2.030	14.780
	NOX	0.755	1.065	1.289	5.114	2.108	1.813	16.003	1.780
Rural Principal Arterial - Other	VOC	0.919	1.119	1.169	1.045	0.714	0.759	0.495	3.360
	CO	8.970	12.003	12.153	6.410	1.690	1.239	2.375	10.930
	NOX	0.688	0.972	1.191	4.111	1.299	1.111	8.950	1.270
Rural Minor Arterial	VOC	0.919	1.119	1.169	1.045	0.714	0.759	0.495	3.360
	CO	8.970	12.003	12.153	6.410	1.690	1.239	2.375	10.930
	NOX	0.688	0.972	1.191	4.111	1.299	1.111	8.950	1.270
Rural Major Collector	VOC	0.945	1.145	1.197	1.116	0.744	0.794	0.533	3.450
	CO	9.014	12.047	12.216	7.026	1.766	1.299	2.605	11.710
	NOX	0.702	0.990	1.213	4.031	1.325	1.134	9.130	1.240
Rural Minor Collector	VOC	0.945	1.145	1.197	1.116	0.744	0.794	0.533	3.450
	CO	9.014	12.047	12.216	7.026	1.766	1.299	2.605	11.710
	NOX	0.702	0.990	1.213	4.031	1.325	1.134	9.130	1.240
Rural Local	VOC	1.314	1.590	1.668	1.995	1.030	1.118	0.891	4.460
	CO	10.305	13.539	13.931	14.781	2.653	1.990	5.301	21.040
	NOX	0.888	1.216	1.486	3.572	1.702	1.460	11.718	1.080
Urban Principal Arterial - Interstate	VOC	0.814	1.001	1.043	0.763	0.582	0.610	0.330	3.040
	CO	10.826	14.066	14.273	5.369	1.491	1.084	1.769	8.070
	NOX	0.727	1.028	1.250	4.823	1.590	1.363	12.441	1.520
Urban Freeway & Expressway	VOC	0.817	1.004	1.047	0.769	0.584	0.613	0.332	3.040
	CO	10.755	13.985	14.182	5.287	1.487	1.081	1.757	8.070
	NOX	0.724	1.025	1.246	4.793	1.553	1.332	12.192	1.490
Urban Principal Arterial - Other	VOC	0.925	1.125	1.176	1.061	0.721	0.767	0.503	3.380
	CO	8.980	12.005	12.173	6.551	1.707	1.253	2.426	11.110
	NOX	0.691	0.976	1.196	4.093	1.305	1.116	8.991	1.260
Urban Minor Arterial	VOC	0.925	1.125	1.176	1.061	0.721	0.767	0.503	3.380
	CO	8.980	12.005	12.173	6.551	1.707	1.253	2.426	11.110
	NOX	0.691	0.976	1.196	4.093	1.305	1.116	8.991	1.260
Urban Collector	VOC	1.012	1.217	1.275	1.296	0.818	0.877	0.625	3.660
	CO	9.194	12.248	12.458	8.664	1.963	1.452	3.202	13.610
	NOX	0.740	1.035	1.269	3.872	1.403	1.202	9.668	1.170
Urban Local	VOC	1.314	1.590	1.668	1.995	1.030	1.118	0.891	4.460
	CO	10.305	13.539	13.931	14.781	2.653	1.990	5.301	21.040
	NOX	0.888	1.216	1.486	3.572	1.702	1.460	11.718	1.080

February 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial – Interstate	VOC	0.733	0.907	0.953	0.662	0.572	0.598	0.316	2.900
	CO	11.226	14.753	14.929	6.763	1.576	1.151	2.030	14.210
	NOX	0.753	1.068	1.287	5.110	2.108	1.813	16.003	1.830
Rural Principal Arterial – Other	VOC	0.859	1.056	1.113	0.970	0.714	0.759	0.495	2.790
	CO	8.920	12.073	12.142	6.329	1.690	1.239	2.375	10.510
	NOX	0.674	0.969	1.184	4.108	1.299	1.111	8.950	1.300
Rural Minor Arterial	VOC	0.859	1.056	1.113	0.970	0.714	0.759	0.495	2.790
	CO	8.920	12.073	12.142	6.329	1.690	1.239	2.375	10.510
	NOX	0.674	0.969	1.184	4.108	1.299	1.111	8.950	1.300
Rural Major Collector	VOC	0.884	1.082	1.141	1.040	0.744	0.794	0.533	2.880
	CO	8.964	12.136	12.215	6.936	1.766	1.299	2.605	11.260
	NOX	0.688	0.987	1.205	4.028	1.325	1.134	9.130	1.270
Rural Minor Collector	VOC	0.884	1.082	1.141	1.040	0.744	0.794	0.533	2.880
	CO	8.964	12.136	12.215	6.936	1.766	1.299	2.605	11.260
	NOX	0.688	0.987	1.205	4.028	1.325	1.134	9.130	1.270
Rural Local	VOC	1.239	1.511	1.597	1.904	1.030	1.118	0.891	3.880
	CO	10.222	13.705	13.995	14.589	2.653	1.990	5.301	20.220
	NOX	0.854	1.206	1.469	3.570	1.702	1.460	11.718	1.110
Urban Principal Arterial – Interstate	VOC	0.759	0.941	0.989	0.694	0.582	0.610	0.330	2.470
	CO	10.587	13.986	14.112	5.298	1.491	1.084	1.769	7.760
	NOX	0.723	1.030	1.247	4.820	1.590	1.363	12.441	1.550
Urban Freeway & Expressway	VOC	0.762	0.945	0.993	0.699	0.584	0.613	0.332	2.470
	CO	10.526	13.906	14.031	5.216	1.487	1.081	1.757	7.760
	NOX	0.720	1.026	1.243	4.790	1.553	1.332	12.192	1.530
Urban Principal Arterial – Other	VOC	0.865	1.062	1.119	0.985	0.721	0.767	0.503	2.810
	CO	8.930	12.093	12.162	6.461	1.707	1.253	2.426	10.680
	NOX	0.677	0.973	1.189	4.090	1.305	1.116	8.991	1.290
Urban Minor Arterial	VOC	0.865	1.062	1.119	0.985	0.721	0.767	0.503	2.810
	CO	8.930	12.093	12.162	6.461	1.707	1.253	2.426	10.680
	NOX	0.677	0.973	1.189	4.090	1.305	1.116	8.991	1.290
Urban Collector	VOC	0.948	1.153	1.218	1.218	0.818	0.877	0.625	3.080
	CO	9.154	12.377	12.496	8.553	1.963	1.452	3.202	13.080
	NOX	0.721	1.031	1.259	3.870	1.403	1.202	9.668	1.200
Urban Local	VOC	1.239	1.511	1.597	1.904	1.030	1.118	0.891	3.880
	CO	10.222	13.705	13.995	14.589	2.653	1.990	5.301	20.220
	NOX	0.854	1.206	1.469	3.570	1.702	1.460	11.718	1.110

March 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial – Interstate	VOC	0.820	0.990	1.024	0.796	0.572	0.598	0.316	3.940
	CO	11.080	14.208	14.656	6.896	1.576	1.151	2.030	15.700
	NOX	0.736	1.040	1.269	5.079	2.108	1.813	16.003	1.700
Rural Principal Arterial – Other	VOC	0.971	1.152	1.195	1.130	0.714	0.759	0.495	3.830
	CO	8.436	11.271	11.610	6.451	1.690	1.239	2.375	11.540
	NOX	0.682	0.954	1.179	4.083	1.299	1.111	8.950	1.210
Rural Minor Arterial	VOC	0.971	1.152	1.195	1.130	0.714	0.759	0.495	3.830
	CO	8.436	11.271	11.610	6.451	1.690	1.239	2.375	11.540
	NOX	0.682	0.954	1.179	4.083	1.299	1.111	8.950	1.210
Rural Major Collector	VOC	0.998	1.179	1.224	1.202	0.744	0.794	0.533	3.920
	CO	8.470	11.305	11.645	7.076	1.766	1.299	2.605	12.390
	NOX	0.698	0.973	1.201	4.004	1.325	1.134	9.130	1.180
Rural Minor Collector	VOC	0.998	1.179	1.224	1.202	0.744	0.794	0.533	3.920
	CO	8.470	11.305	11.645	7.076	1.766	1.299	2.605	12.390
	NOX	0.698	0.973	1.201	4.004	1.325	1.134	9.130	1.180
Rural Local	VOC	1.416	1.638	1.708	2.125	1.030	1.118	0.891	4.940
	CO	9.734	12.678	13.251	14.883	2.653	1.990	5.301	22.450
	NOX	0.893	1.198	1.477	3.548	1.702	1.460	11.718	1.030
Urban Principal Arterial - Interstate	VOC	0.848	1.026	1.062	0.832	0.582	0.610	0.330	3.500
	CO	10.341	13.362	13.760	5.409	1.491	1.084	1.769	8.450
	NOX	0.712	1.006	1.232	4.791	1.590	1.363	12.441	1.450
Urban Freeway & Expressway	VOC	0.852	1.030	1.066	0.838	0.584	0.613	0.332	3.500
	CO	10.271	13.271	13.669	5.318	1.487	1.081	1.757	8.450
	NOX	0.709	1.002	1.229	4.761	1.553	1.332	12.192	1.420
Urban Principal Arterial - Other	VOC	0.977	1.158	1.202	1.146	0.721	0.767	0.503	3.850
	CO	8.446	11.281	11.620	6.592	1.707	1.253	2.426	11.730
	NOX	0.686	0.958	1.184	4.065	1.305	1.116	8.991	1.210
Urban Minor Arterial	VOC	0.977	1.158	1.202	1.146	0.721	0.767	0.503	3.850
	CO	8.446	11.281	11.620	6.592	1.707	1.253	2.426	11.730
	NOX	0.686	0.958	1.184	4.065	1.305	1.116	8.991	1.210
Urban Collector	VOC	1.071	1.255	1.305	1.388	0.818	0.877	0.625	4.130
	CO	8.631	11.466	11.856	8.725	1.963	1.452	3.202	14.430
	NOX	0.738	1.018	1.258	3.847	1.403	1.202	9.668	1.120
Urban Local	VOC	1.416	1.638	1.708	2.125	1.030	1.118	0.891	4.940
	CO	9.734	12.678	13.251	14.883	2.653	1.990	5.301	22.450
	NOX	0.893	1.198	1.477	3.548	1.702	1.460	11.718	1.030

April 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.804	0.950	1.145	0.839	0.597	0.662	0.329	4.100
	CO	10.820	13.688	15.930	10.713	1.622	1.259	2.009	21.370
	NOX	0.714	0.967	1.327	4.841	2.132	1.865	16.339	1.610
Rural Principal Arterial - Other	VOC	0.949	1.092	1.331	1.194	0.742	0.829	0.514	3.990
	CO	8.117	10.823	12.627	10.036	1.735	1.349	2.351	15.650
	NOX	0.671	0.890	1.243	3.891	1.315	1.147	9.098	1.150
Rural Minor Arterial	VOC	0.949	1.092	1.331	1.194	0.742	0.829	0.514	3.990
	CO	8.117	10.823	12.627	10.036	1.735	1.349	2.351	15.650
	NOX	0.671	0.890	1.243	3.891	1.315	1.147	9.098	1.150
Rural Major Collector	VOC	0.976	1.118	1.363	1.274	0.773	0.866	0.554	4.080
	CO	8.140	10.846	12.672	10.996	1.811	1.409	2.579	16.810
	NOX	0.688	0.907	1.267	3.816	1.341	1.170	9.282	1.130
Rural Minor Collector	VOC	0.976	1.118	1.363	1.274	0.773	0.866	0.554	4.080
	CO	8.140	10.846	12.672	10.996	1.811	1.409	2.579	16.810
	NOX	0.688	0.907	1.267	3.816	1.341	1.170	9.282	1.130
Rural Local	VOC	1.396	1.512	1.858	2.293	1.064	1.202	0.926	5.110
	CO	9.409	12.195	14.446	23.134	2.698	2.114	5.247	30.660
	NOX	0.892	1.124	1.558	3.382	1.721	1.504	11.946	0.980
Urban Principal Arterial - Interstate	VOC	0.830	0.980	1.186	0.873	0.608	0.674	0.343	3.660
	CO	10.061	12.861	14.954	8.399	1.536	1.190	1.751	11.390
	NOX	0.692	0.935	1.291	4.566	1.608	1.405	12.672	1.370
Urban Freeway & Expressway	VOC	0.833	0.983	1.190	0.879	0.610	0.677	0.345	3.660
	CO	9.990	12.771	14.854	8.267	1.532	1.187	1.739	11.390
	NOX	0.690	0.932	1.288	4.538	1.572	1.373	12.416	1.350
Urban Principal Arterial - Other	VOC	0.955	1.098	1.338	1.212	0.749	0.838	0.523	4.010
	CO	8.118	10.824	12.638	10.248	1.752	1.362	2.402	15.910
	NOX	0.675	0.894	1.248	3.874	1.321	1.152	9.139	1.150
Urban Minor Arterial	VOC	0.955	1.098	1.338	1.212	0.749	0.838	0.523	4.010
	CO	8.118	10.824	12.638	10.248	1.752	1.362	2.402	15.910
	NOX	0.675	0.894	1.248	3.874	1.321	1.152	9.139	1.150
Urban Collector	VOC	1.047	1.187	1.451	1.480	0.848	0.952	0.649	4.300
	CO	8.292	10.989	12.886	13.554	2.008	1.565	3.170	19.620
	NOX	0.730	0.951	1.326	3.666	1.420	1.240	9.837	1.070
Urban Local	VOC	1.396	1.512	1.858	2.293	1.064	1.202	0.926	5.110
	CO	9.409	12.195	14.446	23.134	2.698	2.114	5.247	30.660
	NOX	0.892	1.124	1.558	3.382	1.721	1.504	11.946	0.980

May 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	1.072	1.213	1.422	1.263	0.597	0.662	0.329	6.420
	CO	12.201	14.892	17.426	12.664	1.622	1.259	2.009	26.780
	NOX	0.738	0.986	1.349	4.785	2.132	1.865	16.339	1.480
Rural Principal Arterial - Other	VOC	1.358	1.429	1.691	1.781	0.742	0.829	0.514	6.310
	CO	8.859	11.546	13.595	11.856	1.735	1.349	2.351	19.470
	NOX	0.707	0.914	1.272	3.845	1.315	1.147	9.098	1.060
Rural Minor Arterial	VOC	1.358	1.429	1.691	1.781	0.742	0.829	0.514	6.310
	CO	8.859	11.546	13.595	11.856	1.735	1.349	2.351	19.470
	NOX	0.707	0.914	1.272	3.845	1.315	1.147	9.098	1.060
Rural Major Collector	VOC	1.407	1.466	1.736	1.887	0.773	0.866	0.554	6.400
	CO	8.883	11.551	13.621	12.988	1.811	1.409	2.579	20.950
	NOX	0.726	0.932	1.297	3.771	1.341	1.170	9.282	1.030
Rural Minor Collector	VOC	1.407	1.466	1.736	1.887	0.773	0.866	0.554	6.400
	CO	8.883	11.551	13.621	12.988	1.811	1.409	2.579	20.950
	NOX	0.726	0.932	1.297	3.771	1.341	1.170	9.282	1.030
Rural Local	VOC	2.274	2.069	2.463	3.390	1.064	1.202	0.926	7.460
	CO	10.394	13.014	15.569	27.331	2.698	2.114	5.247	38.640
	NOX	0.958	1.161	1.604	3.342	1.721	1.504	11.946	0.900
Urban Principal Arterial - Interstate	VOC	1.114	1.257	1.478	1.316	0.608	0.674	0.343	5.960
	CO	11.271	13.926	16.291	9.926	1.536	1.190	1.751	14.040
	NOX	0.718	0.955	1.314	4.513	1.608	1.405	12.672	1.260
Urban Freeway & Expressway	VOC	1.119	1.263	1.485	1.325	0.610	0.677	0.345	5.960
	CO	11.171	13.825	16.180	9.773	1.532	1.187	1.739	14.040
	NOX	0.716	0.952	1.311	4.485	1.572	1.373	12.416	1.240
Urban Principal Arterial - Other	VOC	1.369	1.437	1.702	1.804	0.749	0.838	0.523	6.330
	CO	8.869	11.548	13.606	12.109	1.752	1.362	2.402	19.800
	NOX	0.711	0.918	1.277	3.829	1.321	1.152	9.139	1.050
Urban Minor Arterial	VOC	1.369	1.437	1.702	1.804	0.749	0.838	0.523	6.330
	CO	8.869	11.548	13.606	12.109	1.752	1.362	2.402	19.800
	NOX	0.711	0.918	1.277	3.829	1.321	1.152	9.139	1.050
Urban Collector	VOC	1.527	1.563	1.857	2.151	0.848	0.952	0.649	6.620
	CO	9.054	11.684	13.826	16.021	2.008	1.565	3.170	24.550
	NOX	0.776	0.979	1.359	3.623	1.420	1.240	9.837	0.980
Urban Local	VOC	2.274	2.069	2.463	3.390	1.064	1.202	0.926	7.460
	CO	10.394	13.014	15.569	27.331	2.698	2.114	5.247	38.640
	NOX	0.958	1.161	1.604	3.342	1.721	1.504	11.946	0.900

June 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.830	0.954	1.135	0.905	0.597	0.662	0.329	4.300
	CO	11.818	13.727	15.623	11.100	1.622	1.259	2.009	26.700
	NOX	0.812	1.048	1.390	4.878	2.132	1.865	16.339	1.400
Rural Principal Arterial - Other	VOC	0.942	1.102	1.325	1.242	0.742	0.829	0.514	4.190
	CO	8.206	10.140	11.710	10.392	1.735	1.349	2.351	19.330
	NOX	0.785	0.972	1.316	3.920	1.315	1.147	9.098	1.000
Rural Minor Arterial	VOC	0.942	1.102	1.325	1.242	0.742	0.829	0.514	4.190
	CO	8.206	10.140	11.710	10.392	1.735	1.349	2.351	19.330
	NOX	0.785	0.972	1.316	3.920	1.315	1.147	9.098	1.000
Rural Major Collector	VOC	0.966	1.128	1.358	1.321	0.773	0.866	0.554	4.280
	CO	8.209	10.104	11.695	11.393	1.811	1.409	2.579	20.820
	NOX	0.809	0.993	1.342	3.845	1.341	1.170	9.282	0.980
Rural Minor Collector	VOC	0.966	1.128	1.358	1.321	0.773	0.866	0.554	4.280
	CO	8.209	10.104	11.695	11.393	1.811	1.409	2.579	20.820
	NOX	0.809	0.993	1.342	3.845	1.341	1.170	9.282	0.980
Rural Local	VOC	1.266	1.513	1.843	2.242	1.064	1.202	0.926	5.360
	CO	9.555	11.222	13.214	23.968	2.698	2.114	5.247	38.670
	NOX	1.085	1.244	1.668	3.407	1.721	1.504	11.946	0.850
Urban Principal Arterial - Interstate	VOC	0.852	0.982	1.172	0.937	0.608	0.674	0.343	3.840
	CO	10.813	12.694	14.470	8.704	1.536	1.190	1.751	13.850
	NOX	0.791	1.015	1.355	4.601	1.608	1.405	12.672	1.190
Urban Freeway & Expressway	VOC	0.855	0.986	1.177	0.943	0.610	0.677	0.345	3.840
	CO	10.712	12.584	14.360	8.572	1.532	1.187	1.739	13.850
	NOX	0.789	1.012	1.352	4.572	1.572	1.373	12.416	1.170
Urban Principal Arterial - Other	VOC	0.947	1.108	1.332	1.260	0.749	0.838	0.523	4.210
	CO	8.206	10.131	11.710	10.614	1.752	1.362	2.402	19.660
	NOX	0.791	0.977	1.322	3.903	1.321	1.152	9.139	0.990
Urban Minor Arterial	VOC	0.947	1.108	1.332	1.260	0.749	0.838	0.523	4.210
	CO	8.206	10.131	11.710	10.614	1.752	1.362	2.402	19.660
	NOX	0.791	0.977	1.322	3.903	1.321	1.152	9.139	0.990
Urban Collector	VOC	1.030	1.199	1.448	1.523	0.848	0.952	0.649	4.500
	CO	8.338	10.154	11.807	14.051	2.008	1.565	3.170	24.450
	NOX	0.867	1.045	1.409	3.694	1.420	1.240	9.837	0.930
Urban Local	VOC	1.266	1.513	1.843	2.242	1.064	1.202	0.926	5.360
	CO	9.555	11.222	13.214	23.968	2.698	2.114	5.247	38.670
	NOX	1.085	1.244	1.668	3.407	1.721	1.504	11.946	0.850

July 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.838	0.960	1.141	0.913	0.597	0.662	0.329	4.230
	CO	12.124	13.904	15.830	11.515	1.622	1.259	2.009	28.940
	NOX	0.821	1.054	1.399	4.896	2.132	1.865	16.339	1.340
Rural Principal Arterial - Other	VOC	0.952	1.113	1.336	1.258	0.742	0.829	0.514	4.120
	CO	8.343	10.169	11.769	10.778	1.735	1.349	2.351	20.890
	NOX	0.802	0.981	1.329	3.935	1.315	1.147	9.098	0.960
Rural Minor Arterial	VOC	0.952	1.113	1.336	1.258	0.742	0.829	0.514	4.120
	CO	8.343	10.169	11.769	10.778	1.735	1.349	2.351	20.890
	NOX	0.802	0.981	1.329	3.935	1.315	1.147	9.098	0.960
Rural Major Collector	VOC	0.977	1.139	1.371	1.338	0.773	0.866	0.554	4.210
	CO	8.337	10.133	11.744	11.809	1.811	1.409	2.579	22.520
	NOX	0.827	1.002	1.356	3.859	1.341	1.170	9.282	0.940
Rural Minor Collector	VOC	0.977	1.139	1.371	1.338	0.773	0.866	0.554	4.210
	CO	8.337	10.133	11.744	11.809	1.811	1.409	2.579	22.520
	NOX	0.827	1.002	1.356	3.859	1.341	1.170	9.282	0.940
Rural Local	VOC	1.280	1.536	1.867	2.272	1.064	1.202	0.926	5.310
	CO	9.695	11.192	13.206	24.860	2.698	2.114	5.247	42.020
	NOX	1.117	1.260	1.689	3.420	1.721	1.504	11.946	0.820
Urban Principal Arterial - Interstate	VOC	0.860	0.989	1.179	0.947	0.608	0.674	0.343	3.760
	CO	11.079	12.831	14.638	9.028	1.536	1.190	1.751	14.900
	NOX	0.802	1.022	1.365	4.617	1.608	1.405	12.672	1.140
Urban Freeway & Expressway	VOC	0.863	0.992	1.184	0.952	0.610	0.677	0.345	3.760
	CO	10.969	12.721	14.518	8.887	1.532	1.187	1.739	14.900
	NOX	0.800	1.019	1.362	4.589	1.572	1.373	12.416	1.120
Urban Principal Arterial - Other	VOC	0.958	1.119	1.344	1.276	0.749	0.838	0.523	4.140
	CO	8.343	10.160	11.760	11.010	1.752	1.362	2.402	21.250
	NOX	0.808	0.986	1.335	3.918	1.321	1.152	9.139	0.960
Urban Minor Arterial	VOC	0.958	1.119	1.344	1.276	0.749	0.838	0.523	4.140
	CO	8.343	10.160	11.760	11.010	1.752	1.362	2.402	21.250
	NOX	0.808	0.986	1.335	3.918	1.321	1.152	9.139	0.960
Urban Collector	VOC	1.042	1.212	1.463	1.544	0.848	0.952	0.649	4.440
	CO	8.456	10.154	11.826	14.569	2.008	1.565	3.170	26.480
	NOX	0.888	1.056	1.425	3.707	1.420	1.240	9.837	0.890
Urban Local	VOC	1.280	1.536	1.867	2.272	1.064	1.202	0.926	5.310
	CO	9.695	11.192	13.206	24.860	2.698	2.114	5.247	42.020
	NOX	1.117	1.260	1.689	3.420	1.721	1.504	11.946	0.820

August 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.822	0.945	1.126	0.890	0.597	0.662	0.329	4.180
	CO	11.806	13.696	15.593	11.038	1.622	1.259	2.009	26.320
	NOX	0.812	1.047	1.390	4.876	2.132	1.865	16.339	1.400
Rural Principal Arterial - Other	VOC	0.934	1.093	1.315	1.227	0.742	0.829	0.514	4.060
	CO	8.185	10.100	11.679	10.331	1.735	1.349	2.351	19.050
	NOX	0.786	0.972	1.316	3.919	1.315	1.147	9.098	1.000
Rural Minor Arterial	VOC	0.934	1.093	1.315	1.227	0.742	0.829	0.514	4.060
	CO	8.185	10.100	11.679	10.331	1.735	1.349	2.351	19.050
	NOX	0.786	0.972	1.316	3.919	1.315	1.147	9.098	1.000
Rural Major Collector	VOC	0.958	1.119	1.349	1.306	0.773	0.866	0.554	4.160
	CO	8.188	10.064	11.665	11.322	1.811	1.409	2.579	20.520
	NOX	0.810	0.992	1.342	3.843	1.341	1.170	9.282	0.980
Rural Minor Collector	VOC	0.958	1.119	1.349	1.306	0.773	0.866	0.554	4.160
	CO	8.188	10.064	11.665	11.322	1.811	1.409	2.579	20.520
	NOX	0.810	0.992	1.342	3.843	1.341	1.170	9.282	0.980
Rural Local	VOC	1.258	1.504	1.833	2.225	1.064	1.202	0.926	5.240
	CO	9.524	11.181	13.164	23.817	2.698	2.114	5.247	38.130
	NOX	1.087	1.245	1.668	3.406	1.721	1.504	11.946	0.860
Urban Principal Arterial - Interstate	VOC	0.843	0.973	1.163	0.923	0.608	0.674	0.343	3.710
	CO	10.792	12.663	14.440	8.653	1.536	1.190	1.751	13.640
	NOX	0.792	1.015	1.355	4.599	1.608	1.405	12.672	1.190
Urban Freeway & Expressway	VOC	0.847	0.977	1.168	0.928	0.610	0.677	0.345	3.710
	CO	10.692	12.553	14.330	8.512	1.532	1.187	1.739	13.640
	NOX	0.790	1.011	1.352	4.570	1.572	1.373	12.416	1.170
Urban Principal Arterial - Other	VOC	0.939	1.098	1.322	1.245	0.749	0.838	0.523	4.080
	CO	8.185	10.091	11.670	10.553	1.752	1.362	2.402	19.380
	NOX	0.791	0.977	1.322	3.902	1.321	1.152	9.139	1.000
Urban Minor Arterial	VOC	0.939	1.098	1.322	1.245	0.749	0.838	0.523	4.080
	CO	8.185	10.091	11.670	10.553	1.752	1.362	2.402	19.380
	NOX	0.791	0.977	1.322	3.902	1.321	1.152	9.139	1.000
Urban Collector	VOC	1.021	1.190	1.439	1.508	0.848	0.952	0.649	4.380
	CO	8.308	10.114	11.767	13.960	2.008	1.565	3.170	24.100
	NOX	0.868	1.045	1.409	3.692	1.420	1.240	9.837	0.930
Urban Local	VOC	1.258	1.504	1.833	2.225	1.064	1.202	0.926	5.240
	CO	9.524	11.181	13.164	23.817	2.698	2.114	5.247	38.130
	NOX	1.087	1.245	1.668	3.406	1.721	1.504	11.946	0.860

September 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.788	0.911	1.091	0.835	0.597	0.662	0.329	3.830
	CO	11.579	13.548	15.414	10.493	1.622	1.259	2.009	23.850
	NOX	0.805	1.041	1.381	4.871	2.132	1.865	16.339	1.450
Rural Principal Arterial - Other	VOC	0.898	1.055	1.276	1.165	0.742	0.829	0.514	3.720
	CO	8.086	10.050	11.590	9.825	1.735	1.349	2.351	17.290
	NOX	0.774	0.964	1.304	3.915	1.315	1.147	9.098	1.030
Rural Minor Arterial	VOC	0.898	1.055	1.276	1.165	0.742	0.829	0.514	3.720
	CO	8.086	10.050	11.590	9.825	1.735	1.349	2.351	17.290
	NOX	0.774	0.964	1.304	3.915	1.315	1.147	9.098	1.030
Rural Major Collector	VOC	0.922	1.080	1.309	1.242	0.773	0.866	0.554	3.820
	CO	8.089	10.024	11.585	10.765	1.811	1.409	2.579	18.620
	NOX	0.796	0.984	1.330	3.839	1.341	1.170	9.282	1.010
Rural Minor Collector	VOC	0.922	1.080	1.309	1.242	0.773	0.866	0.554	3.820
	CO	8.089	10.024	11.585	10.765	1.811	1.409	2.579	18.620
	NOX	0.796	0.984	1.330	3.839	1.341	1.170	9.282	1.010
Rural Local	VOC	1.221	1.456	1.783	2.150	1.064	1.202	0.926	4.880
	CO	9.423	11.169	13.122	22.652	2.698	2.114	5.247	34.510
	NOX	1.062	1.231	1.650	3.403	1.721	1.504	11.946	0.880
Urban Principal Arterial - Interstate	VOC	0.809	0.939	1.128	0.866	0.608	0.674	0.343	3.380
	CO	10.614	12.534	14.290	8.227	1.536	1.190	1.751	12.410
	NOX	0.783	1.008	1.346	4.594	1.608	1.405	12.672	1.230
Urban Freeway & Expressway	VOC	0.813	0.942	1.132	0.871	0.610	0.677	0.345	3.380
	CO	10.513	12.434	14.170	8.097	1.532	1.187	1.739	12.410
	NOX	0.781	1.004	1.342	4.566	1.572	1.373	12.416	1.210
Urban Principal Arterial - Other	VOC	0.903	1.061	1.283	1.182	0.749	0.838	0.523	3.740
	CO	8.087	10.041	11.590	10.037	1.752	1.362	2.402	17.590
	NOX	0.778	0.968	1.310	3.898	1.321	1.152	9.139	1.030
Urban Minor Arterial	VOC	0.903	1.061	1.283	1.182	0.749	0.838	0.523	3.740
	CO	8.087	10.041	11.590	10.037	1.752	1.362	2.402	17.590
	NOX	0.778	0.968	1.310	3.898	1.321	1.152	9.139	1.030
Urban Collector	VOC	0.984	1.149	1.397	1.441	0.848	0.952	0.649	4.040
	CO	8.219	10.084	11.707	13.272	2.008	1.565	3.170	21.850
	NOX	0.852	1.035	1.396	3.689	1.420	1.240	9.837	0.960
Urban Local	VOC	1.221	1.456	1.783	2.150	1.064	1.202	0.926	4.880
	CO	9.423	11.169	13.122	22.652	2.698	2.114	5.247	34.510
	NOX	1.062	1.231	1.650	3.403	1.721	1.504	11.946	0.880

October 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.820	0.939	1.127	0.895	0.599	0.668	0.335	4.560
	CO	10.007	12.154	14.512	9.161	1.623	1.278	2.021	19.850
	NOX	0.714	0.946	1.320	4.992	2.176	1.924	16.877	1.560
Rural Principal Arterial - Other	VOC	0.994	1.099	1.328	1.274	0.746	0.839	0.523	4.450
	CO	7.329	9.393	11.272	8.575	1.737	1.371	2.364	14.500
	NOX	0.678	0.873	1.240	4.013	1.342	1.182	9.374	1.120
Rural Minor Arterial	VOC	0.994	1.099	1.328	1.274	0.746	0.839	0.523	4.450
	CO	7.329	9.393	11.272	8.575	1.737	1.371	2.364	14.500
	NOX	0.678	0.873	1.240	4.013	1.342	1.182	9.374	1.120
Rural Major Collector	VOC	1.025	1.127	1.361	1.356	0.778	0.876	0.564	4.540
	CO	7.343	9.387	11.287	9.394	1.814	1.433	2.594	15.580
	NOX	0.696	0.891	1.264	3.936	1.368	1.206	9.564	1.090
Rural Minor Collector	VOC	1.025	1.127	1.361	1.356	0.778	0.876	0.564	4.540
	CO	7.343	9.387	11.287	9.394	1.814	1.433	2.594	15.580
	NOX	0.696	0.891	1.264	3.936	1.368	1.206	9.564	1.090
Rural Local	VOC	1.517	1.550	1.883	2.429	1.073	1.219	0.942	5.600
	CO	8.506	10.437	12.773	19.778	2.710	2.158	5.278	28.540
	NOX	0.910	1.106	1.561	3.487	1.757	1.551	12.302	0.950
Urban Principal Arterial - Interstate	VOC	0.849	0.973	1.170	0.933	0.610	0.681	0.349	4.110
	CO	9.260	11.360	13.558	7.180	1.536	1.207	1.761	10.520
	NOX	0.694	0.916	1.285	4.708	1.641	1.449	13.108	1.330
Urban Freeway & Expressway	VOC	0.853	0.977	1.174	0.939	0.612	0.683	0.352	4.110
	CO	9.180	11.279	13.458	7.068	1.532	1.204	1.749	10.520
	NOX	0.692	0.913	1.282	4.679	1.604	1.416	12.845	1.310
Urban Principal Arterial - Other	VOC	1.001	1.106	1.335	1.292	0.753	0.847	0.532	4.470
	CO	7.330	9.384	11.273	8.757	1.755	1.384	2.416	14.740
	NOX	0.682	0.877	1.245	3.996	1.348	1.188	9.417	1.110
Urban Minor Arterial	VOC	1.001	1.106	1.335	1.292	0.753	0.847	0.532	4.470
	CO	7.330	9.384	11.273	8.757	1.755	1.384	2.416	14.740
	NOX	0.682	0.877	1.245	3.996	1.348	1.188	9.417	1.110
Urban Collector	VOC	1.105	1.200	1.453	1.567	0.853	0.964	0.661	4.760
	CO	7.472	9.476	11.439	11.589	2.013	1.593	3.188	18.220
	NOX	0.741	0.934	1.325	3.780	1.449	1.278	10.134	1.030
Urban Local	VOC	1.517	1.550	1.883	2.429	1.073	1.219	0.942	5.600
	CO	8.506	10.437	12.773	19.778	2.710	2.158	5.278	28.540
	NOX	0.910	1.106	1.561	3.487	1.757	1.551	12.302	0.950

November 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.775	0.921	1.120	0.784	0.599	0.668	0.335	4.010
	CO	11.132	13.626	15.886	8.452	1.623	1.278	2.021	16.610
	NOX	0.730	0.976	1.355	5.039	2.176	1.924	16.877	1.730
Rural Principal Arterial - Other	VOC	0.901	1.053	1.291	1.113	0.746	0.839	0.523	3.900
	CO	8.580	10.902	12.701	7.907	1.737	1.371	2.364	12.280
	NOX	0.676	0.894	1.263	4.051	1.342	1.182	9.374	1.230
Rural Minor Arterial	VOC	0.901	1.053	1.291	1.113	0.746	0.839	0.523	3.900
	CO	8.580	10.902	12.701	7.907	1.737	1.371	2.364	12.280
	NOX	0.676	0.894	1.263	4.051	1.342	1.182	9.374	1.230
Rural Major Collector	VOC	0.925	1.076	1.320	1.189	0.778	0.876	0.564	3.990
	CO	8.604	10.925	12.746	8.665	1.814	1.433	2.594	13.160
	NOX	0.692	0.910	1.286	3.973	1.368	1.206	9.564	1.210
Rural Minor Collector	VOC	0.925	1.076	1.320	1.189	0.778	0.876	0.564	3.990
	CO	8.604	10.925	12.746	8.665	1.814	1.433	2.594	13.160
	NOX	0.692	0.910	1.286	3.973	1.368	1.206	9.564	1.210
Rural Local	VOC	1.280	1.441	1.780	2.136	1.073	1.219	0.942	5.030
	CO	9.825	12.193	14.469	18.238	2.710	2.158	5.278	23.630
	NOX	0.885	1.124	1.577	3.520	1.757	1.551	12.302	1.050
Urban Principal Arterial - Interstate	VOC	0.799	0.951	1.158	0.814	0.610	0.681	0.349	3.570
	CO	10.424	12.850	14.950	6.622	1.536	1.207	1.761	9.070
	NOX	0.706	0.943	1.317	4.752	1.641	1.449	13.108	1.470
Urban Freeway & Expressway	VOC	0.802	0.954	1.162	0.819	0.612	0.683	0.352	3.570
	CO	10.353	12.770	14.859	6.521	1.532	1.204	1.749	9.070
	NOX	0.703	0.940	1.313	4.723	1.604	1.416	12.845	1.450
Urban Principal Arterial - Other	VOC	0.906	1.058	1.297	1.130	0.753	0.847	0.532	3.920
	CO	8.581	10.912	12.703	8.078	1.755	1.384	2.416	12.480
	NOX	0.679	0.897	1.268	4.033	1.348	1.188	9.417	1.230
Urban Minor Arterial	VOC	0.906	1.058	1.297	1.130	0.753	0.847	0.532	3.920
	CO	8.581	10.912	12.703	8.078	1.755	1.384	2.416	12.480
	NOX	0.679	0.897	1.268	4.033	1.348	1.188	9.417	1.230
Urban Collector	VOC	0.988	1.140	1.401	1.385	0.853	0.964	0.661	4.210
	CO	8.764	11.075	12.969	10.696	2.013	1.593	3.188	15.290
	NOX	0.732	0.953	1.345	3.816	1.449	1.278	10.134	1.140
Urban Local	VOC	1.280	1.441	1.780	2.136	1.073	1.219	0.942	5.030
	CO	9.825	12.193	14.469	18.238	2.710	2.158	5.278	23.630
	NOX	0.885	1.124	1.577	3.520	1.757	1.551	12.302	1.050

December 2005 (Weighted by 91.6% of I/M and 8.4% of Non-I/M)

Facility Type	Pollutant	LDGV	LDGT 12	LDGT 34	HDGV	LDDV	LDDT	HDDV	MC
Rural Principal Arterial - Interstate	VOC	0.746	0.910	1.119	0.724	0.599	0.668	0.335	3.510
	CO	11.253	14.045	16.354	7.996	1.623	1.278	2.021	14.540
	NOX	0.723	0.980	1.368	5.019	2.176	1.924	16.877	1.850
Rural Principal Arterial - Other	VOC	0.869	1.044	1.293	1.050	0.746	0.839	0.523	3.400
	CO	8.958	11.517	13.338	7.481	1.737	1.371	2.364	10.850
	NOX	0.654	0.891	1.265	4.034	1.342	1.182	9.374	1.320
Rural Minor Arterial	VOC	0.869	1.044	1.293	1.050	0.746	0.839	0.523	3.400
	CO	8.958	11.517	13.338	7.481	1.737	1.371	2.364	10.850
	NOX	0.654	0.891	1.265	4.034	1.342	1.182	9.374	1.320
Rural Major Collector	VOC	0.894	1.068	1.324	1.128	0.778	0.876	0.564	3.490
	CO	9.001	11.570	13.413	8.198	1.814	1.433	2.594	11.600
	NOX	0.668	0.907	1.287	3.957	1.368	1.206	9.564	1.290
Rural Minor Collector	VOC	0.894	1.068	1.324	1.128	0.778	0.876	0.564	3.490
	CO	9.001	11.570	13.413	8.198	1.814	1.433	2.594	11.600
	NOX	0.668	0.907	1.287	3.957	1.368	1.206	9.564	1.290
Rural Local	VOC	1.236	1.457	1.811	2.072	1.073	1.219	0.942	4.510
	CO	10.222	12.986	15.303	17.265	2.710	2.158	5.278	20.550
	NOX	0.837	1.113	1.569	3.506	1.757	1.551	12.302	1.130
Urban Principal Arterial - Interstate	VOC	0.771	0.939	1.158	0.754	0.610	0.681	0.349	3.070
	CO	10.624	13.327	15.468	6.267	1.536	1.207	1.761	8.100
	NOX	0.696	0.946	1.327	4.733	1.641	1.449	13.108	1.580
Urban Freeway & Expressway	VOC	0.774	0.943	1.163	0.759	0.612	0.683	0.352	3.070
	CO	10.553	13.247	15.377	6.176	1.532	1.204	1.749	8.100
	NOX	0.693	0.942	1.323	4.704	1.604	1.416	12.845	1.550
Urban Principal Arterial - Other	VOC	0.875	1.049	1.301	1.068	0.753	0.847	0.532	3.420
	CO	8.969	11.528	13.359	7.642	1.755	1.384	2.416	11.020
	NOX	0.657	0.895	1.270	4.017	1.348	1.188	9.417	1.310
Urban Minor Arterial	VOC	0.875	1.049	1.301	1.068	0.753	0.847	0.532	3.420
	CO	8.969	11.528	13.359	7.642	1.755	1.384	2.416	11.020
	NOX	0.657	0.895	1.270	4.017	1.348	1.188	9.417	1.310
Urban Collector	VOC	0.955	1.132	1.407	1.324	0.853	0.964	0.661	3.700
	CO	9.181	11.771	13.696	10.118	2.013	1.593	3.188	13.420
	NOX	0.703	0.949	1.344	3.801	1.449	1.278	10.134	1.220
Urban Local	VOC	1.236	1.457	1.811	2.072	1.073	1.219	0.942	4.510
	CO	10.222	12.986	15.303	17.265	2.710	2.158	5.278	20.550
	NOX	0.837	1.113	1.569	3.506	1.757	1.551	12.302	1.130

APPENDIX A

EXHIBIT 2:

Technical Support Document for Ozone Modeling in Support of the Eight-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa Nonattainment Area

TECHNICAL SUPPORT DOCUMENT

FOR

OZONE MODELING IN SUPPORT OF THE EIGHT-HOUR OZONE REDESIGNATION REQUEST AND MAINTENANCE PLAN FOR THE MARICOPA NONATTAINMENT AREA

FEBRUARY 2009

Maricopa Association of Governments
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I. INTRODUCTION

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. 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 Maricopa 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 (MAG, 2004). 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 the Apache Junction portion of Pinal County, was designated as a nonattainment area for eight-hour ozone. The Maricopa Nonattainment Area (MNA) for the eight-hour ozone standard was classified as “Basic” under Part D, Subpart I, of the Clean Air Act, with an attainment date of June 15, 2009.

On June 15, 2007, MAG submitted the Eight-Hour Ozone Plan for the MNA (MAG, 2007) to EPA. The primary objective of the plan was to demonstrate 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 (Tesche, et. al., 1990). To satisfy this requirement, MAG demonstrated attainment of the eight-hour ozone standard during the 2008 ozone season in the plan.

Since the MNA has not exceeded the eight-hour ozone standard since 2004, the area has attained the eight-hour ozone standard. However, EPA has not yet redesignated the area as an attainment area for the eight-hour ozone standard, because EPA requires an eight-hour redesignation request and maintenance plan before redesignating an area to attainment.

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, maintenance and redesignation requests to EPA. A modeling protocol, in support of the eight-hour ozone redesignation request and maintenance plan for the Maricopa Nonattainment Area (MAG, 2008), was developed and submitted to EPA in May

2008. The modeling protocol (Appendix I-i) presented details of the technical approaches used to demonstrate maintenance of the eight-hour ozone standard in the Maricopa County area.

The primary purpose of an eight-hour ozone maintenance plan is to demonstrate maintenance of the eight-hour ozone standard for at least ten years after the area is officially redesignated to attainment by EPA. EPA has indicated that 18 months, as granted in section 107(d)(3)(D) of the Clean Air Act Amendments, should be the assumed length of time for EPA to approve a redesignation request (EPA, 1992). To be conservative, MAG has modeled the year 2025 to assure that the eight-hour ozone standard will be maintained for at least ten years after an official notice of redesignation to attainment by EPA.

I-2. Overview of Study

The main objective of the modeling analysis is to estimate the effects of growth and emission reduction strategies on future eight-hour ozone ambient levels in the MNA. The results of the modeling analysis are intended to provide a quantitative assessment of the potential for continued compliance with the eight-hour ozone standard. This Technical Support Document (TSD) describes the details and formal procedures for conducting all phases of modeling for the eight-hour ozone maintenance demonstration and summarizes the analyses of the eight-hour ozone concentrations for the MNA.

For eight-hour ozone maintenance modeling demonstrations, EPA's modeling guidance (EPA, 2007) describes the different characteristics of base case and baseline emission inventories: *"The base case inventory represents the emissions for the meteorology that is being modeled. These are the emissions that are used for model performance evaluations. Once the model has been shown to perform adequately, it is no longer necessary to model the base case emissions. Now it becomes important to model emissions corresponding to the period with a recent observed baseline design value. The base year inventory corresponds to the middle year of the baseline average design value (e.g., 2005 for a 2003-2007 average design value). This is called the baseline inventory. The baseline emission inventory is the emission inventory that is ultimately projected to a future year. However, modeling time periods need not be selected from the period corresponding to the baseline design value, provided they are representative of meteorological conditions which commonly occur when exceedances of the ozone standard occur."*

The 2005 baseline emission inventory was developed and projected to represent ozone precursor emissions in the maintenance year of 2025 with emission control measures in place. These emission control measures include all committed control measures from the Eight-Hour Ozone Plan and an additional measure (i.e., ban open burning) adopted in Arizona State Senate Bill 1552 on June 20, 2007. The modeling demonstration was performed using the 2005 and 2025 emission inventories. The resulting ozone concentrations were used to evaluate the impact of the emission changes under episode-specific meteorological conditions.

The Emissions Preprocessor System (EPS3.0) (ENVIRON, 2005) was used to process the eight-hour ozone emission inventory. The onroad mobile emissions were generated by EPA's MOBILE6.2 model (EPA, 2003) 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 (EPA, 2008) was used to generate nonroad emissions. Biogenic emissions were based on the Eight-Hour Ozone Plan and were derived using the Model of Emissions and Gases and Aerosols from Nature (MEGAN) (Guenther, 2006).

The air quality analyses of the baseline and future years in support of the Eight-Hour Ozone Maintenance Plan were based on computer simulations using the Comprehensive Air Quality Model with eXtensions Version 4.40 (CAMx) (ENVIRON, 2006). The meteorological inputs to CAMx were based on meteorological data generated for the high ozone episodes in the Eight-Hour Ozone Plan, using the Pennsylvania State University/National Center for Atmosphere Research (PSU/NCAR) Fifth Generation Mesoscale Model (MM5) (NCAR, 2005).

The air quality results from CAMx/MM5 were compared and confirmed with the results from other air quality and meteorological models, including the Community Multiscale Air Quality Modeling System (CMAQ) (CMAQ, 2008) and the Weather Research and Forecasting (WRF) Model (WRF, 2008). These comparisons are described in Appendix VI of this TSD.

The CAMx model performance was evaluated and attainment was demonstrated in the Eight-Hour Ozone Plan for three elevated ozone episodes: June 3-7, 2002, July 8-14, 2002, and August 5-11, 2001. The eight-hour ozone maintenance demonstration does not repeat the CAMx model performance evaluation, since the maintenance plan has adopted the same three high ozone periods and meteorological data for the episodes used in the Eight-Hour Ozone Plan. The results of the CAMx model performance evaluation are discussed in Section III. A more detailed discussion is provided in Appendix A, Exhibit 2 of the 2007 Eight Hour Ozone Plan.

The 2005 baseline design value at each monitoring site in the MNA was calculated as the average of the current design values for the following periods: 2003-2005, 2004-2006, and 2005-2007. The current design value for each period is defined as the three year average of the annual fourth highest daily maximum eight-hour ozone concentrations monitored at each site.

To demonstrate maintenance of the eight-hour ozone standard in the future year 2025, the future design values near each monitor must be less than 85 ppb. The future design value is computed by multiplying a relative response factor (RRF) by a site-specific 2005 baseline design value. The RRF is the ratio of the mean of the eight-hour ozone daily maximum future year model predictions to the mean of the eight-hour ozone daily maximum baseline model predictions over all primary episode days.

As recommended in EPA guidance, MAG used 49 grid cells (an array of 7 x 7 grid cells with the monitor located in the center grid) near each monitoring site to demonstrate maintenance. The eight-hour ozone daily maximum model prediction for the 49 grid cells near a monitoring site was derived for each day in the episode period (except spin-up days). These site-specific daily maximum values were averaged for the days in each episode to obtain the future year and baseline model predictions used to calculate the RRFs. The RRF was then multiplied by the baseline design value in 2005 for each monitoring site to derive the 2025 future design value.

The CAMx/MM5 modeling results were confirmed by comparison with the modeling results from other air quality and meteorology model combinations (i.e., CMAQ/MM5, CAMx/WRF, and CMAQ/WRF). These results were used in the supplemental and corroboratory analyses.

In summary, the maintenance modeling analysis consisted of the following tasks:

(1) Preparation of a modeling protocol.

(2) Preparation of day-specific baseline and future year emission inventories.

(3) Preparation of site-specific baseline design values for use in the maintenance test.

(4) Completion of the maintenance demonstration.

(5) Completion of the supplemental and corroboratory analysis.

(6) Completion of the Technical Support Document (this document).

Unless otherwise noted, all hour-long time periods mentioned in this document are referred to by the start time of a one hour period (e.g. "@ 1200 LST" means hour beginning at 1200 Local Standard Time).

I-3. Data Access Procedure

All modeling data files are saved to a DVD data disk. A comprehensive list of the computer files used for the air quality modeling in support of the Eight-hour Ozone Maintenance Plan is contained in Appendix I-ii. This comprehensive file list is not generally presented in the order in which the named files were used in the modeling. Rather, the comprehensive list is ordered alphabetically by subdirectory name.

For clarity, the job file list indicates the names of the job control files which were used to run each program. A job control file is the batch file used to run a particular air quality model or program for a particular day or scenario. Note: Some air quality models were not run by job files (i.e., MOBILE6.2) and, therefore, no job files are listed. Also, some air quality models have very simple job files (i.e., M6Link) whose purpose is to call a larger control file. All input and output files are also organized on the DVD data disk by program or model in separate subdirectories.

As previously mentioned, files have been placed in the DVD directory structure by either model or program. It is important to note that the DVD directory structure is not identical to the directory structure used on MAG's computers for modeling. As a result, although job files will call the correctly named input and output files when a job file is run, these input and output files will not be automatically found on the DVD disk, since they are stored in different directories than the directories on MAG's computers. Thus, it may be necessary to edit job files or move input files on the DVD disk to reproduce MAG's modeling results. To access the DVD data disk, please contact Taejoo Shin by email (tshin@mag.maricopa.gov) or by phone (602-254-6300).

I-4. Structure of the Document

Section II of this Technical Support Document describes the selection of the modeling domain and episodes used in the eight-hour ozone modeling. Section III summarizes the base case input preparation and model performance evaluation for the historical ozone episodes, which were conducted for the eight-hour ozone attainment demonstration. Section IV illustrates the baseline and future year input preparation, and emission control measures. Section V presents the CAMx modeling and maintenance test results for monitored and unmonitored areas. Section VI provides supplemental analyses to corroborate the CAMx modeling results for the maintenance test. Section VII provides the conclusions of this maintenance demonstration. Each appendix is numbered so that it will be consistent with the section that refers to that appendix.

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II. MODELING DOMAIN AND OZONE EPISODE SELECTION

II-1. Modeling Domain

Selection of the modeling domain took into account the eight-hour ozone nonattainment area boundaries, the distribution of major emissions sources, the locations of the meteorological and air quality monitoring sites, and the regional ozone transport patterns in the vicinity of the MNA. Table II-1 illustrates the nested modeling domains that were selected for the MM5 and CAMx modeling as suggested by ENVIRON (Emery, et. al., 2005). These modeling domains were also used in the modeling for the Eight-Hour Ozone Plan (MAG, 2007).

The MM5 Lambert Conformal Projection (LCP) mapping definition was selected to align the LCP central longitude along the central longitude of UTM Zone 12 (111˚W). The LCP mapping definition was used, since the CAMx modeling and the emission inventories were mapped to the UTM coordinate system. The conic true latitudes were set at 45˚ N and 33˚ N, which minimizes mapping distortion relative to the UTM coordinates in the vicinity of Maricopa County.

The MM5 meteorological model utilizes a full 36/12/4 km nested grid system that corresponds to the CAMx modeling domains for these three grid resolutions. The use of multiple grid nests in the MM5 modeling was necessary to provide superior boundary conditions for the finer grids over the area of interest. The CAMx simulation was run using the 12 km and 4 km domains. The CAMx inner 4 km modeling domain encompasses the entire MNA, which has an area of approximately 9,000 square miles. The outer boundaries of the CAMx modeling domain were slightly inset by several grid cells from the corresponding boundaries of the MM5 modeling domains in order to remove potential boundary "noise" near the MM5 boundaries.

Table II-1. MM5 and CAMx modeling domains

MM5 Modeling Domains		
Grid Resolution	**Grid Size**	**LCP Range (km)**
36 km grid	64 by 49	(-1134, -864) to (1134, 864)
12 km grid	118 by 91	(-810, -612) to (594, 468)
4 km grid	61 by 40	(-234, -132) to (6, 24)
CAMx Modeling Domains		
Grid Resolution	**Grid Size**	**UTM Range (km)**
12 km grid	111 by 84	(-275, 3188) to (1057, 4196)
4 km grid	50 by 29	(297, 3652) to (497, 3768)

A map of the MM5/CAMx modeling domains is presented in Figure II-1. The shaded area represents the EPA-designated nonattainment area for eight-hour ozone. The major emission sources contributing to eight-hour ozone levels are located in the nonattainment area. The grid spacing of the 4-km modeling domain should allow for sufficient resolution of the major emissions sources located in the MNA.

Extensive networks of meteorological and air quality monitoring sites are also located in the MNA. An evaluation of the 36-hour back-trajectory air flow patterns in the modeling domains indicates that the outer 12-km modeling domain is of sufficient size for the CAMx air quality simulations to capture regional transport of ozone for the selected episodes (MAG, 2007).

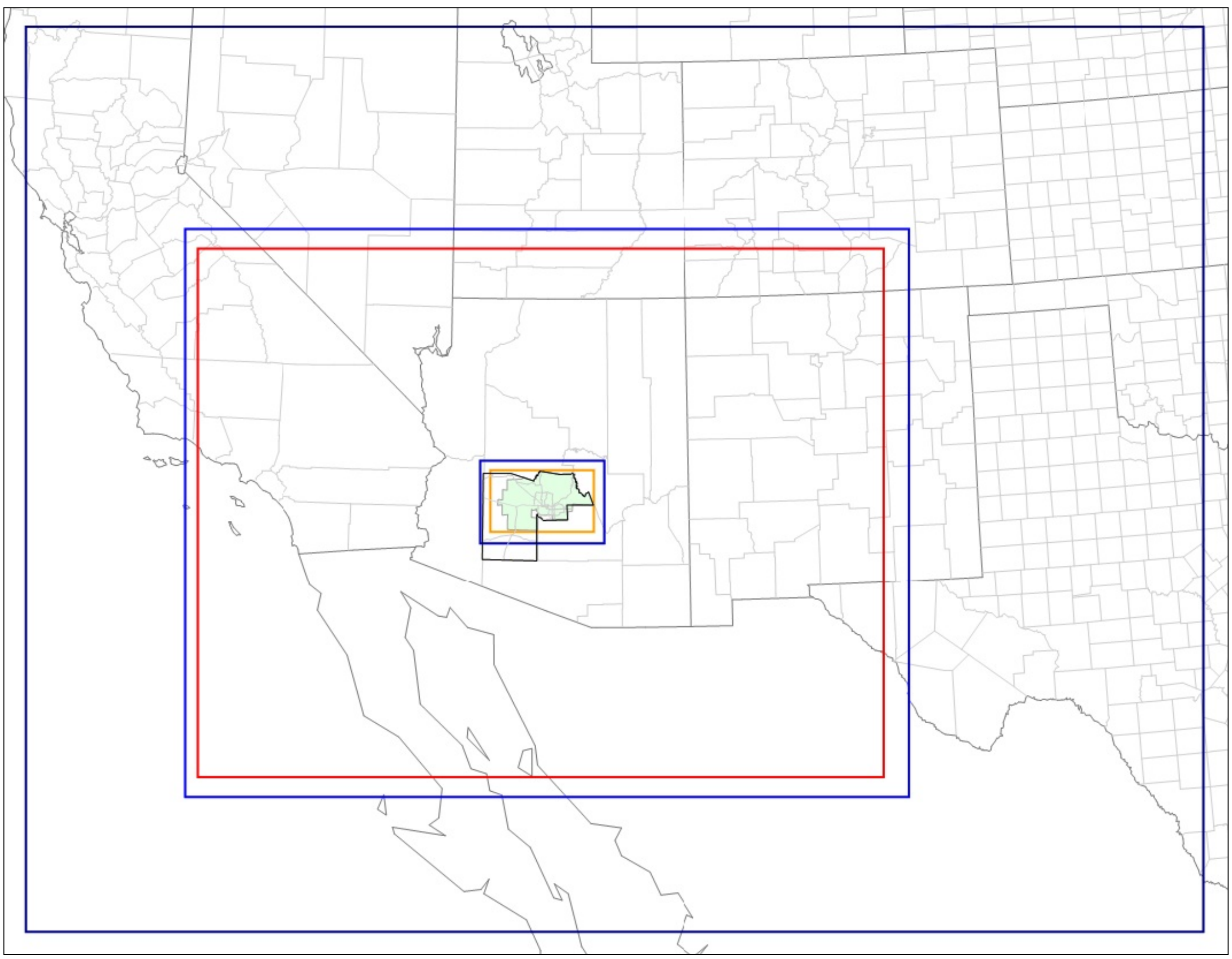

Figure II-1. Eight-hour ozone modeling domains (red: 12 km and orange: 4 km) and meteorological modeling domains (blue: 36 / 12 / 4 km)

II-2. Vertical Layer Structure

Table II-2 presents the MM5 and CAMx vertical layer structures, which are based on the WRAP CMAQ/CAMx regional modeling configuration. The MM5 vertical layer structure is defined on a normalized terrain-following pressure coordinate system ("sigma-p"), which has a value of 1 at ground level and a value of 0 at the top layer. There are 34 layers in the MM5 model, with 20 layers distributed below about 2,500 meters. Such a layer structure facilitates the development of regional boundary conditions. The approximate pressure, height, and thickness values at the layer interfaces are calculated for CAMx by using U.S. Standard Atmosphere parameters: (1) Sea level pressure of 1,013 Mb, (2) Temperature of 288 K, and (3) Lapse rate of 50 (d(T)/d(lnP)). The yellow highlighted cells in Table II-2 indicate the additional layers that were used in the CAMx modeling.

The CAMx layers are defined as a subset of the MM5 layers, since the CAMx layers are allowed to span several MM5 layers. Fifteen layers are distributed below about 2,500 meters for both the 12-km and 4-km domains of the CAMx model. There are also three additional layers between about 2,500 meters and 5,000 meters in the CAMx 4-km modeling domain, which improves the performance of the ozone simulation for the selected episodes. This vertical structure exceeds the minimum standards recommended by EPA guidance (EPA, 2007).

II-3. Ozone Episode Selection

This modeling study employed the same ozone episodes that were used in the Eight-Hour Ozone Plan (MAG, 2007). The procedure and rationale for the ozone episode selection are briefly discussed in the following sections. See Appendix II, "Review of Eight-Hour Ozone Episodes," of the Eight-Hour Ozone Plan for a detailed discussion of the ozone episode selection process.

II-3-1. Episode Selection Methodology

MAG followed EPA guidance (EPA, 2005) which suggests that four primary criteria and several secondary criteria be used in the selection of ozone episodes. A large amount of effort was expended to identify the different meteorological conditions that frequently correspond to observed eight-hour daily maxima above 84 ppb at multiple monitoring sites. In addition, the conditions associated with the annual fourth high ozone concentration of each episode were carefully evaluated. Each selected episode was based on multiple days. The EPA criteria that extensive air quality/meteorological databases be used for ozone modeling was not applicable for this modeling study, since only routine monitoring data were available for the six candidate episodes in the years 2000 -2004.

The following steps were used to select the ozone episodes:

Table II-2. MM5 and CAMx vertical layer configuration

MM5		CAMx							
		12 km Modeling Domain				4 km Modeling Domain			
Layer Index	Sigma-p	Layer Index	Pressure (mb)	Height (m)	Thickness (m)	Layer Index	Pressure (mb)	Height (m)	Thickness (m)
34	0.000	20	100	15604	2000	23	100	15604	2000
33	0.050	19	146	13604	5029	22	146	13604	5029
32	0.100								
31	0.150								
30	0.200								
29	0.250	18	328	8575	3144	21	328	8575	3144
28	0.300								
27	0.350								
26	0.400								
25	0.450	17	511	5431	1806	20	511	5431	641
24	0.500					19	557	4789	600
23	0.550					18	602	4189	565
22	0.600	16	648	3625	1038	17	648	3625	533
21	0.650					16	693	3091	505
20	0.700	15	739	2586	666	15	739	2586	666
19	0.740								
18	0.770	14	803	1920	450	14	803	1920	450
17	0.800								
16	0.820	13	849	1470	346	13	849	1470	346
15	0.840								
14	0.860	12	885	1124	168	12	885	1124	168
13	0.880	11	903	956	166	11	903	956	166
12	0.900	10	922	790	163	10	922	790	163
11	0.910								
10	0.920	9	940	627	160	9	940	627	160
9	0.930								
8	0.940	8	958	466	79	8	958	466	79
7	0.950	7	967	387	79	7	967	387	79
6	0.960	6	976	309	78	6	976	309	78
5	0.970	5	986	231	77	5	986	231	77
4	0.980	4	995	153	39	4	995	153	39
3	0.985	3	999	115	38	3	999	115	38
2	0.990	2	1004	76	38	2	1004	76	38
1	0.995	1	1008	38	38	1	1008	38	38
	1.000	**Surface**	**1013**	**0**		**Surface**	**1013**	**0**	

* Highlighted area indicates additional layers.

1. Tabulate all days in years 2000 to 2004 that had eight-hour ozone concentrations of 80 ppb or higher for every ozone monitor in the MNA.

2 Identify the candidate episodes in which exceedances of the eight-hour ozone standard occurred at multiple sites for several consecutive days in the MNA.

3 Examine the meteorological conditions associated with each episode.

4 Do a backward trajectory analysis, using the HYSPLIT model, to reveal the characteristics of each ozone episodes (i.e., local ozone production versus ozone transport).

5 Select the most appropriate ozone episodes for modeling based on those episodes that satisfy the EPA episode selection criteria.

There are twenty-seven ozone monitors located within the eight-hour ozone nonattainment area. Twenty-two monitors are operated by Maricopa County Air Quality Department (MCAQD), one monitor is operated by Pinal County Air Quality Department (PCAQD), and four monitors are operated by Arizona Department of Environmental Quality (ADEQ). Fourteen monitors had complete data sets for the years 2000 - 2004.

Hourly ozone data for these sites were obtained from the AIRS/AQS database. MAG air quality modeling staff has developed web applications to calculate the following parameters from hourly ozone data downloaded from the AIRS/AQS website: (1) Eight-hour forward running averages (i.e., storing the average in the start hour of the eight-hour period), (2) Daily maximum eight-hour ozone values, (3) Annual fourth highest eight-hour ozone values, and (4) Eight-hour ozone design values. These web applications improve the accuracy of calculations and reduce data processing times dramatically compared to conventional calculation methods using Excel spreadsheets. The results from these web applications have been verified with AIRS/AQS reports.

II-3-2. Candidate Ozone Episodes

Six candidate ozone episodes were selected based on those daily maximum eight-hour ozone concentrations in the modeling domain that were equal to or higher than 85 ppb for at least three consecutive days. These episodes are:

- July 30 - August 5, 2000
- August 9 -16, 2000
- August 5 -11, 2001
- June 3 - 7, 2002
- July 8 - 14, 2002
- July 21 - 23, 2003

It should be noted that July 9th in the July 2002 episode recorded the highest eight-hour ozone concentration of 107 ppb at the Maryvale (MV) monitoring site. The July 2002 episode also had five consecutive days with at least one site having eight-hour ozone concentrations of 85 ppb or more.

The candidate episode for the fourth highest eight-hour ozone concentration was selected by tabulating the monitoring sites that had the fourth highest eight-hour ozone value for each episode day. The June 2002 episode was found to have the greatest number of sites (i.e., nine sites) that recorded fourth highest eight-hour ozone values in a year. An analysis of the episode average maximum eight-hour ozone concentrations versus the design values produced similar results: the June 2002 episode had the largest number of sites that recorded fourth highest eight-hour ozone values in a year.

II-3-3. Meteorological Conditions Associated with Ozone Episodes

The meteorological conditions of the ozone episodes were assessed through review of the Arizona Meteorological Network (AHMET) data, especially the data from the Phoenix Encanto site (ENCA, 33.47 N and 112.09 W). This site is located approximately at the center of the 4-km CAMx modeling domain. HYSPLIT modeling results were used to evaluate the impact of local ozone production versus long-range transport for each episode.

There are two meteorological features that the ozone episodes had in common: (1) Daily maximum temperatures that are generally higher than 105 ˚F, and (2) Surface winds that follow a very consistent diurnal pattern - easterly winds in the morning and westerly winds in the afternoon. This wind pattern is most likely driven by the topography of the basin, where elevated mountainous terrain lies to the north and east, and the valley floor lies along the south and west sides of the basin.

The different meteorological regimes for each ozone episode were identified by assigning the episode days into one of nine bins, which included wind direction data from eight compass directions plus calm (wind speed less than 1.5 m/s, regardless of the wind direction). The assignments of the episode days were based on measurements of surface winds from 7 am - 10 am. The analysis showed that calm wind is the dominant wind parameter among the nine bins, with easterly winds being the second dominant wind parameter. Thus, calm and easterly winds were classified as the primary wind directions (PWD) for the ozone episode days. The remaining seven bins were grouped into “other”.

II-3-4. Selected Ozone Episodes

After reviewing the meteorological conditions associated with each candidate ozone episode, three episodes were selected for modeling:

1. June 3 - 7, 2002 (easterly wind)
2. July 8 - 14, 2002 (calm)
3. August 5 - 11, 2001 (other)

All three selected episodes had one or two days ranked in the top three of each meteorological regime. For modeling purposes, three additional days were added to the beginning of each episode as model ramp-up periods to reduce the air quality model's sensitivity to initial conditions. Thus, the days used in the final simulated ozone episodes are:

1. May 31 - June 7, 2002
2. July 5 - 14, 2002
3. August 2 - 11, 2001

The June 2002 episode was selected, because it had the largest number of sites with the fourth highest eight-hour ozone concentration occurring during an episode. The HYSPLIT back trajectory analysis indicated that long range transport played an important role in the high ozone levels for this episode. The July 2002 episode, which recorded the highest eight-hour ozone concentration of 107 ppb from 2000 to 2004, represents the worst case conditions. The HYSPLIT back trajectory indicated that the high ozone levels recorded in the July 2002 episode were primarily due to local production. The August 2001 ozone episode was selected to evaluate the role of local ozone production versus transported ozone in contributing to high eight-hour ozone concentrations. These three episodes were modeled to provide confirmation of the ability of the CAMx model to simulate the physical and chemical processes leading to high ozone levels under different meteorological conditions in the MNA.

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III. MODEL PERFORMANCE EVALUATION

Before a photochemical air quality grid model can be used to assess the maintenance of the eight-hour ozone standard, it must be demonstrated that the model adequately replicates historical ozone episodes. This process requires a careful and comprehensive evaluation of a model's performance. Since the Comprehensive Air Quality Model with eXtensions (CAMx) model performance was comprehensively evaluated in the Eight-Hour Ozone Plan, this section summarizes the CAMx performance evaluation including the base case input preparations and modeling results. Detailed information on the CAMx model performance evaluation is presented in Sections III and IV of the TSD for the Eight-Hour Ozone Plan.

Traditionally, due to limited resources, the performance evaluation for one-hour ozone modeling applications was based only on the statistical criteria, such as bias, error, and accuracy. However, the U.S. Environmental Protection Agency (EPA) modified their policy on performance evaluations for eight-hour ozone attainment or maintenance demonstrations to include overall model performance with additional qualitative procedures, rather than rigidly applying the three statistical criteria for model acceptance or rejection. As recommended in EPA Guidance (EPA, 2007), the model performance evaluation in the Eight-Hour Ozone Plan was conducted using operational and diagnostic evaluation methodologies. The operational evaluation methodology evaluates a model's ability to replicate observed concentrations while the diagnostic evaluation methodology addresses the model's accuracy in characterizing the sensitivity of ozone to emissions changes. MAG applied both methodologies in evaluating the CAMx model performance for the three eight-hour ozone episodes.

III-1. Base Case CAMx Input Preparation for Model Performance Evaluation

MAG, in coordination with the EPA, Arizona Department of Environmental Quality (ADEQ), Arizona Department of Transportation (ADOT), and Maricopa County Air Quality Department (MCAQD), has elected to apply the CAMx model (Version 4.40), a three-dimensional photochemical grid model, to the MNA for modeling eight-hour ozone levels. The inner ozone modeling domain (4 km) is larger than the MNA, consisting of both urbanized and undeveloped portions of Maricopa County, as well as portions of Gila, Pinal, and Yavapai Counties.

The CAMx inputs include day-specific emission inventories for carbon monoxide (CO), oxides of nitrogen (NOx), and volatile organic compounds (VOCs); meteorological and air quality data for the high ozone episodes; and other data such as gridded land use information for the modeling domain and chemistry parameters. The base case inputs were prepared in accordance with the general guidelines established by the EPA for the regulatory application of eight-hour ozone models (EPA, 2007) as outlined in the modeling protocol which is included in Appendix I-i.

III-1-1. Emission Inventory

The eight-hour ozone precursor emission inventory consists of emissions from stationary point, area, onroad, nonroad, and biogenic sources. The Emissions Preprocessor System (EPS3.0) (ENVIRON, 2005) was used to develop the emission inventory. The emissions were temporally and chemically adjusted, and spatially allocated to the appropriate grid cells using EPS3.0. Point and area source emission data were provided by MCAQD (MCAQD, 2004). The area source emissions for 2001 were backcasted from 2002 to represent the episode days in 2001.

The emission factors used to develop the biogenic emission inventory were based on a field study that identified prevalent plant species in Maricopa County (ENVIRON, 2006a). The onroad emissions were generated by the EPA MOBILE6.2 model and M6Link, based on traffic assignment data for the Maricopa region. M6Link is a MAG software program applied at the transportation link level to generate gridded onroad mobile source emissions. All emissions by source type were merged by EPS3.0 to provide inputs to the CAMx model.

CAMx day-specific emission input files were developed for the August 2-11, 2001, May 31-June 7, 2002, and July 5-14, 2002 episodes. The emission inventory reflects control measures and conditions in effect at that time.

III-1-1-1. Onroad Mobile Emissions

The first step in developing onroad mobile source emissions is to estimate emission factors for onroad source. A very large array of onroad emission factors is required by the M6Link model to produce a complete onroad emission inventory. These factors, in unit of grams per mile, are multiplied by vehicle miles traveled (VMT) in each grid cell of the modeling domain to produce the grid-level onroad emission estimates. These emission factors are specific to the vehicle type or vehicle age, hour of the day, and facility type the vehicle is driving on. The emission factors are also influenced by several other parameters including fuel formulation, scenario specific conditions (e.g., speeds, temperatures), and vehicle fleet characteristics.

MOBILE6.2

EPA developed the MOBILE6.2 model (EPA, 2003) for estimating motor vehicle emission factors. The MOBILE6.2 inputs used in the modeling performance evaluation are generally consistent with the 2002 Periodic Emission Inventory for ozone, although changes have been made when better information became available or when necessary due to the use of the latest version of the MOBILE model. For example, the MOBILE6.2 model simulates the impact of the sulfur content of gasoline, whereas the MOBILE5a model, the earlier version of MOBILE6.2, does not simulate the impact of sulfur content.

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 location in the modeling domain -

Area A and “Outside Area A”. For the 2001 and 2002 base cases, the Area A boundaries are defined by S.B. 1427, not the expanded boundaries mandated in 2001 by H.B. 2538. Most vehicles registered in Area A are required to pass an Inspection and Maintenance (I/M) test either annually or every two years, while vehicles registered Outside of Area A are not required to pass an I/M test. Evaluation of emissions from vehicles operating in Area A requires the weighting of two MOBILE6.2 modeling runs: an 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 Area A.

Fuel emission control measures, including the Stage II Vapor Recovery Program, were assumed in the MOBILE6.2 modeling of Area A. However, emission control measures assumed for Area A (e.g., Vapor Recovery, I/M, and Reformulated Fuels) were not applied outside of Area A. The 2007 Heavy Duty Diesel Vehicle Emission Reduction Rule was also removed from the MOBILE6.2 modeling of both Area A and outside Area A, because this rule was utilized as a contingency measure in the eight-hour ozone attainment demonstration.

The MOBILE6.2 model was run separately for each of five area types: central business district, urban, urban fringe, suburban, and rural. These area types were modeled separately in order to take into account the different speed patterns on the roadways in these different area types. Additionally, local data such as details of the I/M program, vehicle registration data, fractions of the diesel powered vehicle fleet, episode specific temperatures, and gasoline properties are included in the data input to MOBILE6.2. See Table III-1 for the assumptions used in the MOBILE6.2 modeling.

The output from MOBILE6.2 includes hourly emission factors by vehicle class, vehicle age, and facility type. These emission factors are utilized by the M6Link program to derive chemically speciated and gridded motor vehicle emissions.

<u>M6Link</u>

The M6Link system has two components - a vehicle travel demand component and an emissions model component - which are based on a series of FORTRAN programs and GIS-based programs that integrate the travel demand model output and MOBILE6.2 emission factors to produce estimates of onroad mobile emissions.

The output from the travel demand model is grouped into four daily time slots: a.m. peak, midday, p.m. peak, and nighttime. This output is also grouped according to 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 model include link-specific coordinates, traffic estimates, travel time, facility type, and area type. Since a different transportation modeling network is produced for each modeling year, the output from the travel demand model is specific to a modeling year.

Table III-1. Base case measures assumed for Area A (S.B. 1427) in the 2001 and 2002 model validation for the eight-hour ozone attainment plan

Assumptions Used 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)

M6Link reads the vehicle travel component of the travel demand model output and processes this output, using GIS software, to produce vehicle miles traveled (VMT) estimates that have been converted from link-specific to grid cell specific data. The travel demand estimates have also been converted from the four time periods per day to hourly estimates. All VMT estimates generated by the MAG travel demand model are for an average weekday. To account for traffic volumes for a specific episode day, adjustment factors are used to convert the "typical" weekday traffic volumes to specific ozone episode day traffic volumes. For example, the annual average daily traffic volume factor for June (0.8959) is multiplied by the day of the week factor for Monday (1.0774) and then divided by the month of the year factor (1.0100) to yield an adjustment factor for a Monday in June of 0.9557. These adjustment factors are based on the latest MAG congestion study (MAG, 2000).

Vehicle speeds on roadways in the modeling area are incorporated into the air quality modeling. The travel demand model output includes link-specific roadway length, average travel time for a vehicle, and vehicle speeds. Speed estimates are developed for each of the four time periods of the day modeled. The travel demand component of the M6Link program allocates specific roadway speed data to speed bins for freeways and arterials for each hour of the day. These speed bin files, which were developed for the five area types, are used as inputs to the MOBILE6.2 model. By following this modeling chain, the different levels of traffic congestion and roadway capacity in the modeling domain are incorporated in the development of locally-specific onroad emission factors.

The highway network data created by the MAG transportation model is regenerated by the M6Link program in the form of a VMT table. This VMT file includes the hourly VMT estimates for the combination of each grid cell, area type, facility type, and vehicle class.

These individual VMT estimates are combined with an emission factor in grams per VMT in the second component - emissions model - of the M6Link program.

There are several inputs required by the second component of the M6Link program to calculate emissions. In addition to the very detailed outputs of the vehicle travel demand component of the M6Link program, other inputs to the emission model component of the M6Link program include: (1) Emission factor output from MOBILE6.2 in database format, (2) Job file that includes information, such as the year that is being modeled and the names of the MOBILE6.2 files, (3) File that assists in the conversion of the five vehicle classes included in the travel demand model to the 28 vehicle classes considered by the MOBILE6.2 model, and (4) MOBILE6.2 output that reflect the I/M and non-I/M scenarios (output resides in different electronic files).

Like the vehicle travel demand component of the M6Link program, the emission model component of the M6Link program performs several tasks. The program reads in the I/M and non-I/M emission factors for each scenario and weights them internally to produce an hourly single emission factor for the combination of each area type, vehicle type, and facility type. The M6Link 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 model.

Although 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 arterial and local street facilities. It is unlikely that vehicles would produce cold start emissions while on a freeway, since it generally takes several minutes for a vehicle 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 reflect a more realistic spatial allocation of these emissions. Using the emission factor output from MOBILE6.2, M6Link calculates and spatially allocates the onroad emissions to grid cells in the modeling domain. The hourly emissions from M6Link are then processed through the MEDEXPLORA program to provide chemically speciated CAMx-ready input files.

III-1-1-2. Biogenic Source Emissions

Biogenic emission estimates for the modeling domain were prepared using the MEGAN Biogenic Emissions Inventory System (Guenther, 2006a and 2006b). MEGAN is an acronym for <u>M</u>odel of <u>E</u>missions of <u>G</u>ases and <u>A</u>erosols from <u>N</u>ature, 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 for Maricopa County 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-the-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 (ENVIRON, 2006a).

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 to match MEGAN's ASCII input format. Gridded solar radiation, temperature, wind speed, humidity, and soil moisture data are typically obtained from 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 the MEGAN data portal files. These data and MM5 generated meteorological data are used to run the MEGAN model. The MEGAN model calculates emissions from biogenic sources for the chemical species defined in the Carbon Bond IV chemical mechanism.

The MEGAN program creates hourly gridded biogenic emissions files. However, since these files are in ASCII file format, the biogenic emissions need to be re-formatted to EPS3.0 binary emission file format. ENVIRON developed a utility program for this format conversion based on the FORTRAN programming language. The utility program converts biogenic emissions data in ASCII format to a binary file which can be merged with anthropogenic emissions using the EPS3.0 MRGUAM module. Tables III-2(a) through 2(c) summarize the biogenic emissions by species for the August 2001, June 2002, and July 2002 episodes.

Table III-2(a). Summary of the August 2001 biogenic emissions for the CAMx 4 km modeling domain

Date	Biogenic Emissions (metric tons/day)	
	NOx	VOC
August 2, 2001 (Thursday)	9.5	394.1
August 3, 2001 (Friday)	9.2	324.5
August 4, 2001 (Saturday)	8.9	271.5
August 5, 2001 (Sunday)	9.8	437.5
August 6, 2001 (Monday)	10.9	513.7
August 7, 2001 (Tuesday)	10.0	362.3
August 8, 2001 (Wednesday)	9.4	390.7
August 9, 2001 (Thursday)	8.3	271.5
August 10, 2001 (Friday)	9.6	398.4
August 11, 2001 (Saturday)	10.3	440.6

Table III-2(b). Summary of the June 2002 biogenic emissions for the CAMx 4 km modeling domain

Date	Biogenic Emissions (metric tons/day)	
	NOx	VOC
May 31, 2002 (Friday)	8.4	451.4
June 1, 2002 (Saturday)	7.8	407.4
June 2, 2002 (Sunday)	6.8	332.3
June 3, 2002 (Monday)	6.2	286.5
June 4, 2002 (Tuesday)	6.5	303.7
June 5, 2002 (Wednesday)	7.4	374.5
June 6, 2002 (Thursday)	8.6	451.3
June 7, 2002 (Friday)	8.1	435.7

Table III-2(c). Summary of the July 2002 biogenic emissions for the CAMx 4 km modeling domain

Date	Biogenic Emissions (metric tons/day)	
	NOx	VOC
July 5, 2002 (Friday)	10.0	566.0
July 6, 2002 (Saturday)	10.6	610.9
July 7, 2002 (Sunday)	10.9	628.1
July 8, 2002 (Monday)	11.9	651.1
July 9, 2002 (Tuesday)	11.9	639.9
July 10, 2002 (Wednesday)	10.5	522.2
July 11, 2002 (Thursday)	11.2	549.4
July 12, 2002 (Friday)	11.5	541.9
July 13, 2002 (Saturday)	11.4	589.9
July 14, 2002 (Sunday)	8.9	388.0

III-1-1-3. Nonroad Source Emissions

Nonroad 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 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 engines;
- 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 source categories, except aircraft and locomotives, in the modeling domain. Aircraft emissions were calculated using the airport emissions model developed under Phase II of the MAG Aviation Air Quality Study. Locomotive emissions were obtained from MCAQD. The fuel types simulated with the NONROAD2002 model 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 MCAQD (MCAQD, 2004). These inputs are listed below:

- Fuel volatility (Reid Vapor Pressure [RVP], psi): 9.0 in winter, 8.1 in spring, and 7.8 in summer and fall.
- Gasoline oxygen content (weight %): 3.36 from October through February and 0.0 otherwise.
- Gasoline sulfur content (ppm): 179 in fall and winter, and 115 in spring and summer.
- Diesel sulfur content (ppm): 310 for all seasons.
- Temperatures (minimum/average/maximum °F): 39/55/65 in winter, 53/72/83 in spring, 78/94/104 in summer, and 57/78/87 in fall.

Arizona-specific estimates developed for the Western Regional Air Partnership (WRAP) for modeling nonroad source emissions (Adelman, et. al., 2004) were applied in the NONROAD2002 model to produce 2001 and 2002 nonroad 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 Cap and Trade Oversight Committee (CTOC) work (ENVIRON, et. al., 2003). 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 values. Temporal allocations for nonroad equipment categories modeled in the NONROAD2002 model came from EPA's recommendations on weekday and weekend day activity levels for each nonroad equipment category (EPA, 1999).

III-1-1-4. Point and Area Source Emissions

Maricopa and Pinal Counties provided the 2001 and 2002 annual point and area source emission inventories for ozone precursors. The 2002 Maricopa County area source emissions were factored down to represent the episode days in 2001. The point and area source emissions were temporally and chemically adjusted and spatially allocated to the appropriate grid cells in the modeling domain using EPS3.0.

III-1-1-5. Emission Preprocessor System 3.0 (EPS3.0)

The EPS3.0 model is an updated and modified version of EPA's EPS2.0 developed by ENVIRON. EPS3.0 provides a series of modules into which locally derived or default surrogate and emissions data are input. EPS3.0 was used to convert the annual and daily emission inventories to generate chemically speciated and hourly gridded emissions for the modeling domain. The final output of EPS3.0 is an hourly gridded emission file of anthropogenic and biogenic sources for use in the CAMx model. The following section will discuss how the EPS3.0 system processes emission inventories to generate hourly gridded emissions.

EPS3.0 Modules

EPS3.0 consists of a set of FORTRAN programs that are executed sequentially to prepare the gridded eight-hour ozone precursor emission inventory for use by the CAMx model. EPS3.0 was used to process point, area, and nonroad source emissions and merge those emissions with onroad and biogenic emissions, which were prepared separately for the modeling domain. The modules in the EPS3.0 programs are as follows:

PREPNT: Prepares annual or seasonal point source emission inventory for further processing; Identifies which sources are to be treated as elevated point sources by the CAMx model.

PREAM: Prepares annual or seasonal county-level area and nonroad source emissions for further processing.

LBASE: Prepares link-based mobile source emission estimates for further processing and disaggregates total emissions into individual components. Note: This module is used only for processing aviation emissions; the onroad emission processing is done by M6Link.

CNTLEM: Adjusts emission levels to reflect the effects of anticipated growth or implementation of proposed control measures.

CHMSPL: Assigns input hydrocarbon and nitrogen oxide emissions to chemical species defined by the chemical mechanism method.

TMPRL: Temporally adjusts emissions from annual, seasonal, or typical season day to eight-hour ozone episodic levels.

GRDEM: Spatially allocates emissions to grid cells based on source location, link location, or gridded spatial surrogate indicators; Converts ozone precursor emissions to a CAMx-ready inventory of low-level emissions.

PSTPNT: Reformats elevated point sources to be CAMx-ready.

MRGUAM: Merges several files for area, onroad, low-level point source, nonroad, aviation and biogenic emissions into one CAMx-ready emission file.

RPRTEM: Summarizes emission totals for the modeling domain by category.

PIGEMS: Produces an elevated point source emissions file 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 Emissions

EPS3.0 is used to temporally allocate power plant point source emission data based on the operating schedule provided by MCAQD for this source category. 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 annual point source emissions to episode day values (e.g., Thursday in

July 2002 or Monday in August 2001). Point source emission estimates for the episode days were determined from annual emission inventory reports provided by MCAQD. These emission inventory reports list seasonal throughput percentages, operating hours per day, days per week in operation, and specific hours of operation for point sources in Maricopa County.

Nonroad and area source emissions were input to EPS3.0 as ozone season 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 natural gas suppliers for fuel consumption, and area source emission inventory reports for incineration. Limits of permits for open burning were provided by MCAQD.

Spatial Allocation of Emissions

Point sources are spatially allocated on the basis of the location (UTM coordinates or latitude/longitude) of each point source. Area and nonroad source emissions, with the exception of aviation 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 were used to determine the spatial allocation factors for all area and nonroad sources except for aviation.

Tables III-3(a) through 3(c) provide a summary of emissions for Thursday, June 6, 2002; Tuesday, July 9, 2002; and Friday, August 10, 2001.

Table III-3(a). Emissions (metric tons/day) by source category for June 06, 2002 for the 4 km modeling domain

Source	NOx	VOC
Point	11.1	11.7
Area	9.8	90.6
Nonroad	80.0	50.7
Onroad	182.4	91.8
Biogenics	8.6	451.3
Total	**291.8**	**696.1**

Table III-3(b). Emissions (metric tons/day) by source category for July 09, 2002 for the 4 km modeling domain

Source	NOx	VOC
Point	11.1	11.7
Area	9.8	90.6
Nonroad	78.5	50.7
Onroad	163.2	88.1
Biogenics	11.9	639.9
Total	**274.5**	**881.0**

Table III-3(c). Emissions (metric tons/day) by source category for August 10, 2001 for the 4 km modeling domain

Source	NOx	VOC
Point	23.2	10.3
Area	9.4	87.7
Nonroad	68.9	44.2
Onroad	167.1	90.4
Biogenics	9.6	398.4
Total	**278.1**	**631.0**

III-1-2. Meteorological Inputs

Meteorological data are required by many of the processes simulated in the CAMx model. The key meteorological inputs include wind, temperature, humidity, clouds, and planetary boundary layer (PBL) parameters. ENVIRON, using the Penn State University/NCAR MM5 prognostic meteorological model, developed hourly three-dimensional meteorological fields for the three eight-hour ozone episodes. The following section provides highlights of the MM5 model configurations and sensitivity tests:

- The MM5 model, with four-dimensional data assimilation (FDDA), was applied to the three nested-grid domains having grid resolutions of 36, 12, and 4 kilometers for the region surrounding Maricopa County. The 4 km inner domain encompasses the MNA. The three gridded domains were configured with 34 layers in the vertical direction with greater resolution near the surface and in the boundary layers, and with deeper layers aloft. The MM5 configurations and FDDA options used in the WRAP study (Kemball-Cook, et. al., 2004) were also used in the MM5 modeling of the three eight -hour ozone episodes. Data were assimilated into the model runs using analysis nudging on all three gridded domains and observation nudging was used on the 12 km and 4 km gridded domains. Observations from the standard NCAR/NWS hourly surface observation dataset (referred to as "DS472") and MAG (including AZMET, NWS, and FSL) datasets were used in the observation nudging and model evaluation. Due to the lack of convective activity during the June 2002 episode, the MM5 model performed better in the Maricopa County area during this episode than the other two episodes.

- A series of sensitivity tests for the July 2002 episode were designed to address the overestimates of convective activity and related model performance problems. Results of these MM5 modeling runs showed that various FDDA configurations had limited impacts on improving the model performance. However, by changing the cumulus scheme to a more updated and sophisticated algorithm, and making other adjustments to soil moisture initialization, wind, temperature and humidity fields, the July 2002 episode's modeling performance approached the benchmarks suitable for air quality modeling. Similar MM5 modeling configurations were applied to the August 2001 episode.

Detailed information on the MM5 model configurations and sensitivity tests are provided in Appendix III of the Eight-Hour Ozone Plan (MAG, 2007).

The MM5CAMx pre-processor was used to convert the hourly, three-dimensional, and multi-scale meteorological fields produced by the MM5 model into the FORTRAN binary input files for each of the meteorological variables required by the CAMx model. 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: (1) Height/pressure, (2) Wind file, (3) Temperature, (4) Water Vapor, (5) Cloud/Rain, and (6) Vertical Diffusivity. One of the main functions that the MM5CAMx pre-processor offers is horizontal interpolation of MM5 data to another projection and /or resolution grid. The MM5 data simulated in the LCP projection were interpolated to the UTM grid system used in the eight-hour ozone modeling domain. The MM5CAMx pre-processor provides three options to calculate vertical diffusivity (Kv):

- 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)

After conducting several sensitivity tests on Kv options for each episode, the 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 three eight-hour ozone episodes and the 4 km domain for the July 2002 episode. In order to better simulate the vertical air movement in the 4 km domain, three more layers were added directly above the PBL. Note: 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 2,500 meters 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 3,000 meters).

III-1-3. Air Quality Inputs

The air quality inputs required by the CAMx model include gridded initial concentrations (IC) of each chemical species, gridded hourly boundary concentrations (BC) of each chemical species along the edges of the modeling domain, and temporally and spatially constant top concentrations (TOPC) for the area above the modeling domain. These air quality inputs were extracted by ENVIRON from existing modeling outputs of the WRAP (2002) and EPA/CAIR (2001) studies.

For the initial and boundary condition files for the CAMx 12 km grid, ENVIRON used the CMAQ ICON/BCON processors (v4.5) to extract data 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 of the WRAP and EPA/CAIR studies. These CMAQ ICON/BCON files in CMAQ input file format (I/O-API) were converted to CAMx IC/BC/TOPC input files in CAMx format (UAM-IV) using the CMAQ2CAMx preprocessor (v2). The IC and BC files provide concentrations of the 42 chemical species including aerosols used in the CAMx CB-IV chemical mechanism at the initial hour of the simulation and for each simulation hour over 20 layers.

Since measured pollutant concentrations at the top of modeling region are not available, top concentrations were provided in the same manner applied to the IC/BC preparation by ENVIRON. The chemical species and their concentrations used for the TOPC file for each episode are presented in Table III-4.

III-1-4. Other Inputs

In order to operate the CAMx model with realistic regional atmospheric conditions, various parameters such as chemistry parameters, albedo/haze/ozone parameters, photolysys rate parameters, surface roughness and deposition parameters, and simulation control parameters are required to be input to the CAMx model.

The chemistry parameters used in the Carbon-Bond IV (CB-IV) Mechanism are chemical species characteristics, reaction properties, and stoichiometric coefficients. These chemistry parameters are included in the CAMx CHEMPARAM file. As described in the User's Guide (ENVIRON, 2006b), 30 chemical species and 117 chemical reactions of the CB-IV were employed for the eight-hour ozone simulations.

Since chemistry is invoked in this study, CAMx requires the albedo/haze/ozone (AHO) file be used to determine the spatial and temporal variation of photolysis rates. Earth Probe Total Ozone Mapping Spectrometer (EP/TOMS) data were prepared as an 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.

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.

The CAMx landuse file contains time-invariant two-dimensional gridded fields of land use distributions used to define surface resistance for dry deposition calculations and to set default surface roughness lengths. Land use categories for the modeling domain were extracted from the MAG 2004 land use coverage for Maricopa County and converted to roughness lengths and vegetation factors according to the land use categories listed in Table 5-5 in the CAMx User's Guide (ENVIRON, 2006b).

Drought stress codes that impact the dry deposition calculations for non-water landuse categories were applied to the AHO file as an optional field. MAG developed a map of the drought stress codes required by the AHO file. This map shows that most areas in the 12 km grid modeling domain were in a dry condition (moderate ~ extreme drought).

The CAMx run control file contains the following simulation control information: 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. However, the primary episode days, which are the primary interest in CAMx applications, are the main focus in the modeling performance evaluation.

Table III-4. Chemical species and their concentrations used for the TOPC file for each episode (Units: 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-2. Operational Evaluation

Generally, operational evaluations are comprised of graphical and statistical measures indicating how well the model replicates historical air quality values. The performance of CAMx was quantified both graphically and statistically for each of the three episodes.

For statistical performance measures, EPA recommends that the following numerical statistics be applied as measures for operational performance evaluation (EPA, 2007):

(A) Mean Normalized Bias (MNB)

(B) Mean Normalized Gross Error (MNGE)

(C) Peak Prediction Accuracy

The performance of the CAMx model for eight-hour ozone, with a 60 ppb threshold compared to EPA criteria, is summarized in Tables III-5 through 7. As shown in the tables, the three statistical measures remain within EPA acceptable ranges for the June 2002 episode.

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 (EPA, 2005): time series plots, scatter plots, and daily tile/contour plots showing the predicted isopleth superimposed on the observed daily maximum concentrations. Detailed information on the graphical analysis results is presented in Section IV of the Eight-Hour Ozone Plan (MAG, 2007).

CAMx model performance for the June 2002 episode is satisfactory and acceptable by EPA standards. None of the data from the monitoring sites in the MNA was used to calculate relative response factors for the June 3, 2002 modeling day, because the observed daily maximum eight-hour ozone concentrations on that day were less than the 70 ppb threshold value used for the attainment and maintenance tests. 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.

Examination of the model performance criteria of comparing ozone levels near monitor locations also demonstrates that the overall model performance for the June 2002 episode is satisfactory. Although model performance for the other two episodes is less satisfactory, the modeling statistics for these episodes shown in Tables III-6 and III-7 provide a better understanding of the role of other meteorological schemes in contributing to high ozone levels.

For better understanding of the model performance, the monitoring sites were divided into two meaningful subgroup according to their characteristics of a diurnal variation pattern and then model performance evaluation was conducted to each subgroup. The new MPE results by subgroup are provided in Appendix III-i.

Table III-5. Summary of statistical modeling performance evaluation for the June 2002 episode (eight-hour ozone with a 60 ppb threshold)

Statistical Measure	EPA Standard	CAMx Simulations				
		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%

Table III-6. Summary of statistical modeling performance evaluation for the July 2002 episode (eight-hour ozone with a 60 ppb threshold)

Statistical Measure	EPA Standard	CAMx Simulations						
		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%

Table III-7. Summary of statistical modeling performance evaluation for the August 2001 episode (eight-hour ozone with a 60 ppb threshold)

Statistical Measure	EPA Standard	CAMx Simulations						
		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%

III-3. Chemical Process Analysis

Chemical Process Analysis (CPA) is one of several "Process Analysis" tools included in CAMx. In order to understand the physical and chemical processes used in the CAMx model, MAG performed a CAMx CPA for the June 2002 episode using base year anthropogenic and biogenic emissions. This section discusses the CPA results presented in figures.

- **Figures III-1(a) through 1(j)** - Show the CPA results averaged through the PBL depth for the CAMx simulations at noon on the last day of the June 2002 episode (June 7). Other episode days provided qualitatively similar CPA results.

- **Figure III-1(a) through 1(b)** - Figure III-1(a) presents ozone concentrations (ppb) showing an urban plume extending northwest of Phoenix. Ozone production rates (ppb/hr) shown in Figure III-1(b) are much higher inside than outside the urban plume.

- **Figure III-1(c)** - Presents a production ratio of H_2O_2 to HNO_3, which is used to distinguish VOC-sensitive areas from NOx-sensitive areas. This ratio indicates that the core of the urban plume is VOC-sensitive and other areas outside of the plume are NOx-sensitive.

- **Figure III-1(d)** - Shows that the ozone production rate is expected to increase when VOCs are added in VOC-sensitive areas.

The above CPA results reveal that the most rapid ozone production occurs in the core of the urban plume.

- **Figure III-1(e)** - The sum of OH and HO_2, which are called HOx, are inter-converted rapidly. Although HO_2 radicals cause ozone production, the production rate of "new HOx radicals" is also important, because OH initiates the reaction of VOC and NOx. This production rate, shown in Figure III-1(e), indicates that higher HOx production leads to both faster VOC reaction and increased ozone production.

- **Figure III-1(f)** - Depicts HOx chain length, which is the average number of conversion cycles (e.g., OH converted to HO_2 and then back to OH). The longer HOx chain length at the edges of the urban plume, compared with the inside of the plume center, indicates that the rate of ozone production in the plume center could increase with more new radical production.

- **Figure III-1(g)** - Illustrates the fractional contribution of isoprenes to the reaction of OH radicals with VOCs. This indicates that only a small fraction of OH radicals that are reacting with VOCs in the urban plume are reacting with isoprenes, which is one of the major biogenic VOCs.

- **Figures III-1(h) through III-1(j)** - In order to find the sources of new OH radicals, which initiate reactions of VOCs and NOx, the fractional contribution of ozone photolysis, O_3 + alkene reactions, and HONO photolysis to new OH radical production were calculated as shown in Figures III-1(h) through 1(j), respectively. The calculations indicate that: (1) Ozone photolysis ($O_3 + hv \rightarrow O(^1D) + H_2O \rightarrow 2\ OH$) is a dominant source of the new OH radicals in the 4 km grid, and (2) Contribution of ozone photolysis to new OH radicals is lower than other sources of new OH such as HONO photolysis and O_3 + alkene reactions in the urban plume.

The findings from the analysis of CPA results can be summarized as follows:

- The regions of greatest ozone production in the urban plume are VOC-sensitive.

- Ozone production in the urban plume is sensitive to the strength of radical sources, such as photolysis of ozone, formaldehyde, or nitrous acid.

- The contribution of urban biogenic emissions to ozone formation in Phoenix is not dominated by isoprenes and may depend on other VOCs and terpenes.

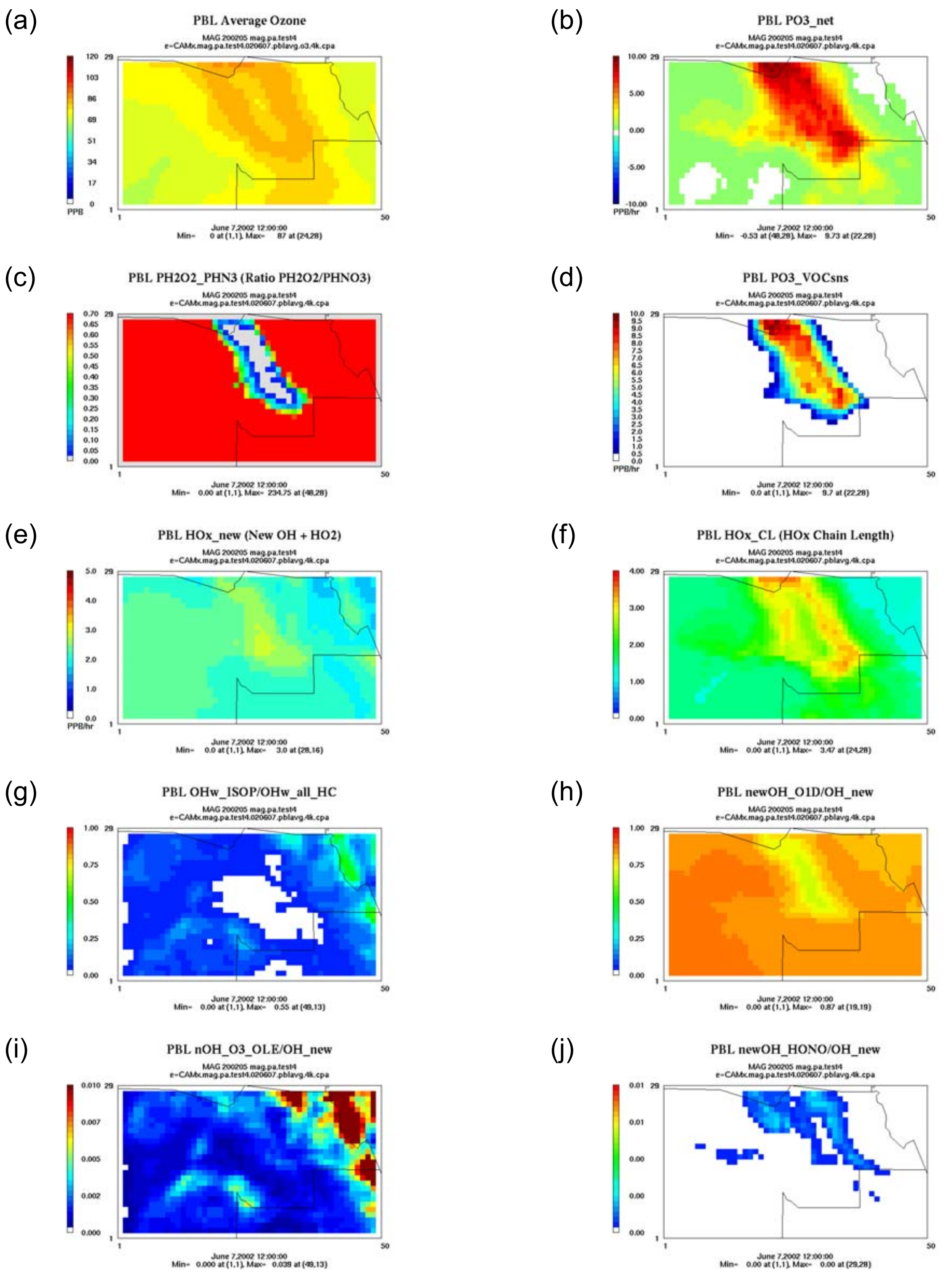

Figure III-1. A series of plots showing CPA results for the CAMx simulations at noon on June 7 of the June 2002 episode

III-4. Sensitivity Tests

Sensitivity analysis was used to investigate how the CAMx model responds to various model inputs and ensure that the model's responses to changes in inputs were physically and chemically realistic. Following the preparation of inputs and the initial application of the CAMx model, a series of sensitivity simulations were performed and the results were examined and assessed using a variety of graphical and statistical measures.

First, the initial concentrations of the 42 chemical species in all grid cells were reduced to zero. The sensitivity of the ozone concentrations within the modeling domain provided a measure of the influence of the initial conditions. The simulation with a zero initial condition indicates that the errors associated with the initial condition 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.

Second, inflow concentrations at the lateral boundaries of the modeling domain were reduced to zero. The sensitivity of the ozone concentrations in the inner core and downwind portions of the modeling domain provided a measure of the influence of the boundary conditions. The results indicate that the CAMx model is highly sensitive to boundary conditions and is also able to reflect the characteristics of ozone formation described in the conceptual model (Jung, 2006).

Last, several diagnostic simulations were performed to address the uncertainty in the emission inventories and specific features of the preliminary simulation results. These simulations help to identify 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 results show that the impact on peak ozone concentrations, due to removal of an emission source for both VOC and NOx, differs by episode.

III-5. 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 for an eight-hour ozone attainment or maintenance demonstration. The overall conclusions from the performance evaluation are:

- Modeled ozone formation is consistent with the conceptual model in that high ozone levels in the MNA resulted from a combination of production from local emission sources combined with regional background and transport of ozone into the MNA.

- Model performance for the June 2002 episode is acceptable on most days when evaluated on the basis of the traditional methods used for one-hour ozone modeling.

- Model performance for the June 2002 episode is satisfactory when compared with eight-hour ozone levels near the monitoring locations.

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IV. BASELINE AND FUTURE YEAR CAMx INPUT PREPARATION

IV-1. Baseline Emission Inventory

The baseline emission inventory for the Eight-Hour Ozone Maintenance Plan includes point, area, onroad, nonroad, and biogenic source emissions for 2005. EPS3.0 was used to process the baseline emission inventories for the ozone maintenance modeling demonstration. All emissions by source type were merged by EPS3.0 to provide input to CAMx. Emission input files were developed for June, July, and August episodes of 2005.

IV-1-1. Emissions for the CAMx 12 km Domain

The 2005 emission inventory for the CAMx 12 km modeling domain was based on the 2002 Western Regional Air Partnership (WRAP) emission inventory provided by ENVIRON for the Eight-Hour Ozone Plan (MAG, 2007a). The 2002 WRAP emission inventory is the only complete data available for the 12 km regional modeling domain and is conservatively assumed to represent the 2005 emissions for the 12 km modeling domain since the WRAP emissions are declining from 2002 to 2025 (see Appendix V-v). The WRAP emission inventory includes stationary point, area, onroad, and nonroad sources for all counties within the CAMx 12 km regional modeling domain. The 2005 biogenic source emission estimates for the CAMx 12 km regional modeling domain were based on GloBEIS biogenic model estimates for the three episodes of 2001 and 2002 developed by ENVIRON. The GloBEIS biogenic model was developed by the National Center for Atmospheric Research and ENVIRON under sponsorship of the Texas Commission on Environmental Quality (TCEQ). Biogenic emissions developed using GloBEIS have been previously used for air quality modeling in East Texas, as well as other regions throughout the US. The GloBEIS biogenic emissions provided by ENVIRON for the three episodes are summarized in Tables IV-1(a) through 1(c).

The WRAP emission inventory was converted to AMS and AFS formats for input to EPS3.0 (ENVIRON, 2005) for the CAMx 12 km regional modeling domain. The emissions from Texas and Mexico were obtained from different sources, and were processed separately. More detailed descriptions on the WRAP, Texas, and Mexico emission data files used in the development of the CAMx 12 km regional emission inventories are provided in the ENVIRON memorandum dated December 19, 2005, which is available in Appendix IV-i.

The 2002 weekday VOC and NOx emissions by source category and state for the CAMx 12 km regional modeling domain are presented in Tables IV-2(a) through 2(b). It should be noted that in December 2005, ENVIRON provided MAG with the 12 km 2002 emission inventory that was used in the Eight-Hour Ozone Plan. In May 2008, ENVIRON provided an updated 2002 12 km emission inventory for use in the maintenance demonstration.

Table IV-1(a). Biogenic emissions for the August episode for the CAMx 12 km modeling domain

Date	Biogenic Daily Emission (metric tons/day)	
	VOC	NOx
August 2, 2001 (Thursday)	15,876.00	945.53
August 3, 2001 (Friday)	16,148.16	971.14
August 4, 2001 (Saturday)	15,331.68	977.69
August 5, 2001 (Sunday)	16,148.16	963.55
August 6, 2001 (Monday)	18,234.72	1,014.57
August 7, 2001 (Tuesday)	18,144.00	1,001.84
August 8, 2001 (Wednesday)	14,787.36	913.39
August 9, 2001 (Thursday)	12,610.08	872.56
August 10, 2001 (Friday)	13,698.72	903.30
August 11, 2001 (Saturday)	14,968.80	938.60

Table IV-1(b). Biogenic emissions for the June episode for the CAMx 12 km modeling domain

Date	Biogenic Daily Emission (metric tons/day)	
	VOC	NOx
May 31, 2002 (Friday)	21,409.92	1,096.98
June 1, 2002 (Saturday)	18,053.28	998.58
June 2, 2002 (Sunday)	14,424.48	893.44
June 3, 2002 (Monday)	12,156.48	814.02
June 4, 2002 (Tuesday)	12,700.80	823.38
June 5, 2002 (Wednesday)	16,329.60	924.65
June 6, 2002 (Thursday)	19,141.92	1,046.12
June 7, 2002 (Friday)	18,779.04	1,028.22

Table IV-1(c). Biogenic emissions for the July episode for the CAMx 12 km modeling domain

Date	Biogenic Daily Emission (metric tons/day)	
	VOC	NOx
July 5, 2002 (Friday)	17,418.24	1,008.05
July 6, 2002 (Saturday)	19,051.20	1,048.56
July 7, 2002 (Sunday)	20,412.00	1,058.61
July 8, 2002 (Monday)	19,686.24	1,067.03
July 9, 2002 (Tuesday)	21,319.20	1,090.90
July 10, 2002 (Wednesday)	21,500.64	1,061.25
July 11, 2002 (Thursday)	19,958.40	1,047.83
July 12, 2002 (Friday)	19,414.08	1,047.69
July 13, 2002 (Saturday)	20,049.12	1,059.23
July 14, 2002 (Sunday)	18,688.32	1,017.17

Table IV-2(a). Summary of 2002 weekday VOC emissions for the CAMx 12 km modeling domain (metric tons/day)

State	Area	Onroad	Nonroad	Point
Arizona	240.23	284.00	206.49	13.49
California	410.56	502.77	335.33	79.52
Colorado	10.19	9.29	8.59	4.35
Nevada	32.68	63.75	42.52	0.95
New Mexico	356.54	84.34	37.57	28.48
Texas	17.96	33.33	5.49	1.96
Utah	10.80	11.68	11.12	0.63
Total	**1,078.96**	**989.16**	**647.11**	**129.38**

Table IV-2(b). Summary of 2002 weekday NOx emissions for the CAMx 12 km modeling domain (metric tons/day)

State	Area	Onroad	Nonroad	Point
Arizona	15.21	434.22	186.87	207.18
California	112.17	841.81	525.70	157.79
Colorado	12.95	12.57	12.37	14.27
Nevada	4.28	62.59	54.45	50.74
New Mexico	136.89	140.25	83.23	94.21
Texas	3.28	46.43	9.34	10.35
Utah	0.66	18.29	6.43	2.53
Total	**285.44**	**1,556.16**	**878.39**	**537.07**

IV-1-2. Emissions for the CAMx 4 km Domain

IV-1-2-1. Onroad Mobile Source Emissions

The onroad mobile source emissions for the CAMx 4 km modeling domain in the 2005 baseline year were obtained from EPA's MOBILE6.2 model and M6Link. MOBILE6.2 was run to derive the 2005 onroad motor vehicle emission factors in the MOBILE6.2 database output format for each episode day of 2005. M6Link was used to process the 2005 emission factors and traffic assignment data that were developed by the MAG transportation model. The output from M6Link is hourly gridded and chemically speciated emissions for each episode day of 2005.

The detailed description of MOBILE6.2 and M6Link emission estimation procedures for 2005 are presented in Appendix IV-ii. Since ADEQ provided updated I/M and anti-tampering program data (Chen, 2008), the updated MOBILE6.2 input parameters for the I/M and anti-tampering programs were utilized in developing onroad emissions for the maintenance modeling. As for the I/M programs, two evaporative I/M programs were added: The first additional I/M program is a biennial fill-pipe pressure (FP) & gas cap (GC) test, which begins in 1995, and the second additional I/M program is an annual GC test, which begins in 1992. Other I/M parameters, such as the stringency, compliance, and waiver rates, were updated based on the latest information provided by ADEQ. Updated compliance rates for anti-tampering programs were also provided by ADEQ.

Table IV-3 summarizes the baseline onroad emissions by species for each episode. In Table IV-3, the episode dates in the model validation year of 2002 do not correspond to the same days of the week in the baseline year of 2005. To be consistent with the model validation for the attainment demonstration, the emissions for the episode days in 2005 represent the same days of the week, rather than the exact same dates, in 2002. For example, the emissions for May 31, 2005 represent conditions that would be expected to occur on a Friday in May 2005, rather than on May 31, 2005, which was actually a Tuesday. This holds true for other episode days in 2005, as well. Due to a sensitivity of MOBILE6.2 to date-specific meteorological inputs such as temperature, relative humidity, and barometric pressure, onroad emissions are different for the same day of the week in the same month.

Table IV-3. Summary of the 2005 baseline onroad emissions for the CAMx 4 km modeling domain

Episode	Date	2005 Onroad Emissions (metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	85.7	169.4
	June 1 (Saturday)	55.4	110.2
	June 2 (Sunday)	42.5	86.5
	June 3 (Monday)	67.5	146.3
	June 4 (Tuesday)	71.3	149.6
	June 5 (Wednesday)	74.1	152.5
	June 6 (Thursday)	72.1	154.3
	June 7 (Friday)	74.4	159.5
July 2002	July 5 (Friday)	75.3	148.1
	July 6 (Saturday)	47.9	92.5
	July 7 (Sunday)	43.0	81.1
	July 8 (Monday)	72.8	143.5
	July 9 (Tuesday)	74.4	149.5
	July 10 (Wednesday)	76.4	151.6
	July 11 (Thursday)	78.6	154.0
	July 12 (Friday)	76.6	148.0
	July 13 (Saturday)	49.8	92.3
	July 14 (Sunday)	42.9	80.4
August 2001	August 2 (Thursday)	78.5	145.5
	August 3 (Friday)	73.0	142.8
	August 4 (Saturday)	55.3	101.2
	August 5 (Sunday)	43.6	81.4
	August 6 (Monday)	74.1	141.2
	August 7 (Tuesday)	74.5	139.6
	August 8 (Wednesday)	67.6	133.6
	August 9 (Thursday)	71.5	136.9
	August 10 (Friday)	72.7	140.7
	August 11 (Saturday)	53.5	98.0

IV-1-2-2. Biogenic Source Emissions

The MEGAN program was used to create an EPS3.0 ready gridded biogenic emissions file for the CAMx 4 km modeling domain. This program calculates the biogenic emissions based on MM5 generated meteorological data and vegetation characteristics, such as monthly leaf area index (LAI), plant function type (PFT), and emission factors. The gridded solar radiation, temperature, wind speed, humidity, and soil moisture data input to MEGAN were produced by MM5. The same biogenic source emissions developed for the June, July, and August episodes for the Eight-Hour Ozone Plan (MAG, 2007a) were used as the 2005 baseline biogenic emissions for the Eight-Hour Ozone Maintenance Plan. The daily biogenic emissions for the three episodes are summarized in Tables III-2(a) through 2(c) in Section III.

IV-1-2-3. Nonroad Source Emissions

EPA's NONROAD2005 model was used to estimate monthly emissions from nonroad sources, except aviation and locomotive emissions, for the period of summer 2005. The fuel types simulated by the NONROAD2005 model include gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG). Temperature and fuel inputs to the NONROAD2005 model were obtained from the 2005 Periodic Emission Inventory for PM-10 (MCAQD, 2007). These data are presented in Table IV-4.

Equipment population numbers and activity levels for commercial lawn and garden equipment were obtained from the Maricopa County Air Quality Department (MCAQD). The equipment population 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 Cap and Trade Oversight Committee (CTOC) work (ENVIRON, et. al., 2003). 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 default values. Temporal allocations for nonroad equipment categories modeled in the NONROAD2005 model were based on the EPS3.0 temporal profiles for each nonroad equipment category.

Table IV-4. 2005 temperature and fuel-related inputs to NONROAD2005 model

Month	Temperature (°F)			Fuel RVP (psi)	Diesel Sulfur (ppm)	Gasoline Sulfur (ppm)
	Maximum	Minimum	Average			
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

(Source: MCAQD, 2005 Periodic Emission Inventory for PM-10)

Locomotive Emissions

Annual locomotive emission estimates were based on the 2005 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 III haul lines were operated in Maricopa County in 2005. Annual emissions from Class I haul operations and Class II yard/switching operations were calculated by multiplying the 2005 diesel fuel usage for each operation category by EPA emission factors for VOC, NOx, and CO (EPA, 1997). The estimated 2005 locomotive emissions were divided by four to obtain the 2005 summer season locomotive emissions shown in Table IV-5.

Table IV-5. Summer 2005 locomotive emissions (metric tons/season) in Maricopa County

Locomotive Type	VOC	NOx
Haul Line (Class I)	21.70	586.23
Yard/Switching Operations (Class II)	4.80	82.87

Aviation Emissions

The airport emissions were estimated by using the MAG Airport Emissions Model developed by Systems Applications International under Phase II of the Maricopa Association of Governments Aviation Air Quality Study (SAI, 1996). This model is composed of a series of FORTRAN programs that calculate emissions from aircraft exhaust, ground service vehicles, aircraft refueling, and fuel storage. It should be noted that auxiliary power units (APUs) were not used in Maricopa County, and emissions from aircraft refueling and fuel storage were included in the area source emission inventory developed by MCAQD. Thus, the emissions from APUs and aircraft refueling and fuel storage were not included in this aviation emission inventory. Details on the emission calculation methodology and related default database used to estimate airport emissions are documented in the User's Guide for the MAG Airport Emissions Model (SAI, 1996).

The aircraft exhaust emissions were calculated based on airport operations in terms of landing and takeoff (LTO) cycles and emission rate per LTO. There are fifteen key airports located within the 4 km ozone modeling domain: Buckeye (BXK), Chandler (CHD), Estrella (E68), Glendale (GEU), Luke Air Force Base (LUF), Memorial (L07), Mesa Falcon Field (FFZ), Phoenix Deer Valley (DVT), Phoenix Goodyear (GYR), Phoenix Sky Harbor (PHX), Pleasant Valley (P48), Scottsdale (SDL), Sky Ranch Carefree (E18), Stellar Airpark (P19), and Williams Gateway (IWA). Phoenix Sky Harbor is the primary commercial airport and is a hub of the airport system. Seven airports have been designated as reliever airports by the Federal Aviation Administration (FAA): Chandler, Glendale, Mesa Falcon Field, Phoenix Deer Valley, Goodyear, Scottsdale, and Williams Gateway. Luke Air Force Base (AFB) is utilized for military aircraft operations. The rest are used for general aviation purposes, which have lower airport activity levels than the reliever airports.

The airport operations for base year 2000 were collected from the MAG Regional Aviation System Plan Update (MAG, 2006). The report contains hourly distributions for all fourteen non-military airports, but information on the fleet mix is available only for Phoenix Sky Harbor's commercial aviation. The annual airport operations for Phoenix Sky Harbor and seven reliever airports for the baseline year 2005 were obtained from FAA. The aviation activity for the general aviation airports that were not in the FAA system was fixed at their 2000 levels. The fleet mix and hourly distribution for base year 2000 were scaled to baseline year 2005 using a ratio of the 2005 airport operations to the 2000 airport operations. Emission rates per LTO were calculated based on modes of operation, duration of each operating mode, fuel flow/consumption rate, and emission factors specific to engine design parameters. There are five operation modes in an LTO: approach, taxi/idle-in, taxi/idle-out, takeoff, and climbout. Emission factors for VOC, CO, and NOx were taken from the Federal Aviation Administration Aircraft Engine and Emission Database (FAAED) model. This model provides emission factors for each operating mode for a specific engine model, with fuel flow rate listed as well. The engines used on each aircraft type were determined through the aircraft/engine cross-reference input data file, which also provides information regarding the number of engines per aircraft type and classification of aircraft types into one of nineteen aircraft category codes. The duration of each operating mode is also listed according to the aircraft category codes. It should be noted that default emission factors in terms of lb/LTO were used to estimate general aviation emissions.

An adjustment was applied to the durations of several of the operating modes. First, mixing height was used to adjust the duration of the approach and climbout modes. ENVIRON provided hourly mixing heights obtained from MM5 for each airport on the episode days. Second, the time-in-mode delay model, developed by Lee Engineering, was applied to account for departure delays. The required information regarding runway lengths and capacity, and the percentage of touch-and-go operations for each airport was collected from previous MAG aviation studies (MAG, 2006). The 2005 aircraft operations and emissions for Luke Air Force Base were obtained from the 2005 Periodic Emission Inventory (PEI) for ozone precursors (MCAQD, 2008).

Emissions from ground support equipment (GSE) were calculated based on activity and emission factors. Their activity is determined by the average number of vehicles in use per day, average duration of use, horsepower, and load factor, which were collected from previous MAG aviation studies (MAG, 2006). The emission factors used in the MAG Airport Emissions model are derived from Air Pollution Mitigation Measures for Airports and Associated Activity (EEA, 1994). It should be noted that the information on GSE activities is available only for Phoenix Sky Harbor Airport and the seven reliever airports. The GSE activities at the general aviation airports were scaled according to the level of airport operations. Glendale was used as the reference airport in the scaling, because it has the lowest airport operation level among the seven reliever airports. The 2005 GSE emissions for Luke Air Force Base were obtained from the 2006 GSE emissions in the One-Hour Ozone Redesignation Request and Maintenance Plan (MAG, 2004).

The MAG Airport Emissions Model produces two output files - a summary report file and an EPS3.0 LBASE formatted file. The summary report gives total emissions for ground service vehicles and aircraft exhaust emissions and emissions at each airport. The LBASE file contains a mixture of hourly emissions for aircraft and daily emissions for ground support vehicles. Emissions from ground support vehicles are assigned to terminal locations, and emissions from aircraft exhaust are assigned to runway links. Tables IV-6(a) through 6(c) provide summaries of aviation emissions by airport for the peak day in each of the three ozone episodes in 2005.

Table IV-6(a). Summary of aviation emissions (metric tons/day) by airport for the CAMx 4 km modeling domain on a Thursday in June, 2005

Airport	Aircraft		GSE		Total	
	VOC	NOx	VOC	NOx	VOC	NOx
Buckeye	0.0214	0.0036	0.0031	0.0044	0.0245	0.0081
Chandler	0.0538	0.0092	0.0030	0.0030	0.0569	0.0122
Estrella	0.0039	0.0006	0.0005	0.0008	0.0044	0.0015
Glendale	0.0308	0.0053	0.0035	0.0053	0.0344	0.0104
Luke Air Force Base*	0.4763	1.0623	0.0121	0.1110	0.4884	1.1733
Memorial	0.0005	0.0001	0.0001	0.0001	0.0006	0.0002
Mesa Falcon Field	0.0611	0.0103	0.0075	0.0104	0.0686	0.0208
Phoenix Deer Valley	0.0852	0.0145	0.0005	0.0005	0.0856	0.0150
Phoenix Goodyear	0.0229	0.0039	0.0109	0.0193	0.0337	0.0232
Phoenix Sky Harbor	0.4832	4.3264	0.2965	1.0377	0.7796	5.3642
Pleasant Valley	0.0122	0.0021	0.0017	0.0025	0.0140	0.0046
Scottsdale	0.0481	0.0082	0.0036	0.0126	0.0517	0.0208
Sky Ranch Carefree	0.0011	0.0002	0.0002	0.0003	0.0013	0.0005
Stellar Airpark	0.0011	0.0002	0.0015	0.0020	0.0025	0.0022
Williams Gateway	0.0611	0.0103	0.0152	0.0794	0.0763	0.0897
Total	**1.37**	**5.45**	**0.35**	**1.18**	**1.71**	**6.63**

** Aircraft emissions are obtained from the 2005 PEI for ozone precursors and GSE emissions are from the 2004 One-Hour Ozone Maintenance Plan.*

Table IV-6(b). Summary of aviation emissions (metric tons/day) by airport for the CAMx 4 km ozone modeling domain on a Tuesday in July, 2005

Airport	Aircraft		GSE		Total	
	VOC	NOx	VOC	NOx	VOC	NOx
Buckeye	0.0214	0.0036	0.0031	0.0044	0.0245	0.0081
Chandler	0.0538	0.0092	0.0030	0.0030	0.0569	0.0122
Estrella	0.0039	0.0006	0.0005	0.0008	0.0044	0.0015
Glendale	0.0308	0.0053	0.0035	0.0053	0.0344	0.0104
Luke Air Force Base*	0.4763	1.0623	0.0121	0.1110	0.4884	1.1733
Memorial	0.0005	0.0001	0.0001	0.0001	0.0006	0.0002
Mesa Falcon Field	0.0611	0.0103	0.0075	0.0104	0.0686	0.0208
Phoenix Deer Valley	0.0852	0.0145	0.0005	0.0005	0.0856	0.0150
Phoenix Goodyear	0.0229	0.0039	0.0109	0.0193	0.0337	0.0232
Phoenix Sky Harbor	0.4687	3.3540	0.2965	1.0377	0.7652	4.3918
Pleasant Valley	0.0122	0.0021	0.0017	0.0025	0.0140	0.0046
Scottsdale	0.0481	0.0082	0.0036	0.0126	0.0517	0.0208
Sky Ranch Carefree	0.0011	0.0002	0.0002	0.0003	0.0013	0.0005
Stellar Airpark	0.0011	0.0002	0.0015	0.0020	0.0025	0.0022
Williams Gateway	0.0611	0.0103	0.0152	0.0794	0.0763	0.0897
Total	**1.35**	**4.48**	**0.35**	**1.18**	**1.70**	**5.66**

** Aircraft emissions are obtained from the 2005 PEI for ozone precursors and GSE emissions are from the 2004 One-Hour Ozone Maintenance Plan.*

Table IV-6(c). Summary of aviation emissions (metric tons/day) by airport for the CAMx 4 km ozone modeling domain on a Friday in August, 2005

Airport	Aircraft		GSE		Total	
	VOC	NOx	VOC	NOx	VOC	NOx
Buckeye	0.0214	0.0036	0.0031	0.0044	0.0245	0.0081
Chandler	0.0538	0.0092	0.0030	0.0030	0.0569	0.0122
Estrella	0.0039	0.0006	0.0005	0.0008	0.0044	0.0015
Glendale	0.0308	0.0053	0.0035	0.0053	0.0344	0.0104
Luke Air Force Base*	0.4763	1.0623	0.0121	0.1110	0.4884	1.1733
Memorial	0.0005	0.0001	0.0001	0.0001	0.0006	0.0002
Mesa Falcon Field	0.0611	0.0103	0.0075	0.0104	0.0686	0.0208
Phoenix Deer Valley	0.0852	0.0145	0.0005	0.0005	0.0856	0.0150
Phoenix Goodyear	0.0229	0.0039	0.0109	0.0193	0.0337	0.0232
Phoenix Sky Harbor	0.4904	4.3264	0.2965	1.0377	0.7868	5.6128
Pleasant Valley	0.0122	0.0021	0.0017	0.0025	0.0140	0.0046
Scottsdale	0.0481	0.0082	0.0036	0.0126	0.0517	0.0208
Sky Ranch Carefree	0.0011	0.0002	0.0002	0.0003	0.0013	0.0005
Stellar Airpark	0.0011	0.0002	0.0015	0.0020	0.0025	0.0022
Williams Gateway	0.0611	0.0103	0.0152	0.0794	0.0763	0.0897
Total	**1.37**	**5.70**	**0.35**	**1.18**	**1.71**	**6.88**

** Aircraft emissions are obtained from the 2005 PEI for ozone precursors and GSE emissions are from the 2004 One-Hour Ozone Maintenance Plan.*

The 2005 summer VOC and NOx emissions from nonroad sources in Maricopa County are summarized in Table IV-7. Table IV-8 summarizes the baseline nonroad emissions in the 4 km modeling domain by species for each episode.

Table IV-7. Summary of 2005 VOC and NOx emissions from nonroad sources in Maricopa County (metric tons/summer season*)

Equipment Category	VOC	NOx
Agricultural Equipment	16.4	118.4
Commercial Equipment	666.6	313.0
Construction and Mining Equipment	684.9	3,963.4
Industrial Equipment	180.5	758.6
Lawn and Garden Equipment (Residential)	1,627.8	76.9
Lawn and Garden Equipment (Commercial)	576.6	152.2
Pleasure Craft	336.7	29.7
Railroad Equipment	0.6	2.1
Recreational Equipment	509.1	17.6
Locomotives	26.5	669.1
GSE	33.1	118.3
Aircraft	125.3	483.8
Total	**4,784.1**	**6,703.1**

** Summer season includes June, July, and August.*

Table IV-8. Summary of the 2005 baseline nonroad emissions for the CAMx 4 km modeling domain

Episode	Date	2005 Nonroad Emissions (Metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	33.3	74.1
	June 1 (Saturday)	43.5	78.1
	June 2 (Sunday)	43.5	78.3
	June 3 (Monday)	40.3	81.4
	June 4 (Tuesday)	40.3	77.1
	June 5 (Wednesday)	40.3	77.0
	June 6 (Thursday)	40.3	77.7
	June 7 (Friday)	40.3	76.5
July 2002	July 5 (Friday)	37.6	75.9
	July 6 (Saturday)	40.1	73.7
	July 7 (Sunday)	40.2	74.3
	July 8 (Monday)	37.6	75.0
	July 9 (Tuesday)	37.6	74.2
	July 10 (Wednesday)	37.6	75.7
	July 11 (Thursday)	37.6	74.4
	July 12 (Friday)	37.6	74.4
	July 13 (Saturday)	40.1	73.5
	July 14 (Sunday)	40.1	72.5
August 2001	August 2 (Thursday)	37.0	76.4
	August 3 (Friday)	37.0	77.3
	August 4 (Saturday)	39.9	72.7
	August 5 (Sunday)	39.9	75.6
	August 6 (Monday)	37.0	76.6
	August 7 (Tuesday)	37.0	75.2
	August 8 (Wednesday)	37.0	76.2
	August 9 (Thursday)	37.0	77.8
	August 10 (Friday)	37.0	76.6
	August 11 (Saturday)	39.9	73.6

IV-1-2-4. Point and Area Source Emissions

The point source category includes the stationary sources that emit significant amounts of air pollution such as power plants and large industrial facilities at a specific location. The emission thresholds for defining a point source are 25 short tons per year or more of carbon monoxide (CO); or 10 short tons per year or more of volatile organic compounds (VOC), oxides of nitrogen (NOx), or sulfur oxides (SOx); or 5 short tons per year or more of particulate matter less than or equal to 10 microns (PM-10) or ammonia compounds (NHx). The stationary source categories with annual emissions lower than the point source threshold are classified as area sources. Area source emissions include emissions from sources considered too small or numerous to be handled individually in the point source emission inventory.

The 2005 point and area source emission inventory data were provided by the Maricopa County Air Quality Department (MCAQD) and Pinal County Air Quality Department (PCAQD) for use in the eight-hour ozone maintenance demonstration. The 2005 point and area source emission inventory data were formatted according to the AIRS Facility Subsystem (AFS) and the AIRS Area and Mobile Subsystem (AMS) work file formats, respectively. The AFS work file for point sources contains information on source description, inventory period, geographic location, source identification, stack characterization, operating schedule, and emissions. The AMS work file for area sources contains information on source description, inventory period, source identification, and emissions. The AFS and AMS emissions data were chemically speciated into Carbon Bond IV chemical species using the EPS3.0 chemical speciation profile and temporally distributed according to operating schedules or temporal profiles. Finally, the point source emissions were spatially assigned to grid cells based on the geographic location of each point source, while the area source emissions were assigned to grid cells using spatial surrogate factors and EPS3.0. Daily emissions of point and area sources for the episode days of 2005 are summarized in Tables IV-9 and 10, respectively.

IV-1-2-5. Temporal and Spatial Allocation, and Chemical Speciation of Emissions

EPS3.0 was used to develop spatially, temporally, and chemically resolved emission inventories of point, area, and nonroad sources. EPS3.0 disaggregates annual or seasonal VOC and NOx emissions of point, area, and nonroad sources to hourly and grid-level emissions of the 30 chemical species in Carbon Bond IV (CB-IV). However, hourly gridded onroad and biogenic source emissions for the CB-IV chemical species were directly developed using MOBILE6.2/M6Link and MEGAN models without going through EPS3.0 processing.

Temporal allocation of point source emission data was based on the operating schedules for emission sources. All point sources were temporally resolved based on profiles for seasonal activity, provided by day of the week, and diurnally. EPS3.0 uses monthly and day-of-week adjustment factors to convert point source emissions to episode day values (e.g., Thursday in July 2005 or Monday in August 2005). For point source emissions, this information was determined from annual emission inventory reports. These emission inventory reports require 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 resolve seasonal emissions to hourly emissions for an ozone episode day, EPS3.0 applies temporal profiles to each emission source category. The temporal profiles contain source identification data (SCC or ASC code), AIRS pollutant code, monthly profile code, weekly profile code, and diurnal profile code. These monthly, weekly, and diurnal profile codes by source category and pollutant are assigned for each emission source category to derive hourly emissions for any specific day of an ozone episode. The temporal distributions of point, area, onroad, biogenic, and nonroad emissions are shown in Figures IV-1(a) through 1(f).

Point sources were spatially allocated on the basis of the location of each source (UTM coordinates or latitude/longitude). Area and nonroad source emissions, with the exception of aviation-related emissions, were spatially distributed based on surrogate factors that indicate emission level or activity. For this analysis, MAG 2004 land use data and GIS data were used to determine the spatial allocation factors for all area and nonroad sources, except for aviation. Appendix IV-iii includes detailed information on the development of the spatial surrogates for this application. Figures IV-2(a) through 4(f) illustrate the spatial distributions of onroad, anthropogenic, and all other sources in the CAMx 4 km modeling domain for the episode days for a Thursday in June 2005; a Tuesday in July 2005; and a Friday in August 2005. The spatial distribution of emissions was derived from EPS3 GRDEM output emissions. Table IV-11 provides the maximum VOC and NOx emissions and grid cell location of the maximum for onroad, anthropogenic and all sources.

Tables IV-12(a) through 12(c) provide total emissions by source category and pie charts for the peak ozone days which were derived from the EPS3 MRGUAM output. The 2005 baseline emissions are compared with emissions for the 2005 Periodic Emission Inventory for ozone precursors. A detailed comparison is given in Appendix IV-iv.

Table IV-9. Summary of 2005 point source emissions for the CAMx 4 km modeling domain

Episode	Date	2005 Point Source Emissions (metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	10.8	5.5
	June 1 (Saturday)	4.8	9.6
	June 2 (Sunday)	3.0	9.0
	June 3 (Monday)	11.1	10.9
	June 4 (Tuesday)	11.1	10.9
	June 5 (Wednesday)	11.1	10.9
	June 6 (Thursday)	11.1	10.9
	June 7 (Friday)	11.1	10.9
July 2002	July 5 (Friday)	11.1	10.9
	July 6 (Saturday)	4.8	9.6
	July 7 (Sunday)	3.0	9.0
	July 8 (Monday)	11.1	10.9
	July 9 (Tuesday)	11.1	10.9
	July 10 (Wednesday)	11.1	10.9
	July 11 (Thursday)	11.1	10.9
	July 12 (Friday)	11.1	10.9
	July 13 (Saturday)	4.8	9.6
	July 14 (Sunday)	3.0	9.0
August 2001	August 2 (Thursday)	11.1	10.9
	August 3 (Friday)	11.1	10.9
	August 4 (Saturday)	4.8	9.6
	August 5 (Sunday)	3.0	9.0
	August 6 (Monday)	11.1	10.9
	August 7 (Tuesday)	11.1	10.9
	August 8 (Wednesday)	11.1	10.9
	August 9 (Thursday)	11.1	10.9
	August 10 (Friday)	11.1	10.9
	August 11 (Saturday)	4.8	9.6

Table IV-10. Summary of 2005 area source emissions for the CAMx 4 km modeling domain

Episode	Date	2005 Area Source Emissions (metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	79.2	19.6
	June 1 (Saturday)	79.1	18.2
	June 2 (Sunday)	79.1	17.5
	June 3 (Monday)	79.2	19.6
	June 4 (Tuesday)	79.2	19.6
	June 5 (Wednesday)	79.2	19.6
	June 6 (Thursday)	79.2	19.6
	June 7 (Friday)	79.2	19.6
July 2002	July 5 (Friday)	79.2	19.6
	July 6 (Saturday)	79.1	18.2
	July 7 (Sunday)	79.1	17.5
	July 8 (Monday)	79.2	19.6
	July 9 (Tuesday)	79.2	19.6
	July 10 (Wednesday)	79.2	19.6
	July 11 (Thursday)	79.2	19.6
	July 12 (Friday)	79.2	19.6
	July 13 (Saturday)	79.1	18.2
	July 14 (Sunday)	79.1	17.5
August 2001	August 2 (Thursday)	79.2	19.6
	August 3 (Friday)	79.2	19.6
	August 4 (Saturday)	79.1	18.2
	August 5 (Sunday)	79.1	17.5
	August 6 (Monday)	79.2	19.6
	August 7 (Tuesday)	79.2	19.6
	August 8 (Wednesday)	79.2	19.6
	August 9 (Thursday)	79.2	19.6
	August 10 (Friday)	79.2	19.6
	August 11 (Saturday)	79.1	18.2

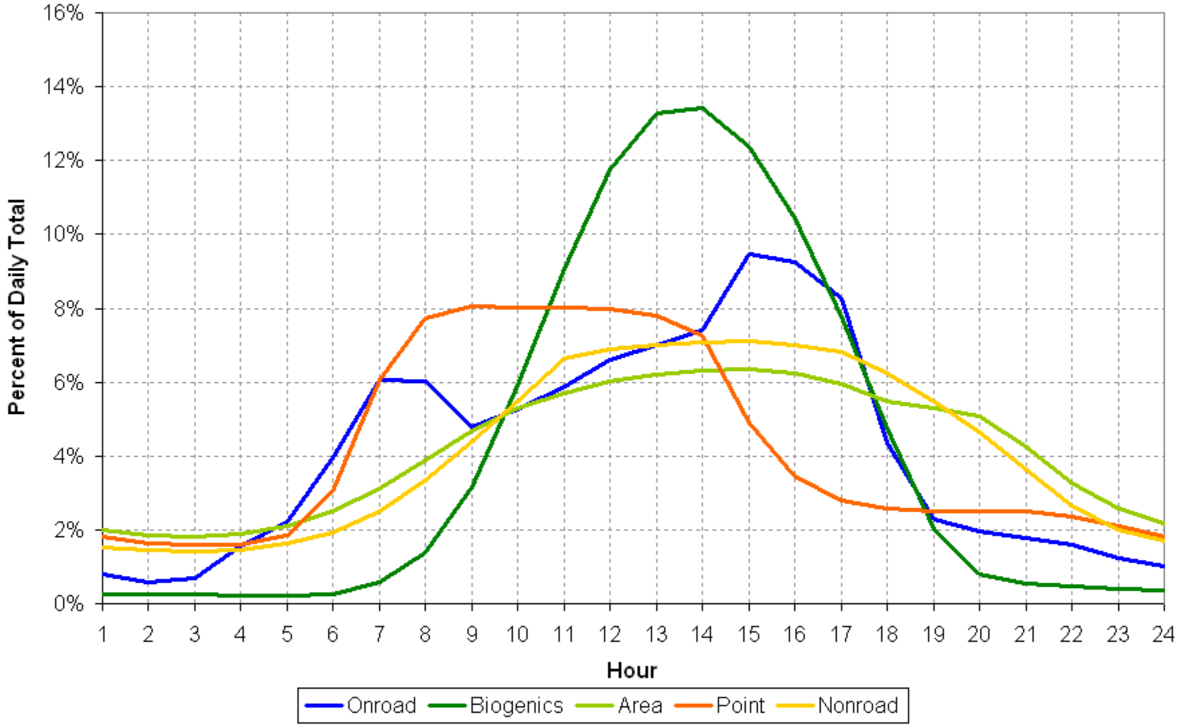


Figure IV-1(a). Temporal distribution of VOC emission sources for the CAMx modeling domain for a Thursday in June, 2005

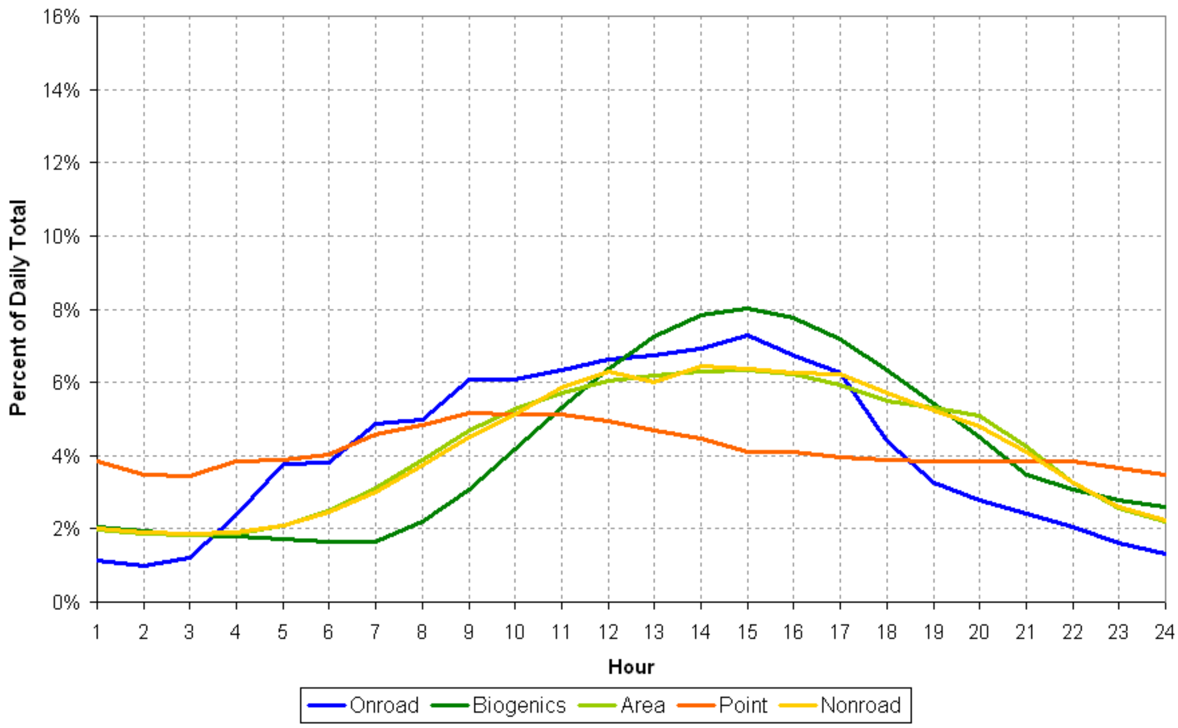


Figure IV-1(b). Temporal distribution of NOx emission sources for the CAMx modeling domain for a Thursday in June, 2005

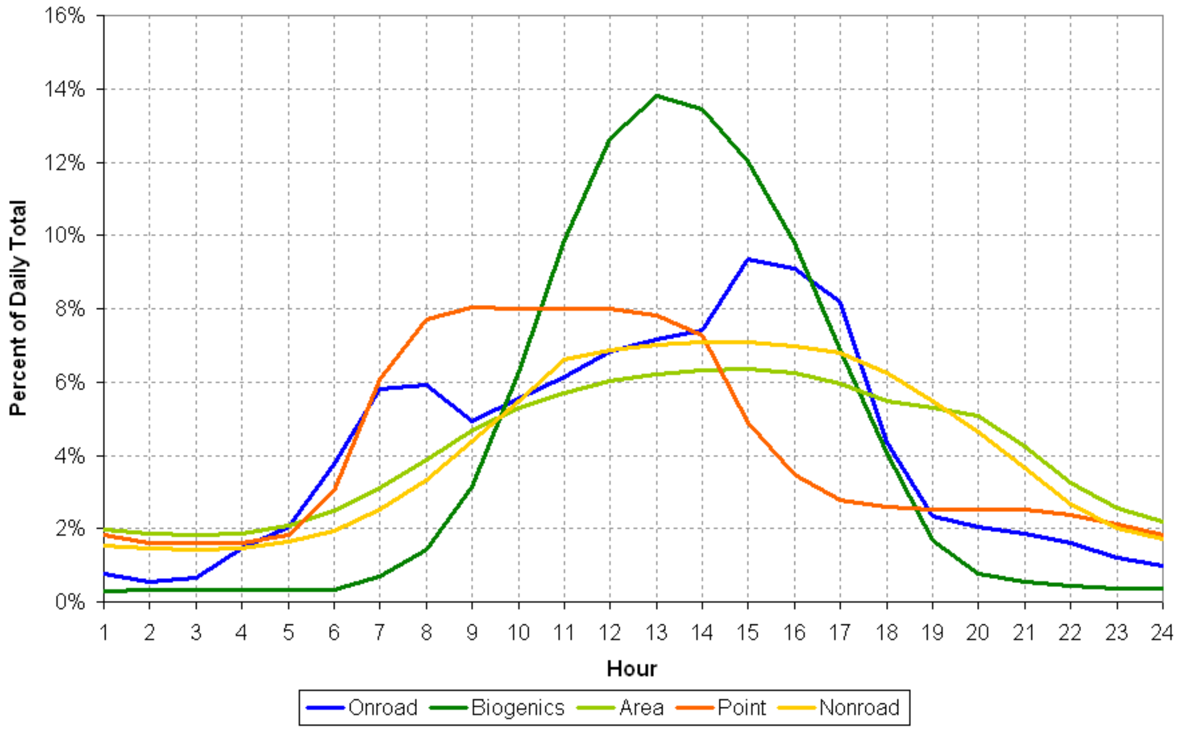


Figure IV-1(c). Temporal distribution of VOC emission sources for the CAMx modeling domain for a Tuesday in July, 2005

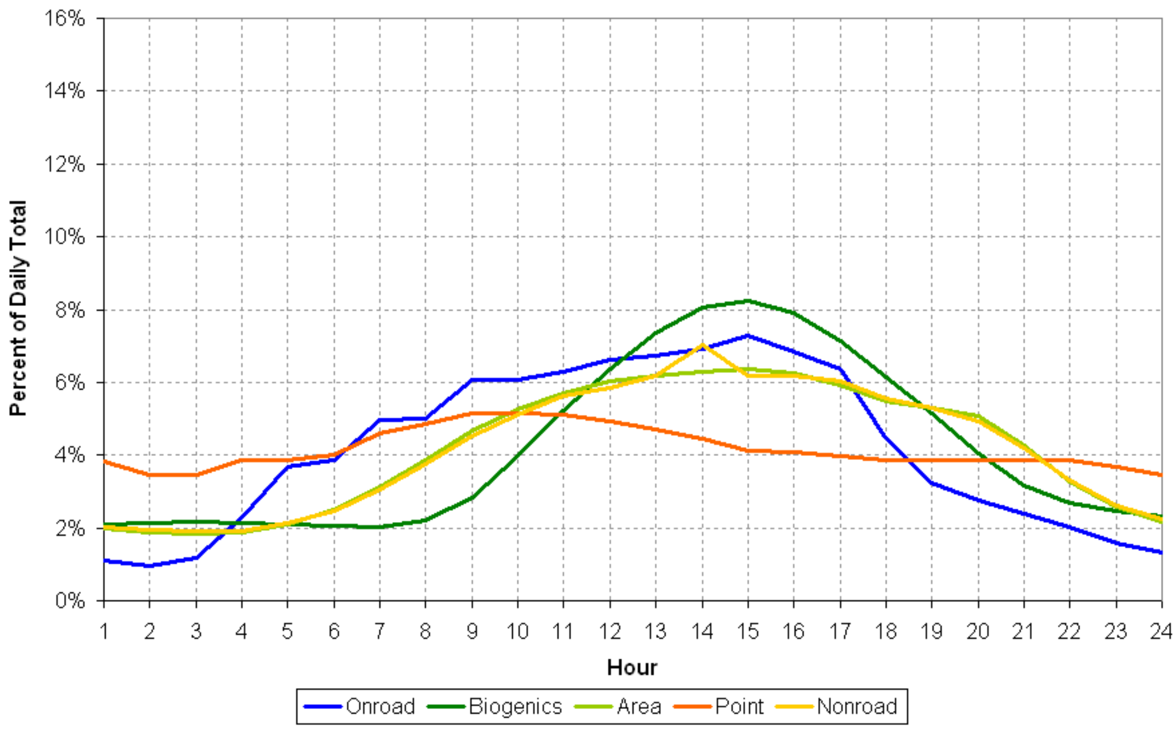


Figure IV-1(d). Temporal distribution of NOx emission sources for the CAMx modeling domain for a Tuesday in July, 2005

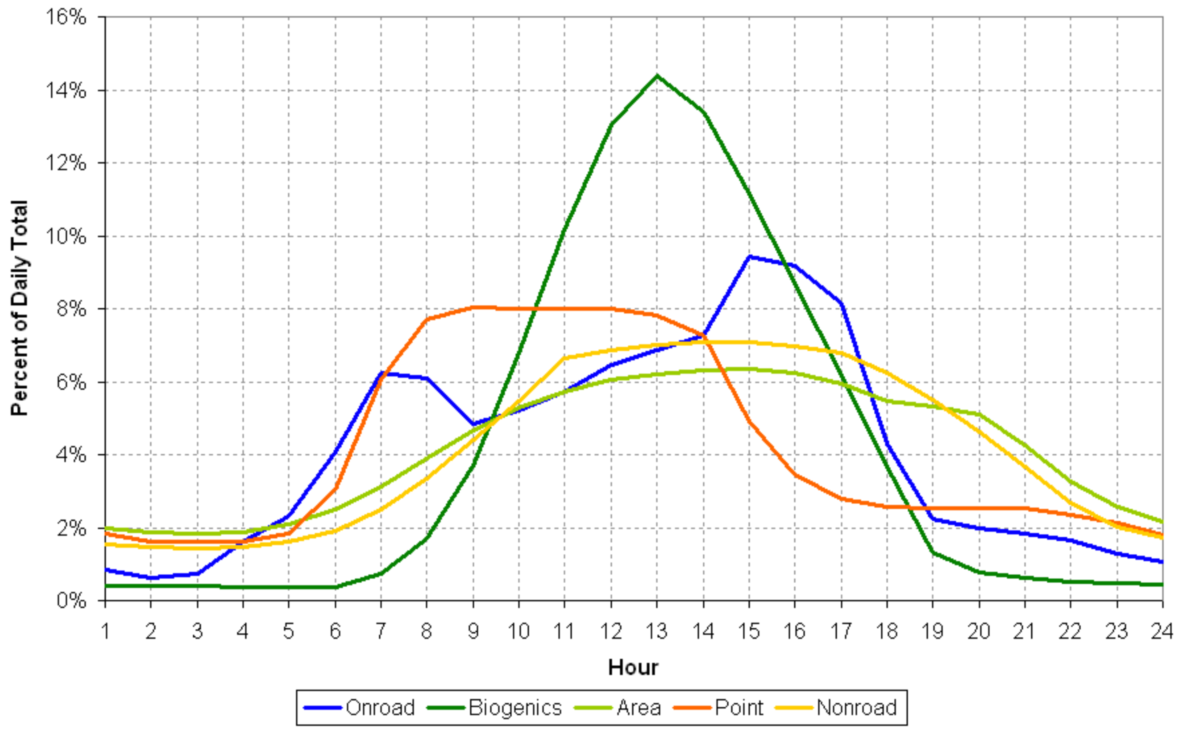


Figure IV-1(e). Temporal distribution of VOC emission sources for the CAMx modeling domain for a Friday in August, 2005

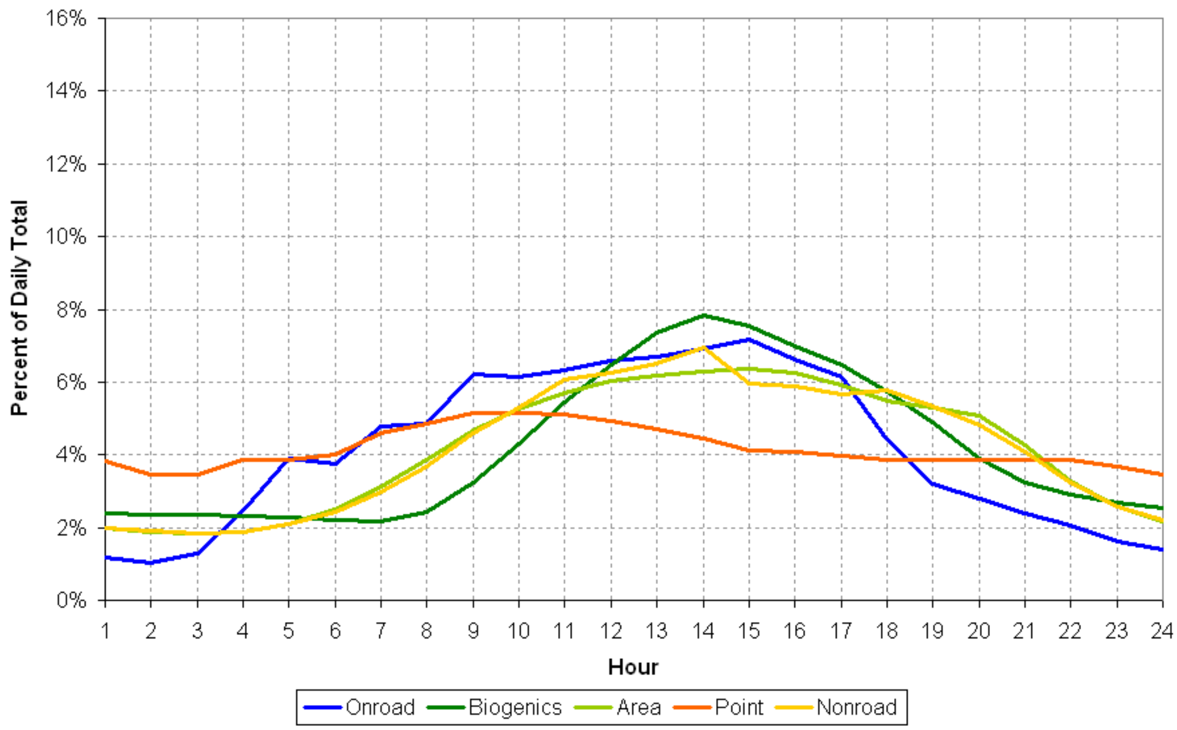


Figure IV-1(f). Temporal distribution of NOx emission sources for the CAMx modeling domain for a Friday in August, 2005

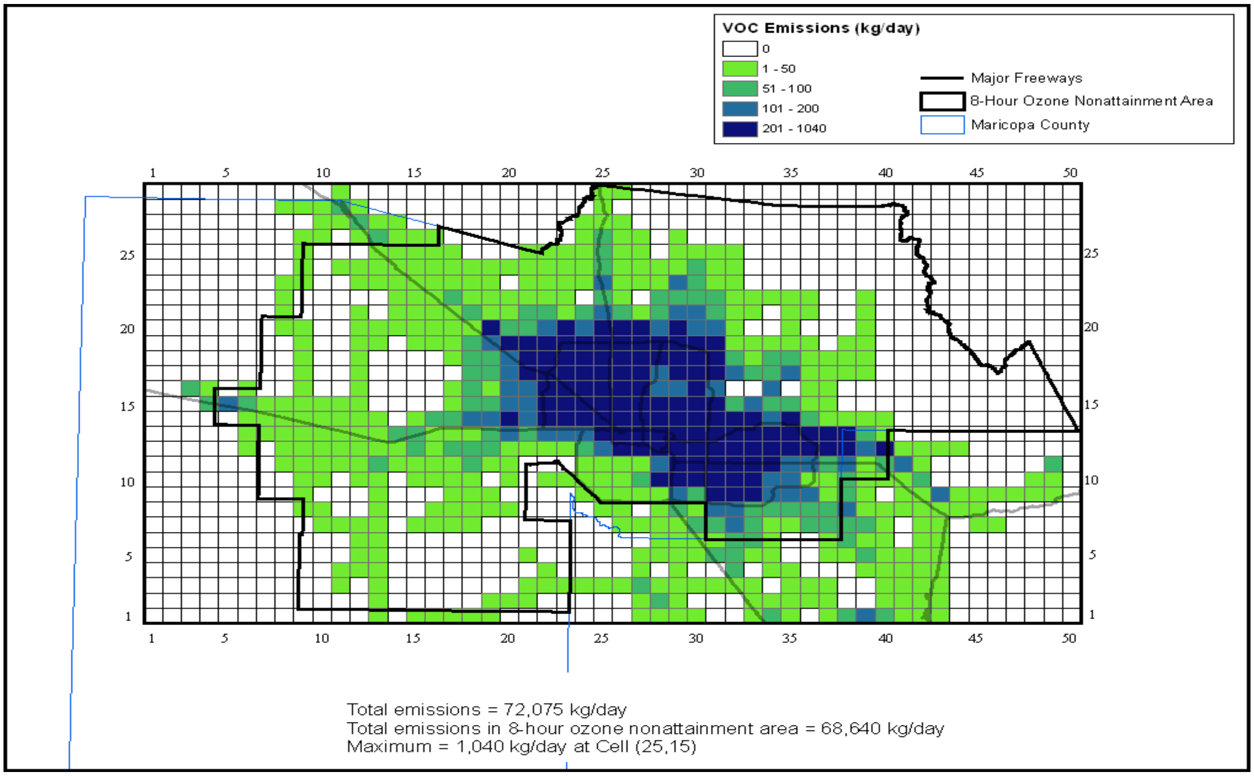


Figure IV-2(a). Onroad source VOC emissions for a Thursday in June, 2005

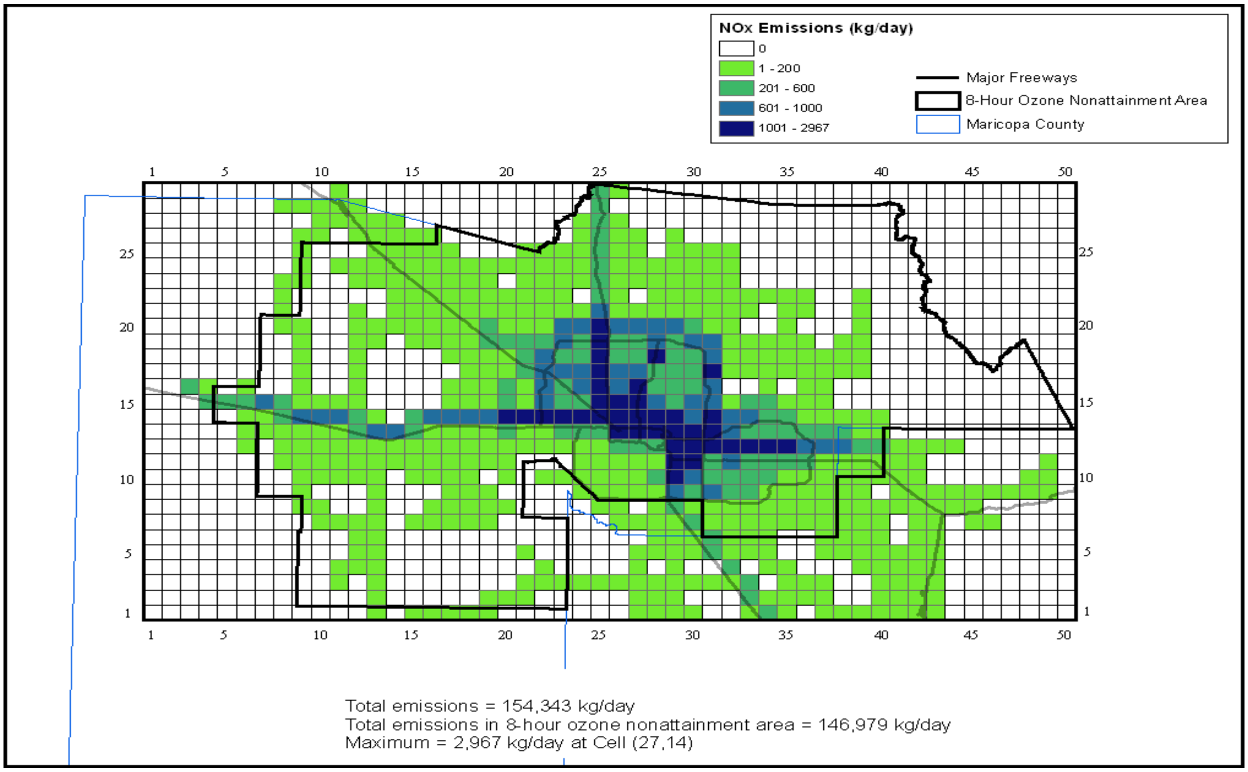


Figure IV-2(b). Onroad source NOx emissions for a Thursday in June, 2005

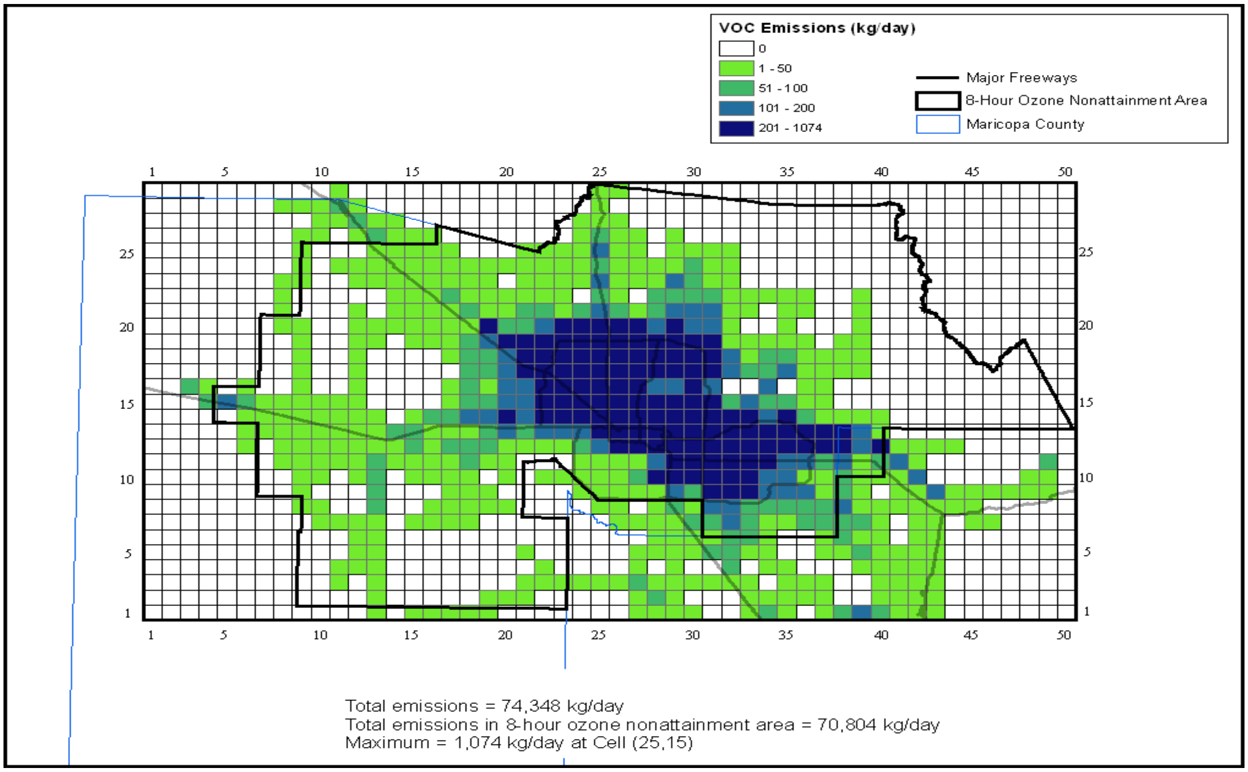


Figure IV-2(c). Onroad source VOC emissions for a Tuesday in July, 2005

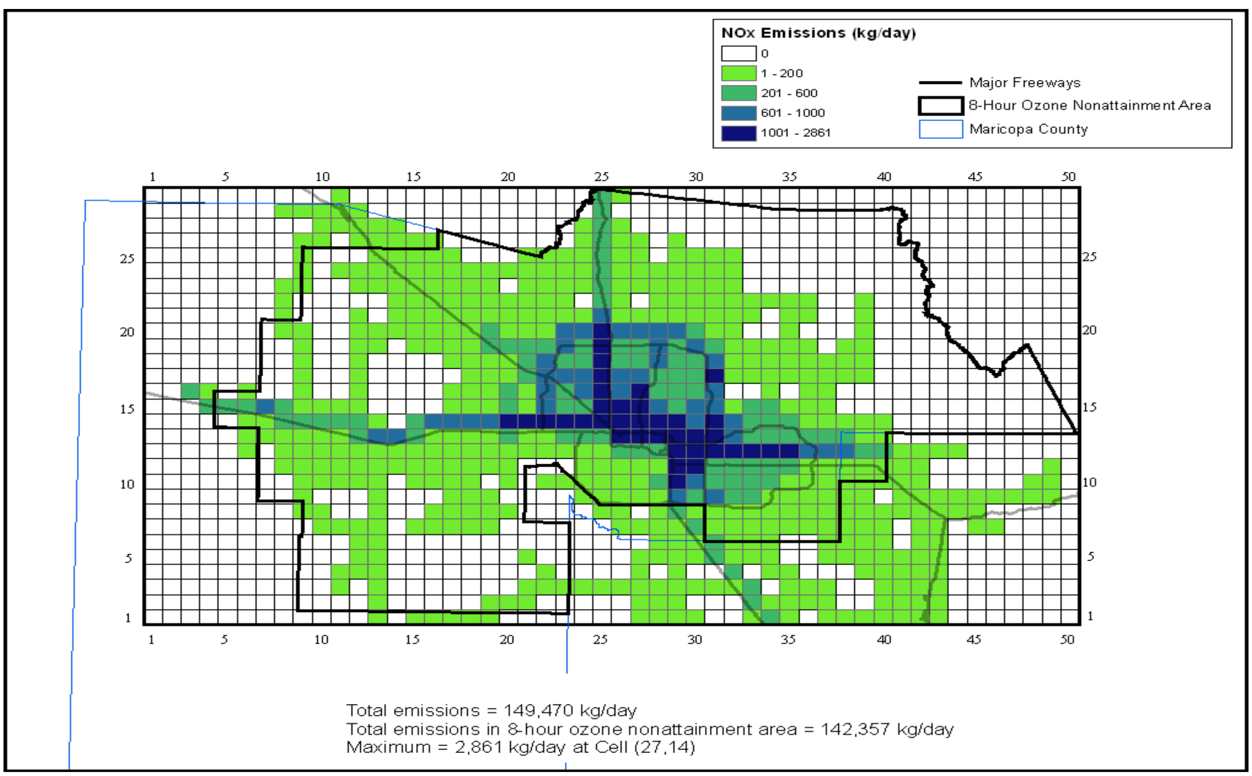


Figure IV-2(d). Onroad source NOx emissions for a Tuesday in July, 2005

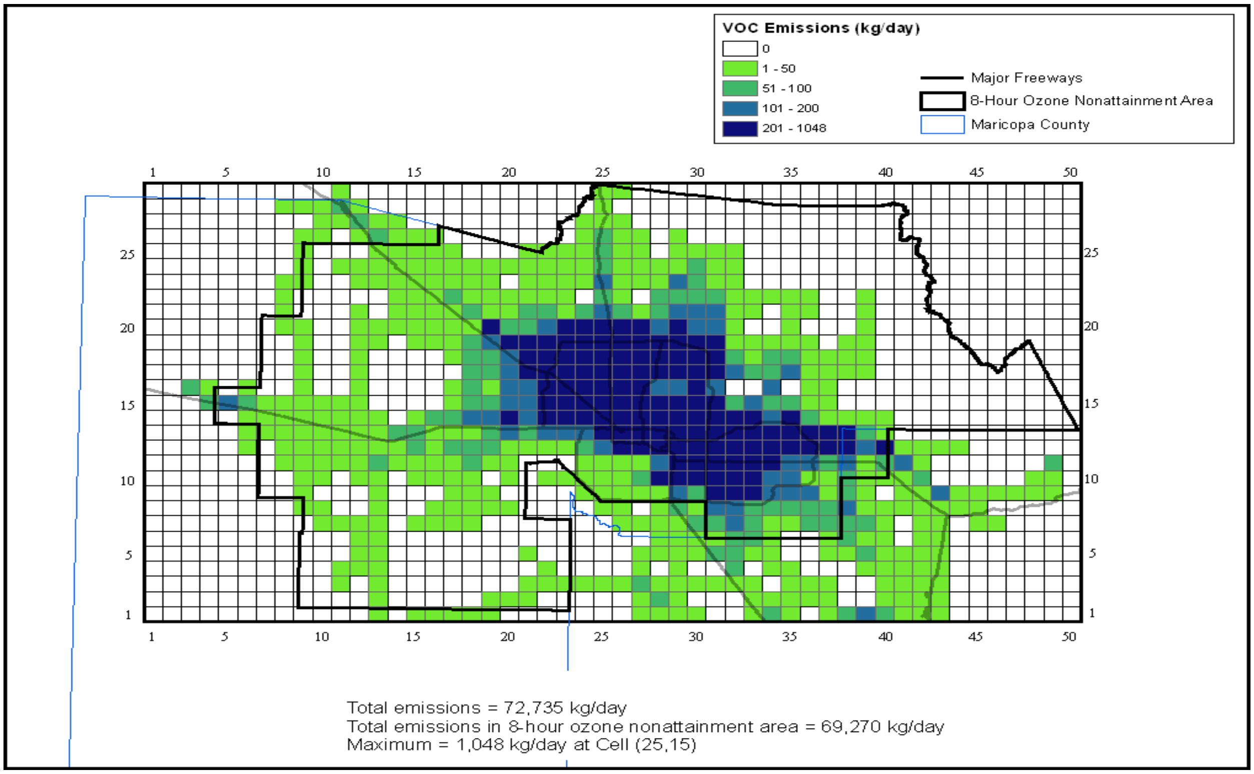


Figure IV-2(e). Onroad source VOC emissions for a Friday in August, 2005

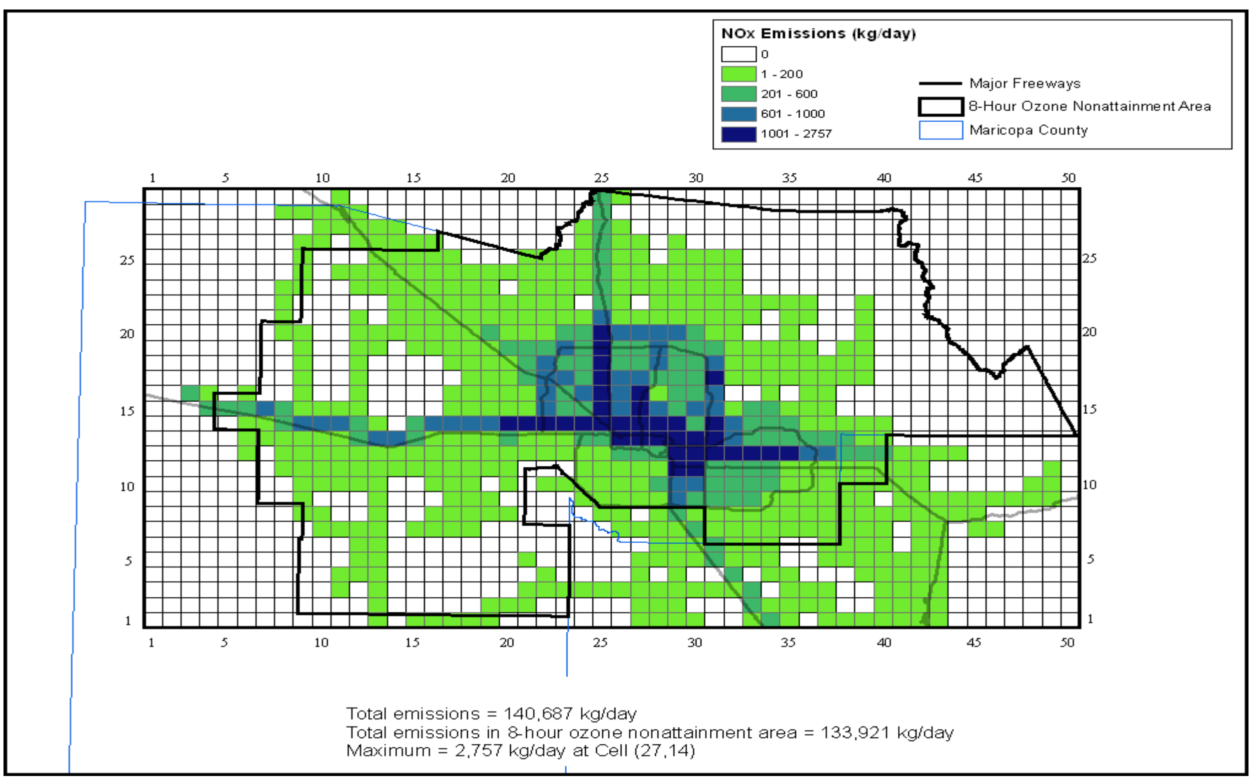


Figure IV-2(f). Onroad source NOx emissions for a Friday in August, 2005

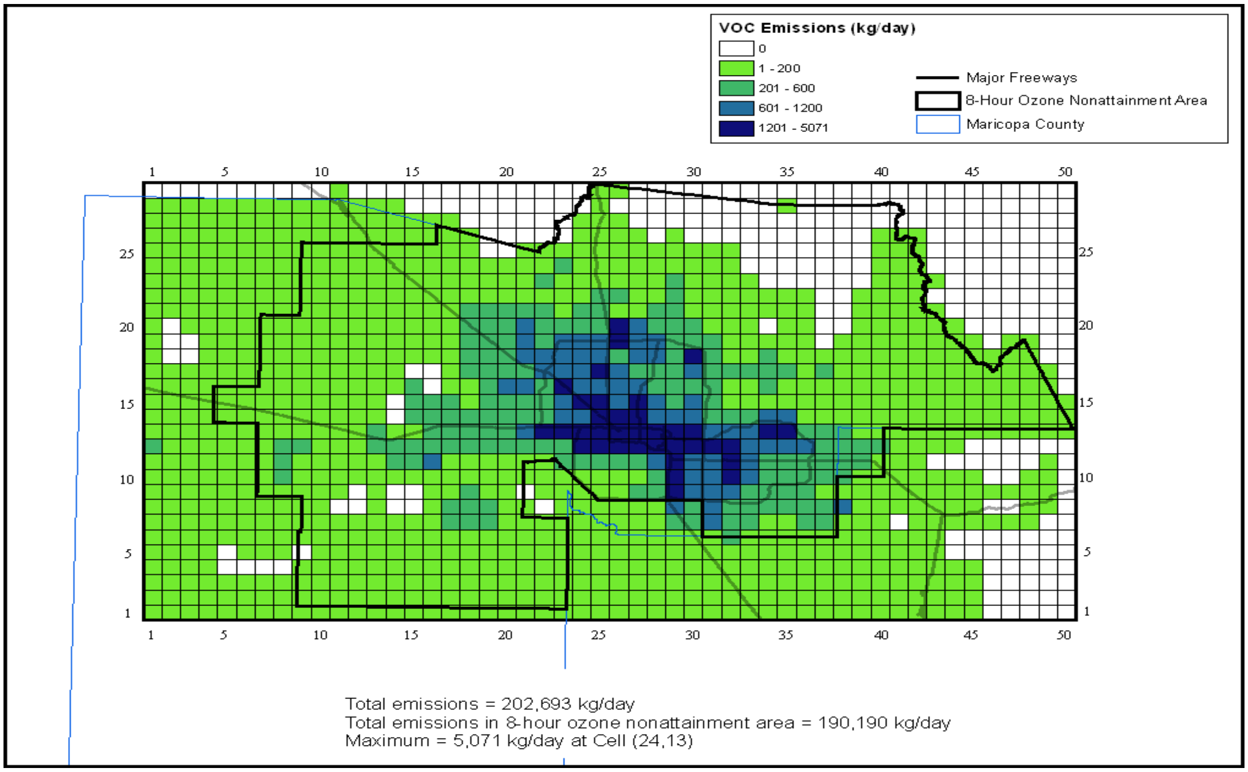


Figure IV-3(a). Anthropogenic VOC emissions for a Thursday in June, 2005

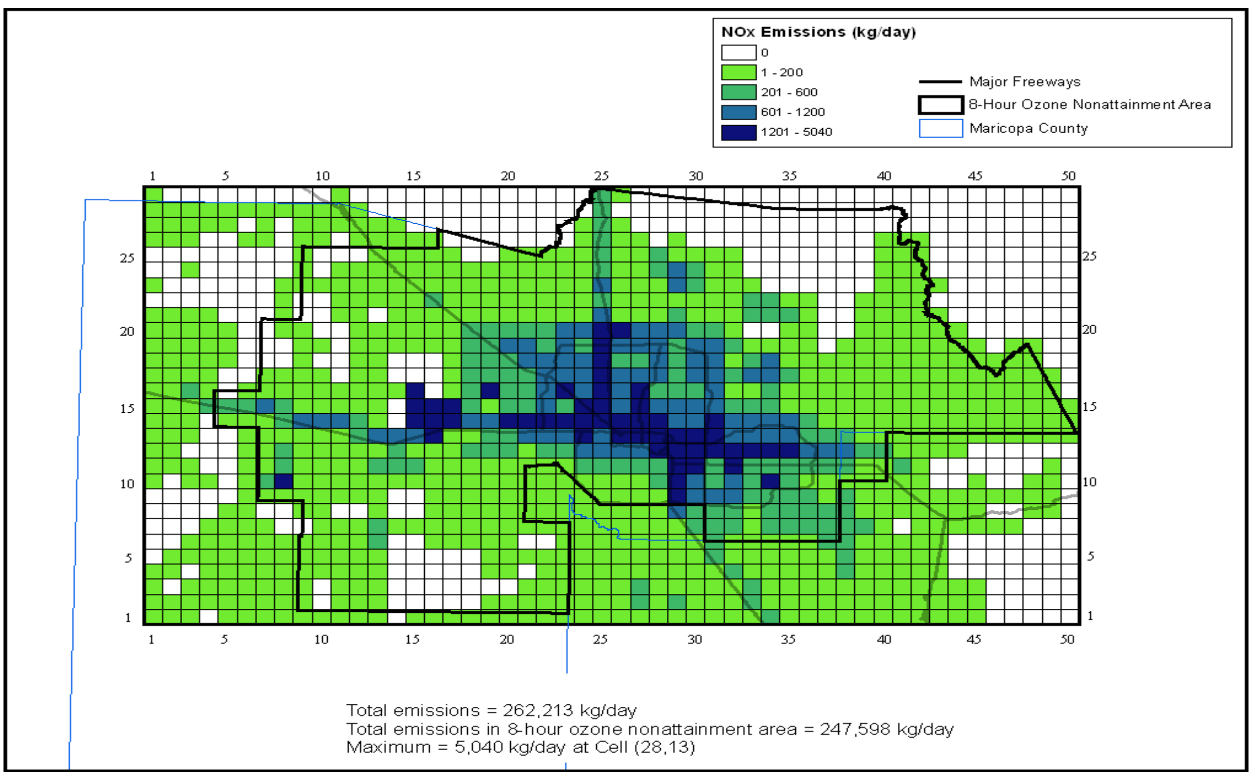


Figure IV-3(b). Anthropogenic NOx emissions for a Thursday in June, 2005

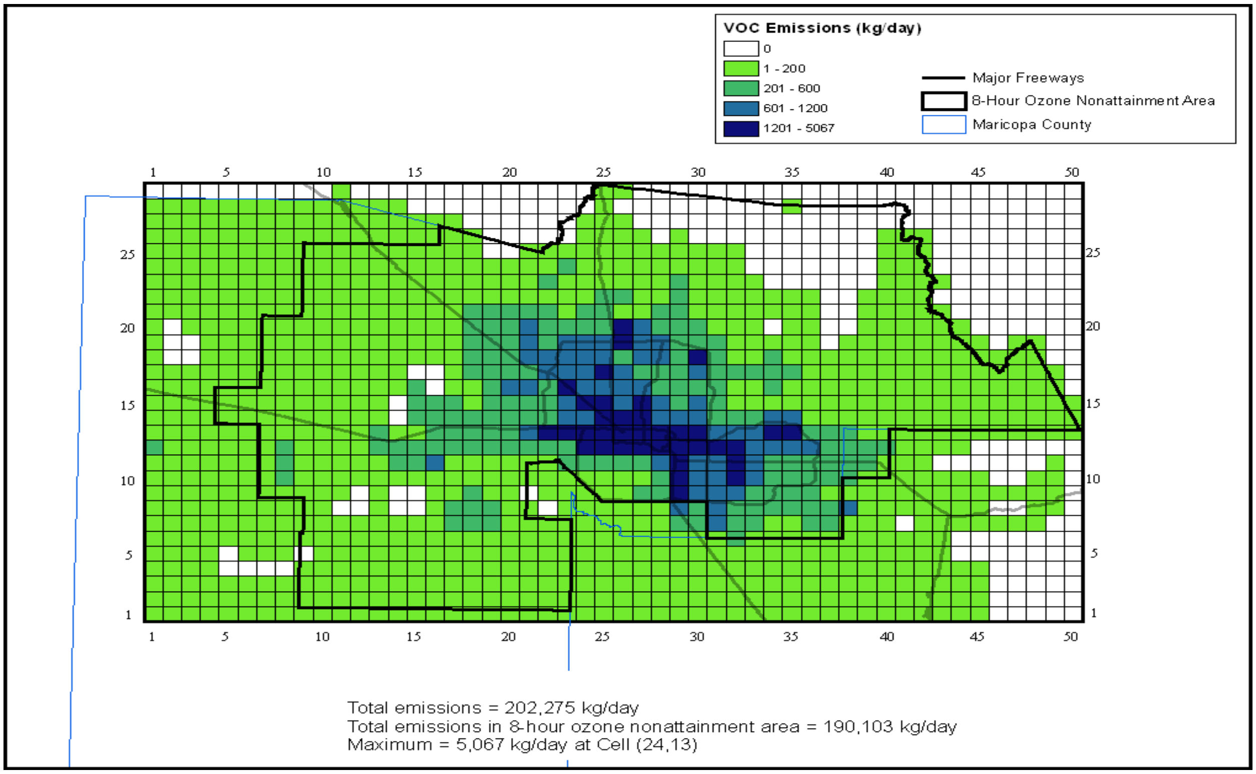


Figure IV-3(c). Anthropogenic VOC emissions for a Tuesday in July, 2005

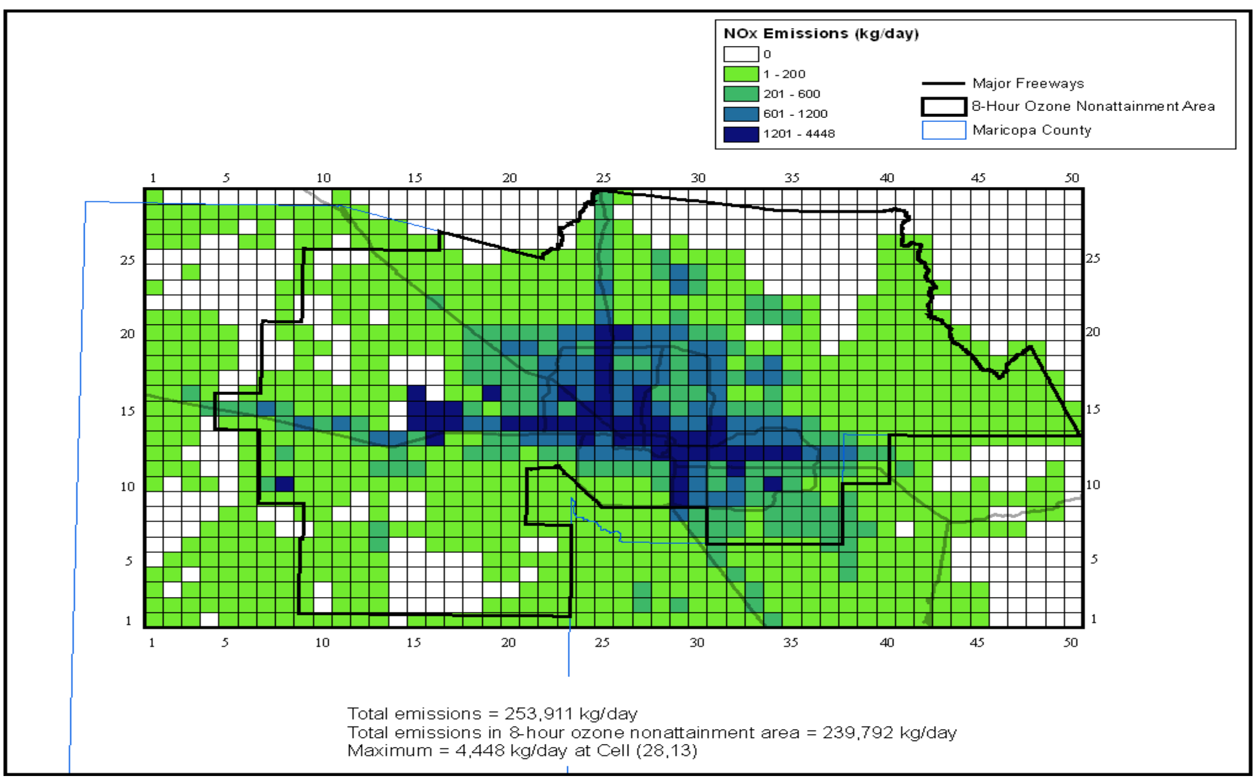


Figure IV-3(d). Anthropogenic NOx emissions for a Tuesday in July, 2005

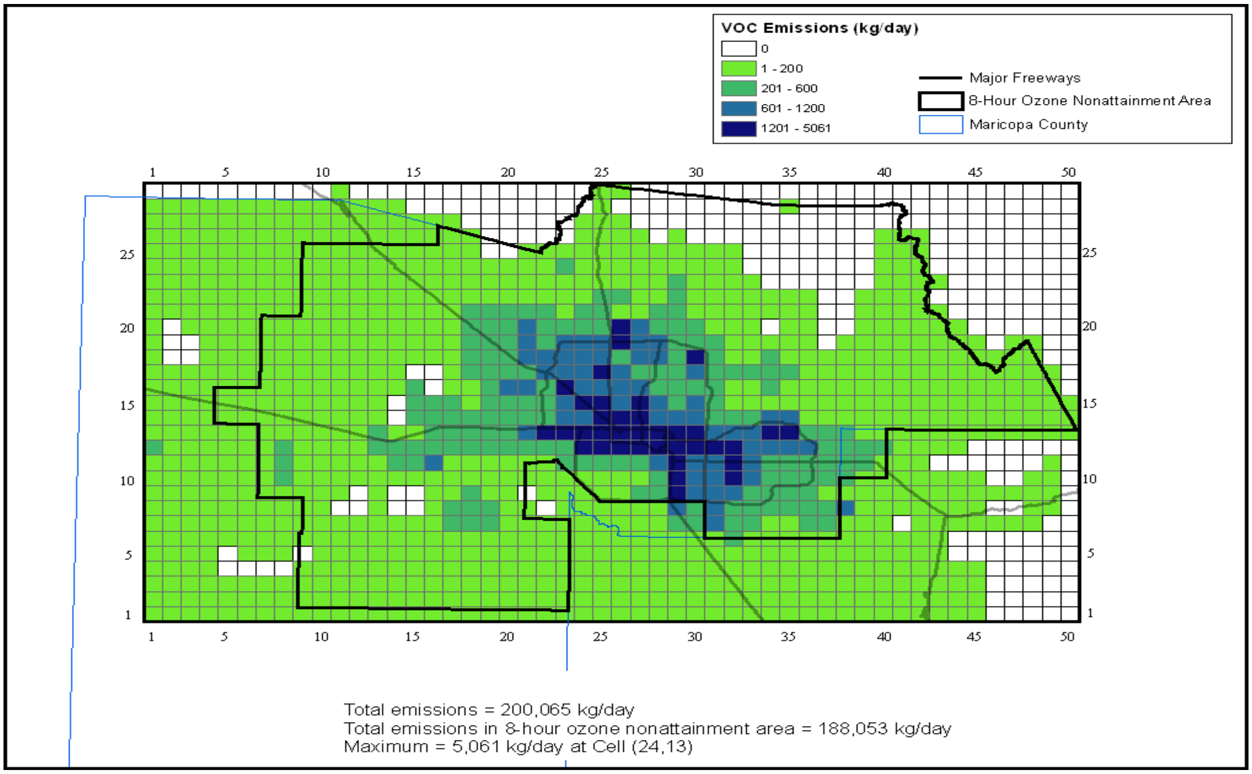


Figure IV-3(e). Anthropogenic VOC emissions for a Friday in August, 2005

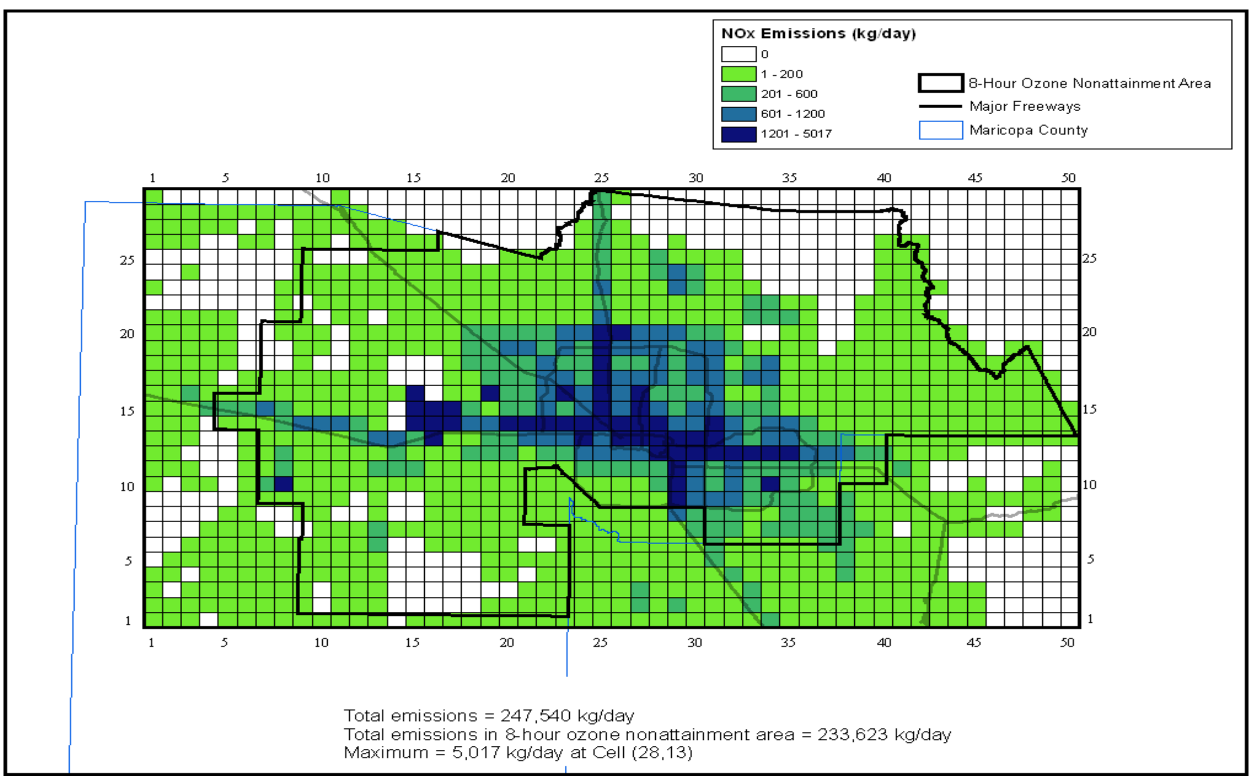


Figure IV-3(f). Anthropogenic NOx emissions for a Friday in August, 2005

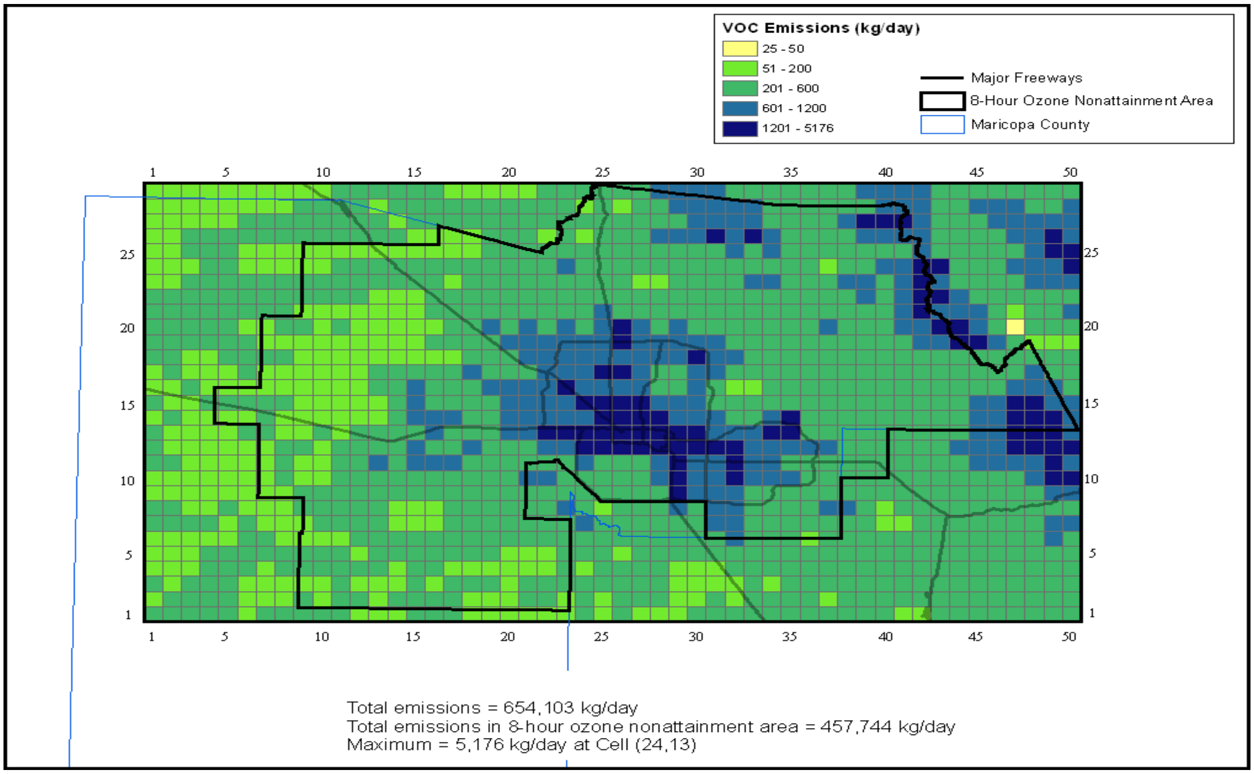


Figure IV-4(a). All source VOC emissions for a Thursday in June, 2005

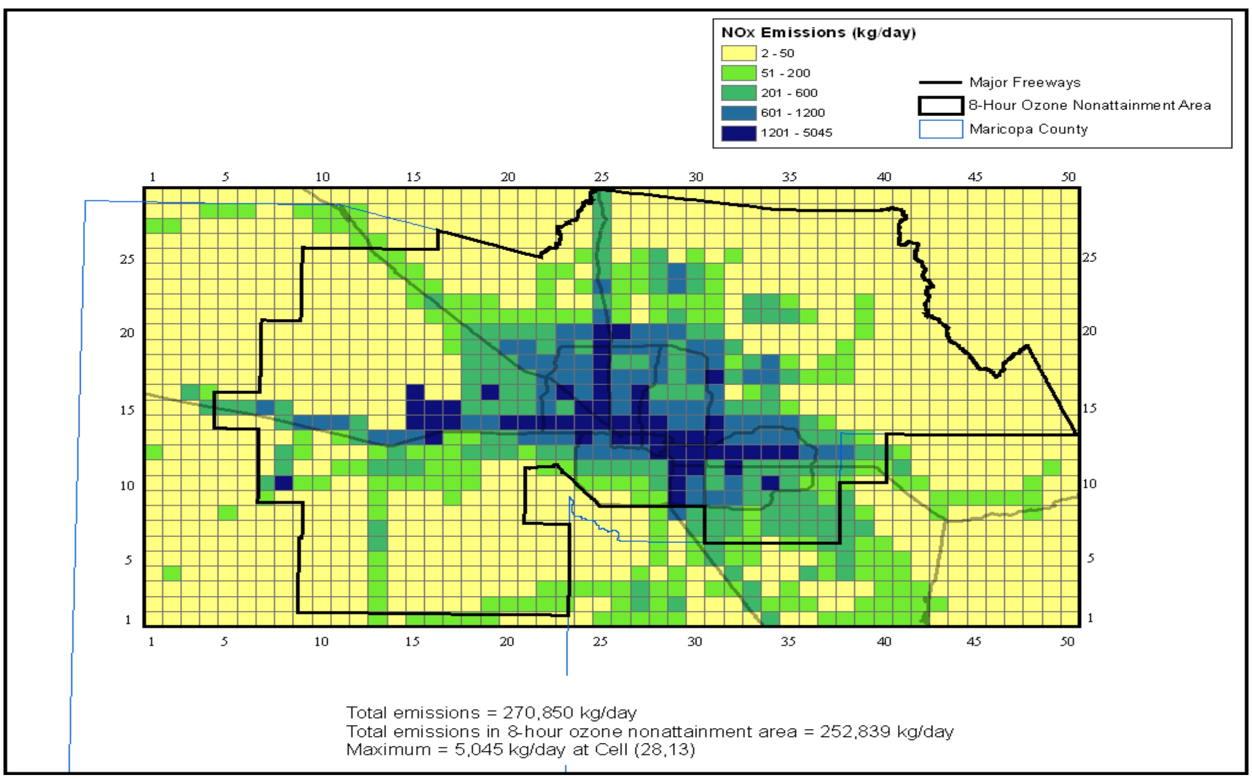


Figure IV-4(b). All source NOx emissions for a Thursday in June, 2005

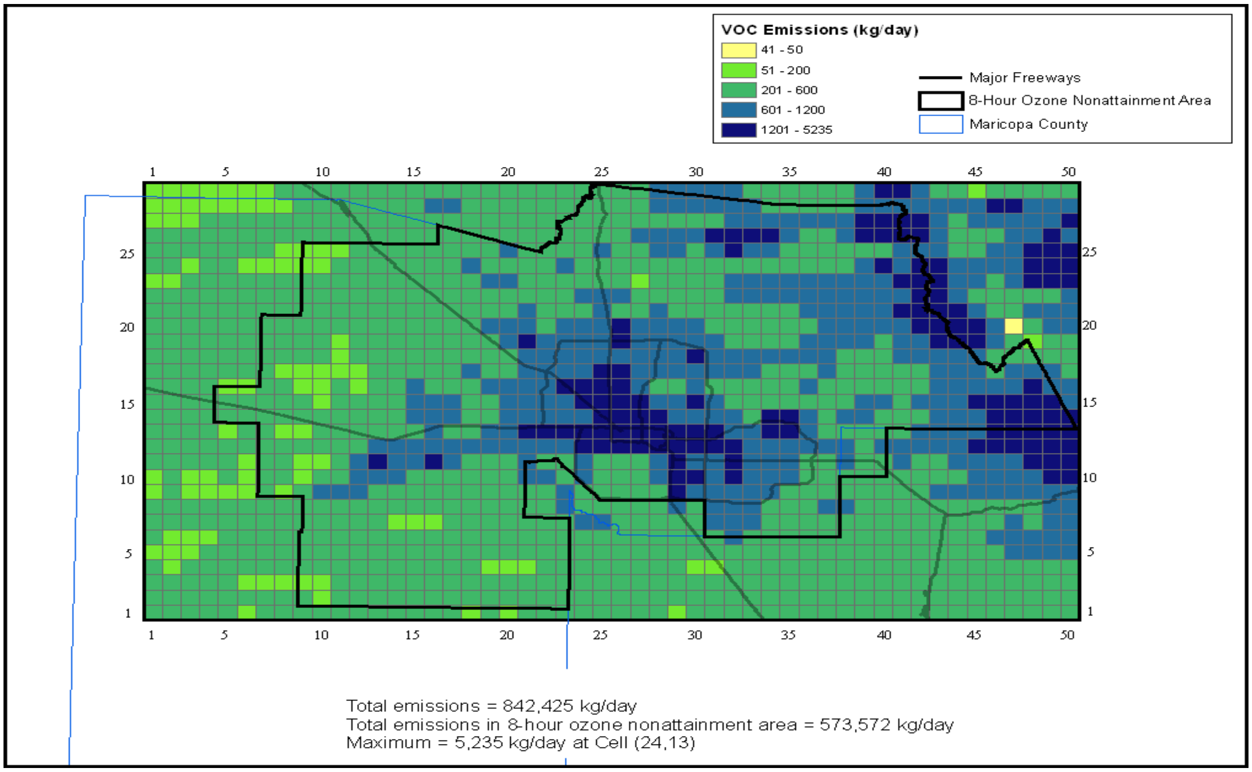


Figure IV-4(c). All source VOC emissions for a Tuesday in July, 2005

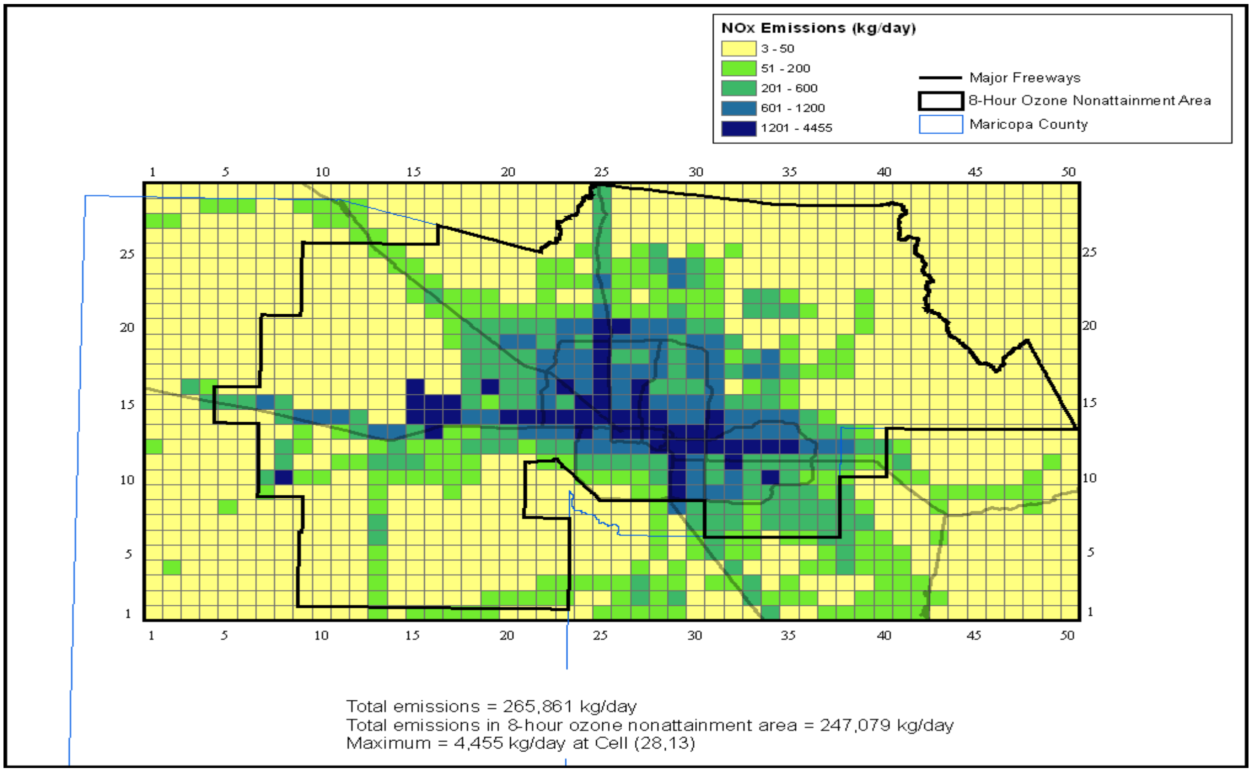


Figure IV-4(d). All source NOx emissions for a Tuesday in July, 2005

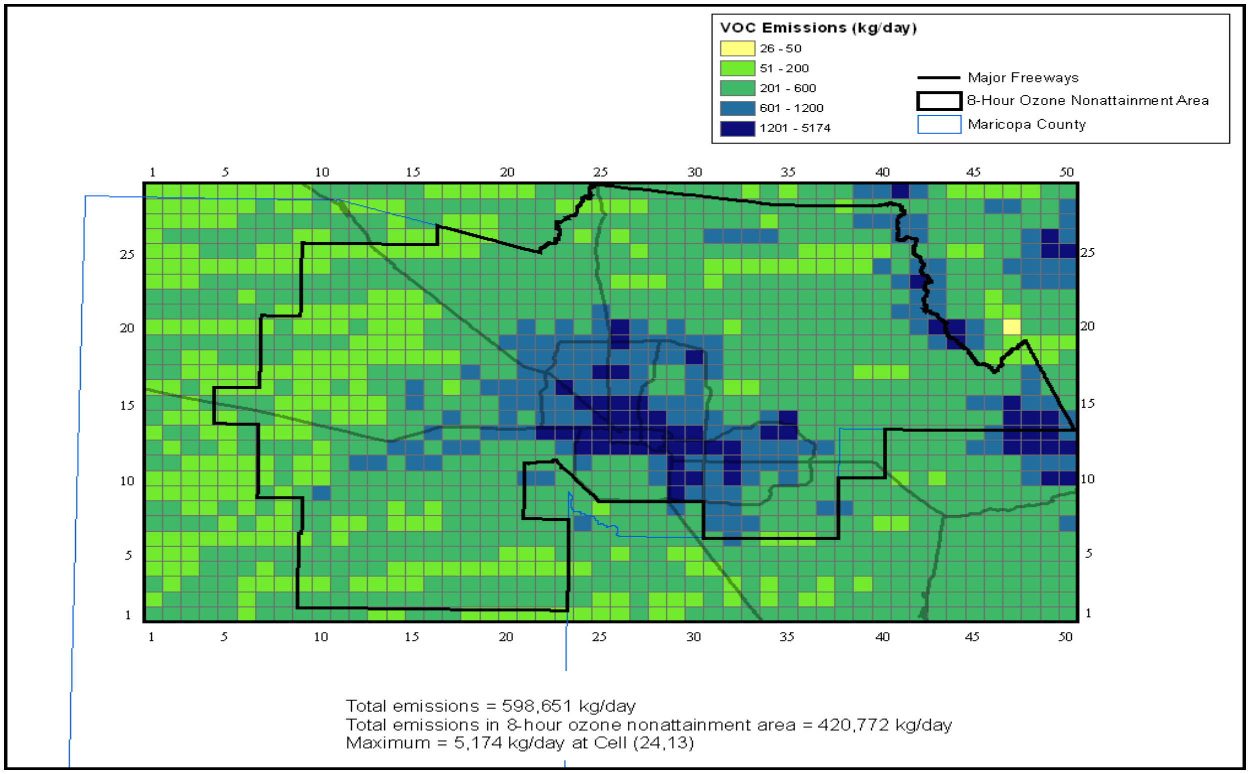


Figure IV-4(e). All source VOC emissions for a Friday in August, 2005

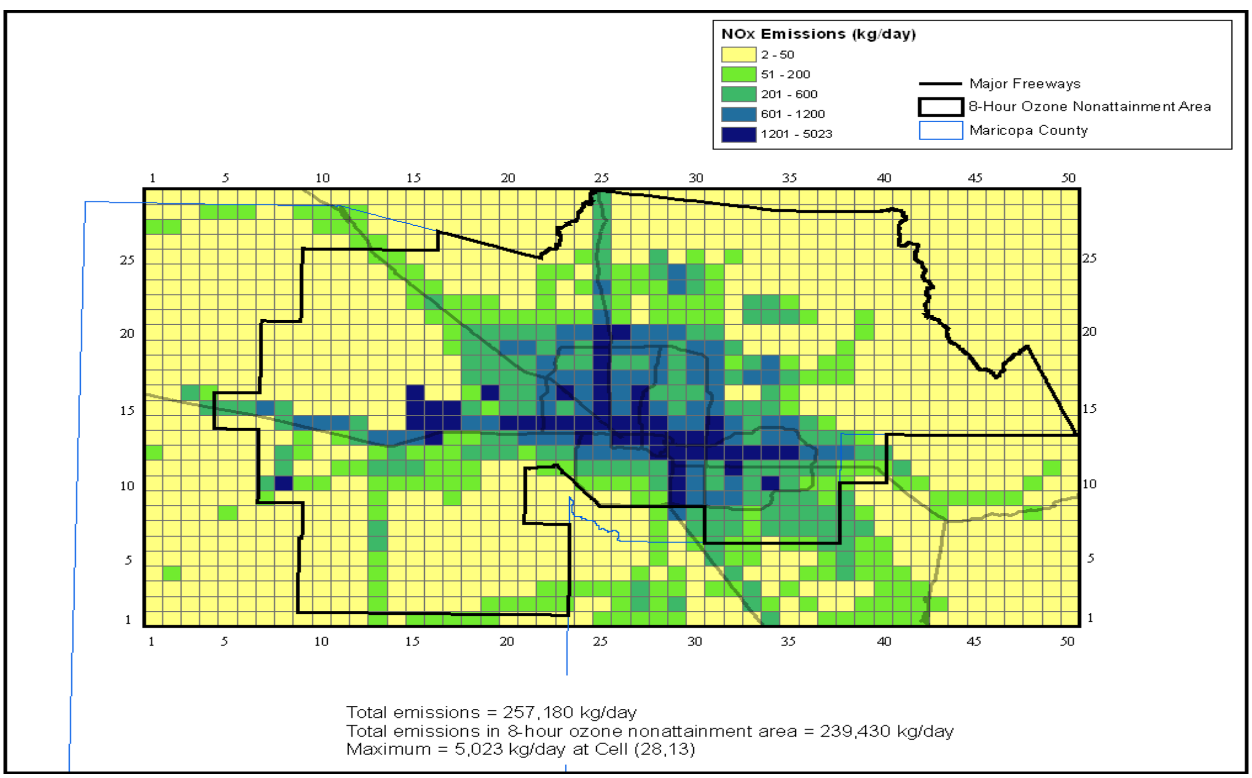


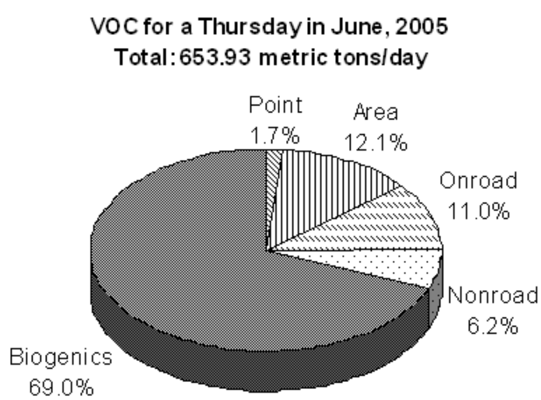
Figure IV-4(f). All source NOx emissions for a Friday in August, 2005

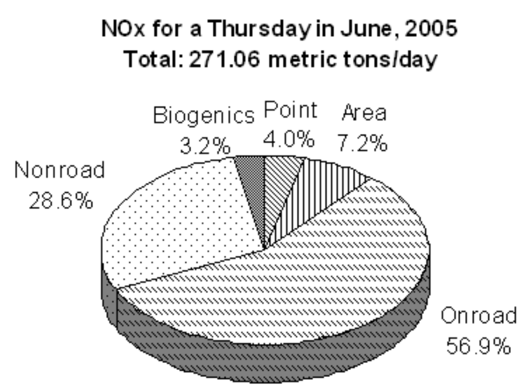
Table IV-11. Grid cell location of maximum VOC and NOx emissions (kilograms/day)

Source	Pollutant	Thursday in June, 2005	Tuesday in July, 2005	Friday in August, 2005
Onroad	VOC	1,040 (25,15)	1,074 (25,15)	1,048 (25,15)
	NOx	2,967 (27,14)	2,861 (27,14)	2,757 (27,14)
Anthropogenic	VOC	5,071 (24,13)	5,067 (24,13)	5,061 (24,13)
	NOx	5,040 (28,13)	4,448 (28,13)	5,017 (28,13)
All	VOC	5,176 (24,13)	5,235 (24,13)	5,174 (24,13)
	NOx	5,045 (28,13)	4,455 (28,13)	5,023 (28,13)

Table IV-12(a). Emission totals (metric tons/day) for a Thursday in June, 2005 for the CAMx 4 km modeling domain

Source	**VOC**	**NOx**
Point	11.10	10.93
Area	79.20	19.57
Nonroad	40.27	77.65
Onroad	72.09	154.35
Biogenic	451.27	8.56
Total	**653.93**	**271.06**

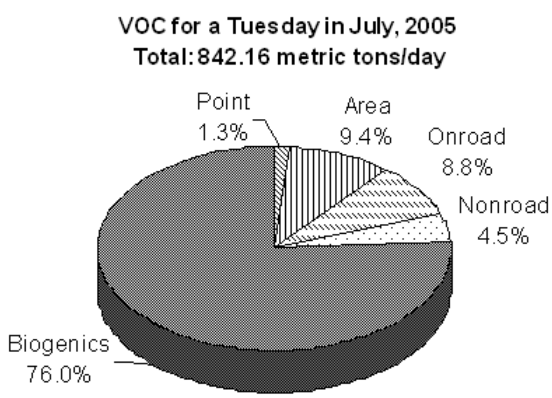


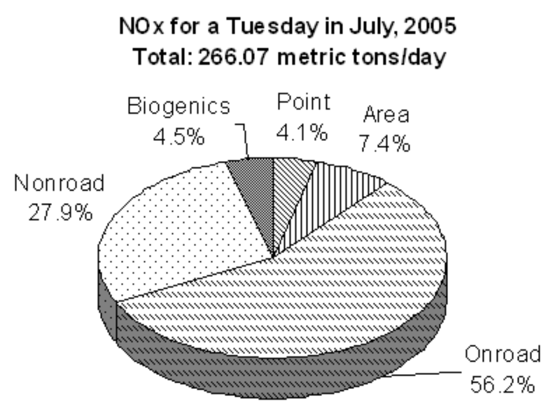


Note: The percent total may not be equal to 100% due to rounding.

Table IV-12(b). Emission totals (metric tons/day) for a Tuesday in July, 2005 for the CAMx 4 km modeling domain

Source	VOC	NOx
Point	11.10	10.93
Area	79.20	19.57
Nonroad	37.60	74.23
Onroad	74.36	149.48
Biogenic	639.90	11.86
Total	**842.16**	**266.07**

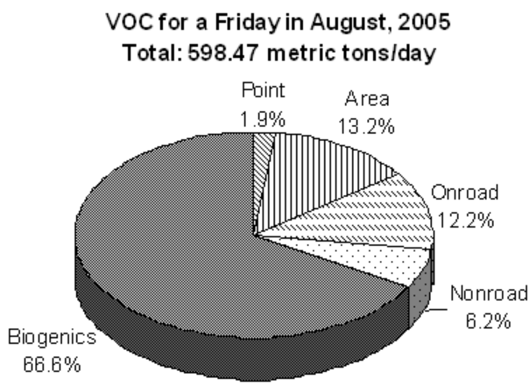


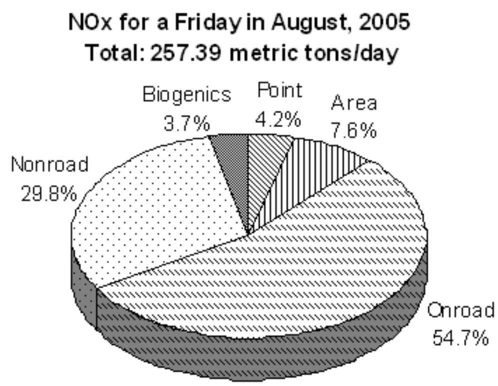


Note: The percent total may not be equal to 100% due to rounding.

Table IV-12(c). Emission totals (metric tons/day) for a Friday in August, 2005 for the CAMx 4 km modeling domain

Source	VOC	NOx
Point	11.10	10.93
Area	79.20	19.57
Nonroad	37.00	76.64
Onroad	72.74	140.69
Biogenics	398.43	9.56
Total	**598.47**	**257.39**





Note: The percent total may not be equal to 100% due to rounding.

IV-2. Future Year Emission Inventory

This section summarizes the development of the 2025 anthropogenic and biogenic emission inventories to be used in simulating the future year eight-hour ozone model predictions. The 2005 baseline emission inventories were adjusted to reflect those emissions expected to occur in 2025. The general methodology for creating the future year emission inventories was based on EPA guidance describing the preparation of emission projections (EPA, 2005). This adjustment to the 2005 baseline emission inventories entailed the use of growth factors, ongoing control programs, and retirement rates for obsolete sources of emissions. The resulting 2025 modeling inventories also reflect the maintenance measures package for VOC and NOx emission sources.

The impact of individual maintenance measures was derived by removing the maintenance measures from the 2025 emission inventories. The growth factors used for the 2025 emission inventory reflect county population and employment forecasts which are based on the 2007 MAG socioeconomic projections for Maricopa County and 2003 placeholder projections for Pinal County. The 2025 emission inventory includes projected emission reductions resulting from the emission control measures described in Section IV-7. The 2025 emission inventories do not take credit for the emission reductions attributable to the contingency measures discussed in Sections IV-7 and 8.

IV-2-1. Emissions for the CAMx 12 km Domain

ENVIRON developed county-level ozone precursor emission estimates for the calendar year 2025 by linearly extrapolating the 2002 and 2018 WRAP emissions data in support of the MAG air quality modeling efforts. The 2025 emission estimates include stationary area, onroad, nonroad, and stationary point sources for all counties within the CAMx 12 km modeling domain. The 2002 biogenic source emissions data for the 12 km regional modeling domain were also used for 2025. All point source emissions for 2025 were held constant at 2018 levels, and all source emissions for Mexico were also held constant at 2018 levels. Tables IV-13(a) through 13(b) present 2025 average daily VOC and NOx emissions by source category and state provided by ENVIRON. Detailed descriptions of the development of the 12 km emission inventories are available in ENVIRON's memorandum dated May 5, 2008, which is available in Appendix IV-v.

Table IV-13(a). Summary of 2025 weekday VOC emissions for the CAMx 12 km modeling domain (metric tons/day)

State	Area	Onroad	Nonroad	Point
Arizona	476.66	69.40	105.36	23.99
California	505.97	133.44	142.84	76.62
Colorado	15.36	3.05	4.71	5.61
Nevada	82.56	17.92	21.12	2.18
New Mexico	577.75	22.88	20.82	45.42
Texas	17.95	27.83	4.71	2.60
Utah	17.29	5.14	6.42	1.05
Total	**1,693.54**	**279.66**	**305.98**	**157.47**

Table IV-13(b). Summary of 2025 weekday NOx emissions for the CAMx 12 km modeling domain (metric tons/day)

State	Area	Onroad	Nonroad	Point
Arizona	23.83	60.78	116.56	159.84
California	153.57	185.32	223.33	166.71
Colorado	15.04	3.35	5.96	9.89
Nevada	5.49	7.59	24.31	52.61
New Mexico	219.39	33.45	51.66	89.95
Texas	3.28	10.28	3.47	7.38
Utah	0.76	6.62	3.40	2.29
Total	**421.36**	**307.39**	**428.69**	**488.67**

IV-2-2. Emissions for the CAMx 4 km Domain

IV-2-2-1. Onroad Mobile Source Emissions

The onroad mobile source emissions for the 2025 future year were obtained from the EPA MOBILE6.2 model and M6Link. MOBILE6.2 was run to derive 2025 onroad motor vehicle emission factors in the MOBILE6.2 database output format for each episode day of 2025. The updated MOBILE6.2 input parameters for the I/M and anti-tampering programs, which were suggested by ADEQ, were used in deriving the 2025 onroad emissions.

M6Link was run to process the 2025 emission factors and 2025 traffic assignment data that were developed by the MAG transportation model. The output from M6Link is hourly gridded and chemically speciated onroad source emissions for each episode day of 2025. Appendix IV-vi presents a detailed description of the emission factor estimation procedure for 2025.

The 2025 emission inventory reflects the impact of the maintenance control measures used for numeric credit, as documented in Section IV-7. This section presents a brief description of how the onroad source control measures in the maintenance package were quantified for 2025. Onroad source emissions were adjusted to reflect these control 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 the fraction of tested vehicles that receive waivers from the I/M program. The “One-Time Waiver from Vehicle Emissions Test” control measure was modeled by changing the waiver rates to reflect the effect of this measure in Area A.

- The output from MOBILE6.2 runs for the I/M versus non-I/M cases were 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 “Tougher Enforcement of Vehicle Registration and Emission Test Compliance” control measure in Area A.

- MOBILE6.2 runs for both the I/M and non-I/M cases reflect the properties of the gasoline used by vehicles in the modeling area to quantify the effects of the “Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30" control measure in Area A.

- MOBILE6.2 runs for the I/M scenario included data inputs on the nature of the I/M program itself. In the case of enhanced I/M programs, these data included the emission levels allowed by the program (cutpoints) before a vehicle is failed for excessive emissions. The benefits from the ”Phased-In Emission Test Cutpoints” control measure 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 onroad source emission factors for the 2025 maintenance 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, that went into effect in 2006, were modeled as a contingency measure in this Plan.

- The onroad source emission factors for the Stage II Vapor Recovery Program in Area A were derived from MOBILE6.2 with the "Stage II Refueling Program". The program started in 1994 and was phased in over one year. An efficiency of 46 percent was assumed for LDGVs, LDGTs, and HDGVs (Yantorno, 2007).

Table IV-14 summarizes the future year onroad emissions by species for each episode. Due to a revision to the Arizona State Implementation Plan (ADEQ, 2006), credit for motorcycle I/M was not taken in the 2025 maintenance demonstration. The 2025 onroad VOC and NOx emissions were increased by ten percent to create a safety margin for the conformity budgets.

Table IV-14. Summary of the future year onroad emissions for the CAMx 4 km modeling domain

Episode	Date	2025 Onroad Emissions (metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	53.2	120.2
	June 1 (Saturday)	36.4	78.8
	June 2 (Sunday)	28.2	62.1
	June 3 (Monday)	45.4	104.5
	June 4 (Tuesday)	47.2	106.8
	June 5 (Wednesday)	48.7	108.8
	June 6 (Thursday)	47.9	109.8
	June 7 (Friday)	49.4	113.3
July 2002	July 5 (Friday)	48.6	104.4
	July 6 (Saturday)	31.1	65.8
	July 7 (Sunday)	27.9	58.2
	July 8 (Monday)	47.1	102.1
	July 9 (Tuesday)	48.2	105.8
	July 10 (Wednesday)	49.6	107.3
	July 11 (Thursday)	50.9	108.8
	July 12 (Friday)	49.3	104.3
	July 13 (Saturday)	32.0	65.7
	July 14 (Sunday)	27.6	57.9
August 2001	August 2 (Thursday)	51.2	105.6
	August 3 (Friday)	48.9	105.0
	August 4 (Saturday)	36.3	74.3
	August 5 (Sunday)	28.5	59.5
	August 6 (Monday)	48.1	102.3
	August 7 (Tuesday)	48.8	101.8
	August 8 (Wednesday)	45.6	98.9
	August 9 (Thursday)	47.7	101.2
	August 10 (Friday)	48.6	104.0
	August 11 (Saturday)	35.5	72.7

IV-2-2-2. Biogenic Emissions

The same biogenic emissions estimated for the June, July, and August episodes of 2001 and 2002 in the Eight-Hour Ozone Plan (MAG, 2007a) were assumed for the June, July, and August episodes of 2025 in this eight-hour ozone maintenance demonstration. The biogenic emissions used for each episode day of 2025 are presented in Tables II-2(a) through 2(c) in Section III.

IV-2-2-3. Nonroad Source Emissions

Monthly temperature and fuel-related inputs were used to generate 2025 nonroad source emissions by month with the EPA NONROAD2005 model. Table IV-15 provides the temperature and fuel related inputs that were used. The temperatures and the Reid Vapor Pressures (RVP) are the same as were used to generate 2005 nonroad emissions. Due to more stringent federal standards, the sulfur content of gasoline and diesel fuels is lower in 2025, but the reduced sulfur contents do not reduce VOC and NOx emissions from nonroad equipment.

As mentioned in Section IV-1-2-3, Maricopa County-specific equipment population and activity levels were applied to estimate the 2025 emissions for commercial lawn and garden equipment. Other 2025 equipment population and activity levels for Maricopa County were derived from EPA defaults in the NONROAD2005 model. The NONROAD2005 model applied 2025 technology, emission factors, and growth factors to estimate the 2025 nonroad emissions. Table IV-16 provides the growth factors that the NONROAD model applied by equipment category for 2025, relative to the baseline year of 2005.

Table IV-15. 2025 temperature and fuel-related inputs to the NONROAD2005 model

Month	Temperature (°F)			Fuel RVP (psi)	Diesel Sulfur (ppm)	Gasoline Sulfur (ppm)
	Maximum	Minimum	Average			
May	109	60	82.7	7	15	30
June	114	71	90.4	7	15	30
July	116	79	97.3	6	15	30
August	113	72	92.2	7	15	30

Table IV-16. NONROAD model growth factors by equipment category

NONROAD Category	Growth Factor (2025/2005)
Construction & Mining Equipment	1.3914
Agricultural Equipment	1.4516
Industrial Equipment	1.4537
Lawn and Garden Equipment	1.3985
Commercial Equipment	1.5978
Logging Equipment	1.6242
Railroad Equipment	1.4023
Recreational Equipment	1.1594
Oil Field Equipment	1.0276

Locomotive Emissions

To be consistent with the assumption used in the Five Percent Plan for PM-10 (MAG, 2007b), no growth in locomotive activities and emissions was assumed beyond the baseline year of 2005. The 2025 summer season locomotive emissions are summarized in Table IV-17.

Table IV-17. Summer 2025 locomotive emissions (metric tons/season) in Maricopa County

Locomotive Type	VOC	NOx
Haul Line (Class I)	21.70	586.23
Yard/Switching Operations (Class II)	4.80	82.87

Aviation Emissions

The same methodology that was used in estimating aviation emissions for the baseline year 2005 was used to calculate the 2025 aviation emissions (see Section IV-1-3). However, predicted operation data at each airport for the future year are required by the MAG Airport Emissions Model as inputs in estimating the 2025 aviation emissions. The 2025 operational predictions for the fourteen non-military airports were obtained from MAG Regional Aviation System Plan Update 2006 (MAG, 2006). The 2025 annual airport operational prediction for Luke AFB was estimated by multiplying the 2005 annual airport operations (MCAQD, 2008) by a ratio of the number of the F-16 and F-35 aircrafts in 2025 to the number of F-16 aircrafts in 2005. Luke AFB provided MAG with annual and daily average sorties, and the numbers of F-16 aircrafts in 2005 and F-16 and F-35 aircrafts in 2025 (FAORB, 2007). The 2005 historical operations and total projected operations at each airport in 2025 are provided in Table IV-18.

The 2025 aircraft emissions for Luke AFB were estimated by multiplying the 2005 aircraft emissions for Luke AFB (MCAQD, 2008) by a ratio of the F-16 and F-35 aircraft emissions in 2025 to the F-16 aircraft emissions in 2005. The F-16 aircraft emissions were derived using the F-16 emission rates of the MAG aviation model (SAI, 1996) and daily average sorties (FAORB, 2007) and the F-35 aircraft emissions were calculated based on the F-35 emission rates (USAF, 2008) and daily average sorties (FAORB, 2007). Tables IV-19(a) through 19(c) provide summaries of the aviation emissions by airport for the peak ozone day in each of the three ozone episodes in 2025.

Table IV-18. Airport operations in 2005 and 2025 (operations/year)

Airport	2005	2025
Buckeye	90,000	215,200
Chandler	227,150	514,500
Estrella	16,500	16,500
Glendale	128,884	197,000
Luke Air Force Base[1]	119,000	110,990
Memorial	2,300	5,500
Mesa Falcon Field	257,028	472,100
Phoenix Deer Valley	358,213	640,600
Phoenix Goodyear	96,211	334,200
Phoenix Sky Harbor[2]	559,887	724,400*
Pleasant Valley	52,000	134,300
Scottsdale	212,153	262,600
Sky Ranch Carefree	4,732	13,000
Stellar Airpark	40,880	78,400
Williams Gateway	261,021	420,300
Total	2,306,959	4,028,600

[1] The 2005 annual airport operations for Luke AFB were obtained from the 2005 PEI for ozone precursors and the 2025 annual airport operations for Luke AFB were projected by multiplying the 2005 airport operations by the ratio of F-16 and F-35 aircrafts in 2025 to F-16 aircrafts in 2005.

[2] The 2025 operations projection for Phoenix Sky Harbor International airport uses the commercial operations projection from Scenario 1 (MAG RASP 2006). Scenario 2 in the MAG RASP 2006 indicated that total operations are 892,100 in 2025.

Table IV-19(a). Summary of the aviation emissions (metric tons/day) by airport for the CAMx 4 km ozone modeling domain on a Thursday in June, 2025

Airport	Aircraft		GSE		Total	
	VOC	NOx	VOC	NOx	VOC	NOx
Buckeye	0.0512	0.0087	0.0078	0.0114	0.0590	0.0201
Chandler	0.1219	0.0207	0.0060	0.0061	0.1279	0.0268
Estrella	0.0039	0.0006	0.0006	0.0009	0.0044	0.0015
Glendale	0.0471	0.0080	0.0071	0.0104	0.0542	0.0184
Luke Air Force Base*	0.0918	3.8680	0.0133	0.1223	0.1051	3.9790
Memorial	0.0013	0.0002	0.0002	0.0003	0.0015	0.0005
Mesa Falcon Field	0.1122	0.0191	0.0114	0.0171	0.1237	0.0362
Phoenix Deer Valley	0.1522	0.0259	0.0009	0.0009	0.1531	0.0268
Phoenix Goodyear	0.0795	0.0135	0.0277	0.0652	0.1071	0.0787
Phoenix Sky Harbor	0.7601	5.8107	0.3806	1.3299	1.1405	7.1406
Pleasant Valley	0.0315	0.0054	0.0048	0.0072	0.0363	0.0125
Scottsdale	0.0595	0.0101	0.0044	0.0142	0.0639	0.0244
Sky Ranch Carefree	0.0029	0.0005	0.0005	0.0007	0.0034	0.0012
Stellar Airpark	0.0022	0.0004	0.0028	0.0042	0.0050	0.0045
Williams Gateway	0.0984	0.0167	0.0229	0.1198	0.1212	0.1365
Total	**1.52**	**5.94**	**0.48**	**1.59**	**2.00**	**7.53**

* *GSE emissions are assumed to be constant from 2005 to 2025*.

Table IV-19(b). Summary of the aviation emissions (metric tons/day) by airport for the CAMx 4 km ozone modeling domain on a Tuesday in July, 2025

Airport	Aircraft		GSE		Total	
	VOC	NOx	VOC	NOx	VOC	NOx
Buckeye	0.0512	0.0087	0.0078	0.0114	0.0590	0.0201
Chandler	0.1219	0.0207	0.0060	0.0061	0.1279	0.0268
Estrella	0.0039	0.0006	0.0006	0.0009	0.0044	0.0015
Glendale	0.0471	0.0080	0.0071	0.0104	0.0542	0.0184
Luke Air Force Base*	0.0918	3.8680	0.0133	0.1223	0.1051	3.9790
Memorial	0.0013	0.0002	0.0002	0.0003	0.0015	0.0005
Mesa Falcon Field	0.1122	0.0191	0.0114	0.0171	0.1237	0.0362
Phoenix Deer Valley	0.1522	0.0259	0.0009	0.0009	0.1531	0.0268
Phoenix Goodyear	0.0795	0.0135	0.0277	0.0652	0.1071	0.0787
Phoenix Sky Harbor	0.7411	4.5095	0.3806	1.3299	1.1217	5.8393
Pleasant Valley	0.0315	0.0054	0.0048	0.0072	0.0363	0.0125
Scottsdale	0.0595	0.0101	0.0044	0.0142	0.0639	0.0244
Sky Ranch Carefree	0.0029	0.0005	0.0005	0.0007	0.0034	0.0012
Stellar Airpark	0.0022	0.0004	0.0028	0.0042	0.0050	0.0045
Williams Gateway	0.0984	0.0167	0.0229	0.1198	0.1212	0.1365
Total	**1.50**	**4.64**	**0.48**	**1.59**	**1.98**	**6.23**

* *GSE emissions are assumed to be constant from 2005 to 2025*.

Table IV-19(c). Summary of the aviation emissions (metric tons/day) by airport for the 4 km ozone modeling domain on a Friday in August, 2025

Airport	Aircraft		GSE		Total	
	VOC	NOx	VOC	NOx	VOC	NOx
Buckeye	0.0512	0.0090	0.0080	0.0114	0.0590	0.0201
Chandler	0.1219	0.0207	0.0060	0.0060	0.1279	0.0268
Estrella	0.0039	0.0006	0.0006	0.0009	0.0040	0.0015
Glendale	0.0471	0.0080	0.0071	0.0104	0.0542	0.0184
Luke Air Force Base*	0.0918	3.8680	0.0133	0.1223	0.1051	3.9790
Memorial	0.0013	0.0002	0.0002	0.0003	0.0015	0.0005
Mesa Falcon Field	0.1122	0.0191	0.0114	0.0171	0.1237	0.0362
Phoenix Deer Valley	0.1522	0.0259	0.0009	0.0009	0.1531	0.0268
Phoenix Goodyear	0.0795	0.0135	0.0277	0.0652	0.1071	0.0787
Phoenix Sky Harbor	0.7748	6.1586	0.3806	1.3299	1.1554	7.4884
Pleasant Valley	0.0315	0.0054	0.0048	0.0072	0.0363	0.0125
Scottsdale	0.0595	0.0101	0.0044	0.0142	0.0639	0.0244
Sky Ranch Carefree	0.0029	0.0005	0.0005	0.0007	0.0034	0.0010
Stellar Airpark	0.0022	0.0004	0.0028	0.0042	0.0050	0.0050
Williams Gateway	0.0984	0.0167	0.0229	0.1198	0.1212	0.1365
Total	**1.54**	**6.29**	**0.48**	**1.59**	**2.02**	**7.88**

* *GSE emissions are assumed to be constant from 2005 to 2025*.

The 2025 summer VOC and NOx emissions from nonroad sources in Maricopa County are summarized in Table IV-20. Table IV-21 summarizes the future year nonroad emissions in the 4 km modeling domain by species for each episode.

Table IV-20. Summary of 2025 summer emissions of VOC and NOx from nonroad sources in Maricopa County (metric tons/summer season*)

Equipment Category	VOC	NOx
Agricultural Equipment	7.7	42.7
Commercial Equipment	789.0	213.1
Construction and Mining Equipment	352.9	1,111.1
Industrial Equipment	22.7	197.3
Lawn and Garden Equipment (Residential)	1,808.9	79.9
Lawn and Garden Equipment (Commercial)	572.2	144.0
Pleasure Craft	223.2	43.5
Railroad Equipment	0.3	1.0
Recreational Equipment	331.7	20.1
Locomotives	26.5	669.1
GSE	43.5	154.2
Aircraft	148.8	881.0
Total	**4,327.4**	**3,557.0**

** Summer season include June, July, and August.*

Table IV-21. Summary of the future year nonroad emissions for the CAMx 4 km modeling domain

Episode	Date	2025 Nonroad Emissions (Metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	26.7	39.4
	June 1 (Saturday)	34.3	40.5
	June 2 (Sunday)	34.3	40.8
	June 3 (Monday)	31.9	42.9
	June 4 (Tuesday)	31.8	37.2
	June 5 (Wednesday)	31.8	37.0
	June 6 (Thursday)	31.8	37.9
	June 7 (Friday)	31.8	36.4
July 2002	July 5 (Friday)	28.9	37.8
	July 6 (Saturday)	30.5	36.7
	July 7 (Sunday)	30.5	37.6
	July 8 (Monday)	28.8	36.6
	July 9 (Tuesday)	28.8	35.5
	July 10 (Wednesday)	28.9	37.5
	July 11 (Thursday)	28.8	35.7
	July 12 (Friday)	28.8	35.8
	July 13 (Saturday)	30.5	36.5
	July 14 (Sunday)	30.5	35.1
August 2001	August 2 (Thursday)	29.1	38.1
	August 3 (Friday)	29.1	39.3
	August 4 (Saturday)	31.4	35.0
	August 5 (Sunday)	31.4	38.9
	August 6 (Monday)	29.1	38.3
	August 7 (Tuesday)	29.1	36.4
	August 8 (Wednesday)	29.1	37.8
	August 9 (Thursday)	29.1	39.9
	August 10 (Friday)	29.1	38.4
	August 11 (Saturday)	31.4	36.2

IV-2-2-4. Point and Area Source Emissions

Emissions for point and area sources were developed for the 2005 baseline year and then projected to 2025 through the application of appropriate growth factors. The growth factors derived for point and area source emissions are included in Appendix IV-vii. The growth factors were based on county population and employment forecasts derived from the MAG 2007 Socioeconomic Projections for Maricopa County and 2003 placeholder projections for Pinal County. Daily emissions of point and area sources for episode days of 2025 are given in Tables IV-22 and 23, respectively.

For power plants, the permitted hourly Potential to Emit (PTE) rates provided by MCAQD were assumed for 2025. The hourly PTE rates of VOC and NOx for power plants are provided in Tables IV-24 and 25. To demonstrate permanent and enforceable improvement in air quality, EPA guidance, *"Procedures for Processing Requests for Redesignation to Attainment"* (EPA, 1992) states that *"the analysis should assume that sources are operating at permitted levels (or historic peak levels) unless evidence is presented that such an assumption is unrealistic."* The PTE rates assumed for power plants in 2025 represent the maximum levels currently permitted by MCAQD for power plants that are expected to be operating in 2025. The anticipated growth in population and industry between 2005 and 2025 will increase the demand for electricity in the eight-hour ozone nonattainment area. In addition, the summer ozone season is the time of year when peak demand typically occurs. In general, the uncertainties inherent in long-range power generation forecasts support the use of PTE rates for the maintenance demonstration.

In order to determine the sensitivity of the maintenance demonstration to a range of power plant emission rates, MAG performed a supplemental analysis that replaced the PTE emission rates in 2025 with the 2005 baseline emission rates. The supplemental analyses included CAMx/MM5 modeling and unmonitored area analysis. Both analyses concluded that the eight-hour ozone standard would be maintained in 2025 with the 2005 emission rates. These supplemental analyses, described in Appendix IV-viii, provides convincing evidence that the standard will be maintained in the future, with power plant emission rates ranging from minimum (2005) to maximum (PTE) levels.

IV-2-2-5. Spatial and Temporal Allocation of Emissions

Point sources were spatially allocated on the basis of the location (UTM coordinates or latitude/longitude) of each source. Area and nonroad source emissions, with the exception of aviation-related emissions, were spatially distributed based on surrogate factors that indicate emission level or activity in the grid cells. For this analysis, the latest MAG 2004 land use and GIS data were used to develop the spatial allocation factors for the area and nonroad sources, except for aviation. Spatial density plots of the 2025 VOC and NOx onroad, anthropogenic, and all emissions are shown in Figures IV-5(a) through 7(f). The spatial density plots were developed by the EPS3 GRDEM output emissions.

The temporal emission allocation was based on temporal profiles being held constant between the baseline year (2005) and the future year (2025). There were no committed measures that affected the hourly distribution of these emissions. Thus, hourly temporal profiles of emissions are identical for both 2005 and 2025. Temporal plots of the 2025 VOC and NOx emissions for the peak day in each episode are shown in Figures IV-8(a) through 8(f). Table IV-26 provides the maximum VOC and NOx emissions and grid cell locations for onroad, anthropogenic and all emissions.

IV-2-2-6. Summary of Emission Inventories

The 2005 baseline year and the 2025 maintenance year emissions by source category and pie charts for VOC and NOx for each episode are presented in Tables IV-27(a) through 27(f) that are derived from the EPS3 MRGUAM output emissions.

The biogenic source emissions range from 66.6 to 76.0 percent of total VOC emissions in the baseline year and 64.3 to 74.4 percent of total VOC emissions in the future year. Onroad source emissions range from 54.7 to 56.9 percent of total NOx emissions in the baseline year and 43.0 to 44.6 percent of total NOx emissions in the future year. These two categories represent the largest portion of emission sources for VOC and NOx, respectively.

Due to the implementation of emission control measures and stricter Federal controls on light duty vehicles, VOC emissions from onroad mobile sources decrease by 33.1 to 35.2 percent between the baseline and the future years and NOx emissions decrease by 26.1 to 29.3 percent. In the future year, area source emissions increase by 57.5 percent for VOC and 58.8 percent for NOx due to anticipated population and employment growth between 2005 and 2025.

Point source VOC emissions increase by 68.5 percent between 2005 and 2025 and NOx emissions in 2025 are approximately 4.4 times higher than in 2005 due to the assumption of the potential to emit (PTE) for all power plant units in Maricopa County for the future year.

Nonroad source emissions decrease by 21.0 to 23.3 percent for VOC and 49.9 to 52.1 percent for NOx between 2005 and 2025. This decrease occurs because of the more stringent federal emission standards for new nonroad vehicles and equipment purchased between 2005 and 2025.

Table IV-22. Summary of 2025 point source emissions for the CAMx 4 km modeling domain

Episode	Date	2025 Point Source Emissions (metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	18.3	58.9
	June 1 (Saturday)	8.7	57.8
	June 2 (Sunday)	5.7	57.0
	June 3 (Monday)	18.7	59.1
	June 4 (Tuesday)	18.7	59.1
	June 5 (Wednesday)	18.7	59.1
	June 6 (Thursday)	18.7	59.1
	June 7 (Friday)	18.7	59.1
July 2002	July 5 (Friday)	18.7	59.1
	July 6 (Saturday)	8.7	57.8
	July 7 (Sunday)	5.7	57.0
	July 8 (Monday)	18.7	59.1
	July 9 (Tuesday)	18.7	59.1
	July 10 (Wednesday)	18.7	59.1
	July 11 (Thursday)	18.7	59.1
	July 12 (Friday)	18.7	59.1
	July 13 (Saturday)	8.7	57.8
	July 14 (Sunday)	5.7	57.0
August 2001	August 2 (Thursday)	18.7	59.1
	August 3 (Friday)	18.7	59.1
	August 4 (Saturday)	8.7	57.8
	August 5 (Sunday)	5.7	57.0
	August 6 (Monday)	18.7	59.1
	August 7 (Tuesday)	18.7	59.1
	August 8 (Wednesday)	18.7	59.1
	August 9 (Thursday)	18.7	59.1
	August 10 (Friday)	18.7	59.1
	August 11 (Saturday)	8.7	57.8

Table IV-23. Summary of 2025 area source emissions for the CAMx 4 km modeling domain

Episode	Date	2025 Area Source Emissions (metric tons/day)	
		VOC	NOx
June 2002	May 31 (Friday)	124.8	31.1
	June 1 (Saturday)	124.6	28.9
	June 2 (Sunday)	124.6	27.8
	June 3 (Monday)	124.8	31.1
	June 4 (Tuesday)	124.8	31.1
	June 5 (Wednesday)	124.8	31.1
	June 6 (Thursday)	124.8	31.1
	June 7 (Friday)	124.8	31.1
July 2002	July 5 (Friday)	124.8	31.1
	July 6 (Saturday)	124.6	28.9
	July 7 (Sunday)	124.6	27.8
	July 8 (Monday)	124.8	31.1
	July 9 (Tuesday)	124.8	31.1
	July 10 (Wednesday)	124.8	31.1
	July 11 (Thursday)	124.8	31.1
	July 12 (Friday)	124.8	31.1
	July 13 (Saturday)	124.6	28.9
	July 14 (Sunday)	124.6	27.8
August 2001	August 2 (Thursday)	124.8	31.1
	August 3 (Friday)	124.8	31.1
	August 4 (Saturday)	124.6	28.9
	August 5 (Sunday)	124.6	27.8
	August 6 (Monday)	124.8	31.1
	August 7 (Tuesday)	124.8	31.1
	August 8 (Wednesday)	124.8	31.1
	August 9 (Thursday)	124.8	31.1
	August 10 (Friday)	124.8	31.1
	August 11 (Saturday)	124.6	28.9

Table IV-24. Hourly PTEs of VOC for power plants in the 4 km modeling domain

Plant Name	Unit Name	PTE Normal Operation (lbs/hr)	PTE Normal Operation (short tons/hr)	SCC	Zone 12 UTM_X (m)	Zone 12 UTM_Y (m)	Stack Height (ft)	Dia-meter (ft)	Velocity (ft/sec)	Temp (°F)
SRP Agua Fria										
MCAQD Permit # V95010	Boiler Unit 1	6.38	0.0032	10100601	387,108	3,713,387	120.00	8.00	50.00	300
	Boiler Unit 2	6.38	0.0032	10100601	387,108	3,713,387	120.00	8.00	50.00	300
	Boiler Unit 3	9.96	0.0050	10100601	387,108	3,713,387	123.00	9.25	58.00	242
	Unit 4 CT	2.24	0.0011	10100501	387,108	3,713,387	34.00	23.42	63.50	942
	Unit 5 CT	2.22	0.0011	10100501	387,108	3,713,387	39.00	19.17	92.80	942
	Unit 6 CT	2.22	0.0011	10100501	387,108	3,713,387	39.00	19.17	92.80	942
SRP Kyrene										
MCAQD Permit # V95009	Boiler Unit 1	0.00	0.0000	10100601	412,877	3,691,004	23.16	8.00	47.00	350
	Boiler Unit 2	0.00	0.0000	10100601	412,877	3,691,004	36.58	10.99	43.98	338
	Unit 4 CT	0.14	0.0001	20100201	412,877	3,691,004	37.00	18.76	91.97	894
	Unit 5 CT	0.00	0.0000	20100201	412,877	3,691,004	31.98	18.93	146.98	1,190
	Unit 6 CT	0.00	0.0000	20100201	412,877	3,691,004	31.98	18.93	146.98	1,190
	New Unit K7 CC	3.90	0.0020	20100201	412,877	3,691,004	149.96	18.01	61.43	181
SRP Santan										
MCAQD Permit # V95008	Unit S-1	0.00	0.0000	20100201	430,407	3,688,183	49.00	13.25	84.20	370
	Unit S-2	0.00	0.0000	20100201	430,407	3,688,183	49.00	13.25	85.20	371
	Unit S-3	0.00	0.0000	20100201	430,407	3,688,183	49.00	13.25	86.20	372
	Unit S-4	7.69	0.0038	20100201	430,407	3,688,183	52.00	13.25	87.20	373
	New Unit S-5A	5.80	0.0029	20100201	430,407	3,688,183	149.96	18.01	61.43	181
	New Unit S-5B	5.80	0.0029	20100201	430,407	3,688,183	149.96	18.01	61.43	181
	New Unit S-6A	5.80	0.0029	20100201	430,407	3,688,183	149.96	18.01	61.43	181
APS West Phoenix										
MCAQD Permit # V95006	Unit 1 CC	1.80	0.0009	20100201	392,414	3,701,190	54.00	15.40	70.40	342
	Unit 2 CC	1.80	0.0009	20100201	392,414	3,701,190	54.00	15.40	70.40	342
	Unit 3 CC	6.85	0.0034	20100201	392,334	3,701,685	54.00	15.40	70.40	350
	Unit 4 CC	2.70	0.0013	20100201	392,292	3,700,520	120.00	14.00	66.00	170
	Unit 5CC, Stack 1	5.40	0.0027	20100201	392,325	3,700,805	175.00	18.00	65.00	170
	Unit 5CC, Stack 2	5.40	0.0027	20100201	392,325	3,700,805	175.00	18.00	65.00	170
	Unit 1 Ct	6.60	0.0033	20100201	392,414	3,701,190	32.00	17.17	108.40	846
	Unit 2 Ct	6.60	0.0033	20100201	392,414	3,701,190	32.00	17.17	108.40	846
APS: Ocotillo										
MCAQD Permit # V95007	Boiler Unit1,Stack1	33.00	0.0165	10100604	415,224	3,698,573	178.00	8.58	55.60	274
	Boiler Unit1,Stack2	33.00	0.0165	10100604	415,224	3,698,573	178.00	8.58	55.60	274
	Boiler Unit2,Stack1	33.00	0.0165	10100604	415,224	3,698,573	178.00	8.58	55.60	274
	Boiler Unit2,Stack2	33.00	0.0165	10100604	415,224	3,698,573	178.00	8.58	55.60	274
	Unit 1 Ct	1.90	0.0010	38500101	415,224	3,698,573	35.00	17.17	108.00	846
	Unit 2 Ct	1.90	0.0010	38500101	415,224	3,698,573	36.00	17.17	108.00	846
Redhawk Generating Facility										
MCAQD Permit # V99013	CC1A	6.20	0.0031	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	CC1B	6.20	0.0031	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	CC2A	6.20	0.0031	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	CC2B	6.20	0.0031	20100201	328,664	3,690,049	175.00	18.00	65.00	170
Duke Energy Arlington Valley LLC										
MCAQD Permit # V99014	CTG1	12.80	0.0064	20100201	324,297	3,690,571	185.00	18.00	64.60	182
	CTG2	12.80	0.0064	20100201	324,297	3,690,571	185.00	18.00	64.60	182
	CTG3 & CTG4 can no longer be built									

Table IV-24. (Continued)

Plant Name	Unit Name	PTE Normal Operation (lbs/hr)	PTE Normal Operation (short tons/hr)	SCC	Zone 12 UTM_X (m)	Zone 12 UTM_Y (m)	Stack Height (ft)	Dia-meter (ft)	Velocity (ft/sec)	Temp (°F)
New Harquahala Generating Co										
MCAQD Permit # V99015	CTG1	7.8	0.0039	20100201	303,619	3,705,788	180.00	19.00	65.00	170
	CTG2	7.8	0.0039	20100201	303,688	3,705,787	180.00	19.00	65.00	170
	CTG3	7.8	0.0039	20100201	303,758	3,705,786	180.00	19.00	65.00	170
Mesquite Generating Station										
MCAQD Permit # V99017	CC1	16.6	0.0083	20100201	326,602	3,691,016	170.00	18.00	61.20	169
	CC2	16.6	0.0083	20100201	326,602	3,691,016	170.00	18.00	61.20	169
	CC3	16.6	0.0083	20100201	326,602	3,691,016	170.00	18.00	61.20	169
	CC4	16.6	0.0083	20100201	326,602	3,691,016	170.00	18.00	61.20	169
Gila River Power Generating Station										
MCAQD Permit # V99018	CT/DB 1A	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 1B	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 2A	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 2B	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 3A	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 3B	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 4A	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 4B	4.1	0.0021	20100201	341,423	3,649,546	130.00	18.00	62.00	180

Table IV-25. Hourly PTEs of NOx for power plants in the 4 km modeling domain

Plant Name	Unit Name	PTE Normal Operation (lbs/hr)	PTE Normal Operation (short tons/hr)	SCC	Zone 12 UTM_X (m)	Zone 12 UTM_Y (m)	Stack Height (ft)	Dia-meter (ft)	Velocity (ft/sec)	Temp (°F)
SRP Agua Fria										
MCAQD Permit # V95010	Boiler Unit 1	324.80	0.1624	10100601	387,108	3,713,387	120.00	8.00	50.00	300
	Boiler Unit 2	324.80	0.1624	10100601	387,108	3,713,387	120.00	8.00	50.00	300
	Boiler Unit 3	507.08	0.2535	10100601	387,108	3,713,387	123.00	9.25	58.00	242
	Unit 4 CT	341.28	0.1706	10100501	387,108	3,713,387	34.00	23.42	63.50	942
	Unit 5 CT	337.79	0.1689	10100501	387,108	3,713,387	39.00	19.17	92.80	942
	Unit 6 CT	337.79	0.1689	10100501	387,108	3,713,387	39.00	19.17	92.80	942
SRP Kyrene										
MCAQD Permit # V95009	Boiler Unit 1	0.0000	0.0000	10100601	412,877	3,691,004	23.16	8.00	47.00	350
	Boiler Unit 2	0.0000	0.0000	10100601	412,877	3,691,004	36.58	10.99	43.98	338
	Unit 4 CT	0.0000	0.0000	20100201	412,877	3,691,004	37.00	19.00	92.00	894
	Unit 5 CT	0.0000	0.0000	20100201	412,877	3,691,004	32.00	19.00	147.00	1,190
	Unit 6 CT	11.1644	0.0056	20100201	412,877	3,691,004	32.00	19.00	147.00	1,190
	New Unit K7 CC	18.3000	0.0092	20100201	412,877	3,691,004	150.00	18.00	61.00	181
SRP Santan										
MCAQD Permit # V95008	Unit S-1	0.0000	0.0000	20100201	430,407	3,688,183	49.00	13.00	84.00	370
	Unit S-2	0.0000	0.0000	20100201	430,407	3,688,183	49.00	13.00	85.00	371
	Unit S-3	0.0000	0.0000	20100201	430,407	3,688,183	49.00	13.00	86.00	372
	Unit S-4	241.10	0.1205	20100201	430,407	3,688,183	52.00	13.00	87.00	373
	New Unit S-5A	16.60	0.0083	20100201	430,407	3,688,183	150.00	18.00	61.00	181
	New Unit S-5B	16.60	0.0083	20100201	430,407	3,688,183	150.00	18.00	61.00	181
APS West Phoenix										
MCAQD Permit # V95006	Unit 1 CC	255.8	0.1279	20100201	392,414	3,701,190	54.00	15.40	70.40	342
	Unit 2 CC	255.8	0.1279	20100201	392,414	3,701,190	54.00	15.40	70.40	342
	Unit 3 CC	56.3	0.0282	20100201	392,334	3,701,685	54.00	15.40	70.40	350
	Unit 4 CC	34.2	0.0171	20100201	392,292	3,700,520	120.00	14.00	66.00	170
	Unit 5CC, Stack 1	24.3	0.0122	20100201	392,325	3,700,805	175.00	18.00	65.00	170
	Unit 5CC, Stack 2	24.3	0.0122	20100201	392,325	3,700,805	175.00	18.00	65.00	170
	Unit 1 Ct	292.7	0.1464	20100201	392,414	3,701,190	32.00	17.17	108.40	846
	Unit 2 Ct	292.7	0.1464	20100201	392,414	3,701,190	32.00	17.17	108.40	846
APS: Ocotillo										
MCAQD Permit # V95007	Boiler Unit1,Stack1	120	0.0600	10100604	415,224	3,698,573	178.00	9.00	56.00	274
	Boiler Unit1,Stack2	120	0.0600	10100604	415,224	3,698,573	178.00	9.00	56.00	274
	Boiler Unit2,Stack1	120	0.0600	10100604	415,224	3,698,573	178.00	9.00	56.00	274
	Boiler Unit2,Stack2	120	0.0600	10100604	415,224	3,698,573	178.00	9.00	56.00	274
	Unit 1 Ct	290	0.1450	38500101	415,224	3,698,573	35.00	17.00	108.00	846
	Unit 2 Ct	290	0.1450	38500101	415,224	3,698,573	36.00	17.00	108.00	846
Redhawk Generating Facility										
MCAQD Permit # V99013	CC1A	23.1	0.0116	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	CC1B	23.1	0.0116	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	CC2A	23.1	0.0116	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	CC2B	23.1	0.0116	20100201	328,664	3,690,049	175.00	18.00	65.00	170
	(plantwide total PTE)	1452								
Duke Energy Arlington Valley LLC										
MCAQD Permit # V99014	CTG1	24.0	0.0120	20100201	324,297	3,690,571	185.00	18.00	64.60	182
	CTG2	24.0	0.0120	20100201	324,297	3,690,571	185.00	18.00	64.60	182
	CTG3 & CTG4 can no longer be built									
	New Unit S-6A	16.6	0.0083	20100201	430,407	3,688,183	150.00	18.00	61.00	181

Table IV-25. (Continued)

Plant Name	Unit Name	PTE Normal Operation (lbs/hr)	PTE Normal Operation (short tons/hr)	SCC	Zone 12 UTM_X (m)	Zone 12 UTM_Y (m)	Stack Height (ft)	Dia-meter (ft)	Velocity (ft/sec)	Temp (°F)
New Harquahala Generating Co										
MCAQD Permit # V99015	CTG1	25.0	0.0125	20100201	303,619	3,705,788	180.00	19.00	65.00	170
	CTG2	25.0	0.0125	20100201	303,688	3,705,787	180.00	19.00	65.00	170
	CTG3	25.0	0.0125	20100201	303,758	3,705,786	180.00	19.00	65.00	170
Mesquite Generating Station										
MCAQD Permit # V99017	CC1	22.2	0.0111	20100201	326,602	3,691,016	170.00	18.00	61.00	169
	CC2	22.2	0.0111	20100201	326,602	3,691,016	170.00	18.00	61.00	169
	CC3	22.2	0.0111	20100201	326,602	3,691,016	170.00	18.00	61.00	169
	CC4	22.2	0.0111	20100201	326,602	3,691,016	170.00	18.00	61.00	169
Gila River Power Generating Station										
MCAQD Permit # V99018	CT/DB 1A	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 1B	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 2A	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 2B	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 3A	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 3B	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 4A	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180
	CT/DB 4B	22.9	0.0115	20100201	341,423	3,649,546	130.00	18.00	62.00	180

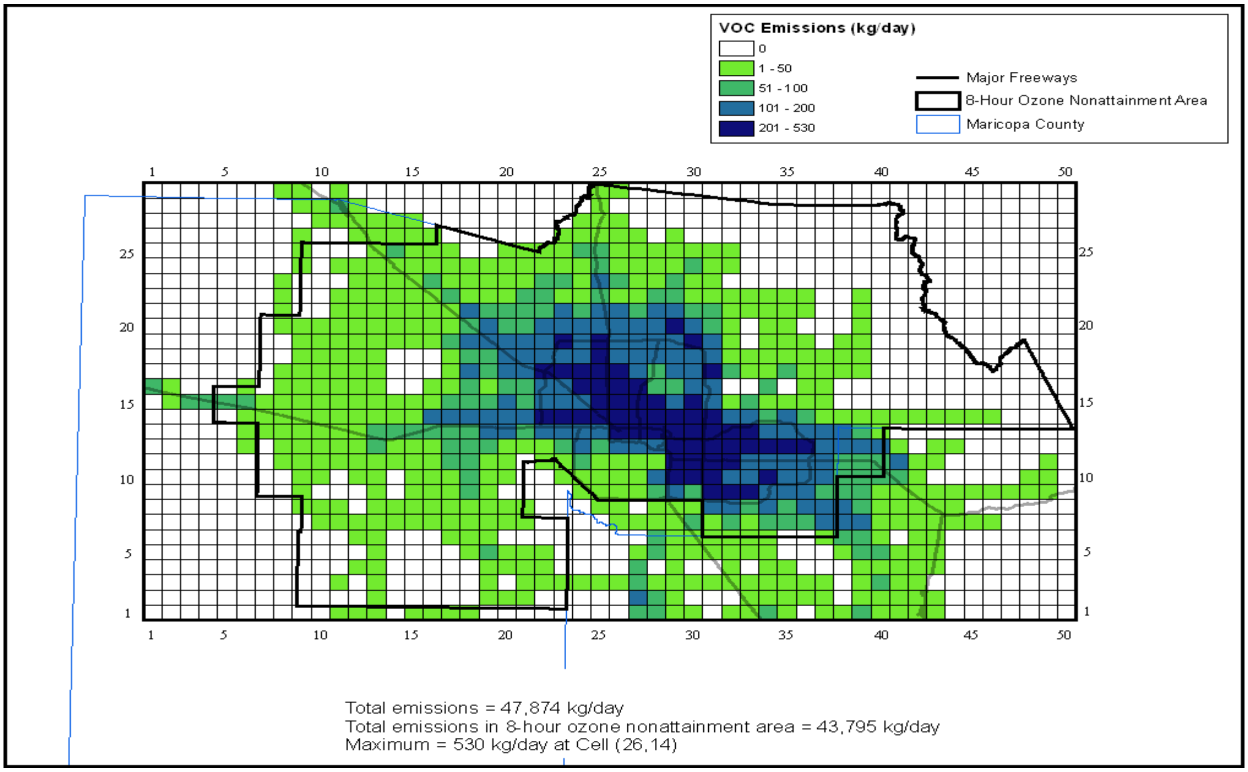


Figure IV-5(a). Onroad source VOC emissions for a Thursday in June, 2025

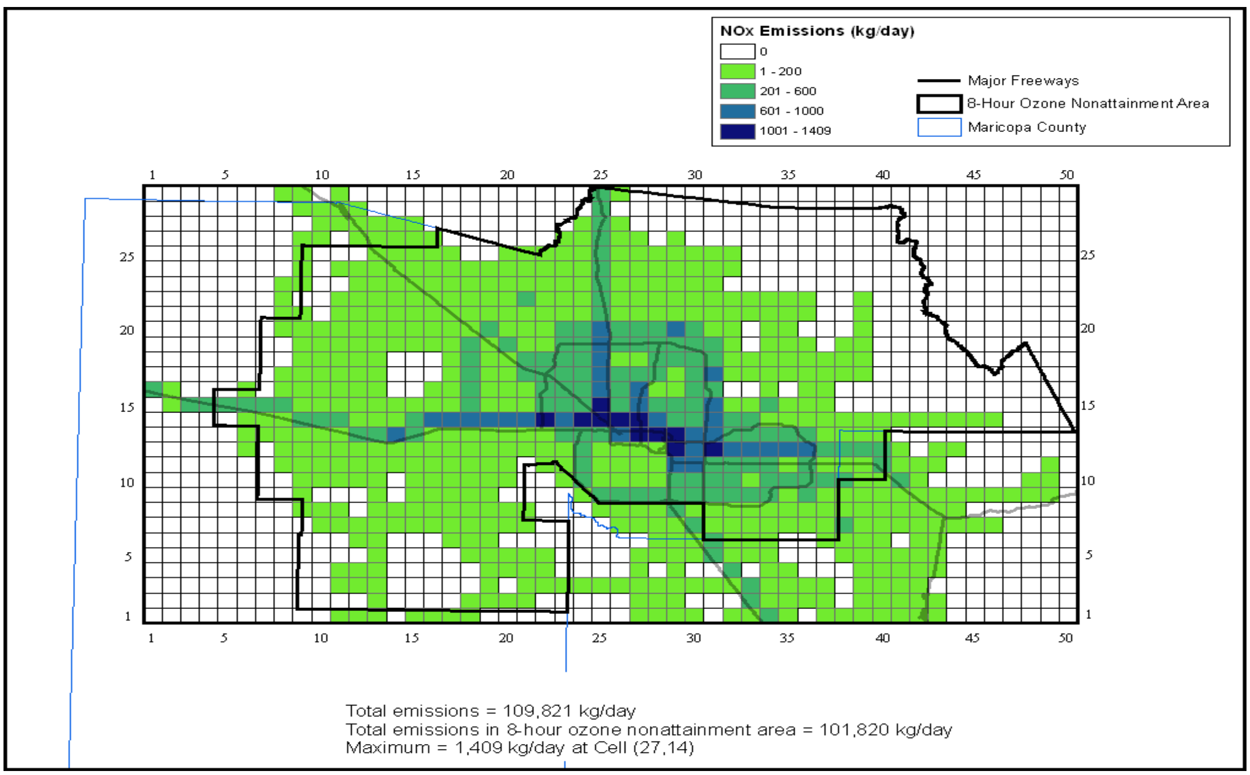


Figure IV-5(b). Onroad source NOx emissions for a Thursday in June, 2025

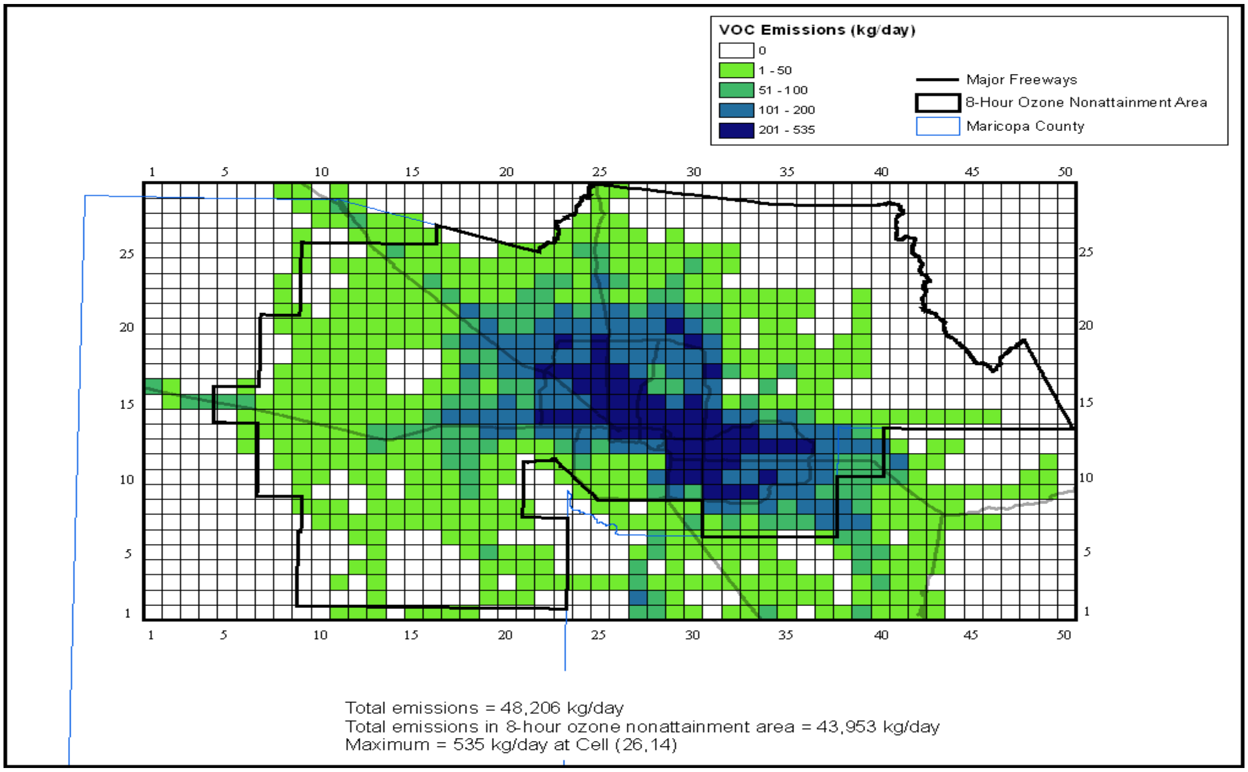


Figure IV-5(c). Onroad source VOC emissions for a Tuesday in July, 2025

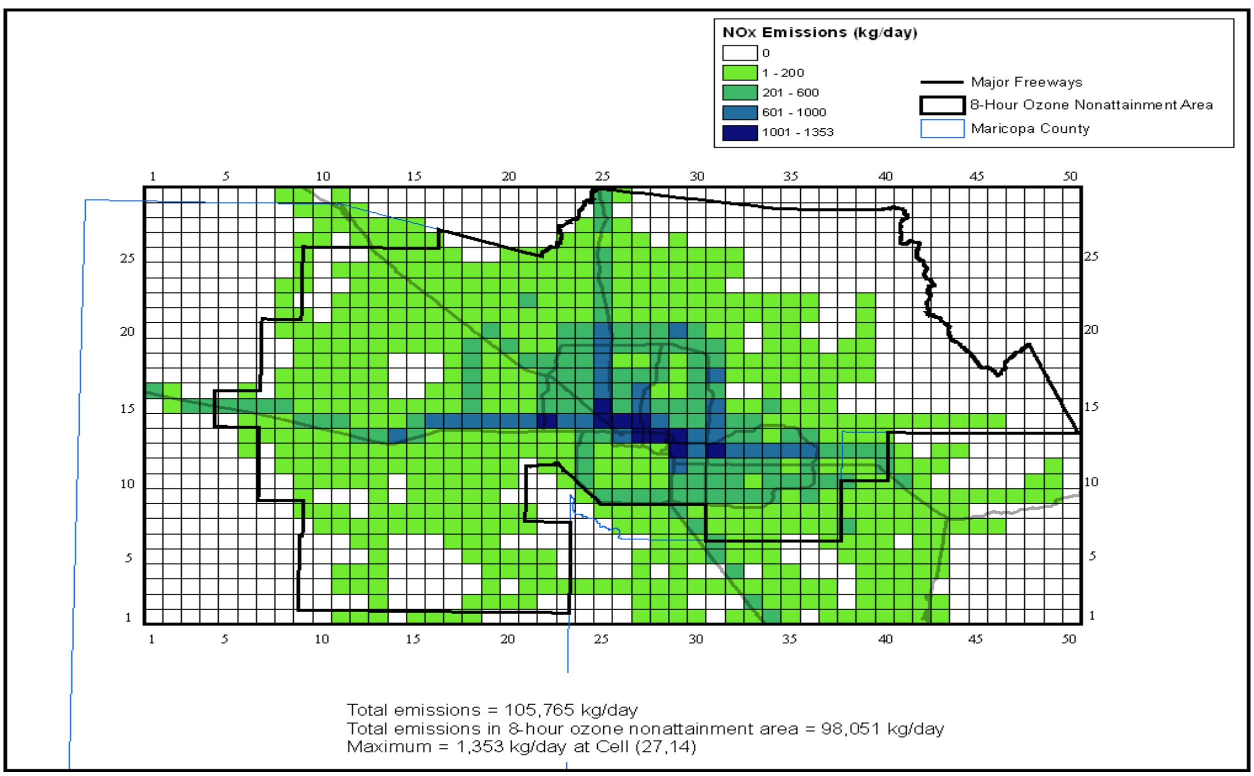


Figure IV-5(d). Onroad source NOx emissions for a Tuesday in July, 2025

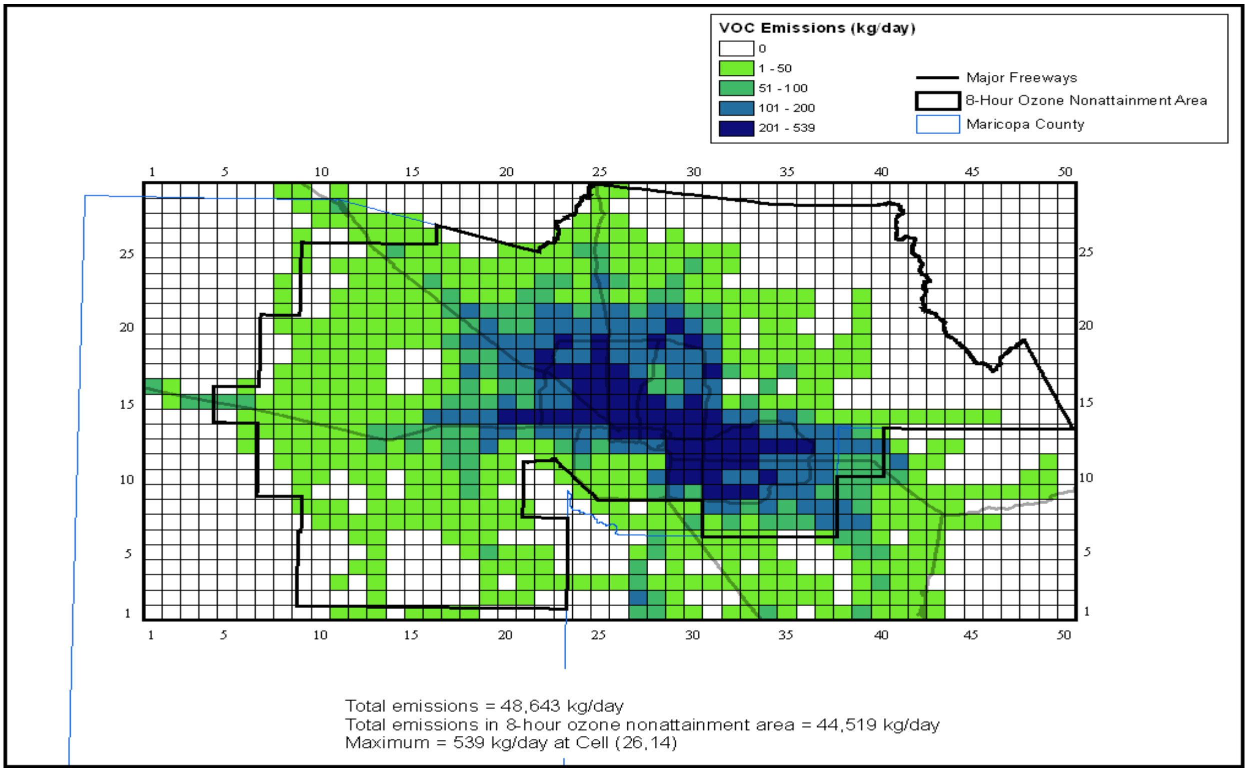


Figure IV-5(e). Onroad source VOC emissions for a Friday in August, 2025

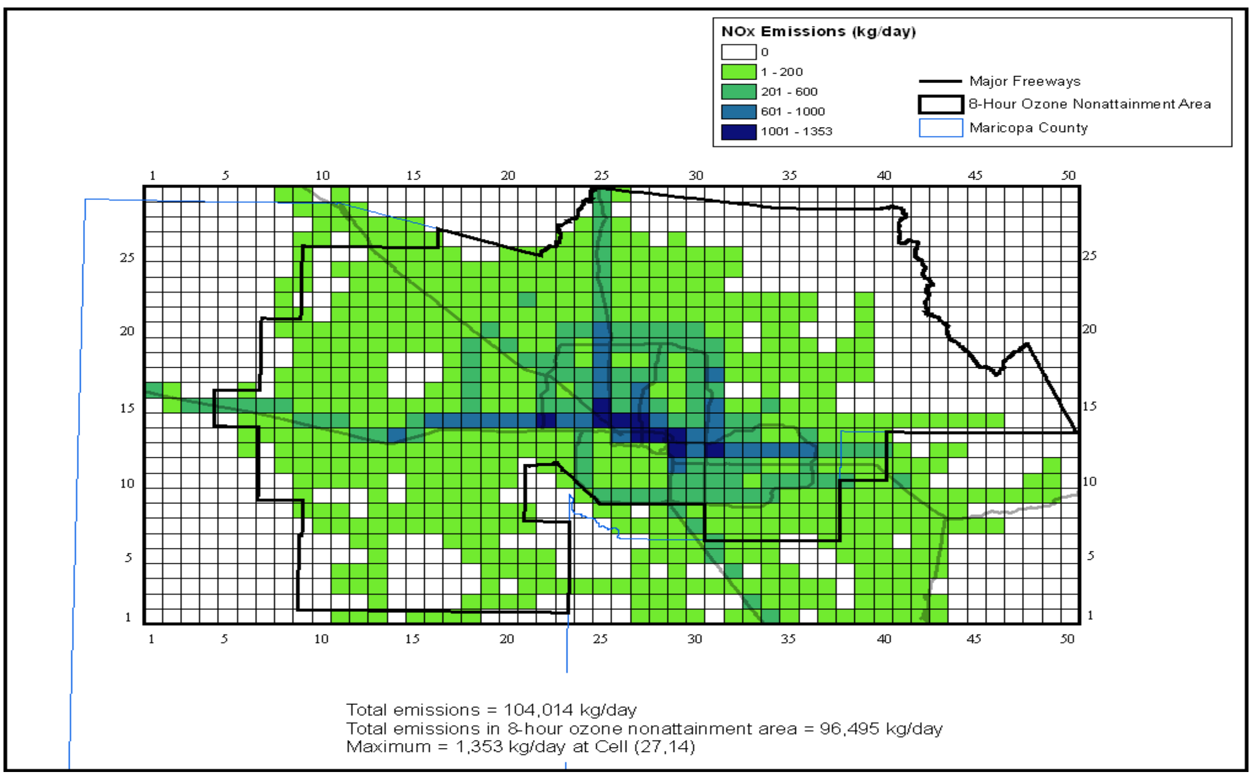


Figure IV-5(f). Onroad source NOx emissions for a Friday in August, 2025

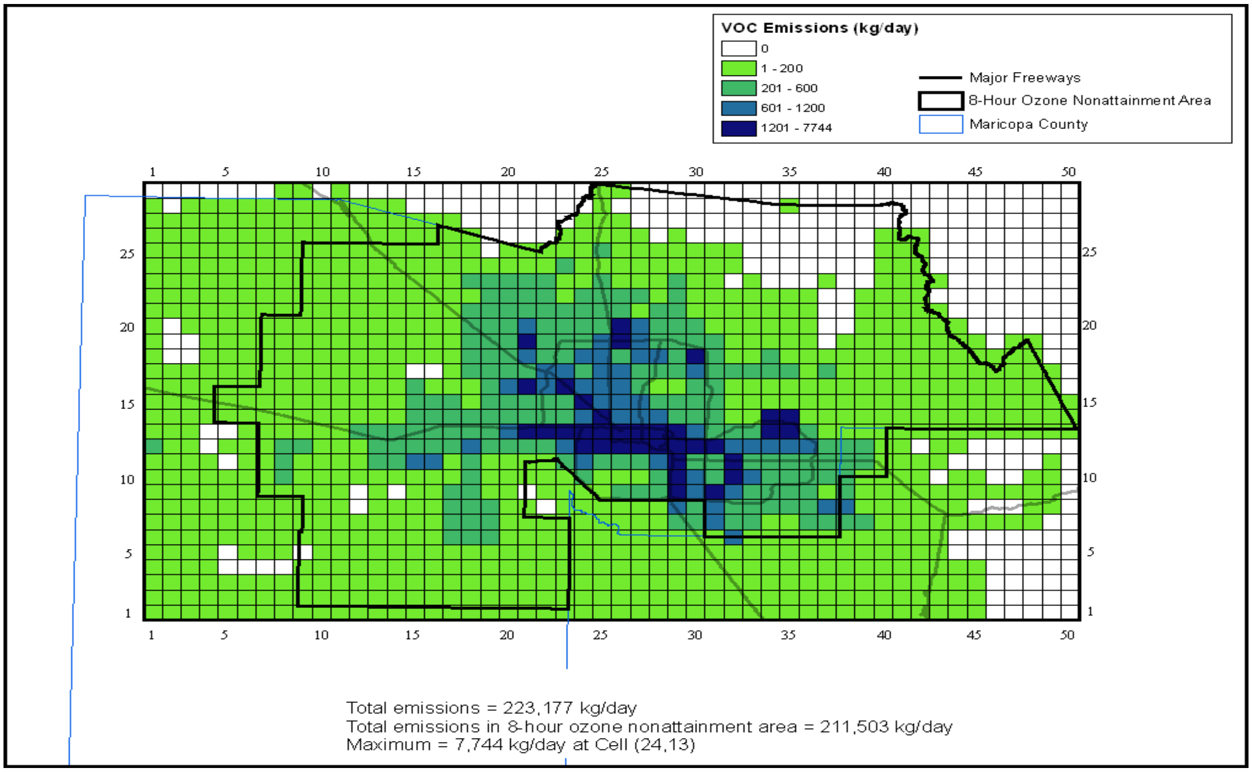


Figure IV-6(a). Anthropogenic VOC emissions for a Thursday in June, 2025

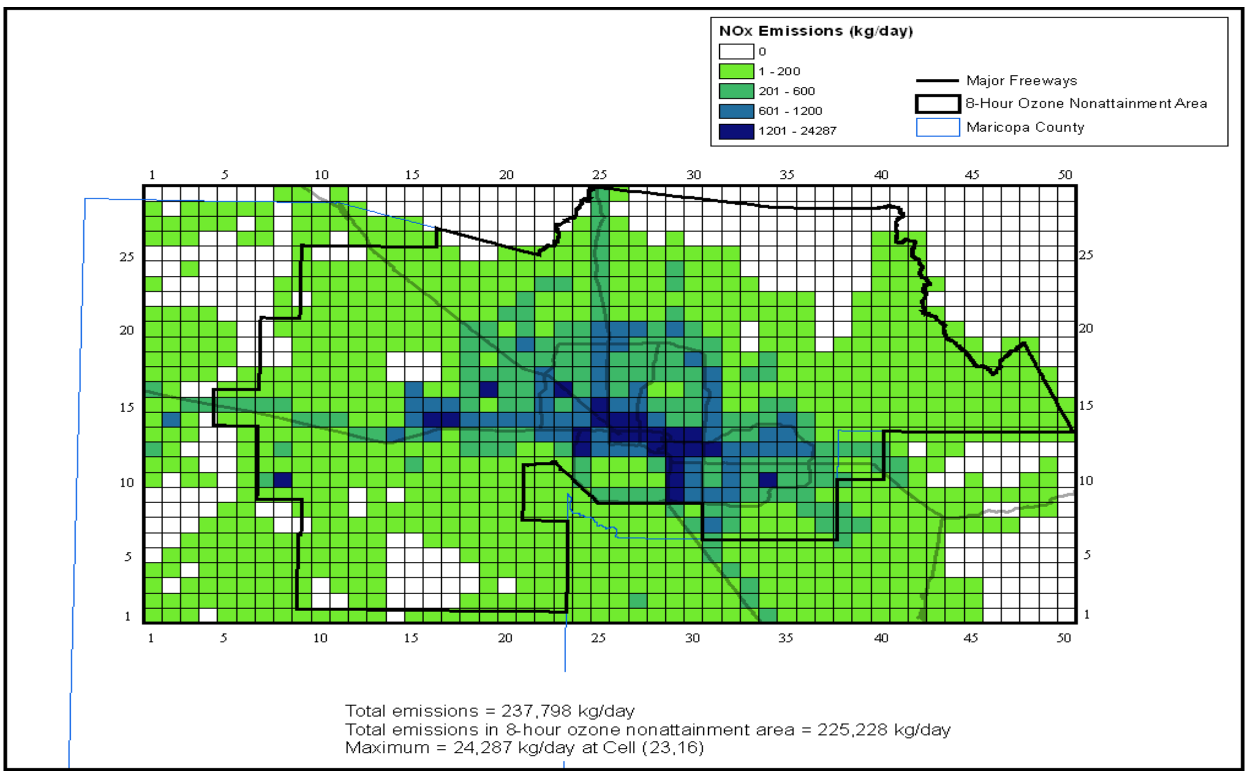


Figure IV-6(b). Anthropogenic NOx emissions for a Thursday in June, 2025

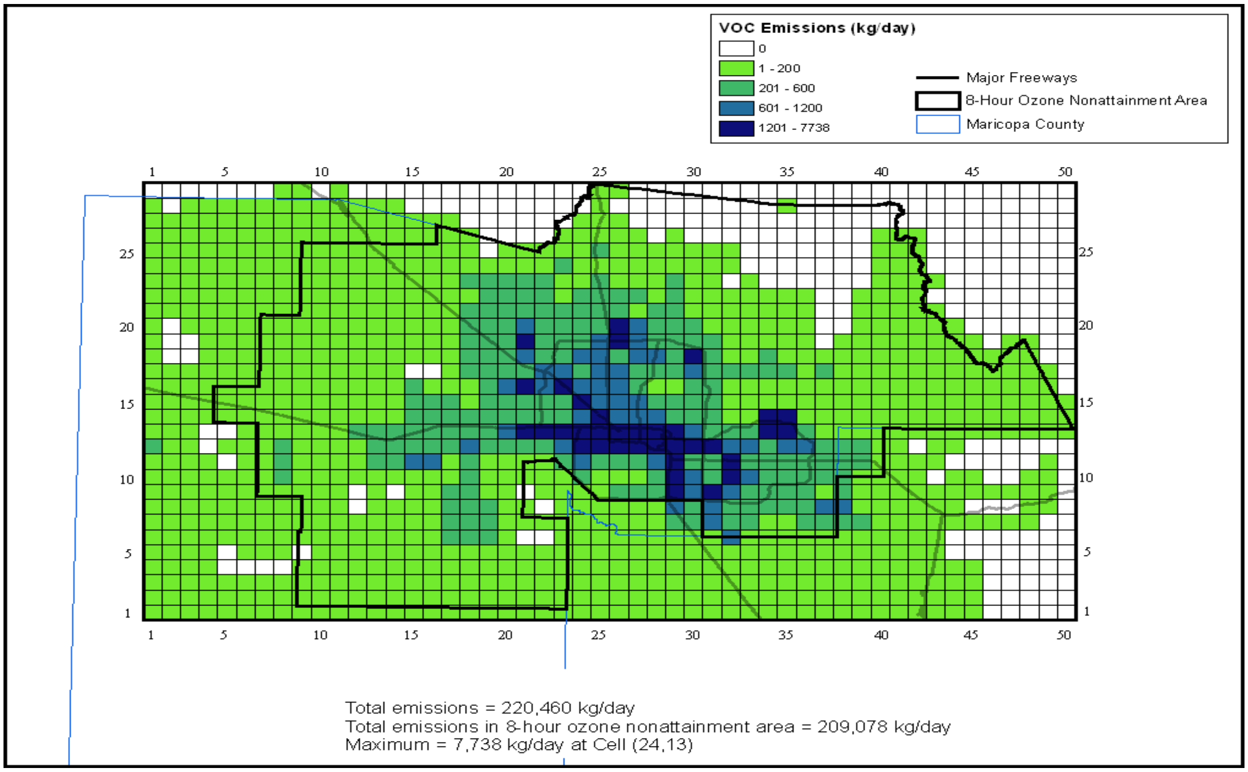


Figure IV-6(c). Anthropogenic VOC emissions for a Tuesday in July, 2025

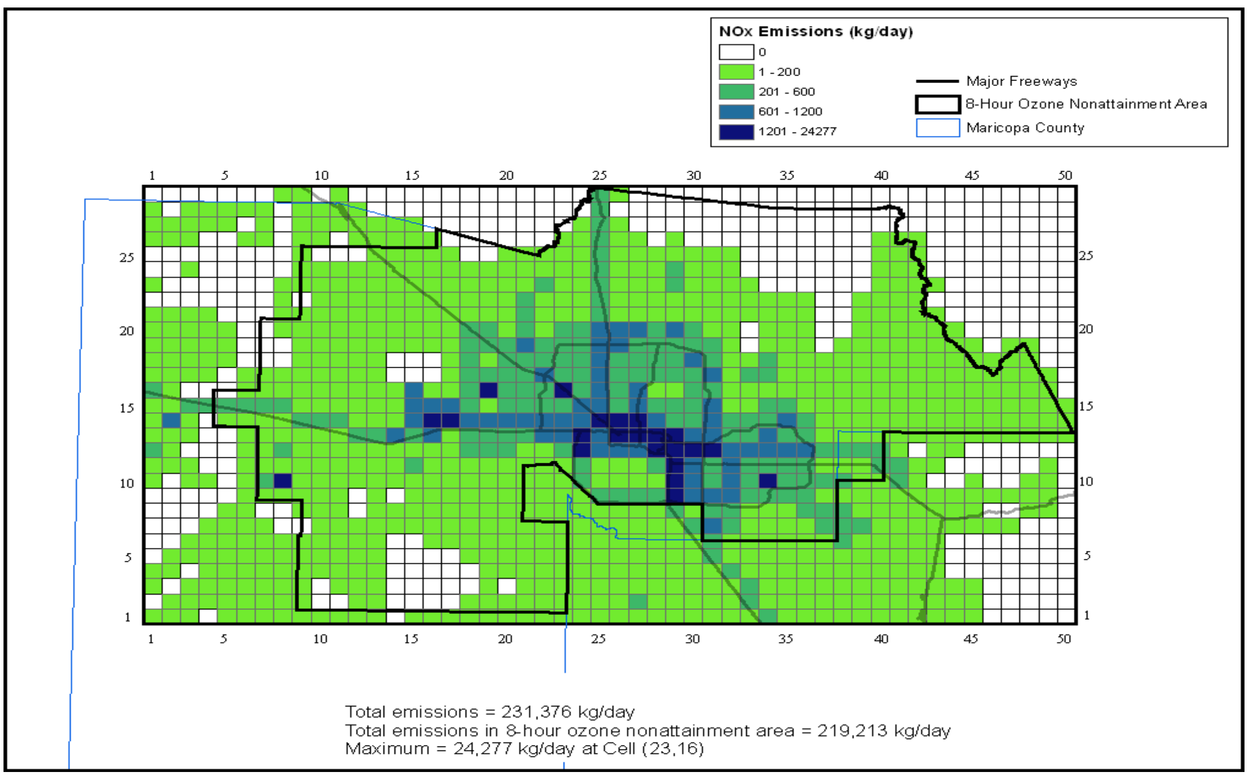


Figure IV-6(d). Anthropogenic NOx emissions for a Tuesday in July, 2025

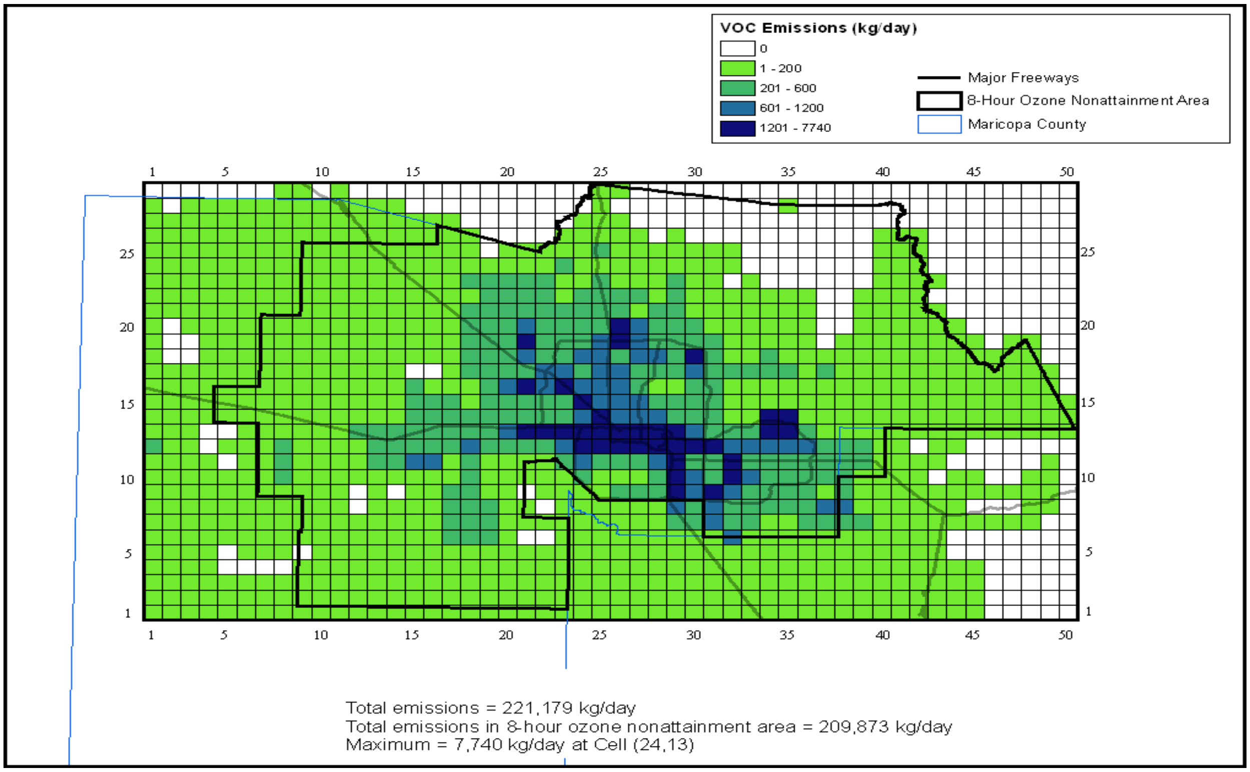


Figure IV-6(e). Anthropogenic VOC emissions for a Friday in August, 2025

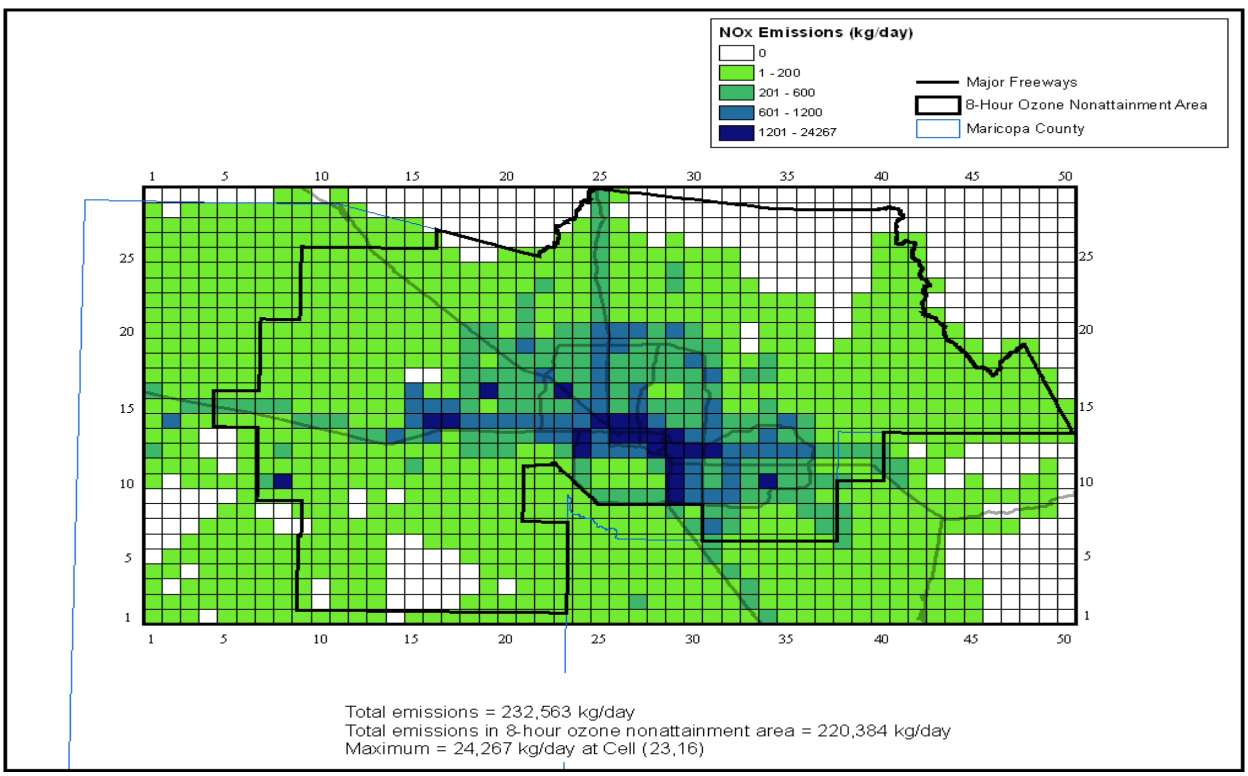


Figure IV-6(f). Anthropogenic NOx emissions for a Friday in August, 2025

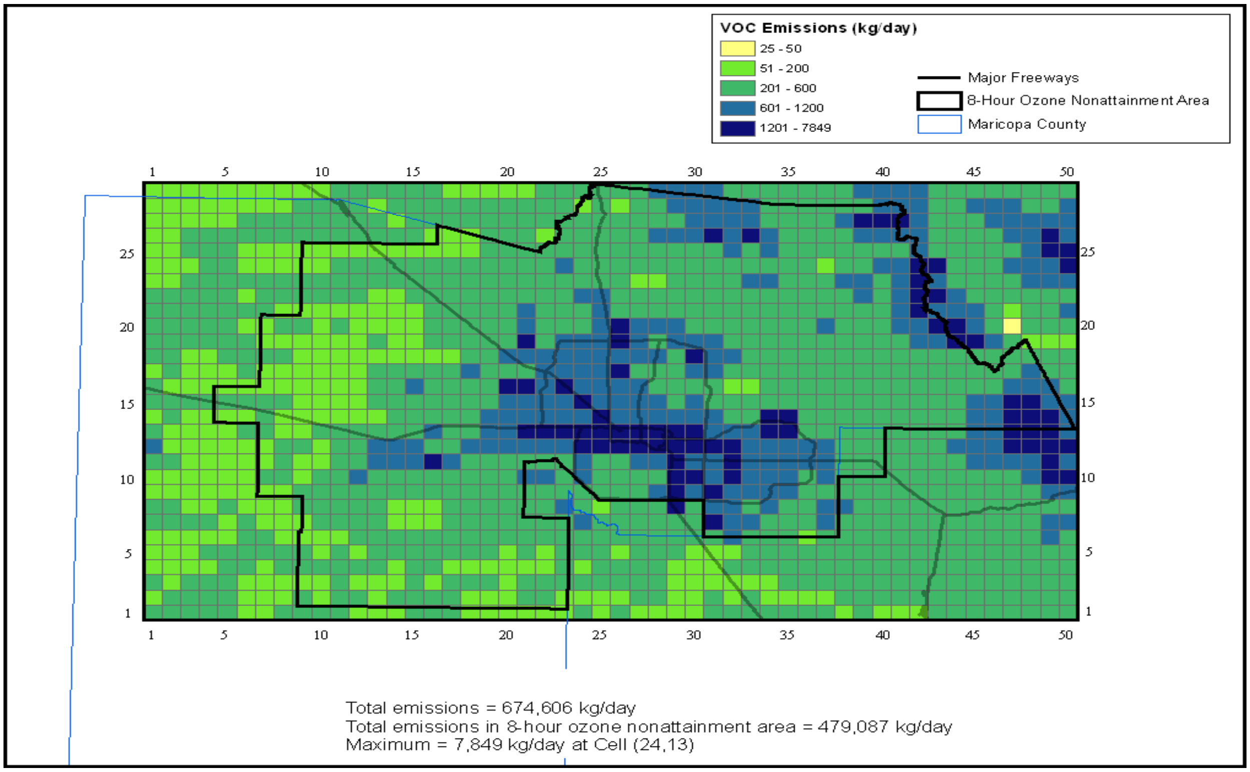


Figure IV-7(a). All source VOC emissions for a Thursday in June, 2025

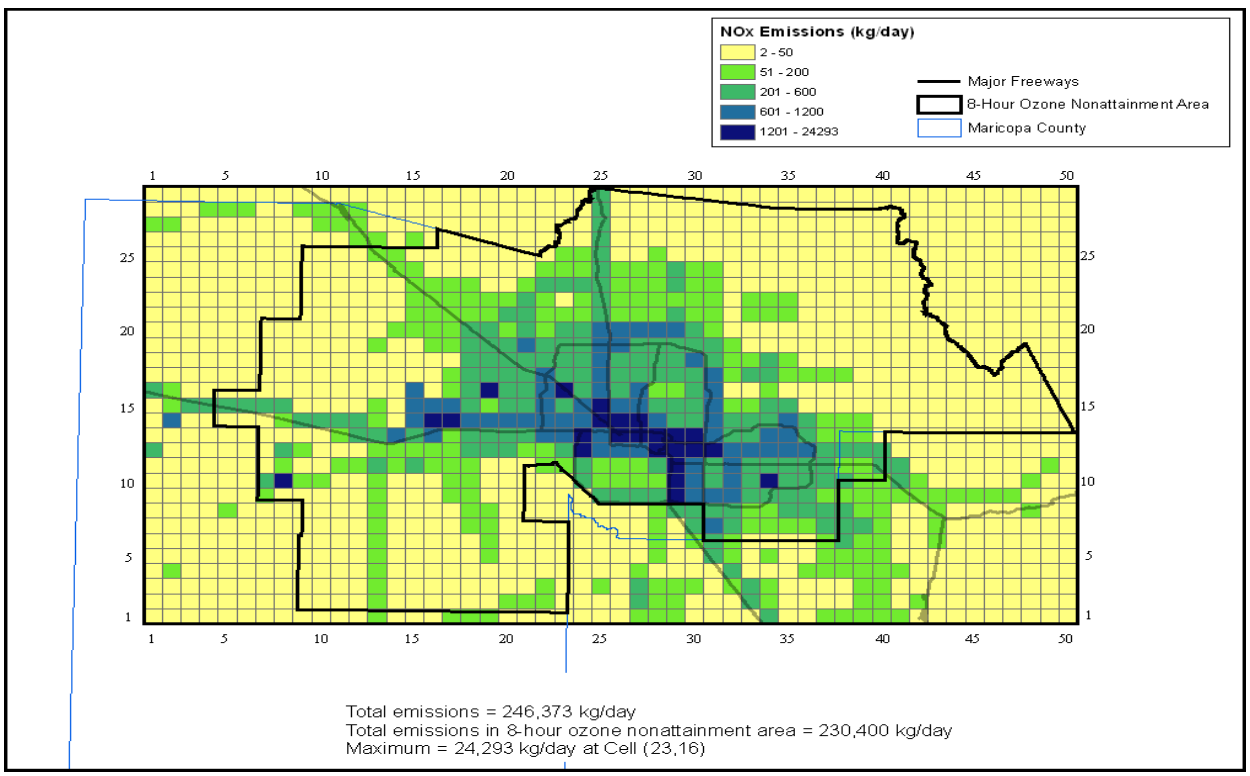


Figure IV-7(b). All source NOx emissions for a Thursday in June, 2025

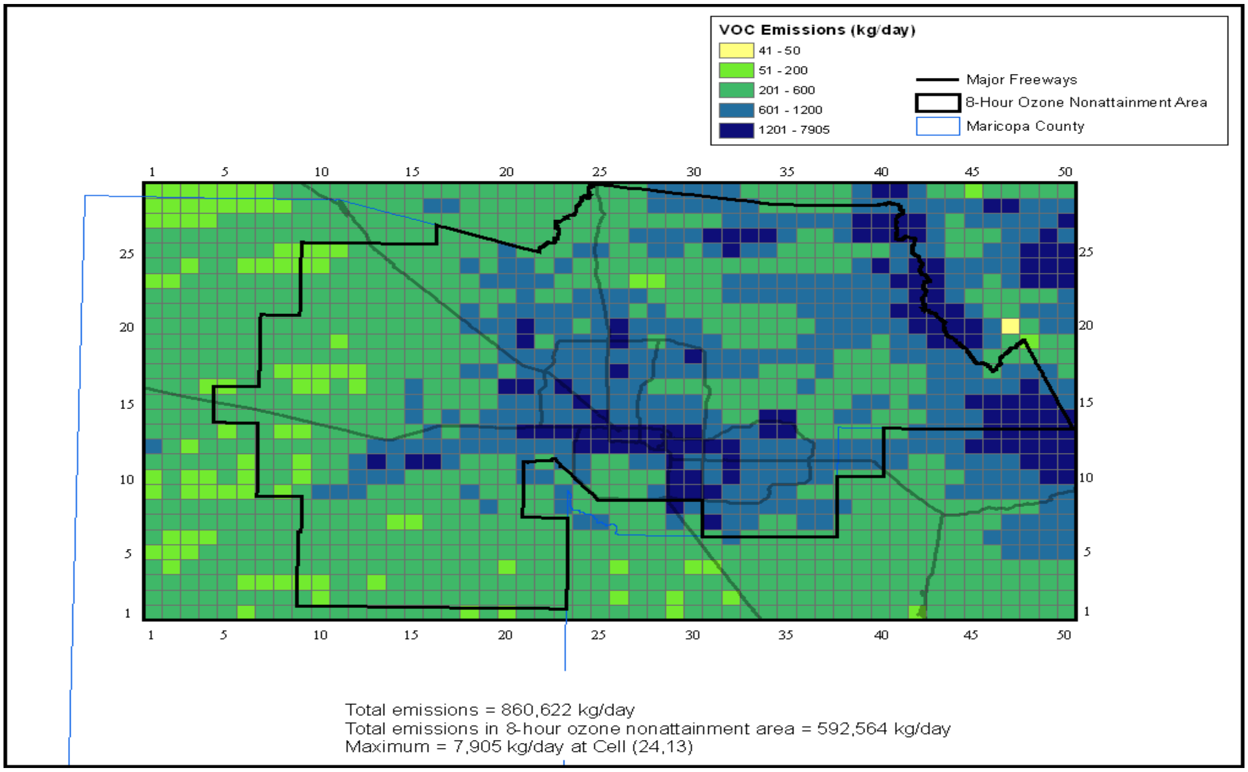


Figure IV-7(c). All source VOC emissions for a Tuesday in July, 2025

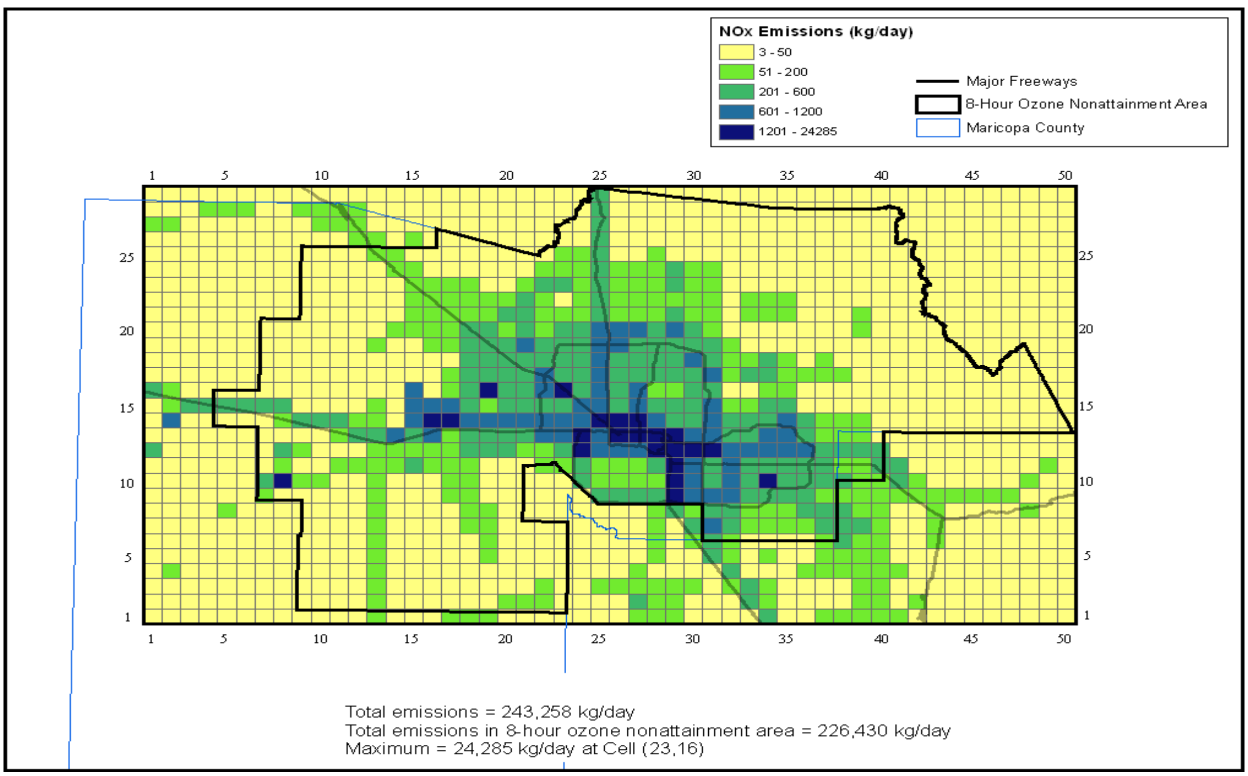


Figure IV-7(d). All source NOx emissions for a Tuesday in July, 2025

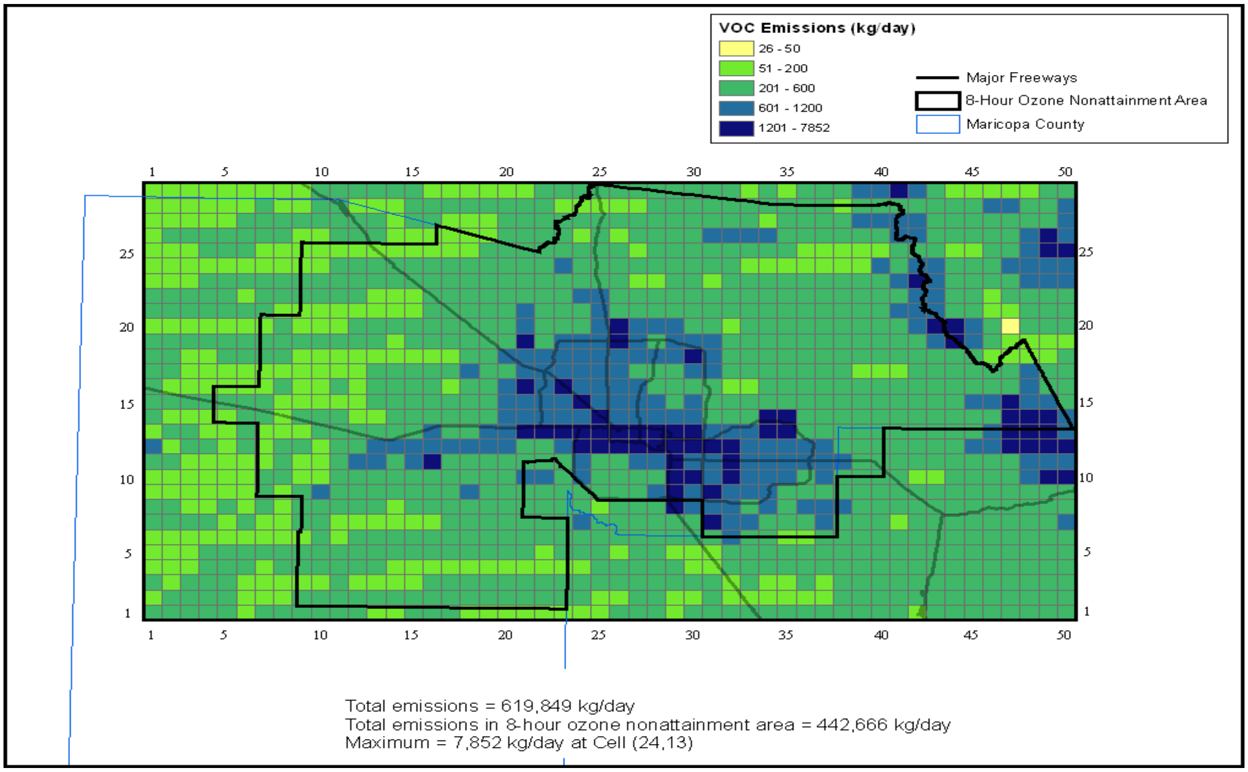


Figure IV-7(e). All source VOC emissions for a Friday in August, 2025

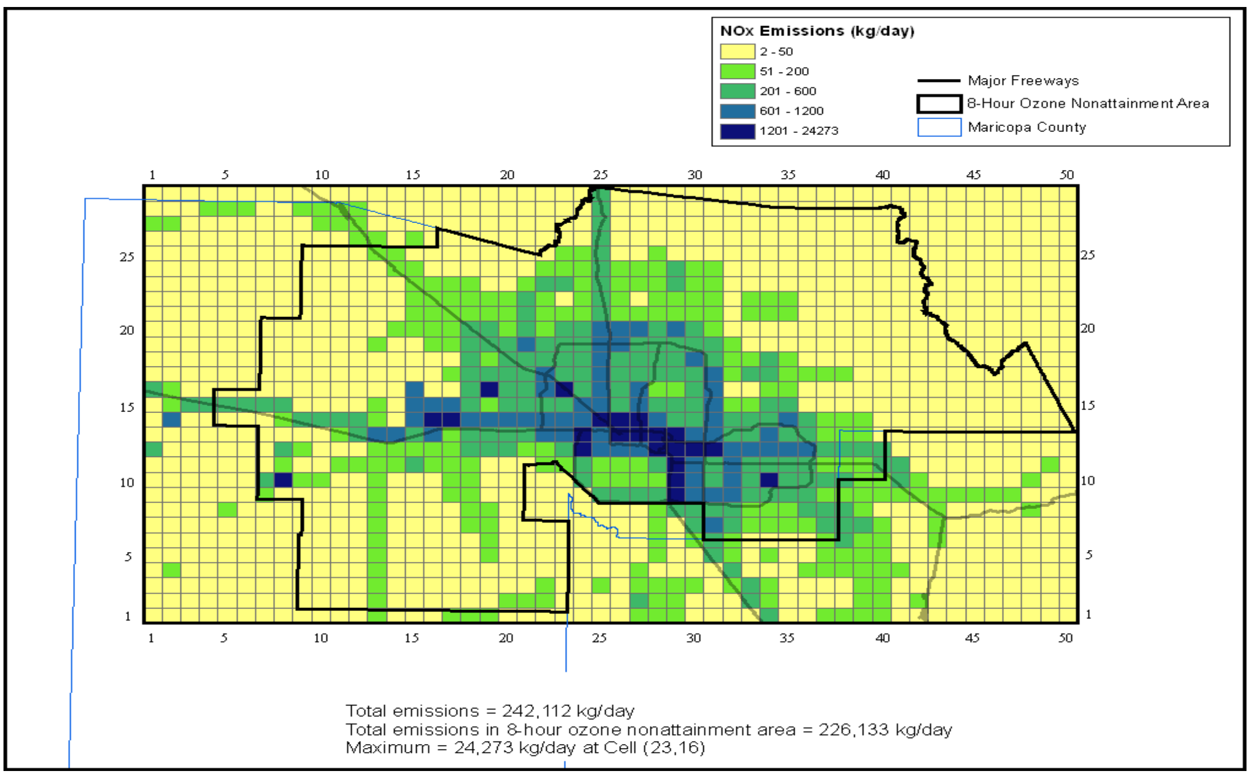


Figure IV-7(f). All source NOx emissions for a Friday in August, 2025

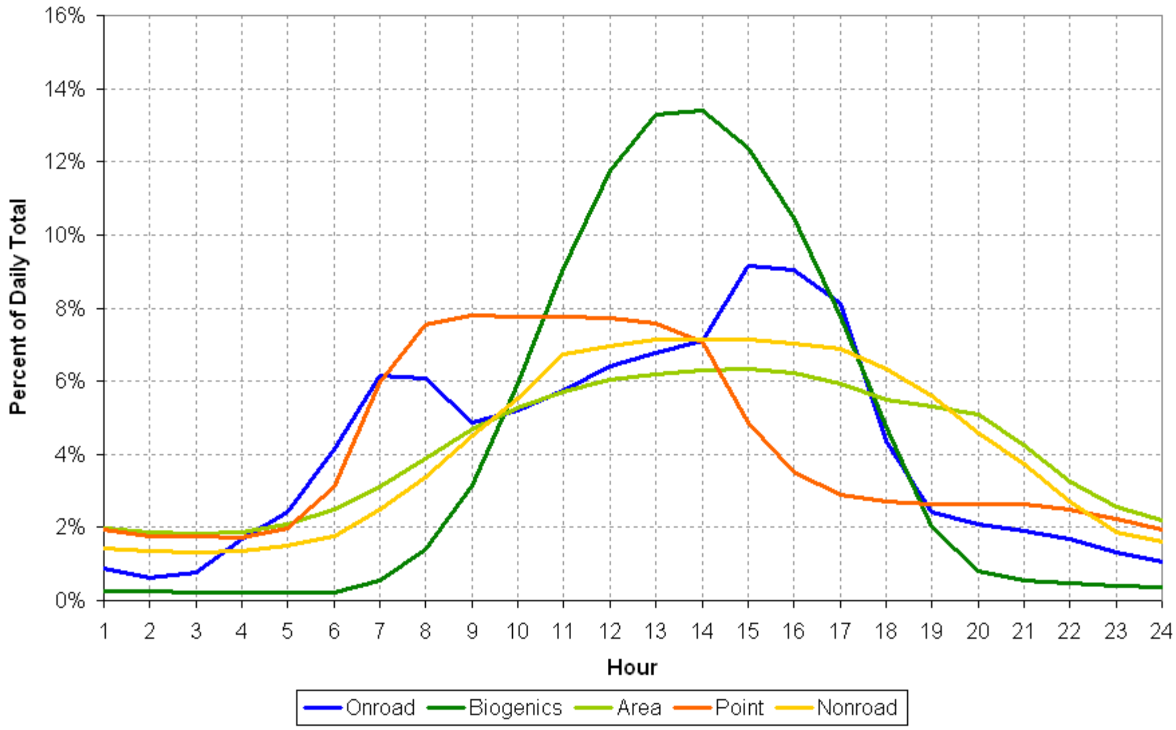


Figure IV-8(a). Temporal distribution of VOC emission sources for the CAMx modeling domain for a Thursday in June, 2025

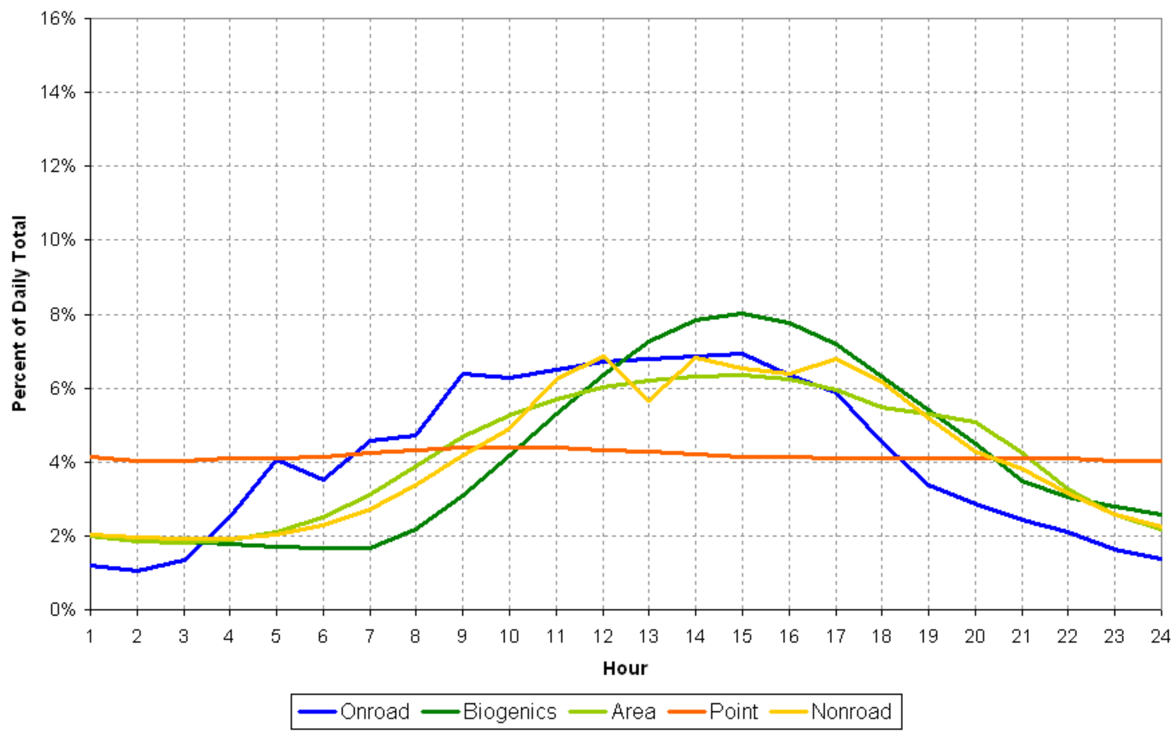


Figure IV-8(b). Temporal distribution of NOx emission sources for the CAMx modeling domain for a Thursday in June, 2025

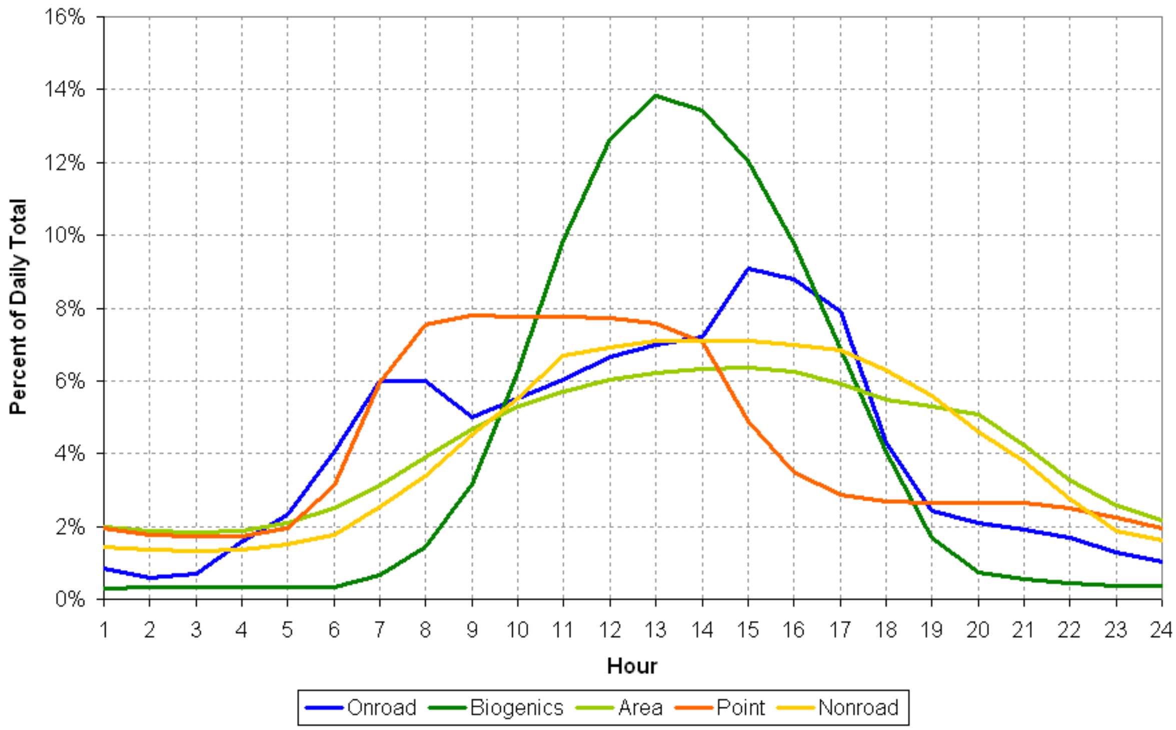


Figure IV-8(c). Temporal distribution of VOC emission sources for the CAMx modeling domain for a Tuesday in July, 2025

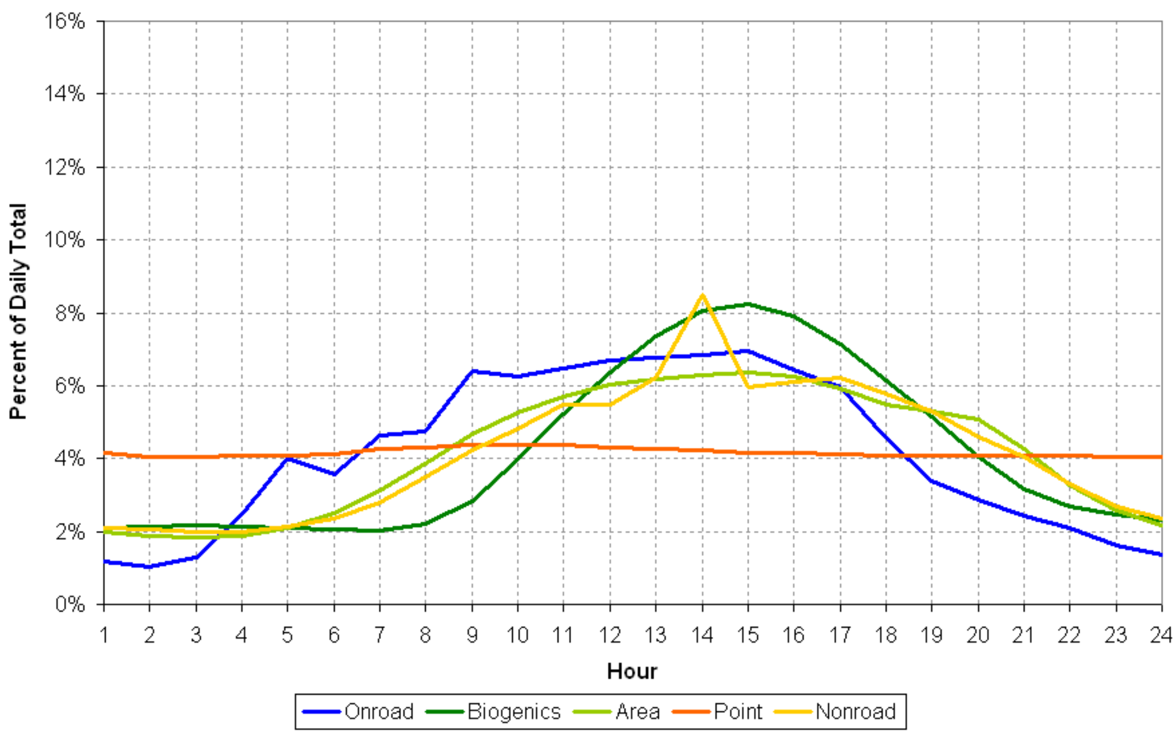


Figure IV-8(d). Temporal distribution of NOx emission sources for the CAMx modeling domain for a Tuesday in July, 2025

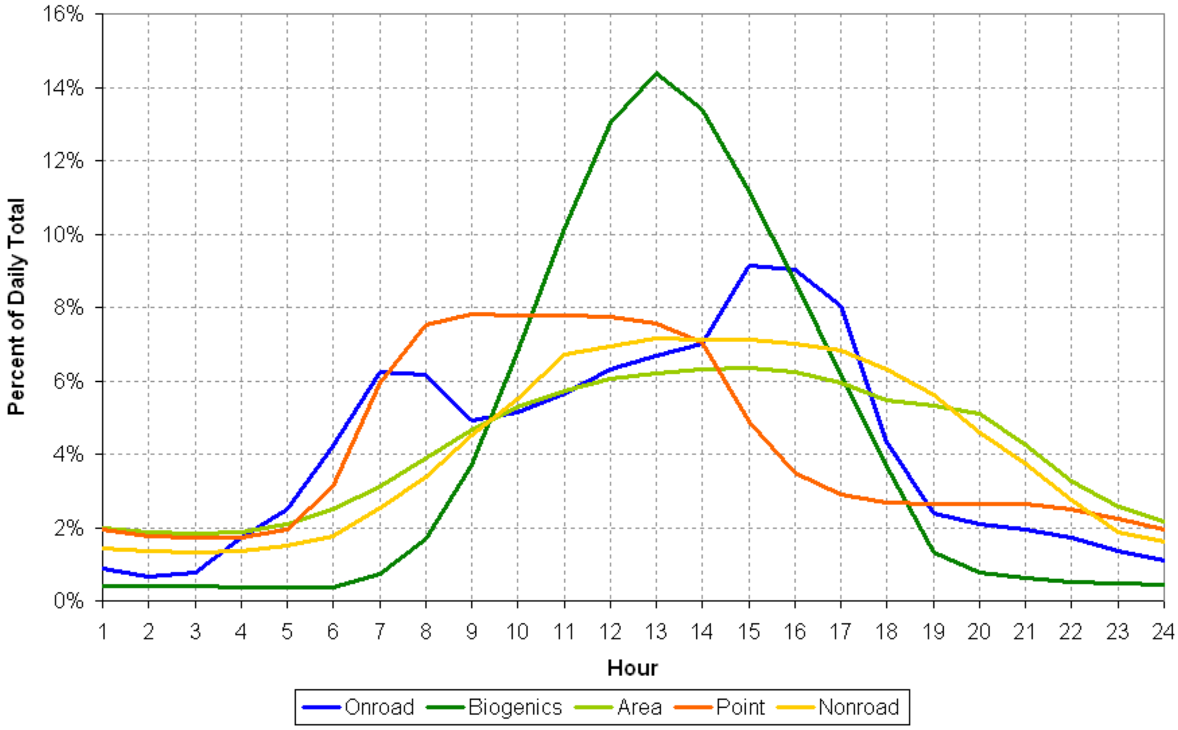


Figure IV-8(e). Temporal distribution of VOC emission sources for the CAMx modeling domain for a Friday in August, 2025

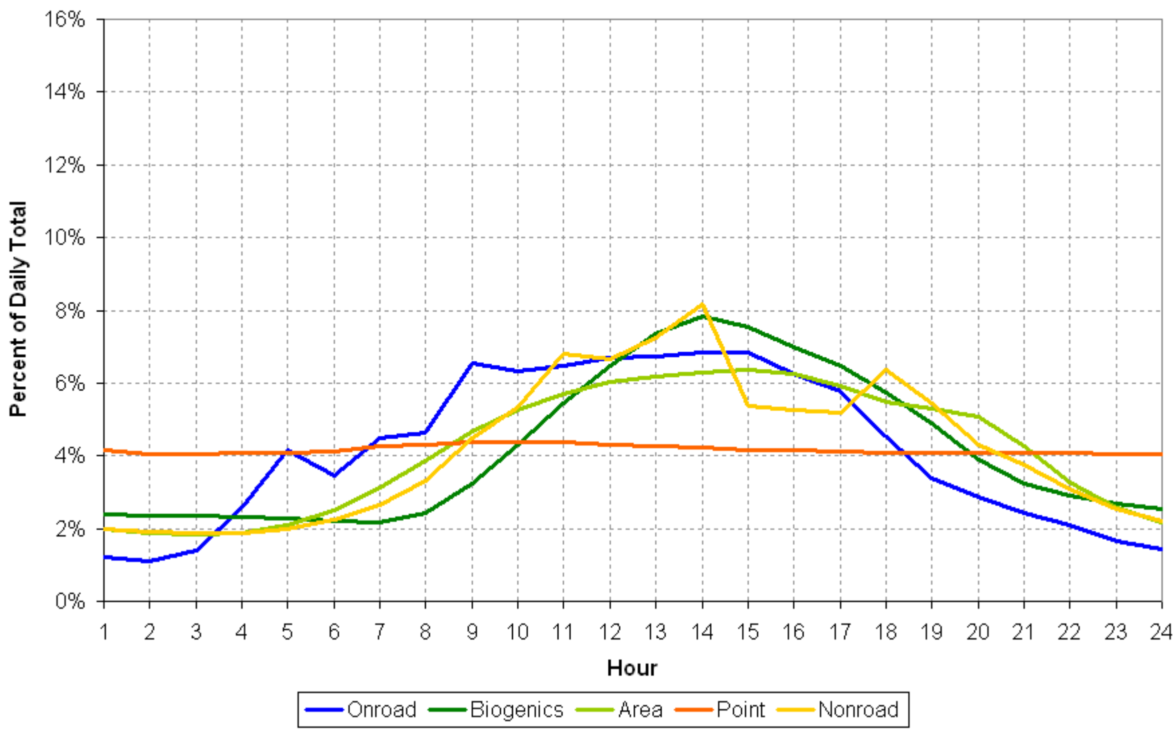


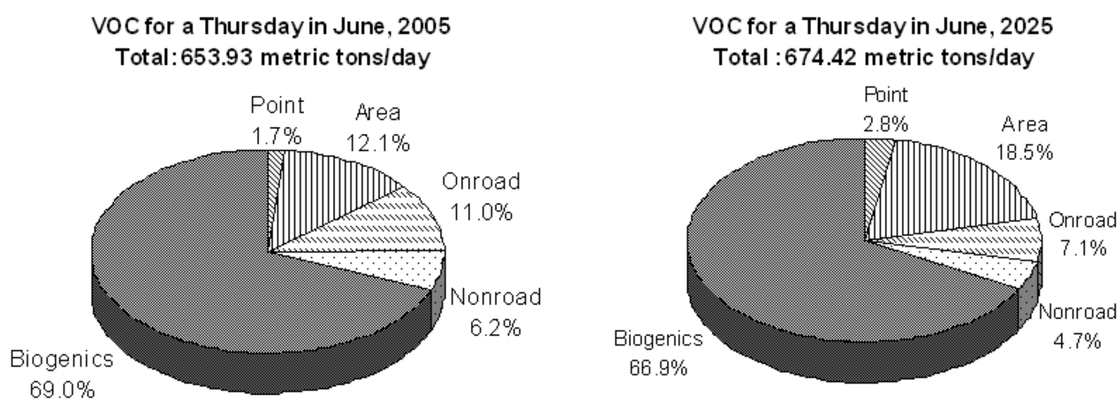
Figure IV-8(f). Temporal distribution of NOx emission sources for the CAMx modeling domain for a Friday in August, 2025

Table IV-26. Grid cell location of maximum VOC and NOx emissions (kilograms/day)

Source	Pollutant	Thursday in June, 2025	Tuesday in July, 2025	Friday in August, 2025
Onroad	VOC	530 (26,14)	535 (26,14)	539 (26,14)
	NOx	1,409 (27,14)	1,353 (27,14)	1,353 (27,14)
Anthropogenic	VOC	7,744 (24,13)	7,738 (24,13)	7,740 (24,13)
	NOx	24,287 (23,16)	24,277 (23,16)	24,267 (23,16)
All	VOC	7,849 (24,13)	7,905 (24,13)	7,852 (24,13)
	NOx	24,293 (23,16)	24,285 (23,16)	24,273 (23,16)

Table IV-27(a). VOC emissions by source category for a June episode day in 2005 and 2025 in the CAMx 4 km modeling domain

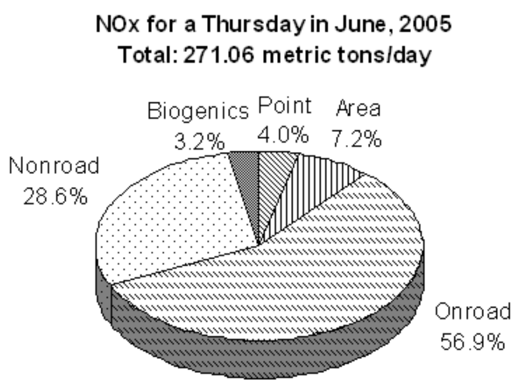
Source Category	Thursday in June, 2005 (metric tons/day)	Thursday in June, 2025 (metric tons/day)	2025-2005 Difference (%)
Point	11.10	18.69	68.5
Area	79.20	124.76	57.5
Nonroad	40.27	31.82	-21.0
Onroad	72.09	47.87	-33.6
Biogenics	451.27	451.27	0.0
Total	**653.93**	**674.42**	**3.1**

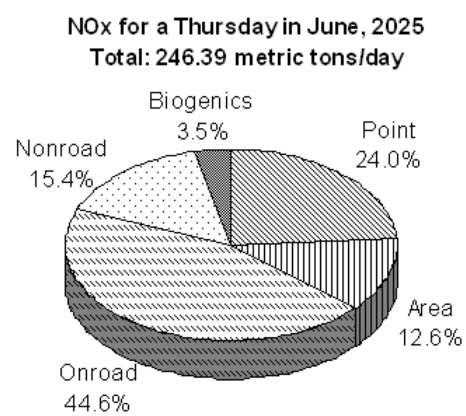


Note: The percent total may not be equal to 100% due to rounding.

Table IV-27(b). NOx emissions by source category for a June episode day in 2005 and 2025 in the CAMx 4 km modeling domain

Source Category	Thursday in June, 2005 (metric tons/day)	Thursday in June, 2025 (metric tons/day)	2025-2005 Difference (%)
Point	10.93	59.1	440.3
Area	19.57	31.1	58.8
Nonroad	77.65	37.9	-51.2
Onroad	154.35	109.8	-28.9
Biogenics	8.56	8.56	0.0
Total	**271.06**	**246.39**	**-9.1**

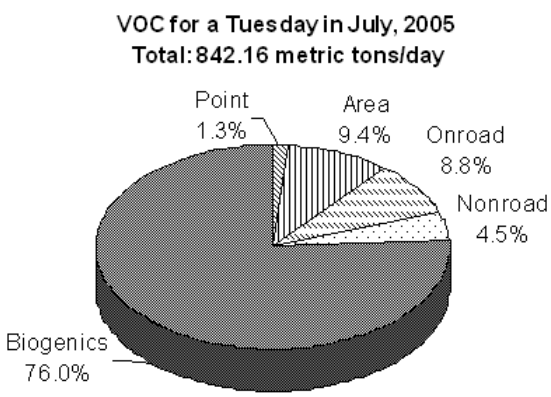


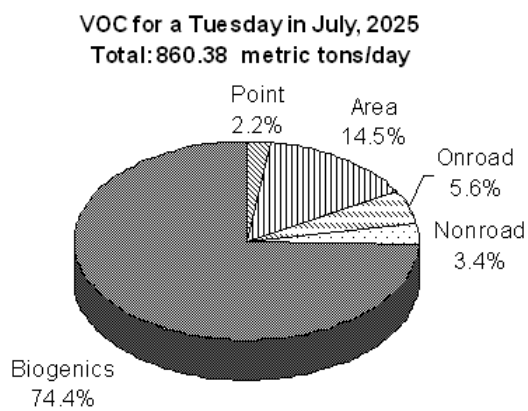


Note: The percent total may not be equal to 100% due to rounding.

Table IV-27(c). VOC emissions by source category for a July episode day in 2005 and 2025 in the CAMx 4 km modeling domain

Source Category	Tuesday in July, 2005 (metric tons/day)	Tuesday in July, 2025 (metric tons/day)	2025-2005 Difference (%)
Point	11.10	18.69	68.5
Area	79.20	124.76	57.5
Nonroad	37.60	28.83	-23.3
Onroad	74.36	48.18	-35.2
Biogenics	639.90	639.90	0.0
Total	**842.16**	**860.38**	**2.2**

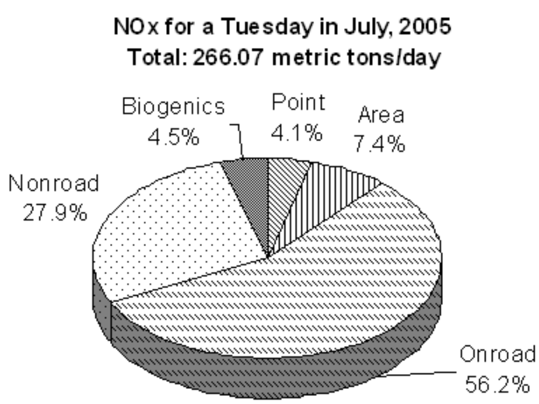


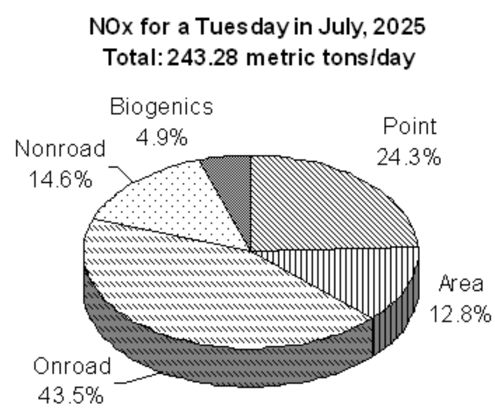


Note: The percent total may not be equal to 100% due to rounding.

Table IV-27(d). NOx emissions by source category for a July episode day in 2005 and 2025 in the CAMx 4 km modeling domain

Source Category	Tuesday in July, 2005 (metric tons/day)	Tuesday in July, 2025 (metric tons/day)	2025-2005 Difference (%)
Point	10.93	59.06	440.3
Area	19.57	31.08	58.8
Nonroad	74.23	35.53	-52.1
Onroad	149.48	105.75	-29.3
Biogenics	11.86	11.86	0.0
Total	**266.07**	**243.28**	**-8.6**

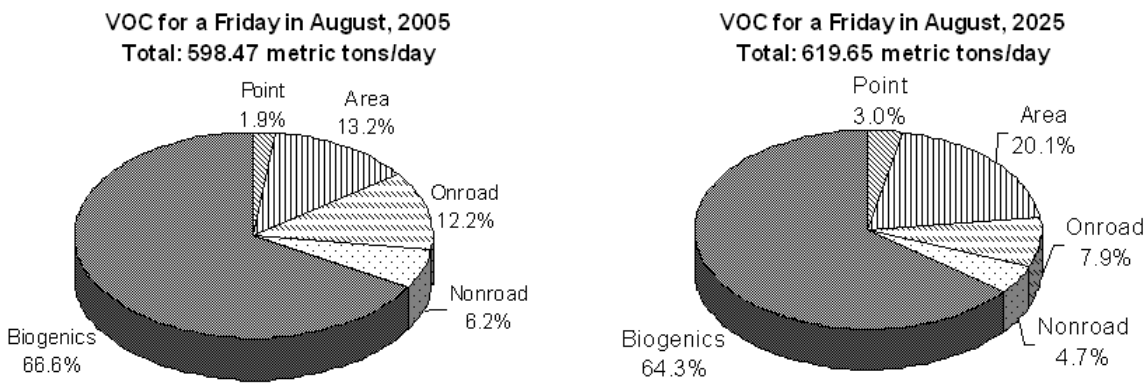




Note: The percent total may not be equal to 100% due to rounding.

Table IV-27(e). VOC emissions by source category for an August episode day in 2005 and 2025 in the CAMx 4 km modeling domain

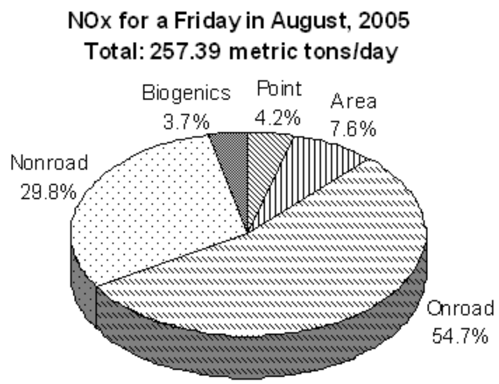
Source Category	Friday in August, 2005 (metric tons/day)	Friday in August, 2025 (metric tons/day)	2025-2005 Difference (%)
Point	11.10	18.69	68.5
Area	79.20	124.76	57.5
Nonroad	37.00	29.12	-21.3
Onroad	72.74	48.65	-33.1
Biogenics	398.43	398.43	0.0
Total	**598.47**	**619.65**	**3.5**

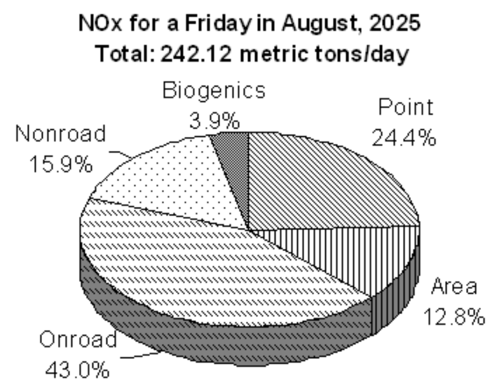


Note: The percent total may not be equal to 100% due to rounding.

Table IV-27(f). NOx emissions by source category for an August episode day in 2005 and 2025 in the CAMx 4 km modeling domain

Source Category	Friday in August, 2005 (metric tons/day)	Friday in August 10, 2025 (metric tons/day)	2025-2005 Difference (%)
Point	10.93	59.06	440.3
Area	19.57	31.08	58.8
Nonroad	76.64	38.41	-49.9
Onroad	140.69	104.01	-26.1
Biogenics	9.56	9.56	0.0
Total	**257.39**	**242.12**	**-5.9**





Note: The percent total may not be equal to 100% due to rounding.

IV-3. Meteorological Inputs

The same MM5 meteorological input data developed for the three ozone episodes in 2001 and 2002 were applied for the baseline and future years. Detailed information on the meteorological data preparation is presented in Section III-1-2.

IV-4. Air Quality Inputs

The following air quality inputs were prepared from the existing in-house modeling outputs of the WRAP emissions inventories (2002 and 2018) and EPA/CAIR (2001) studies: (1) Gridded Initial Condition (IC) of each chemical species, (2) Gridded hourly Boundary Condition (BC) of each chemical species along the edges of the modeling domain, and (3) Temporally and spatially constant Top Concentration (TOPC) for the area above the modeling domain.

IV-4-1. Initial and Boundary Conditions

In order to prepare initial and boundary conditions for the baseline and future year, MAG applied the same approach used for the eight-hour ozone attainment demonstration, which extracts 3-D gridded emissions from a previous photochemical modeling study. ENVIRON provided IC and BC files extracted from the 2002 and 2018 WRAP results. Details on the extraction process is described in Appendix IV-ix: "Development of CAMx 2025 regional initial/boundary conditions". The IC and BC files for the baseline and future years were derived by interpolating and extrapolating 2002 and 2018 WRAP IC and BC files.

The IC and BC files contain concentration data for the 45 chemical species including aerosols at the initial hour of the simulation and for each simulation hour over 20 layers. The 45 chemical species contained in the IC and BC files are: NO, NO2, O3, PAN, NXOY, OLE, PAR, TOL, TOLA, XYL, XYLA, FORM, ALD2, ETH, CRES, MGLY, OPEN, PNA, CO, HONO, H2O2, HNO3, ISOP, ISP, ISPD, NTR, SO2, SULF, NH3, TRP, CG1, CG2, CG5, CG6, HCL, PSO4, PNO3, PNH4, POA, PEC, FPRM, CPRM, NA, PCL, and PH2O.

IV-4-2. Top Concentrations

The Top Concentration (TOPC) file contains pollutant concentration data for the area along the top of the modeling region. Since measured pollutant concentrations at the top of modeling region are not available, top concentration data were extracted from the 2018 WRAP results by ENVIRON (ENVIRON, 2008). Interpolation and extrapolation of the TOPC files from the 2002 and 2018 WRAP data were performed to derive the TOPC files for the baseline and future year, respectively. The chemical species and their concentrations used for the TOPC file for the baseline and future year are presented in Tables IV-28 and 29, respectively.

Table IV-28. Chemical species and their concentrations used for the TOPC file for the baseline year (Units: ppmV)

Species	June Episode	July Episode	August Episode
NO	1.31E-12	2.27E-12	2.93E-11
NO2	3.13E-05	1.75E-05	1.54E-05
O3	9.57E-02	8.65E-02	4.82E-02
PAN	1.57E-04	1.67E-04	2.51E-04
NXOY	1.21E-05	3.99E-06	2.80E-06
OLE	1.58E-06	9.44E-06	6.01E-06
PAR	2.08E-03	3.14E-03	4.71E-03
TOL	1.40E-06	6.27E-06	8.05E-06
TOLA	2.64E-07	1.24E-06	1.20E-06
XYL	2.67E-08	1.59E-07	4.25E-07
XYLA	4.83E-09	2.97E-08	2.41E-08
FORM	1.13E-04	1.30E-04	1.03E-04
ALD2	2.02E-05	6.09E-05	5.31E-05
ETH	3.30E-06	1.85E-05	1.33E-05
CRES	2.22E-07	8.99E-07	1.53E-06
MGLY	7.92E-07	1.54E-06	9.94E-07
OPEN	2.49E-08	9.67E-08	1.22E-07
PNA	4.79E-05	2.93E-05	1.73E-05
CO	7.78E-02	7.51E-02	8.36E-02
HONO	8.37E-08	3.57E-08	3.42E-08
H2O2	9.72E-04	9.05E-04	1.09E-03
HNO3	2.63E-04	1.86E-04	9.36E-05
ISOP	4.42E-07	2.31E-06	2.45E-06
ISP	7.98E-08	4.62E-07	1.26E-06
ISPD	3.72E-06	1.06E-05	1.13E-05
NTR	3.22E-05	9.54E-05	2.64E-04
SO2	1.73E-05	1.07E-05	7.48E-06
SULF	4.41E-10	4.25E-10	2.29E-10
NH3	1.72E-06	1.53E-06	9.63E-07
TRP	4.36E-09	9.67E-08	8.45E-08
CG1	3.04E-07	9.27E-07	1.41E-06
CG2	7.01E-07	1.99E-06	3.14E-06
CG5	4.74E-07	1.40E-06	2.28E-06
CG6	1.25E-06	3.50E-06	6.17E-06
HCL	1.08E-09	2.96E-09	7.26E-09
PSO4	4.69E-02	6.74E-02	6.56E-02
PNO3	1.24E-01	1.10E-01	3.60E-02
PNH4	2.77E-02	3.33E-02	1.61E-02
POA	3.03E-02	4.99E-02	1.41E-02
PEC	1.05E-02	1.24E-02	4.63E-03
FPRM	4.05E-03	1.96E-02	7.32E-03
CPRM	2.60E-01	1.26E-01	2.46E-02
NA	4.48E-03	1.00E-03	3.06E-04
PCL	6.90E-03	1.50E-03	3.97E-04
PH2O	9.01E-03	1.75E-02	1.81E-02

Table IV-29. Chemical species and their concentrations used for the TOPC file for the future year (Units: ppmV)

Species	June Episode	July Episode	August Episode
NO	1.12E-12	1.97E-12	0.00E+00
NO2	2.68E-05	1.60E-05	1.61E-05
O3	9.52E-02	8.63E-02	7.28E-02
PAN	1.52E-04	1.53E-04	1.60E-04
NXOY	1.20E-05	3.96E-06	6.22E-06
OLE	1.56E-06	1.06E-05	5.18E-06
PAR	2.07E-03	3.14E-03	3.35E-03
TOL	1.41E-06	6.80E-06	3.48E-06
TOLA	1.41E-06	6.61E-06	5.08E-06
XYL	2.52E-08	1.58E-07	0.00E+00
XYLA	2.58E-08	1.58E-07	1.02E-07
FORM	1.11E-04	1.29E-04	1.12E-04
ALD2	1.97E-05	6.33E-05	4.01E-05
ETH	3.26E-06	1.79E-05	7.70E-06
CRES	2.35E-07	1.00E-06	5.13E-07
MGLY	7.27E-07	1.59E-06	1.46E-06
OPEN	2.41E-08	1.01E-07	5.48E-08
PNA	4.45E-05	2.86E-05	2.62E-05
CO	7.78E-02	7.39E-02	7.97E-02
HONO	7.19E-08	3.26E-08	3.08E-08
H2O2	9.87E-04	8.95E-04	9.94E-04
HNO3	4.00E-05	1.26E-04	8.76E-05
ISOP	4.16E-07	2.55E-06	6.92E-06
ISP	4.26E-07	2.46E-06	5.36E-06
ISPD	3.52E-06	1.15E-05	1.46E-05
NTR	2.79E-05	8.48E-05	1.00E-04
SO2	1.57E-05	1.06E-05	1.83E-05
SULF	4.75E-10	6.36E-10	5.69E-10
NH3	1.32E-05	1.18E-05	5.73E-06
TRP	2.32E-08	5.16E-07	3.59E-07
CG1	2.76E-07	8.86E-07	1.59E-06
CG2	6.22E-07	1.89E-06	3.37E-06
CG5	2.14E-06	6.01E-06	8.36E-06
CG6	6.68E-06	1.87E-05	2.62E-05
HCL	5.77E-09	1.58E-08	3.09E-08
PSO4	4.64E-02	6.37E-02	7.67E-02
PNO3	3.03E-01	1.49E-01	1.79E-01
PNH4	2.50E-02	2.97E-02	3.99E-02
POA	3.18E-02	3.84E-02	4.94E-02
PEC	1.10E-02	1.25E-02	1.54E-02
FPRM	2.08E-03	3.48E-03	1.24E-02
CPRM	2.61E-01	1.26E-01	1.11E-01
NA	0.00E+00	5.10E-04	1.84E-03
PCL	0.00E+00	4.39E-04	2.38E-03
PH2O	3.72E-03	6.32E-03	9.87E-03

IV-5. Other Inputs

The same “other inputs” used for the eight-hour ozone attainment demonstration were employed for the baseline and future year CAMx runs. The other inputs include chemistry, albedo/haze/ozone, photolysis rate, surface roughness, deposition, and simulation control parameters. Details on the other inputs are described in Section III-1-4.

IV-6. 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 purpose of quality assurance on input components is to establish that a good model result is the result of valid model inputs and assumptions, not the result of compensating errors in input data.

Plots showing hourly surface temperature and wind fields are presented in Appendices III-iv through ix of the Eight-Hour Ozone Plan (MAG, 2007a). Ground level ozone concentration plots are presented in Appendices IV-x through IV-xv. 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 overlaid on the simulated wind fields to facilitate comparison between the predicted and observed winds. As a 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 the resulting fields were physically reasonable.

Prior to conducting the baseline and future years simulations, individual air quality, meteorological, and emissions data were carefully evaluated for consistency and errors. In addition, spatial and temporal characteristics of these data were examined to verify the quality of the data.

IV-7. Committed Control Measures

The overall approach taken in preparing the Eight-Hour Ozone Maintenance Plan is to demonstrate maintenance of the eight-hour ozone standard in 2025 with the seven maintenance measures which are listed in Table IV-30. Emission reduction credit was taken for these seven committed measures in the modeling for the maintenance demonstration. However, there are numerous other committed control measures in plans and programs for the Maricopa Nonattainment Area (MNA) that have previously been approved by EPA. The legally-binding State, Maricopa County, and local government commitments in these plans and programs will continue to reinforce the benefits of the seven maintenance measures between 2005 and 2025.

Most of the control measures in the Eight-Hour Ozone Maintenance Plan, whether used for credit or not, were derived from EPA-approved programs and plans for the MNA, 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, both effective on April 8, 2005; and the Final Serious Area Ozone State Implementation Plan (SIP) for Maricopa County and the One-Hour Ozone Redesignation Request and Maintenance Plan, both effective on June 14, 2005.

Although the one-hour ozone standard was revoked by EPA on June 15, 2005, all control measures in the One-Hour Ozone Redesignation Request and 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 these 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, maintenance of the eight-hour ozone standard through 2025 will be facilitated by more stringent federal emission standards for light duty motor vehicles and nonroad equipment. Together, these federal measures and the legally-binding commitments contained in prior EPA-approved plans and programs have been effective in reducing ozone in the MNA, as evidenced by the fact that there has not been a violation of the eight-hour ozone standard since 2004.

Descriptions of the committed control measures in the Eight-Hour Ozone Maintenance Plan are organized into three groups below. The first group includes those measures for which numeric emissions credit was assumed in the maintenance demonstration (see Section IV-7-1). The combined emission reductions from this group of maintenance control measures are reflected in the 2025 modeling inventory described in Section IV-2. Table IV-30 lists the seven maintenance measures in Group 1. The first four maintenance measures in this Table were attainment measures in the Eight-Hour Ozone Plan. The fifth and sixth measures were contingency measures in the Eight-Hour Ozone Plan. The last maintenance measure, Ban Open Burning During the Ozone Season, was passed by the Arizona legislature as part of S.B. 1552 in June 2007.

The second group of committed control measures includes the contingency measures that are part of the Eight-Hour Ozone Maintenance Plan (see Section IV-7-2). No emissions reduction credit was taken for these measures in the modeling for the maintenance demonstration and the impact of these measures is not reflected in the 2025 emission inventories in Section IV-2. The first three contingency measures in Table IV-30 were also contingency measures in the 2007 Eight-Hour Ozone Plan. The fourth contingency measure, Liquid Leaker Test as Part of the Vehicle Emissions Inspection (VEI) Program, is a new ozone measure passed by the Arizona legislature in June 2007. The last two contingency measures, Coordinate Traffic Signal Systems and Develop Intelligent Transportation Systems, were attainment measures in the 2007 Eight-Hour Ozone Plan. Descriptions of these contingency measures are provided later in this section.

The third group of control measures includes the 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 that were not used for numeric credit in those approved plans (see Section IV-7-3). 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 will continue to reinforce the air quality benefits of the measures for which numeric credit towards maintenance was taken.

Table IV-30. Committed Maintenance and Contingency Measures in the Eight-Hour Ozone Maintenance Plan

Maintenance 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. Gross Polluter Waiver Provision
2. Phased-In Emission Test Cutpoints (I/M 147 Program)	2. Increased Waiver Repair Limit
3. One Time Waiver from Vehicle Emissions Test	3. Federal Heavy Duty Diesel Vehicle Emissions Standards
4. Tougher Enforcement of Vehicle Registration and Emission Test Compliance	4. Liquid Leaker Test as Part of VEI Program
5. Federal Nonroad Equipment Emissions Standards	5. Coordinate Traffic Signal Systems
6. Expansion of Area A Boundary (H.B. 2538)	6. Develop Intelligent Transportation Systems
7. Ban Open Burning During Ozone Season	

IV-7-1. Measures Used for Numeric Credit

Seven maintenance measures were quantified for emissions reduction credit in the Eight-Hour Ozone Maintenance Plan. Figures IV-9 and IV-10 illustrate the percent reductions in anthropogenic VOC and NOx emissions, respectively, due to implementation of the committed maintenance measures in the ozone 4 km modeling domain. Table IV-31 quantifies the emission reductions from the individual measures in metric tons per day.

The base 2025 anthropogenic VOC emissions shown in Table IV-31 were estimated by removing the emissions reductions due to implementation of maintenance measures from the emissions for a Thursday in June 2025. Thursday is the day of the week during the June episode in 2002 when the highest eight-hour ozone concentrations were measured. A comparison by source category of the base emissions and the lower emissions resulting from implementation of the maintenance measure package is provided in Tables IV-32 (a) and (b). The maintenance measures and the methodology used to quantify the emissions reduction credits are described in the section following Table IV-32(b). More details on the maintenance measures and the methodology are provided in Appendix IV-xvi.

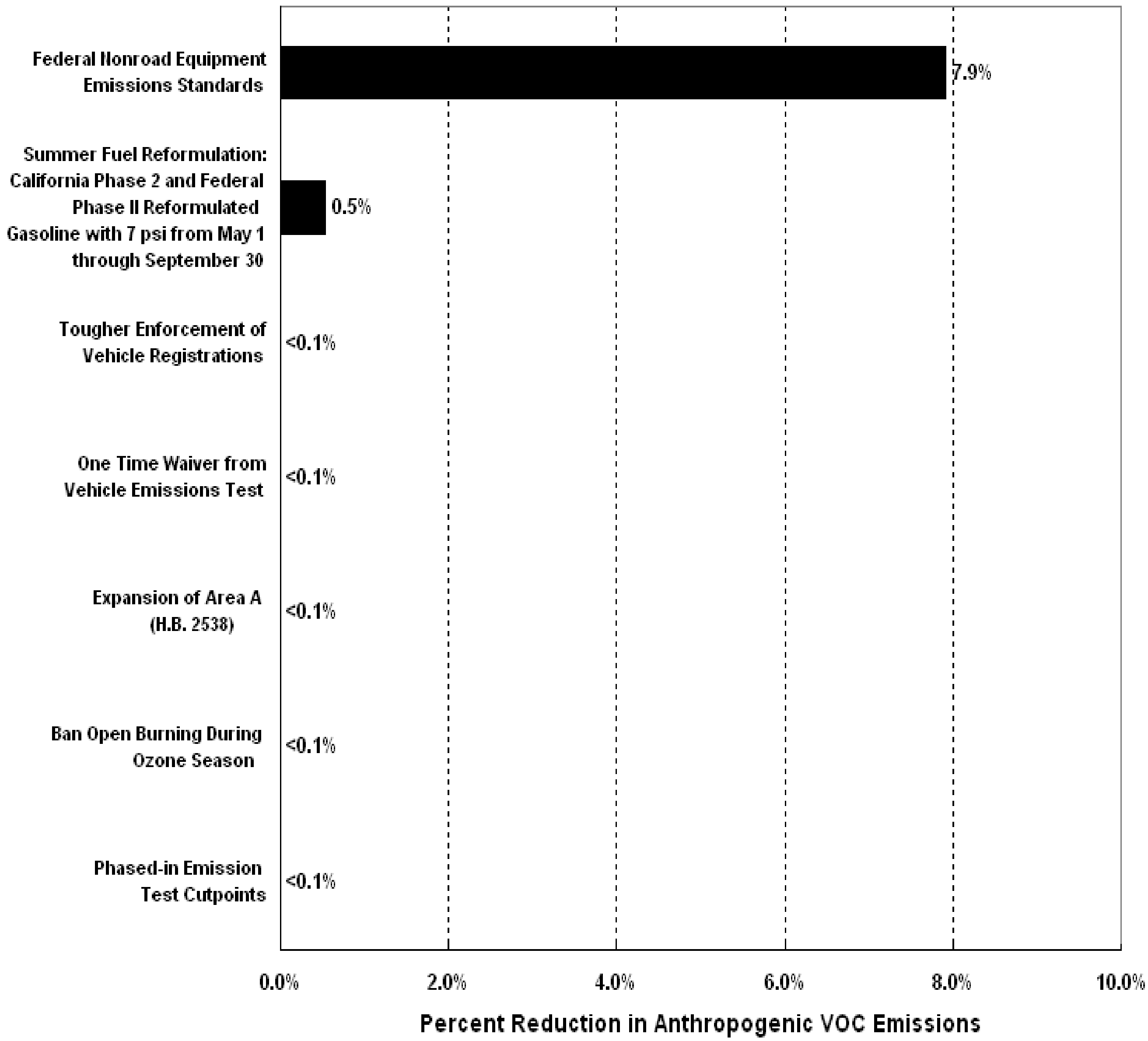


Figure IV-9. 2025 anthropogenic VOC emission reductions for individual maintenance measures in the eight-hour ozone modeling domain (4 km).

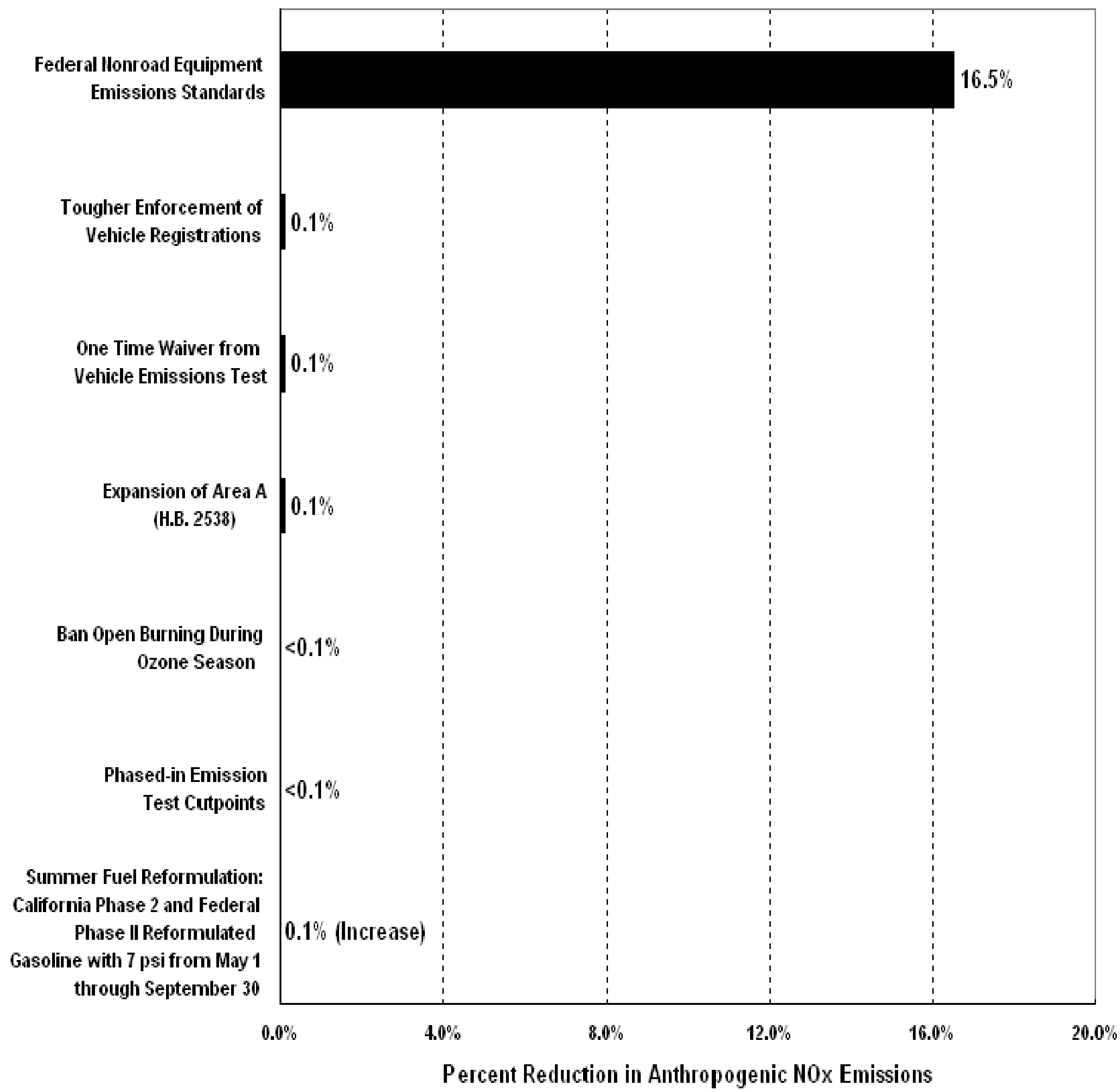


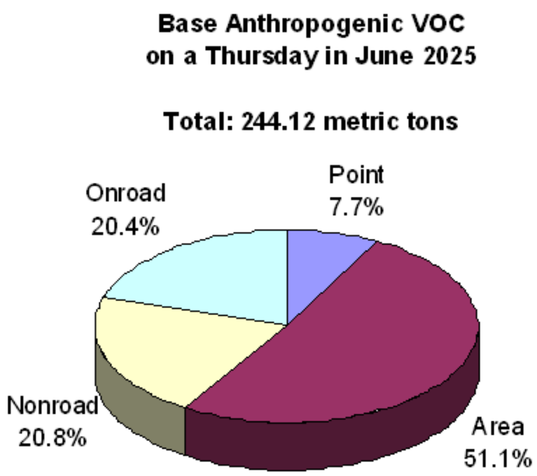
Figure IV-10. 2025 anthropogenic NOx emission reductions from individual maintenance measures in the eight-hour ozone modeling domain (4 km)

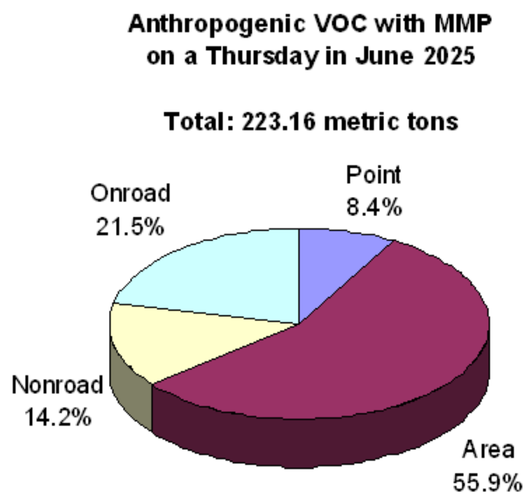
Table IV-31. 2025 emission reductions in metric tons per day for committed maintenance measures used for numeric credit

2025 Emission Reductions by Individual Measure for the Eight-Hour Ozone Modeling Domain (4 km)				
	VOC		NOx	
Base Total Anthropogenic Emissions on a Thursday in June 2025 (metric tons/day)	244.1		285.8	
Maintenance 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	1.3	0.5%	0.4 (increase)	0.1% (increase)
2. Phased-In Emission Test Cutpoints	< 0.1	< 0.1%	< 0.1	< 0.1%
3. One Time Waiver from Vehicle Emissions Test	0.2	< 0.1%	0.3	0.1%
4. Tougher Enforcement of Vehicle Registration and Emission Test Compliance	0.2	< 0.1%	0.4	0.1%
5. Federal Nonroad Equipment Standard	19.3	7.9%	47.2	16.5%
6. Expansion of Area A Boundary	0.2	< 0.1%	0.4	0.1%
7. Ban Open Burning during Ozone Season	< 0.1	< 0.1%	< 0.1	< 0.1%

Table IV-32(a). Comparison of anthropogenic VOC emissions in 2025 for the base and maintenance measure package (MMP) in the eight-hour ozone modeling domain (4 km)

Source Category	Base Anthropogenic VOC Emissions on a Thursday in June 2025 (metric tons/day)	Anthropogenic VOC Emissions with Maintenance Measure Package (MMP) on a Thursday in June 2025 (metric tons/day)	2025 MMP vs Base Anthropogenic VOC Emissions (%)
Point	18.70	18.70	0.0
Area	124.79	124.76	0.0
Nonroad	50.83	31.80	-37.4
Onroad	49.80	47.90	-3.8
Total	244.12	223.16	-8.6

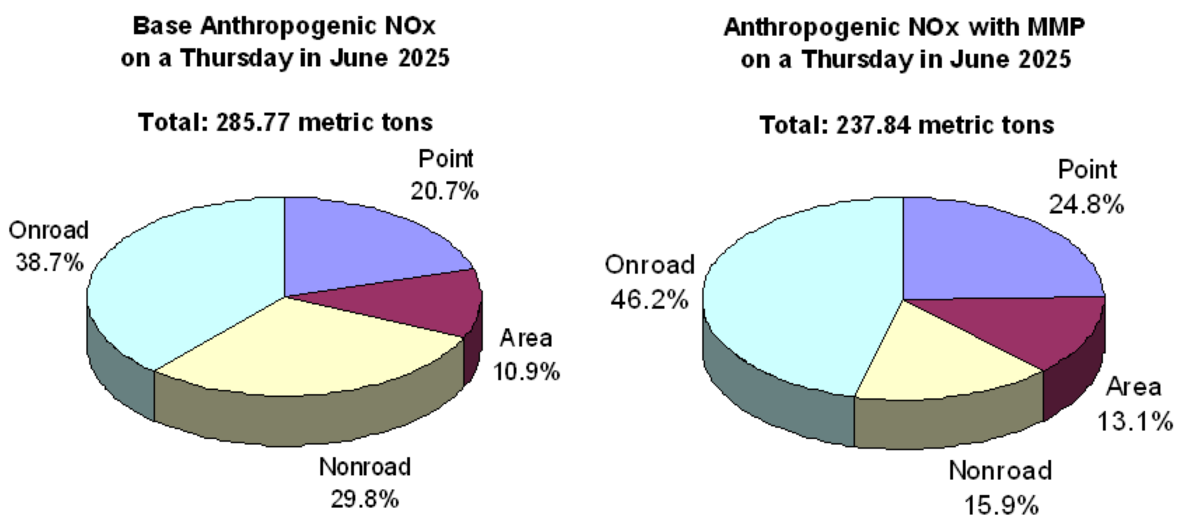




Note: The percent total may not be equal to 100% due to rounding.

Table IV-32(b). Comparison of anthropogenic NOx emissions in 2025 for the base and maintenance measure package (MMP) in the eight-hour ozone modeling domain (4 km)

Source Category	Base Anthropogenic NOx Emissions on a Thursday in June 2025 (metric tons/day)	Anthropogenic NOx with Maintenance Measure Package (MMP) on a Thursday in June 2025 (metric tons/day)	2025 MMP vs. Base Anthropogenic NOx Emissions (%)
Point	59.06	59.06	0.0
Area	31.09	31.08	0.0
Nonroad	85.12	37.90	-55.5
Onroad	110.50	109.80	-0.6
Total	285.77	237.84	-16.8



Note: The percent total may not be equal to 100% due to rounding.

Descriptions of Individual Maintenance Measures

1. *Summer Fuel Reformulation: California Phase 2 and Federal Phase II Reformulated Gasoline with 7 psi from May 1 through September 30*

   The Arizona Legislature passed House Bill 2307 in 1997. This legislation contains requirements that the sale of gasoline, from and after May 1, 1999 in Area A, be subject to an appropriate waiver granted under Section 211 (c)(4) of the Clean Air Act and 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.

   By September 15, 1997, the Director of the Arizona Department of Environmental Quality in consultation with the Director of the Weights and Measures, was 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. This measure was a committed control measure in the EPA-approved Serious Area Ozone SIP (ADEQ, 2000); Serious Area Carbon Monoxide Plan (MAG, 2001); Carbon Monoxide Maintenance Plan (MAG, 2003), and One-Hour Ozone Maintenance Plan, (MAG, 2004). It was also an attainment measure in the Eight-Hour Ozone Plan (MAG, 2007a).

<u>Modeling Methodology</u>

The Summer Fuel Reformulation measure was modeled by modifying MOBILE6.2 input files. MOBILE6.2 includes the option of setting a flag to one of four gasoline formulations: (1) Conventional gasoline east, (2) Reformulated gasoline, (3) Conventional gasoline west, and(4) User-supplied gasoline sulfur levels. For the purposes of this analysis, the MOBILE6.2 flag was set to reflect the reformulated gasoline described by this committed control measure. No specific emissions reduction credit was taken for reformulated gasoline use in nonroad sources, as it was assumed that the very stringent nonroad engine standards includes the use of cleaner burning reformulated gasoline.

The “S” option was set in MOBILE6.2 to reflect the southern location of Arizona. Additionally, the locally required maximum RVP of 7.0 psi was input to the MOBILE6.2 model. The emissions reduction credit for this measure was applied exclusively to Area A (S.B. 1427).

The emission reduction credits attributable to this measure on a Thursday in June 2025 are a 1.3 metric ton per day decrease in VOC and a 0.4 metric ton per day increase in NOx. This is equivalent to an reduction in total 2025 anthropogenic emissions of 0.5 percent in VOC and an increase of 0.1 percent in NOx.

2. *Phased-In Emission Test Cutpoints*

The Arizona Legislature passed House Bill 2237 in 1997 which contained 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 House Bill 2237).

In 1998, the Arizona Legislature passed Senate Bill 1427 which requires that vehicles in Areas A and B be emissions tested. Vehicles subject to the Vehicle Emissions Inspection Program within the new boundaries of Areas A and B were required to comply with Vehicle Emissions Inspection Program 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. Senate Bill 1427 also allowed 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).

This measure was a committed control measure in the EPA-approved Serious Area Carbon Monoxide Plan (MAG, 2001); Carbon Monoxide Maintenance Plan (MAG, 2003), and One-Hour Ozone Maintenance Plan, (MAG, 2004). It was also an attainment measure in the Eight-Hour Ozone Plan (MAG, 2007a).

Modeling Methodology

The alternative test protocol for vehicle emissions testing is anticipated to consist of a change from the previous I/M 240 test to a test consisting of dual tests where the composite test is the first phase of the traditional I/M 240 test.

This measure was modeled by modifying the MOBILE6.2 input files. With the implementation of this measure, vehicles which are subject to the enhanced I/M program are held to composite cutpoints for carbon monoxide, hydrocarbons, and NOx. 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.

For the 2025 emissions inventory, vehicle model years 1980 and older were assumed to be subject to a basic I/M test. Model years 1996 and newer were expected to be subject to an on-board diagnostic test in 2025. For these reasons, it was assumed that the only model years affected by the phased-in cutpoints would be model years 1981 through 1995, when looking at a 2025 scenario. The maintenance 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 (ADEQ, 2001) on the composite cutpoints. The composite cutpoints used in the I/M147 program were applied to the MOBILE6.2 model. The emissions reduction credits for this measure were applied exclusively to Area A (S.B. 1427).

The emission reductions attributable to this measure on a Thursday in June 2025 are less than 0.1 metric ton per day of VOC and less than 0.1 metric ton per day of NOx. This is equivalent to a reduction in base total 2025 anthropogenic emissions of less than 0.1 percent in VOC and NOx.

3. *One Time Waiver from Vehicle Emissions Test*

The Arizona Legislature passed Senate Bill 1002 in 1996. This legislation limits the issuance of a waiver for failure to comply with the emission testing requirements to one-time only beginning January 1, 1997.

The Arizona Legislature also 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. This 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.

This measure was a committed control measure in the EPA-approved Serious Area Carbon Monoxide Plan (MAG, 2001); Carbon Monoxide Maintenance Plan (MAG, 2003), and One-Hour Ozone Maintenance Plan, (MAG, 2004). It was also an attainment measure in the Eight-Hour Ozone Plan (MAG, 2007a).

<u>Modeling Methodology</u>

This measure was modeled by modifying the 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 was assumed that the average remaining vehicle life of a vehicle which has received a waiver is three years as estimated on page E-5 of a 1993 Sierra Research report (Sierra Research, 1993). The waiver rate, which was four percent for pre-81 model years and three percent for 1981 and later model years, was changed to 0.709 percent and 0.781 percent, respectively. The credit for this measure was applied exclusively to Area A (S.B. 1427).

The emission reductions attributable to this measure on a Thursday in June 2025 are 0.2 metric ton per day of VOC and 0.3 metric ton per day of NOx. This is equivalent to a reduction in the base total 2025 anthropogenic emissions of less than 0.1 percent of VOC and 0.1 percent of NOx.

4. *Tougher Enforcement of Vehicle Registration and Emission Test Compliance*

<u>Tougher Enforcement of Vehicle Registration</u>

The Arizona Department of Transportation (ADOT) indicates that this control measure would use additional methods to increase the vehicle 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 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's 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 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.

Emission Test Compliance

The Arizona Legislature passed Senate Bill 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 Areas A and B are currently subject to A.R.S. 49-552 (Enforcement on city, town, county, school district or special district property).

In 1999, the Arizona Legislature passed House Bill 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 House Bill 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.

This measure was a committed control measure in the EPA-approved Serious Area Carbon Monoxide Plan (MAG, 2001); Carbon Monoxide Maintenance Plan (MAG, 2003), and One-Hour Ozone Maintenance Plan, (MAG, 2004). It was also an attainment measure in the Eight-Hour Ozone Plan (MAG, 2007a).

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 Carbon Monoxide 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 was applied as an input to the M6Link program.

The emissions reduction attributable to this control measure on a Thursday in June 2025 is 0.2 metric tons per day of VOC and 0.4 metric tons per day of NOx. This is equivalent to a reduction in base total 2025 anthropogenic emissions of less than 0.1 percent of VOC and 0.1 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.

This federal measure was a contingency measure in the Eight-Hour Ozone Plan (MAG, 2007a). EPA allows federally-enforceable measures to be used as maintenance measures.

Modeling Methodology

This measure was modeled by running the EPA NONROAD model for 2005 using the 2025 equipment growth factors and 2005 technology and comparing this with a 2025 run that includes the Federal Nonroad Diesel Equipment Standards. The decrease in emissions between 2005 and 2025 represents the impact of the more stringent federal nonroad diesel equipment standards implemented between 2005 and 2025.

The emissions reduction attributable to this measure is 19.3 metric tons per day of VOC and 47.2 metric tons per day of NOx. This is equivalent to a reduction in total base 2025 anthropogenic emissions of 7.9 percent of VOC and 16.5 percent of NOx.

6. *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, and 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. 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. The expansion of Area A by H.B. 2538 was a contingency measure in the Eight-Hour Ozone Plan (MAG, 2007a).

Modeling Methodology

This measure was modeled by running M6Link using the expanded GIS coverage files for Area A (S.B. 2538) and comparing with a run applying the previous GIS coverage files for Area A (S.B. 1427). The difference in emissions between these two runs represents the impact of the expansion of Area A boundaries implemented in 2025.

The emissions reductions attributable to this measure are 0.2 metric tons per day of VOC and 0.4 metric tons per day of NOx. This is equivalent to a reduction in the base total 2025 anthropogenic emissions of less than 0.1 percent of VOC and 0.1 percent of NOx.

7. *Ban Open Burning During Ozone Season*

This measure, along with the liquid leaker test rule, was adopted by Senate Bill 1552 on June 20, 2007. This new ozone control measure prohibits open outdoor fires during May 1 through September 30 of each year during the ozone season (see A.R.S. § 49-501). The rule also prohibits all indoor burning using fireplaces in commercial non-residential establishments, such as hotels and restaurants, during Restricted-Burn Periods with the exception of those that use gaseous fuels.

Modeling Methodology

ADEQ and MCAQD estimated the impact of this measure. Emission reductions attributable to this measure are less than 0.1 metric ton per day of VOC and NOx. This is equivalent to a reduction in total 2025 anthropogenic emissions of less than 0.1 percent of VOC and NOx.

IV-7-2. Measures Included in the Contingency Plan

The six contingency measures in Table IV-30 are described in this section. All of these contingency measures have already been implemented in the nonattainment area. Early implementation of contingency measures is allowed by EPA (EPA, 1993) and helps to ensure that the standard will be maintained through 2025. The Eight-Hour Ozone Maintenance Plan discusses procedures that will be followed to consider and implement additional contingency measures, if they are needed. No credit was quantified in this maintenance plan for these contingency measures. The following section describes the six contingency measures in the Eight-Hour Ozone Maintenance Plan.

Descriptions of Individual Contingency Measures

1. *Gross Polluter Option for I/M Program Waivers*

   The Arizona Legislature passed Senate Bill 1427 in 1998. This legislation 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 emissions standard (A.R.S. 49-542). This measure was also a committed contingency measure in the EPA-approved One-Hour Ozone Redesignation Request and Maintenance Plan (MAG, 2004) and the Eight-Hour Ozone Plan (MAG, 2007a).

2. *Increased Waiver Repair Limit Options*

   The Arizona Legislature passed Senate Bill 1427 in 1998. This legislation 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). This measure was also a committed contingency measure in the EPA-approved One-Hour Ozone Redesignation Request and Maintenance Plan (MAG, 2004) and the Eight-Hour Ozone Plan (MAG, 2007a).

3. *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 mandated that ultra-low sulfur (i.e., 15 ppm sulfur or less) 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. This measure was also a committed contingency measure in the Eight-Hour Ozone Plan (MAG, 2007a).

4. *Liquid Leaker Test As Part of Vehicle Emissions Inspection (VEI) Program*

This new measure, mandated by Senate Bill 1552 in June 2007, is codified as R18-2-1006 (see A.R.S § 49-542) and known as the “liquid leaker test” rule. This rule implements a visual inspection of a vehicle’s components for liquid fuel leaks (one visible drop or more of fuel or the formation of a fuel puddle). This test will be in addition to the current vehicle emissions inspection (VEI) that is performed on vehicles registered in Area A (Phoenix) and Area B (Tucson) on at least a biennial basis for vehicles manufactured after the 1974 model year, excluding diesel vehicles. Currently, the vehicle inspection includes: anti-tampering, gas cap, and either a loaded/idle or dynamometer exhaust test, and pressure test.

Vehicle inspection facilities, dealers, and repair businesses will be able to identify defects in fuel delivery, metering, and evaporative systems through a quick inspection using a flashlight and a mirror. The goal of the “liquid leaker test” is to identify vehicles having liquid leak problems and have them repaired to eliminate or significantly reduce non-exhaust-related volatile organic compound (VOC) emissions from being emitted into the atmosphere.

Because this measure only applies to model year vehicles that are 1995 or older, the effectiveness of this measure will be negligible in 2025, when vehicles of that vintage will no longer be operating in the fleet. However, this measure will provide benefits during the maintenance period, 2005-2025, and therefore, has been classified as a contingency measure in the Eight-Hour Ozone Maintenance Plan.

5. *Coordinate Traffic Signal Systems*

House Bill 2237 passed in 1997 contained 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, the cities, towns, and ADOT also responded to the measure, Coordinate Traffic Signal Systems. The synchronization of existing traffic 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 contingency measure #6, “Develop Intelligent Transportation Systems” below. This measure reduces VOC and NOx emissions by increasing vehicle speeds and reducing congestion.

This measure was a committed measure in the EPA-approved Serious Area Carbon

Monoxide Plan (MAG, 2001), Carbon Monoxide Maintenance Plan (MAG, 2003), and One-Hour Ozone Maintenance Plan (MAG, 2004). It was also an attainment measure in the Eight-Hour Ozone Plan (MAG, 2007a).

6. *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). This measure reduces VOC and NOx emissions by increasing vehicle speeds and reducing congestion.

This measure was a committed measure in the EPA-approved Serious Area Carbon Monoxide Plan (MAG, 2001), Carbon Monoxide Maintenance Plan (MAG, 2003), and One-Hour Ozone Maintenance Plan, (MAG, 2004). It was also an attainment measure in the Eight-Hour Ozone Plan (MAG, 2007a).

IV-7-3. Measures Which Improve Air Quality, but 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 Maintenance Plan, and One-Hour Ozone Maintenance Plan. These committed measures improve air quality, but 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 will continue to reinforce the air quality benefits of the measures for which numeric credit towards maintenance was taken.

IV-8. Contingency Provisions

Section 175A(d) of the Clean Air Act requires that maintenance plans contain contingency provisions. EPA guidance on the required content of the maintenance plan is provided in the September 4, 1992 EPA memorandum. This memo indicates that the maintenance plan is not required to contain fully adopted contingency measures. However, the plan should contain clearly identified contingency measures to be adopted, schedule and procedures for adoption and implementation, and a specific time limit for action by the State. In addition, specific indicators should be identified which will be used to determine when the contingency measures need to be implemented. The Eight-Hour Ozone Maintenance Plan addresses each of these requirements for the contingency measures.

Consistent with the August 13, 1993 EPA guidance memorandum titled, "Early Implementation of Contingency Measures for Ozone and Carbon Monoxide (CO) Nonattainment Areas," the contingency measures described in the Eight-Hour Ozone Maintenance Plan are comprised of committed control measures that are expected to be implemented early. An example of early implementation of contingency measures in a maintenance plan that has been approved by EPA is the redesignation of the Salt Lake City Carbon Monoxide Nonattainment Area to attainment (see page 3216 of the January 21, 1999 Federal Register). In that action, EPA noted that both contingency measures in the Salt Lake City contingency plan had already been partially implemented.

There are six contingency measures in the Eight-Hour Ozone Maintenance Plan. Emission reduction credit for these contingency measures was not taken in the eight-hour ozone maintenance demonstration.

A description of the individual contingency measures was previously provided in Section IV-7-2 of this TSD. Early implementation of these contingency measures provides additional confidence that the eight-hour ozone standard will be maintained through 2025. In order to ensure that violations of the eight-hour ozone standard do not occur in the future, ambient air quality monitoring data will be examined to determine if additional contingency measures are needed. Contingency provisions will be triggered when the three year average of the annual fourth highest daily maximum eight-hour ozone concentration monitored at each site exceeds 84 ppb at any ozone monitor. If this occurs, additional control measures will be considered, which may include the strengthening of existing contingency measures. When the trigger is activated, the following schedule of actions would be followed: (1) Verification of the monitoring data to be completed three months after activation of the trigger; (2) Applicable control measures to be considered for adoption six months after the date established in A above; and (3) Resultant committed measures to be implemented within six to twelve months, depending upon the time needed to put the measures in place.

IV-9. Onroad Emissions Budget for Conformity

Background

In accordance with the 1990 Clean Air Act Amendments (CAAA), 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 the 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. These 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.”

MAG submitted an Eight-Hour Ozone Plan for the Maricopa Area to EPA in June 2007 (MAG, 2007a). This Plan contained 2008 transportation conformity budgets for VOC and NOx for the eight-hour ozone nonattainment area. EPA found these eight-hour ozone conformity budgets to be adequate, effective November 7, 2007. The 2008 eight-hour ozone budgets of 67.9 metric tons per day for VOC and 138.3 metric tons per day for NOx were used in the 2008 MAG Conformity Analysis.

The Eight-Hour Ozone Maintenance Plan establishes 2025 conformity budgets based on 2025 onroad mobile source VOC and NOx emissions in the eight-hour ozone nonattainment area. These maintenance budgets include emission reduction credit for the maintenance measure package, but not the contingency measures. The 2025 conformity budgets are represented by the onroad VOC and NOx emissions for the peak episode day in June 2025 that was used to model maintenance of the eight-hour ozone standard, as discussed in the previous section. As shown in Tables IV-31(a) and 31(b), the onroad source emissions in the eight-hour ozone modeling domain on a Thursday in June 2025 are 47.9 metric tons per day for VOC and 109.8 metric tons per day for NOx, respectively. A GIS analysis was used to extract the onroad emissions in the eight-hour ozone nonattainment area from the larger eight-hour ozone modeling domain. The resultant onroad emissions for the eight-hour nonattainment area are 43.8 metric tons per day for VOC and 101.8 metric tons per day for NOx. These represent the 2025 eight-hour ozone emissions budgets that will be used in transportation conformity.

MAG will use the new 2025 VOC and NOx emissions budgets in transportation conformity analyses that begin after these emissions budgets have been found to be adequate or are approved by EPA as part of the Eight-Hour Ozone Maintenance Plan. In subsequent conformity analyses, onroad source emissions for conformity horizon years can not exceed either the 2008 or the 2025 VOC and NOx emission budgets.

Future Transportation Conformity Analyses

The methodology used to estimate onroad mobile source emissions for 2025 is documented in Section IV-2. The models and assumptions used in estimating onroad 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 (FHWA, 2001).

Due to the inherent uncertainties in using latest planning assumptions in conformity analyses, the onroad emissions used in the eight-hour ozone maintenance modeling were increased by ten percent to create a safety margin for the transportation conformity budgets. EPA has indicated that safety margins are allowed, if attainment can be modeled with the increased emissions (EPA, 2007). The 2025 onroad mobile source VOC and NOx emissions used in modeling maintenance of the eight-hour ozone standard for all three episodes were increased by ten percent. This increase was distributed spatially in the ozone modeling domain based on the proportion of onroad emissions assigned to each 4 km grid cell. Both the 47.9 metric tons per day of VOC and 109.8 metric tons per day of NOx for the onroad mobile source emissions used in the eight-hour ozone maintenance modeling, and the 43.8 metric tons per day of VOC and 101.8 metric tons per day of NOx that represent the transportation conformity budgets, reflect the ten percent increases in VOC and NOx emissions used to ensure an adequate safety margin.

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V. MAINTENANCE DEMONSTRATION

As the designated regional air quality planning agency, MAG conducts modeling of emissions and pollutant concentrations and prepares the attainment and maintenance plans necessary for redesignation of nonattainment areas to attainment. The purpose of conducting this latest photochemical air quality grid modeling for the Maricopa County Eight-Hour Ozone Nonattainment Area (MNA) is to demonstrate the maintenance of the eight-hour ozone standard through the ozone season of 2025 with the control measures that have already been implemented. The simulations for the June, July, and August 2025 episodes were conducted using the CAMx model and MM5 meteorology inputs. The results from the CAMx modeling were used to determine whether the MNA will maintain the federal standard of 85 ppb for eight-hour ozone with the committed control measures.

The modeling conducted for this Plan demonstrates that maintenance is achieved in 2025 for all three ozone episodes. These three ozone episodes had different meteorological regimes that resulted in the eight-hour ozone violations in August 2001, June 2002, and July 2002. The maintenance demonstrations for all three ozone episodes are discussed in the following section to provide insights into the role of different meteorological regimes during periods of high ozone concentrations.

Ozone precursor emissions from onroad and nonroad sources are declining and are likely to continue trending downward as a result of stricter federal emissions standards for: (1) Year 2004 and newer light duty vehicle models (Tier 2), (2) Year 2007 and newer heavy duty gas and diesel engines, and (3) Nonroad diesel equipment (Tier 4 - effective between 2011 and 2015). In addition, the State, Maricopa County, and local jurisdictions in the MNA made legally-binding commitments in the Eight-Hour Ozone Plan (MAG, 2007) that will continue to reduce emissions. The modeling for the 2025 maintenance demonstration shows that seven of these control measures will more than offset future growth in population, employment, and vehicle miles traveled (VMT) in the region.

V-1. Identification of Maintenance Date

EPA indicated that 18 months, as granted in section 107(d)(3)(D) of the Clean Air Act Amendments, should be the assumed length of time for EPA to approve a redesignation request (EPA, 1992). Due to uncertainties regarding when the MNA will be redesignated to attainment, to be conservative, the year 2025 was modeled to assure that the eight-hour ozone standard will be maintained for at least ten years after the official notice of redesignation to attainment by EPA.

V-2. Maintenance Demonstration

The maintenance demonstration followed the deterministic procedure described in EPA guidance (EPA, 2007). To demonstrate maintenance 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 all three episodes.

EPA provided the following modeled maintenance test (Equation 1) to be applied to individual monitoring sites in the modeling domain.

$$(DVF)_I = (RRF)_I \, (DVB)_I \qquad (1)$$

where:

$(DVB)_I$ = Baseline design value at site I (units = ppb)

$(RRF)_I$ = Relative response factor calculated near site I (unitless)

- The relative response factor is the ratio of the future eight-hour daily maximum ozone concentrations predicted near a monitor (averaged over multiple days) to the baseline eight-hour daily maximum ozone concentrations predicted near the monitor (averaged over the same days as the future ozone concentrations).

$(DVF)_I$ = Future design value (units = ppb)

- Note that the final future design value is truncated to one decimal place[1].

Applying the test in Equation 1 requires that several data issues be resolved beforehand, such as: (1) Calculating site-specific baseline design values, (2) Identifying surface grid cells near a monitoring site, (3) Choosing model predicted values for calculating RRF, (4) Limiting modeled values chosen to calculate RRF, (5) Choosing adequate baseline year to calculate RRF, and (6) Choosing a future year.

The Year 2005 eight-hour ozone design values for each monitor in the MNA were calculated as the average of the current design values for the periods: 2003 - 2005, 2004 - 2006, and 2005 - 2007. The current design value for each period was defined as the three-year average of the annual fourth highest daily maximum eight-hour ozone concentration at each site. Table V-1 lists the site-specific baseline design values for 2005 and their associated three-year averages (three-year average of the annual fourth highest daily maximum eight-hour ozone concentrations).

EPA guidance (EPA, 2007) recommends that an array of 7 x 7 grid cells (total of 49 grid cells) be used in the case of a 4 km gridded modeling domain as nearby grid cells of a monitor. For this maintenance test, the highest daily maximum eight-hour ozone value predicted by the CAMx model for the forty-nine grid cells near each monitor was used to calculate the RRF for each day in an episode period. These daily values were averaged over the number of episode days to obtain baseline and future eight-hour ozone

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[1] This effectively defines attainment in the modeled test as <= 84.999 ppb and nonattainment as >= 85.0 ppb (EPA, 2007).

concentrations.

Figure V-1 depicts the daily RRFs versus the baseline daily maximum predicted eight-hour ozone concentrations and their linear regression lines (defined as Power) for all episode days. The CAMx modeling results for the three eight-hour ozone episodes shown in Figure V-1 are described as follows:

- **June Episode -** CAMx modeling results showed a relatively constant response to emissions reductions. From the June episode results, it can be inferred that the CAMx model will predict similar controllable ozone benefits from ozone precursor emission reductions over all episode days due to the consistently high contributions of background and boundary conditions to peak ozone concentrations.

- **July Episode** - CAMx modeling results showed more sensitivity to emissions reductions at lower peak ozone concentrations. This indicates that the greater model response at lower peak ozone concentrations is likely due to more controllable ozone at lower concentrations.

- **August Episode** - CAMx modeling results showed more sensitivity to emissions reductions at higher peak ozone concentrations than occurred in the modeling of the July episode. This indicates that the CAMx model predicts less benefit from emissions reductions at lower peak ozone concentrations. In other words, there is a relatively high percentage of locally generated ozone on days with high peak ozone concentrations as compared to days with low peak ozone concentrations.

Tables V-2 through 4 show that the mean RRF (averaged across all sites) is sensitive to the minimum eight-hour ozone thresholds for the July and August episodes, while it is almost constant for the June episode. As the minimum eight-hour ozone threshold is increased from 60 ppb to 85 ppb, the variability of the daily RRFs (which is measured by the standard deviation of the daily RRFs) is decreased. Lower variability in the daily RRFs indicates lower uncertainty in the mean RRFs. A minimum concentration threshold of 70 ppb for eight-hour ozone was applied to calculate RRFs in this maintenance test, because this threshold level provides not only a sufficient number of days to estimate mean RRFs that are robust, but also provides reasonably conservative mean RRFs and low variability in the daily RRFs.

Table V-5 presents the maintenance test results for the three episodes. All monitoring sites have decremental RRFs less than one for the three episodes, which indicates that ozone predictions in the future year are lower than those for the baseline year. The maximum future design values were predicted to occur at the North Phoenix site for all three episodes. Since EPA suggests that significant figures to the right of the decimal point in future design values should be truncated as the final future design value for the maintenance test (EPA, 2007), the peak predicted future design values given in Table V are 81 ppb for the June episode, and 79 ppb for the July and August episodes. Ranges of the future design values are 61 - 81 ppb for the June 2025 episode, 60 - 79 ppb for the

July 2025 episode, and 63 - 79 ppb for the August 2025 episode. Since all of these future design values are less than the 85 ppb EPA standard, the MNA passes the eight-hour ozone maintenance test for all three eight-hour ozone episodes that were modeled for the ozone season of 2025.

Table V-1. Calculation of Site-Specific Baseline Design Value $(DVB)_I$ for Year 2005

Site Name	Site Abbr.	AIRS	2003-2005 (ppb)	2004-2006 (ppb)	2005-2007 (ppb)	Mean* (ppb)
Tonto NM	TNM	04-007-0010	81	80	80	80.3
West Phoenix	WP	04-013-0019	72	74	74	73.3
North Phoenix	NP	04-013-1004	83	83	82	82.7
Falcon Field	FF	04-013-1010	75	75	76	75.3
Glendale	GL	04-013-2001	79	76	75	76.7
Pinnacle Peak	PP	04-013-2005	78	75	78	77.0
Central Phoenix	CP	04-013-3002	76	76	75	75.7
South Scottsdale	SS	04-013-3003	76	76	78	76.7
South Phoenix	SP	04-013-4003	74	72	72	72.7
West Chandler	WC	04-013-4004	74	75	76	75.0
Tempe	TEMP	04-013-4005	75	75	77	75.7
Cave Creek	CC	04-013-4008	80	79	79	79.3
Dysart	DY	04-013-4010	68	67	67	67.3
Buckeye	BE	04-013-4011	n/a	63	65	64.0
Laveen	LV	04-013-7003	74	69	67	70.0
Humboldt Mountain	HM	04-013-9508	84	81	81	82.0
Blue Point	BP	04-013-9702	80	72	67	73.0
Fountain Hills	FH	04-013-9704	82	82	82	82.0
Rio Verde	RV	04-013-9706	81	81	83	81.7
Super Site	SUPR	04-013-9997	74	74	76	74.7
Apache Junction	AJ	04-021-3001	69	73	76	72.7
Casa Grande	CG	04-021-3003	71	71	71	71.0
Queen Creek	QC	04-021-3009	66	65	65	65.3
Maricopa	MCPA	04-021-3010	66	64	62	64.0
Sacaton	SAC	04-021-7001	73	70	69	70.7
Queen Valley	QV	04-021-8001	81	79	80	80.0

* According to EPA Guidance (EPA, 2007), the average design value carries one significant figure to the right of the decimal point.

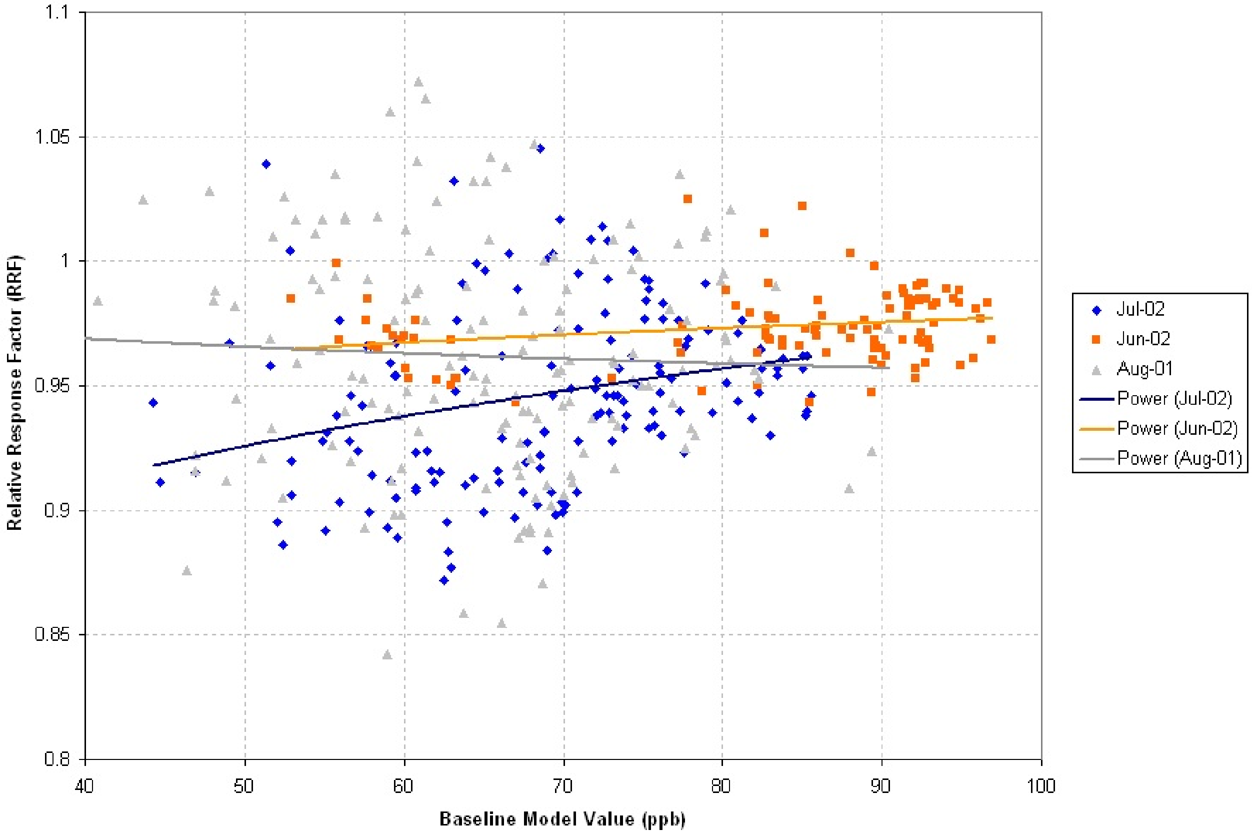

Figure V-1. Daily relative response factors (RRFs) as a function of daily maximum baseline modeled concentrations for monitors in the MNA.

Table V-2. Mean RRFs and standard deviations as a function of various minimum thresholds for the June episode

Minimum Threshold (ppb)	Mean RRF	Mean Standard Deviation
60	0.974	0.015
65	0.975	0.014
70	0.975	0.014
75	0.976	0.014
80	0.976	0.013
85	0.975	0.012

Table V-3. Mean RRFs and standard deviations as a function of various minimum thresholds for the July episode

Minimum Threshold (ppb)	Mean RRF	Mean Standard Deviation
60	0.950	0.034
65	0.954	0.031
70	0.958	0.024
75	0.957	0.019
80	0.952	0.013
85	0.949	0.010

Table V-4. Mean RRFs and standard deviations as a function of various minimum thresholds for the August episode

Minimum Threshold (ppb)	Mean RRF	Mean Standard Deviation
60	0.963	0.044
65	0.957	0.041
70	0.964	0.033
75	0.968	0.032
80	0.965	0.029
85	0.948	0.030

Table V-5. Maintenance test results (based on the CAMx/MM5 runs)

Site Name	Site ID	AIRS	2005 Baseline Design Value (ppb)	June RRF	June 2025 Future Design Value (ppb)	July RRF	July 2025 Future Design Value (ppb)	August RRF	August 2025 Future Design Value (ppb)
Tonto NM	TNM	40070010	80.3	0.9672	77.6	n/a*	n/a*	n/a*	n/a*
West Phoenix	WP	40130019	73.3	0.9826	72.0	0.9499	69.6	0.9888	72.4
North Phoenix	NP	40131004	82.7	0.9804	**81.0**	0.9606	**79.4**	0.9664	**79.9**
Falcon Field	FF	40131010	75.3	0.9808	73.8	0.9658	72.7	0.9734	73.2
Glendale	GL	40132001	76.7	0.9825	75.3	0.9566	73.3	0.9778	74.9
Pinnacle Peak	PP	40132005	77.0	0.9770	75.2	0.9578	73.7	0.9493	73.0
Central Phoenix	CP	40133002	75.7	0.9867	74.6	0.9611	72.7	0.9563	72.3
South Scottsdale	SS	40133003	76.7	0.9884	75.8	0.9548	73.2	0.9812	75.2
South Phoenix	SP	40134003	72.7	0.9926	72.1	0.9618	69.9	0.9916	72.0
West Chandler	WC	40134004	75.0	0.9774	73.3	0.9645	72.3	0.9560	71.7
Tempe	TEMP	40134005	75.7	0.9899	74.9	0.9682	73.2	0.9930	75.1
Cave Creek	CC	40134008	79.3	0.9641	76.4	0.9520	75.4	0.9544	75.6
Dysart	DY	40134010	67.3	0.9719	65.4	0.9619	64.7	0.9520	64.0
Buckeye	BE	40134011	64.0	0.9750	62.4	0.9683	61.9	0.9922	63.5
Laveen	LV	40137003	70.0	0.9751	68.2	0.9463	66.2	0.9944	69.6
Humboldt Mountain	HM	40139508	82.0	0.9535	78.1	0.9227	75.6	0.9373	76.8
Blue Point	BP	40139702	73.0	0.9753	71.1	0.9640	70.3	0.9544	69.6
Fountain Hills	FH	40139704	82.0	0.9727	79.7	0.9586	78.6	0.9421	77.2
Rio Verde	RV	40139706	81.7	0.9710	79.3	0.9389	76.7	0.9388	76.6
Super Site	SUPR	40139997	74.7	0.9814	73.3	0.9573	71.5	0.9792	73.1
Apache Junction	AJ	40213001	72.7	0.9712	70.6	0.9635	70.0	0.9451	68.7
Casa Grande	CG	40213003	71.0	0.9606	68.2	n/a*	n/a*	n/a*	n/a*
Queen Creek	QC	40213009	65.3	0.9658	63.0	0.9296	60.7	n/a*	n/a*
Maricopa	MCPA	40213010	64.0	0.9615	61.5	n/a*	n/a*	n/a*	n/a*
Sacaton	SAC	40217001	70.7	0.9594	67.8	n/a*	n/a*	n/a*	n/a*
Queen Valley	QV	40218001	80.0	0.9696	77.5	0.9279	74.2	n/a*	n/a*

* Since the minimum concentration threshold is 70 ppb, some sites predicting baseline eight-hour ozone values lower than 70 ppb for all episode days do not have an RRF or a future design value. These are indicated as “n/a”.

V-3. Unmonitored Area Analysis

Unmonitored area analysis is one of the tests used to identify areas without ozone monitors where predicted future year design values might be greater than the eight-hour ozone standard. In order to conduct this analysis, EPA recommends using gradient adjusted spatial fields to get more accurate estimates for the unmonitored areas. Gradient adjusted spatial fields, which are created by the combination of interpolated spatial fields of monitored data and gridded modeled outputs, take advantage of the strengths of these two datasets.

MAG used the Modeled Attainment Test Software (MATS) Version 2.0.1 developed by EPA to conduct this analysis. In order to implement gradient adjusted spatial fields, MATS performs the following procedures internally:

- Interpolates baseline design values, which are also used in the monitor based model maintenance test, to develop ambient spatial fields.

- Adjusts the spatial fields using gridded baseline model output gradients.

- Creates future year fields by applying model derived gridded RRFs to the gradient adjusted spatial fields.

The future year gradient adjusted spatial fields produced by MATS were evaluated to determine if any predicted values in the grid cells were above the eight-hour ozone standard. All predicted values in the grid cells of the MNA remained under the eight-hour ozone standard for all three eight-hour ozone episodes. The maximum design values from this analysis were 81 ppb for the June episode, 79 ppb for the July episode, and 83 ppb for the August episode of 2025. The isopleth plots of the unmonitored area analysis results overlaid with the future year design value for each monitoring site are depicted in Figures V-2 through V-4 for the modeling episodes. The configurations used for MATS are provided in Appendix V-I.

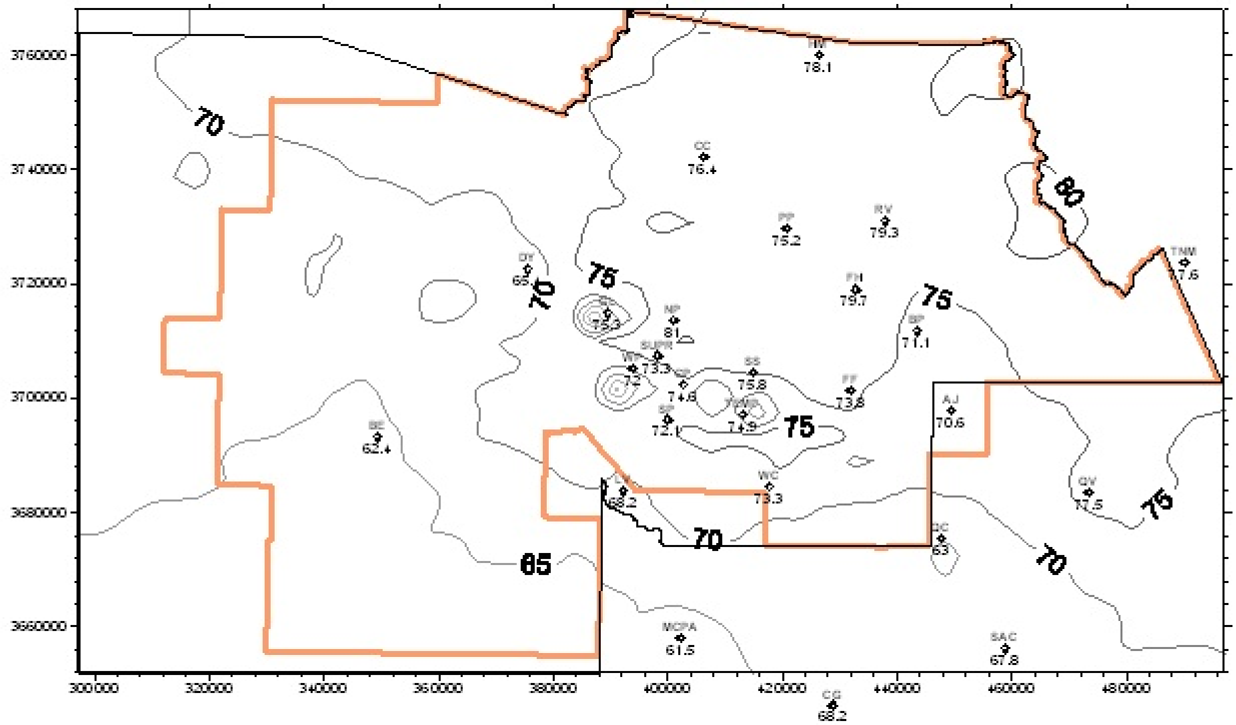

Figure V-2. Isopleth of the future design values for the June episode

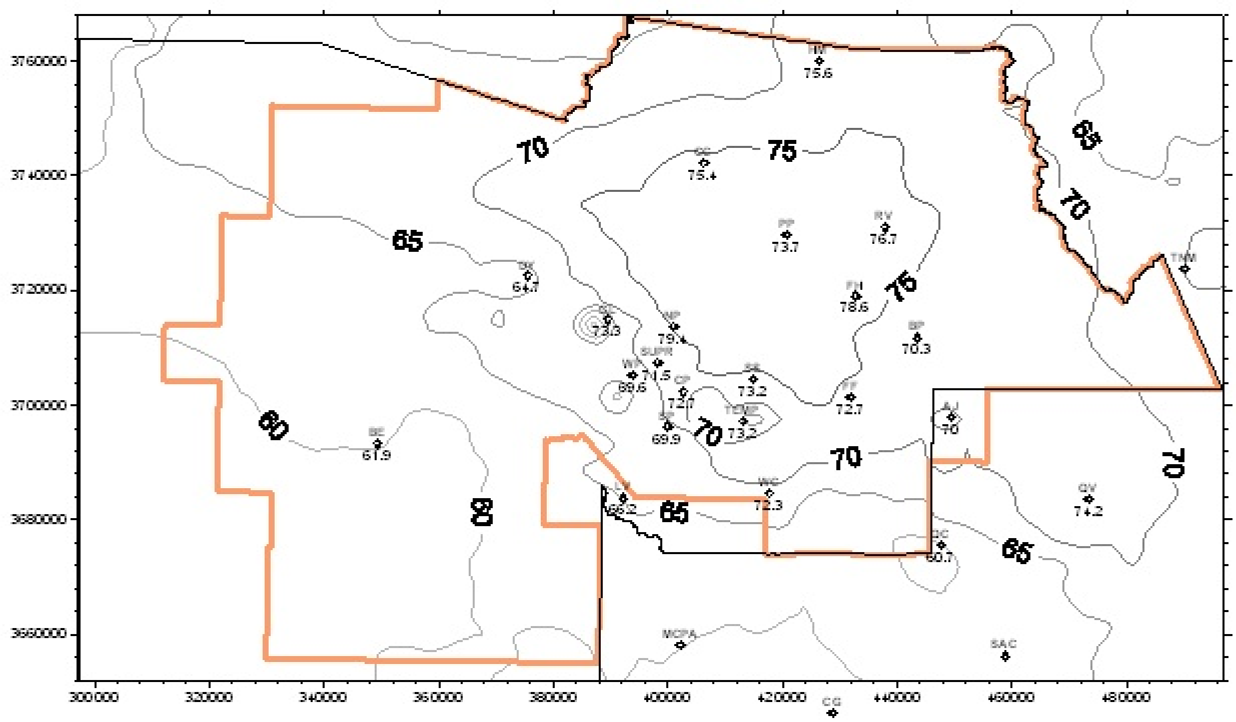

Figure V-3. Isopleth of the future design values for the July episode

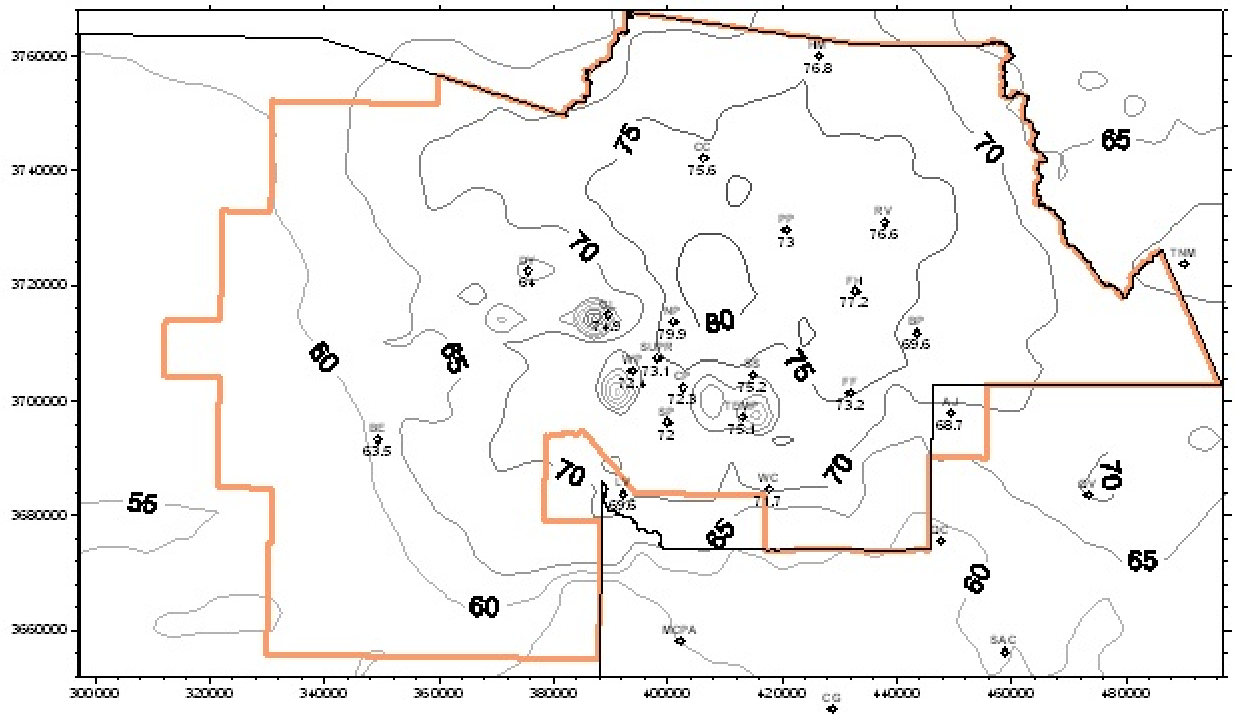

Figure V-4. Isopleth of the future design values for the August episode

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VI. SUPPLEMENTAL ANALYSES

In accordance with EPA's recommendation (EPA, 2007; MAG, 2008), MAG conducted additional analyses to supplement the primary modeling analysis of the eight-hour ozone maintenance demonstration. This section presents corroboratory analyses such as absolute model forecasts, process analysis, photochemical source apportionment, decoupled direct method, and weight of evidence analysis.

VI-1. Absolute Model Forecasts

As a tool to corroborate the results derived by relative response factors (RRFs), the following metrics were used in estimating the magnitude, frequency, and relative amount of nonattainment:

- Percent change in the total amount of ozone greater than or equal to 85 ppb in the MNA and the modeling domain
- Percent change in the number of grid cells greater than or equal to 85 ppb in the MNA and the modeling domain
- Percent change in the grid cell hours (days) greater than or equal to 85 ppb in the MNA and the modeling domain
- Percent change in the maximum modeled eight-hour ozone concentration in the MNA and the modeling domain

Tables VI-1 through 3 present the above metrics for the MNA and the 4-km modeling domain for all three episodes. Note that the predicted eight-hour ozone concentrations for the July and August episodes of the baseline and future years were artificially increased by 20 percent before applying these metrics because the predicted eight-hour ozone concentrations for the July and August episodes were consistently underestimated by about 20 percent. EPA guidance suggests that care should be taken in interpreting the metrics if the model evaluation indicates a large underprediction of ozone. A review of the metrics shows that the June episode, which represents the transport meteorological regime, has the least percent change, while the July episode, which represents the local meteorological regime, has the highest percent change. The August episode, which represents the mixed meteorological regime, shows the midst amount of percent change in the metrics compared with those for the other two episodes representing the transport and local meteorological regimes. It was shown that the predicted eight-hour ozone concentration change between the baseline and future years is higher under the conditions of the local meteorological regime than the transported meteorological regime in terms of the magnitude, frequency, and relative amount of nonattainment. This is valid for both the MNA and the 4-km grid modeling domain.

For a clear visualization of the ozone distribution under the baseline and future conditions, modeled gridded ozone concentration maps for the baseline and future years are provided in Appendix VI-i.

Table VI-1. Absolute modeling metrics for the June episode

Metrics	MNA			Modeling Domain (4 km)		
	Baseline Year (2005)	Future Year (2025)	Percent Change	Baseline Year (2005)	Future Year (2025)	Percent Change
Total amount of	987,214 ppb	564,532 ppb	-42.8%	1,515,656 ppb	858,637 ppb	-43.3%
Number of grid	790 cells	729 cells	-7.7%	1,205 cells	1,073 cells	-11.0%
Grid cell-hours >=	57 hours	47 hours	-17.5%	58 hours	48 hours	-17.2%
Max modeled	98.47 ppb	95.65 ppb	-2.9%	98.47 ppb	95.65 ppb	-2.9%

Table VI-2. Absolute modeling metrics for the July episode

Metrics	MNA			Modeling Domain (4 km)		
	Baseline Year (2005)	Future Year (2025)	Percent Change	Baseline Year (2005)	Future Year (2025)	Percent Change
Total amount of	307,951 ppb	133,625 ppb	-56.6%	311,829 ppb	133,625 ppb	-57.1%
Number of grid	443 cells	292 cells	-34.1%	462 cells	292 cells	-36.8%
Grid cell-hours	40 hours	31 hours	-22.5%	40 hours	31 hour	-22.5%
Max modeled	102.68 ppb	98.46 ppb	-4.1%	102.68 ppb	98.46 ppb	-4.1%

Table VI-3. Absolute modeling metrics for the August episode

Metrics	MNA			Modeling Domain (4 km)		
	Baseline Year (2005)	Future Year (2025)	Percent Change	Baseline Year (2005)	Future Year (2025)	Percent Change
Total amount of	152,976 ppb	75,912 ppb	-50.4%	153,063 ppb	75,998 ppb	-50.3%
Number of grid	335 cells	250 cells	-25.4%	336 cells	251 cells	-25.3%
Grid cell-hours	30 hours	22 hours	-26.7%	30 hours	22 hours	-26.7%
Max modeled	106.62 ppb	101.98 ppb	-4.4%	106.62 ppb	101.98 ppb	-4.4%

It should not be interpreted from the absolute modeling metrics shown in the tables above that the eight-hour ozone standard will not be maintained in 2025. Models such as CAMx attempt to simulate complex chemical and meteorological phenomena, but can not be relied upon to accurately predict absolute ozone concentrations. This is why EPA advises that the modeling output be applied in a relative sense, by comparing 2005 modeled values with 2025 modeled values to create the RRFs, and applying the RRFs to actual ozone design values in 2005. This RRF approach that reconciles modeling results with real world monitoring data concludes that the eight-hour ozone standard of 85 ppb will not be exceeded in the modeling domain in 2025.

VI-2. Process Analysis

Following the process analysis approach to assess which ozone precursor will limit ozone production in the MNA for the future year, MAG conducted the CAMx Chemical Process Analysis (CPA) for the June episode, using the future year anthropogenic and biogenic emission inputs, because the model performance for the June episode was the best among the three episodes. CPA results for the other two episodes are provided in Appendix VI-ii. CPA provides detailed reaction rate information for quantifying chemically meaningful attributes such as ozone and oxidant production/loss rates, radical initiation rates, radical propagation efficiencies, radical termination rates, HOx chain lengths, formaldehyde production rates, and NOy reaction rates.

Figures VI-1(a) through (j) present CPA results averaged through the PBL depth for the CAMx simulations at noon on the last day of the simulation (June 7). Other episode days provided qualitatively similar CPA results. These CPA results were also compared with those for the base year presented in Section III-3. The following section summarizes the CAMx modeling results for the June episode:

- **Figure VI-1(a)** - Depicts ozone concentrations showing that an organized urban plume extends to the northwest of Phoenix. The urban plume shape is similar to that for the base year but the peak ozone plume lies over the downtown area. This phenomenon also appears in the ozone production rates shown in Figure VI-1(b).

- **Figure VI-1(b)** - The urban plume shape is more distinctive in the future year when ozone production rates are much higher inside than outside the urban plume.

- **Figure VI-1(c)** - The ratio of the production rate of H_2O_2 to HNO_3, which is used to distinguish VOC-sensitive from NOx-sensitive areas, shows that the VOC-sensitive area has shrunk and its magnitude gets weaker in the future year. This indicates that the core of the Phoenix urban plume, which is sensitive to VOC, is getting smaller and appears to be in transition toward NOx sensitivity.

- **Figure VI-1(d)** - A similar interpretation to that in Figure V1-1(c) can be derived from the ozone production rate in the VOC-sensitive area, where an increase in the ozone production rate is expected when VOCs are added. It also shows that the most rapid ozone production occurs in the core of the urban plume.

- **Figure VI-1(e)** - The production rate of new HOx radicals is illustrated in Figure VI-1(e). The higher production rate of HOx radicals led to both faster VOC reactions and faster ozone production. This indicates that both the VOC reactions and ozone production are getting faster in the core of the urban plume in the future year of 2025.

- **Figure VI-1(f)** - The HOx chain length is the average number of conversion cycles between OH and HO_2. The HOx chain lengths at the northern edge of the urban plume and in the plume center are getting longer in the future year. This may indicate that the rate of ozone production in the plume center is becoming limited due to new radical production.

- **Figure VI-1(g)** - The fractional contribution of isoprene to the reaction of OH radicals with VOCs is similar to that of the base year, while the future year shows a slight expansion of the urban plume area where only a small fraction of OH radicals reacts with isoprene. It appears that only a small fraction of the OH radicals in the urban plume reacts with biogenic VOCs in the future year.

- **Figures VI-1(h) and VI-1(j)** - Present the fractional contribution of ozone photolysis, O_3 + alkene reactions, and HONO photolysis to new OH radical production, respectively. An examination of these two figures indicates that the ozone photolysis ($O_3 + hv \rightarrow O(^1D) + H_2O \rightarrow 2\ OH$) is the dominant source of the new OH radicals in the 4 km grid in the future year.

The findings from the analysis of CPA results are as follows:

- **VOC Sensitive** - The regions of greatest ozone production in the Phoenix urban plume are still VOC sensitive in the future. However, the urban plume is getting smaller and appears to be in transition toward NOx sensitivity in the future year.

- **Sensitive to Radical Sources** - Ozone production in the Phoenix urban plume is still sensitive to the strength of radical sources such as photolysis of ozone, formaldehyde, or nitrous acid.

- **Biogenic Emission Contribution** - The contribution of urban biogenic isoprene emissions to ozone formation in the Phoenix area is still not significant in the future year.

The CPA results indicate that anthropogenic emissions affected the maintenance of the eight-hour ozone standard inside and outside the urban plume in the following way: NOx emission reductions from onroad and nonroad sources appear to contribute to a decline in ozone concentrations outside the urban plume, while VOC emission decreases from onroad and nonroad sources and NOx emission increases from point sources seem to

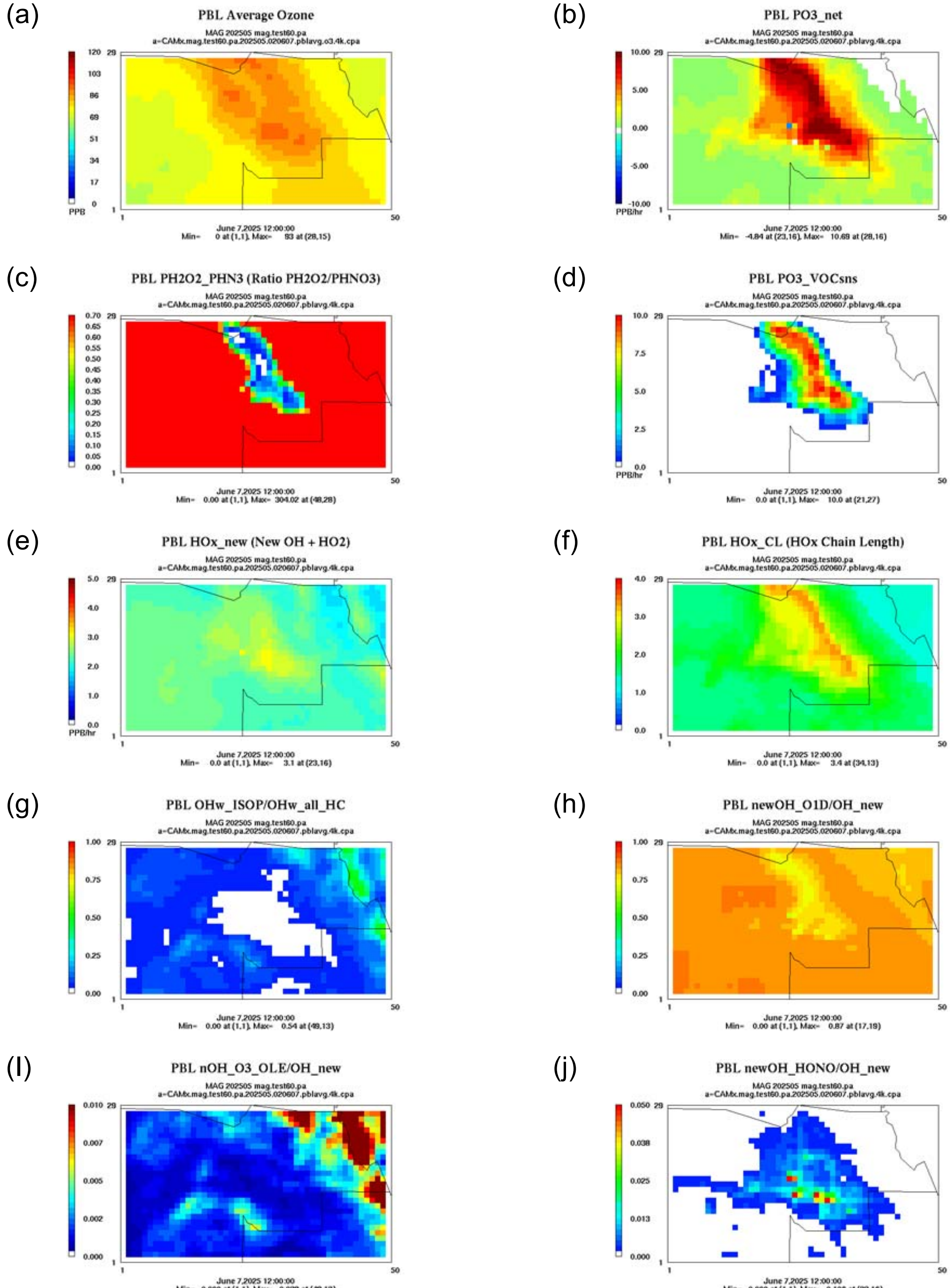


Figure VI-1. A series of plots showing CPA results for the future year CAMx simulations at noon on a Friday in June contribute to a decline in ozone concentrations inside the urban plume.

VI-3. Photochemical Source Apportionment

Photochemical model source apportionment is a valuable probing tool to estimate the contributions of multiple source areas, categories, and pollutant types to ozone formation. In this study, the contribution to high ozone levels from the above factors is tracked using the "Ozone Source Apportionment Technology" (OSAT) tool for twenty-eight geographic regions and five emission source categories: point, area, onroad, non-road, and biogenic sources. Emissions in the baseline year (2005) and future year (2025) were used in applying the OSAT tool to provide a better understanding of the contribution of emission sources to ozone when certain emission controls and emission sector growth are taken into consideration.

The emission sources impacting the two ozone monitoring sites of North Phoenix (NP) and Humboldt Mountain (HM) were evaluated as part of the OSAT analysis. These two monitoring sites showed the highest future design values in the Eight-Hour Ozone Plan (MAG, 2007). The geographic regions tracked for ozone contribution are listed in Table VI-4 and graphically depicted in Figure VI-2 over the 12-km modeling domain. The contribution from the initial and boundary concentrations of the model (12 km) is also tracked for each receptor location.

The source apportionment data shown in this study represent the one-hour period showing the modeled peak one-hour ozone concentration (known as "high ozone" hereafter) at each monitor on the June 6, July 9, and August 10 episodes. Examination of the peak one-hour ozone concentrations for the modeling episodes showed that high ozone varies by monitor and episode.

The percent contribution of VOC and NOx to high ozone in 2005 and 2025 are shown in Tables VI-5 and 6, respectively. An interesting feature of the VOC and NOx contributions to high ozone is that the NOx contribution is much higher than the VOC contribution for all three episodes at the Humboldt Mountain site and the July episode at the North Phoenix site in 2005 and 2025. The characteristics of the VOC and NOx contributions to high ozone at the North Phoenix site in the June and August episodes are different from those in the July episode. The ratio of the NOx to VOC contribution is higher at the Humboldt Mountain site than at the North Phoenix site.

The contribution of the boundary condition represents the ozone and ozone precursors entering the modeling domain through the lateral boundaries of the domain. This may represent a mesoscale background contribution. The North Phoenix site is similar to the Humboldt Mountain site in terms of high contribution of the boundary condition to high ozone in the June episode. Comparison of the two monitoring sites shows that the Humboldt Mountain site is apparently more sensitive to the contributions of the boundary

Table VI-4. Complete list of source regions tracked for ozone contribution

Modeling Domain	Region Index	Source Region
12 km	1	Mohave County
	2	Coconino County
	3	Navajo County
	4	Apache County
	5	La Paz County
	6	Yavapai County
	7	Gila County
	8	Yuma County
	9	Maricopa County
	10	Pinal County
	11	Graham County
	12	Greenlee County
	13	Pima County
	14	Santa Cruz County
	15	Cochise County
	16	California
	17	Nevada
	18	Utah
	19	Colorado
	20	New Mexico
	21	Texas
	22	Mexico
	23	Gulf of California
	24	Pacific Ocean

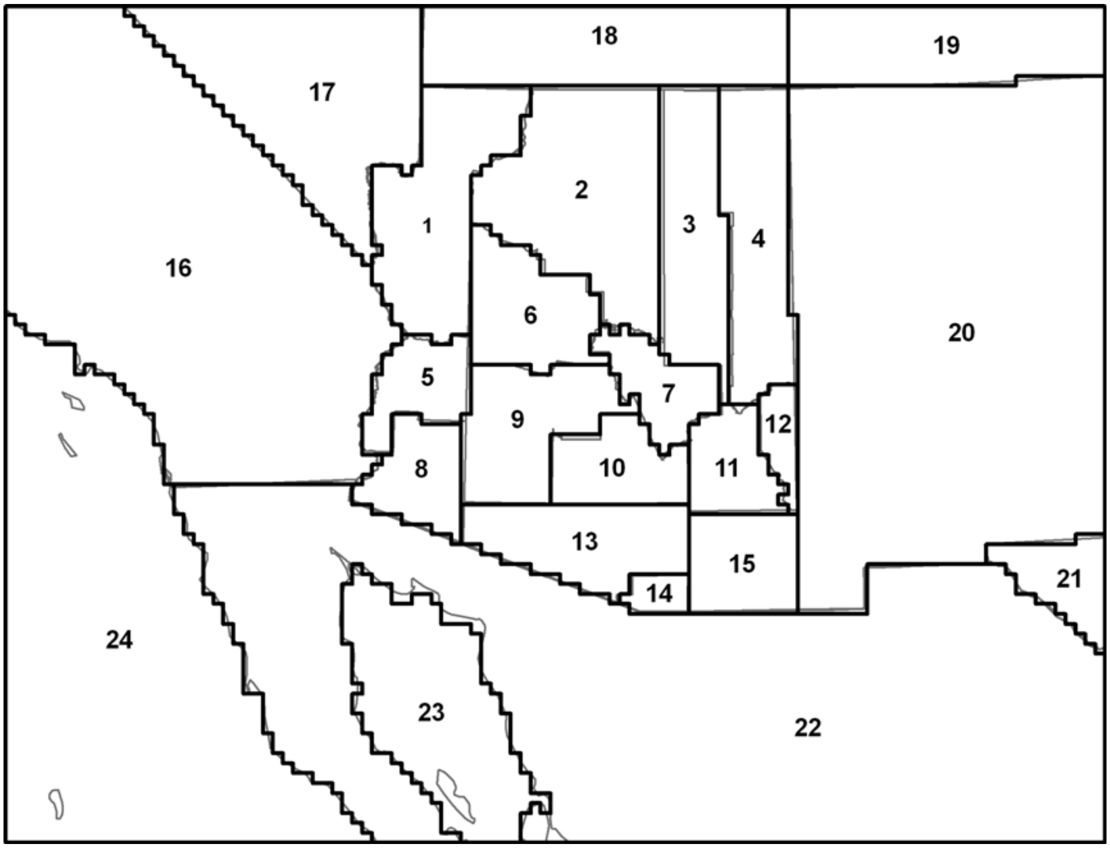


Figure VI-2. Sub-division of a 12 km CAMx domain into separate areas for geographic source apportionment

Table VI-5. Percent contribution of VOC and NOx to high ozone in baseline year (2005)

	June		July		August	
Site	**VOC**	**NOx**	**VOC**	**NOx**	**VOC**	**NOx**
North Phoenix	49.3%	50.7%	43.4%	56.6%	48.6%	51.4%
Humboldt Mountain	40.4%	59.6%	31.7%	68.3%	31.0%	69.0%

Table VI-6. Percent contributions of VOC and NOx to high ozone in future year (2025)

	June		July		August	
Site	**VOC**	**NOx**	**VOC**	**NOx**	**VOC**	**NOx**
North Phoenix	49.9%	50.1%	38.3%	61.7%	50.2%	49.8%
Humboldt Mountain	40.5%	59.5%	32.6%	67.4%	31.1%	68.9%

conditions. This phenomenon is notable for the July episode. The contribution of boundary conditions to high ozone at the Humboldt Mountain site increases for all episodes in the future year, while it slightly decreases at the North Phoenix site for the June and July episodes of the future year.

The percent contribution of anthropogenic emission source sectors (onroad, nonroad, area, and point emission sources) to high ozone is presented in Tables VI-7 and 8. The anthropogenic emission source sector contribution to high ozone differs from site to site, but the biggest anthropogenic emission contributor for all monitoring sites is onroad mobile in 2005. Onroad mobile is also the largest anthropogenic source for the Humboldt Mountain site in 2025. However, area sources are the biggest anthropogenic emission contributor to high ozone for the North Phoenix site during the June and August episodes of 2025. This indicates that the onroad mobile source in 2025 is no longer a major anthropogenic emission contributor to high ozone in the Phoenix urban area, due to the substantial decrease of onroad mobile source emissions in 2025. An interesting feature of the source sector contribution changes in the future year is that the contribution of onroad and nonroad mobile emission sources to total emissions decrease, while the contribution of area and point sources increase due to the conservative assumption in projecting the 2025 area and point source emissions.

Table VI-7. Percent contributions of anthropogenic emission source sectors to high ozone in the baseline (2005)

Emissions Source	June		July		August	
	North Phoenix	Humboldt Mountain	North Phoenix	Humboldt Mountain	North Phoenix	Humboldt Mountain
Onroad	42.3%	56.0%	65.0%	55.3%	38.4%	53.7%
Nonroad	23.5%	29.1%	14.3%	25.3%	21.6%	28.5%
Area	21.6%	7.1%	15.7%	8.9%	26.9%	8.4%
Point	12.7%	7.7%	5.1%	10.5%	13.1%	9.4%

Table VI-8. Percent contributions of anthropogenic emission source sectors to high ozone in the future year (2025)

Emissions Source	June		July		August	
	North Phoenix	Humboldt Mountain	North Phoenix	Humboldt Mountain	North Phoenix	Humboldt Mountain
Onroad	29.0%	54.8%	46.4%	45.4%	24.9%	48.0%
Nonroad	14.7%	18.1%	11.6%	18.5%	14.5%	19.0%
Area	33.5%	14.2%	27.9%	19.0%	38.2%	14.3%
Point	22.8%	12.9%	14.1%	17.1%	22.4%	18.7%

The contributions of the regions and source sectors to high ozone were traced using the ozone source apportionment technology. The results from this analysis are plotted for the North Phoenix site in Figures VI-3 and 4. In these Figures, the Boundary Condition (BC) indicates all four boundaries of the 12 km modeling domain. At the North Phoenix site, the contribution of emission sources in Maricopa County to high ozone is clearly the highest for all three episodes. The next largest geographic contributors, which vary episode by episode, include the neighboring Arizona counties (Pinal, Mohave, Graham, and Yuma Counties) and the neighboring states of New Mexico, and California, and the neighboring country of Mexico. The source contribution ratio varies by region for those regions which contribute to high ozone at the North Phoenix site. These ratios are dependent upon meteorological conditions.

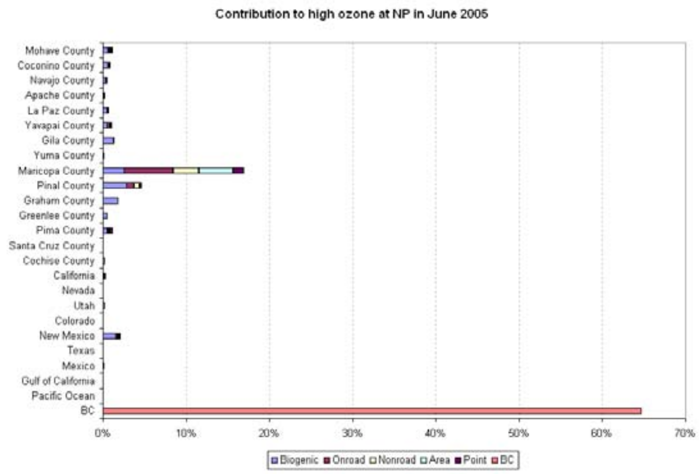
There are relatively high contributions from local sources to high ozone at the North Phoenix site for all three episodes. The contribution of transported sources to high ozone at the North Phoenix site is also relatively high and includes transported sources from the east for the June and July episodes, and transported sources from other directions besides east for the August episode.

The contribution ratio to high ozone at the Humboldt Mountain site is shown in Figures VI-5 and 6. Anthropogenic emission sources from Maricopa County are still the largest contributor to high ozone, although their contribution at the Humboldt Mountain site is much less than that for the North Phoenix site. The next largest contributors include the neighboring states of New Mexico, and California; neighboring country of Mexico; and the Arizona counties located north of Maricopa County - Yavapai, Mohave, and Coconino Counties. The onroad mobile and nonroad mobile emission sources dominated the local emission source contribution from Maricopa County.

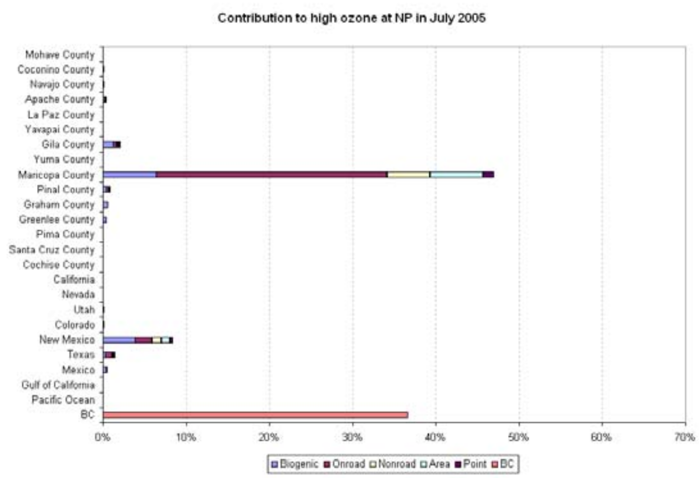
The above source apportionment analysis indicates the similarities and differences in the contribution of various geographic regions and their emission source groups to high ozone. This emission source contribution information is useful in the development of efficient emission control measures and for improving the understanding of the role of local and regional emission sources on high ozone formation under different meteorological regimes.

The results of the photochemical source apportionment analysis show that the NOx contribution to high ozone concentrations is greater than the VOC contribution, onroad mobile sources are the major contributor among anthropogenic emission sources, and the impact of both local and boundary emissions on local ozone concentrations is substantial. Therefore, NOx control outside the urban plume, onroad emission controls, and the implementation of federal, state, and local government emission control programs all contribute to maintaining the eight-hour ozone standard in 2025.

(a)



(b)



(c)

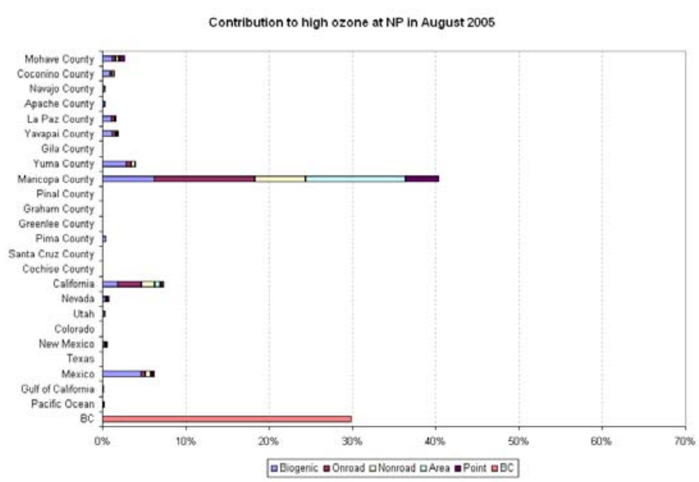
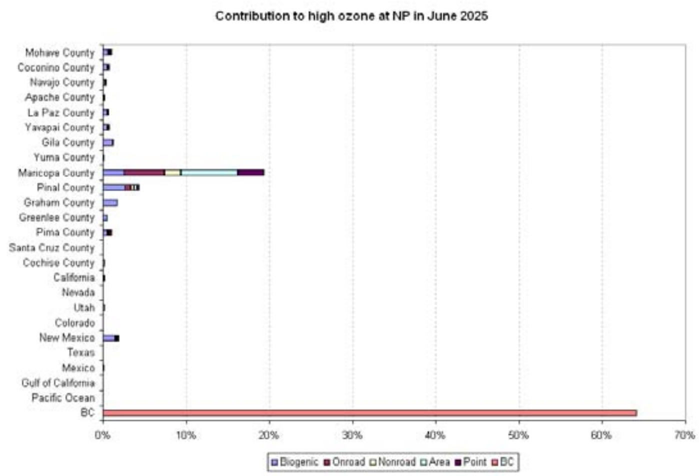


Figure VI-3. Contribution to high ozone at the North Phoenix site in (a) June, (b) July, and (c) August 2005

* BC indicates all four boundaries of the 12 km modeling domain.

(a)



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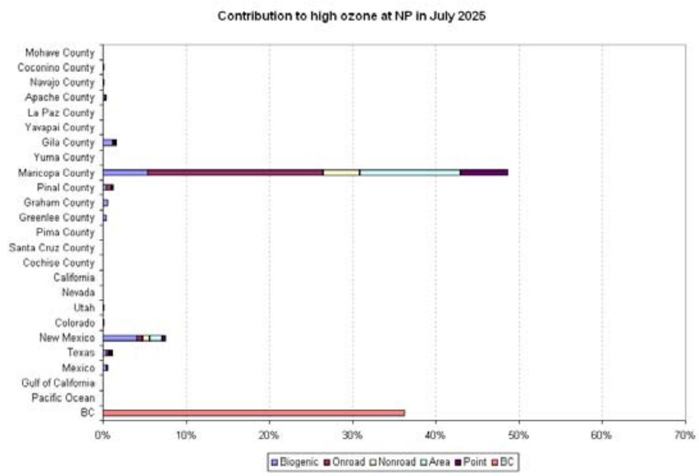

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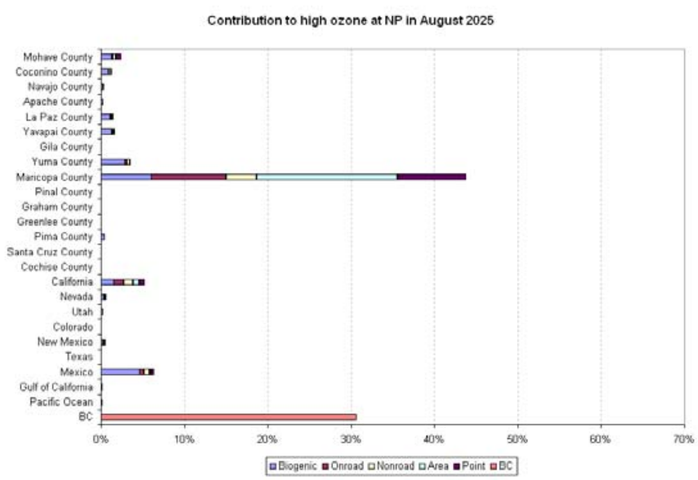
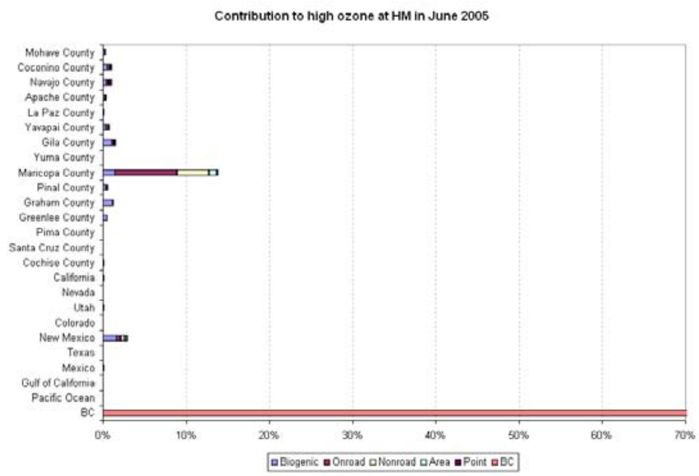


Figure VI-4. Contribution to high ozone at the North Phoenix site in (a) June, (b) July, and (c) August 2025

* BC indicates all four boundaries of the 12 km modeling domain.

(a)



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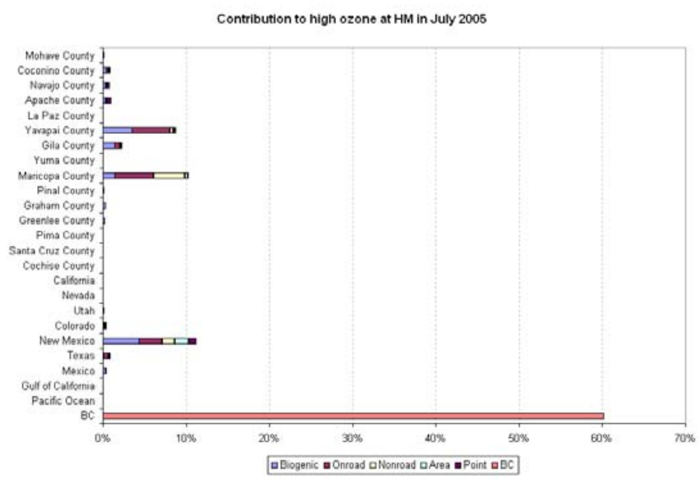

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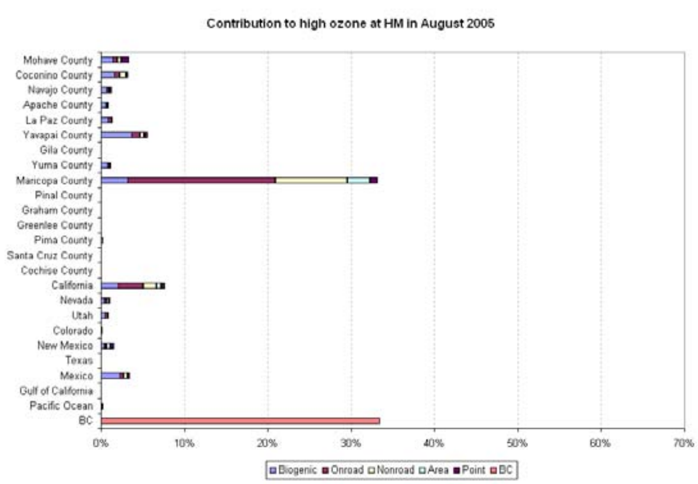
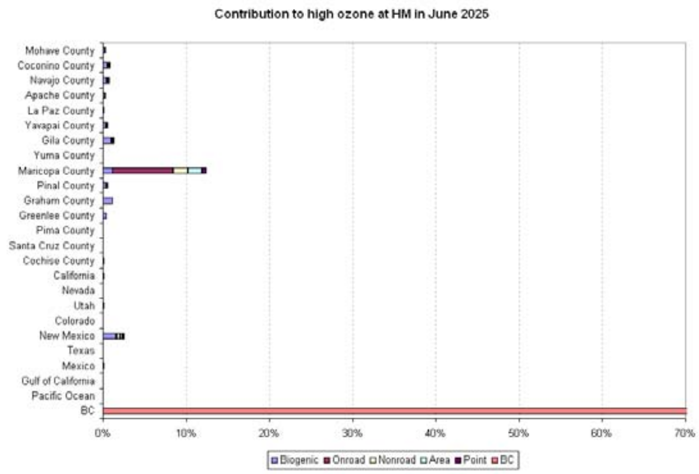


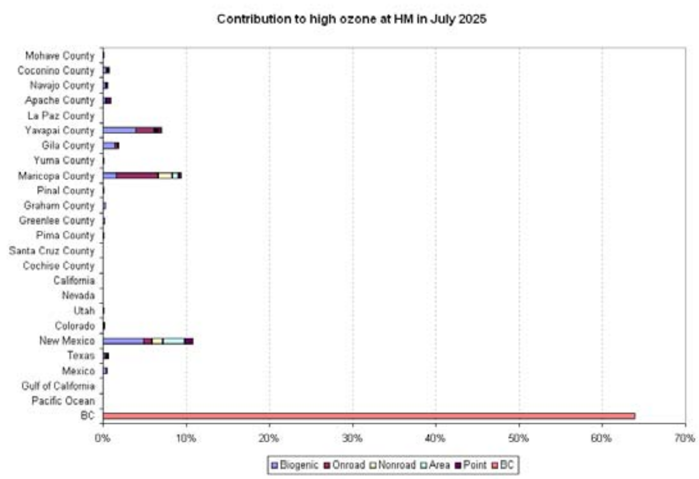
Figure VI-5. Contribution to high ozone at the Humboldt Mountain site in (a) June, (b) July, and (c) August 2005

* BC indicates all four boundaries of the 12 km modeling domain.

(a)



(b)



(c)

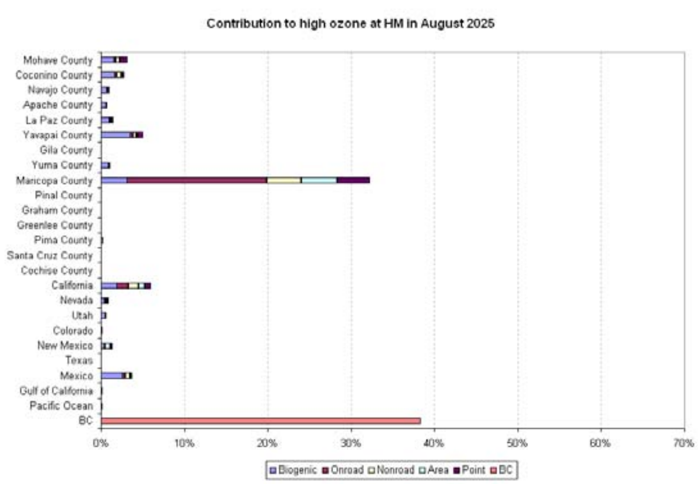


Figure VI-6. Contribution to high ozone at the Humboldt Mountain site in (a) June, (b) July, and (c) August 2025

* BC indicates all four boundaries of the 12 km modeling domain.

VI-4. Decoupled Direct Method

The decoupled direct method (DDM), which is embedded in the CAMx model, was used for a sensitivity analysis of emission sources for the future year. The DDM was implemented in the evaluation of first order sensitivity coefficients with respect to predicted ozone concentrations to pollutant sources such as initial conditions (IC), boundary conditions (BC), top concentration (TOPC), and anthropogenic emissions. The sensitivity analysis, provided with the CAMx DDM, includes an option for varying emission inputs to the CAMx model, such as scaling emissions by a factor, additively increasing emissions by a constant amount everywhere, or zeroing-out emissions by source category and geographic region. In this study, DDM was run with the emissions input consisting of zeroing-out emissions for those source categories (onroad, nonroad, area, and point sources) located in selected regions (Maricopa County, Arizona Counties excluding Maricopa County, California, New Mexico, and Mexico) along with initial conditions, boundary conditions, and top concentration. This DDM practice is comparable to the "brute force method", which runs the CAMx model separately for a number of perturbations and calculates the differences from the base case run used in Section III-4.

One-hour ozone sensitivity plots for each pollutant source, showing the difference between the base case run and the zero-out emissions run at a single hour (noon) on a Thursday in June, 2025, are discussed in the following section:

- **Figures VI-7(a) through 7(f)** - Plots of one-hour ozone sensitivity for initial conditions, boundary conditions, and top concentration are presented in Figures VI-7(a) through 7(f) Using three spin-up days, ozone sensitivity to initial conditions is negligible for the Thursday in June episode. Also the influence of top concentration is minimal in the eight-hour ozone Maricopa Nonattainment Area (MNA). The largest impact of boundary conditions (BC) on ozone levels in the MNA is from the north side BC (among all stratified boundaries). However, the maximum ozone impact in the 12-km modeling domain is from the east side BC. While the influence of emissions from the north side BC on ozone levels occurs mostly over the center of the 12-km modeling domain, the emissions from the other boundaries only affect nearby regions in the domain due to meteorological conditions.

- **Figures VI-8(a) through 8(d)** - Plots of ozone sensitivity to Maricopa County anthropogenic emissions such as onroad, nonroad, area, and point sources, respectively, are presented in Figures VI-8(a) through 8(d). These plots show that Maricopa County emissions have only local ozone impacts within the county. Maricopa County area sources have the largest impact on ozone levels in Maricopa County. Maricopa County point, onroad, and nonroad emission sources generally have a positive impact on ozone formation, which means that ozone concentrations decrease when these emission sources are removed. There are a few areas (blue shaded areas in Figure VI-8) that showed a negative relationship between these emissions and ozone levels in the Phoenix urban core (ozone concentrations increased when these emission sources were removed).

- **Figures VI-9(a) through 9(d)** - Plots of ozone sensitivity to anthropogenic emissions from Arizona counties, excluding Maricopa County, are presented in Figures VI-9(a) through 9(d). All emission sources, except area sources, from these Arizona counties influence ozone formation in Maricopa County. Onroad emissions from these counties have the greatest and widest ozone impact over the MNA.

- **Figures VI-10(a) through 10(d)** - Plots of ozone sensitivity to California anthropogenic emissions are presented in Figures VI-10(a) through 10(d). Over all source categories, the magnitude of ozone sensitivity to California emissions is greater than that of emissions from the other regions within the 12-km modeling domain. Major ozone impacts occur along the California side of the Pacific Ocean, where major urban areas are located. California emissions influence ozone formation over the state of California, as well as Mexico, and the state of Arizona.

- **Figures VI-11(a) through 11(d)** - Plots of ozone sensitivity to New Mexico anthropogenic emissions are presented in Figures VI-11(a) through 11(d). The plots show that none of the emission sources in New Mexico influence ozone formation in Maricopa County.

- **Figures VI-12(a) through 12(d)** - Plots of ozone sensitivity to Mexico anthropogenic emissions are presented in Figures VI-12(a) through 12(d). Examination of these plots indicates that Mexico emissions do not influence ozone formation in the MNA.

These DDM results, along with the results from the process analysis and the source apportionment application presented in the previous sections, provide a better understanding of ozone formation in the MNA.

The DDM analysis reveals that the ozone formation over the MNA is significantly influenced by the boundary condition transported from the north side in the June episode. This result supports that anthropogenic VOC and NOx emission reductions at the boundaries contributed to the maintenance of the eight-hour ozone standard in 2025.

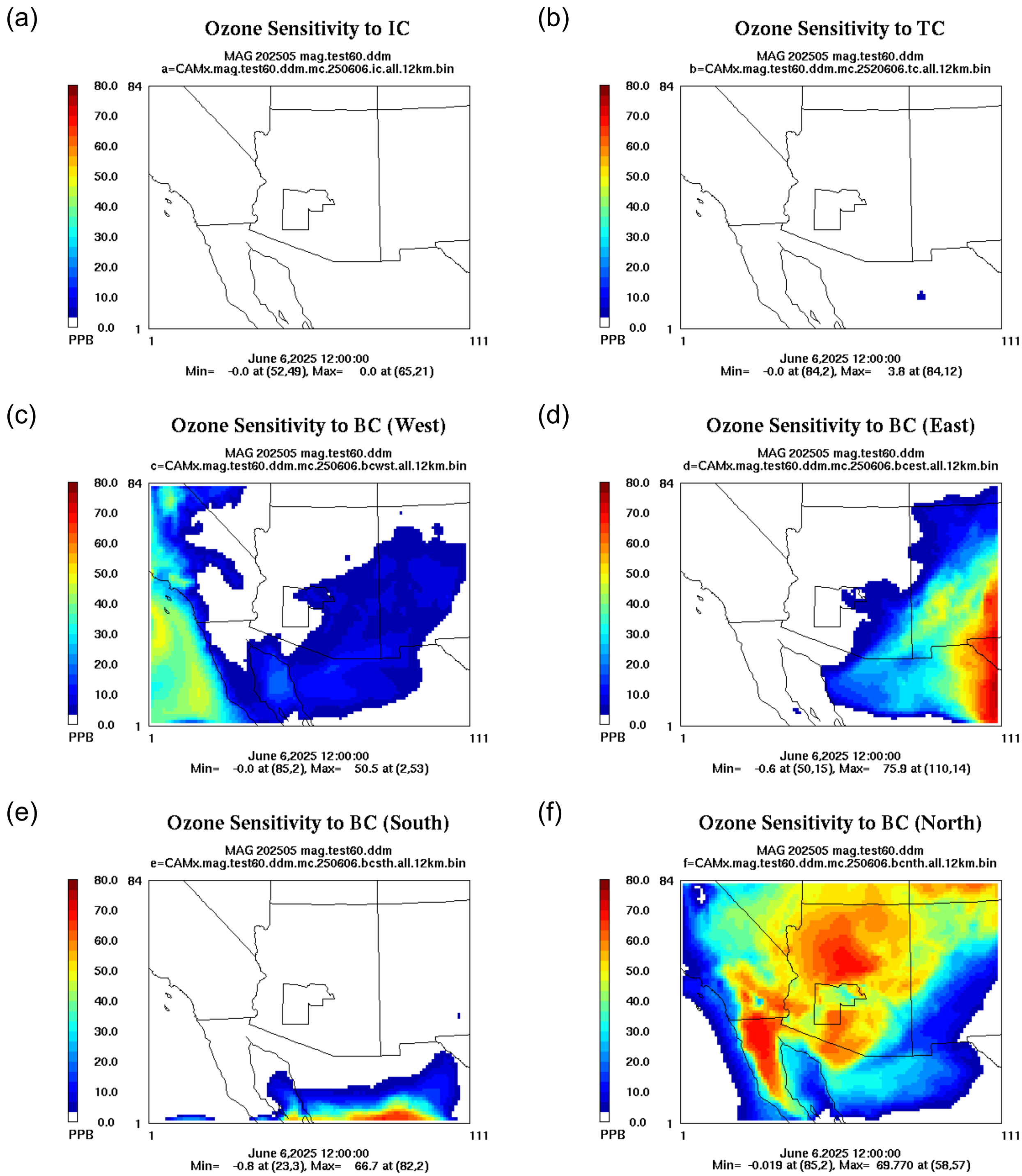


Figure VI-7. Ozone sensitivity plots to (a) IC, (b) TC, (c) BC-West, (d) BC-East, (e) BC-South, and (f) BC-North at noon on a Thursday in June, 2025

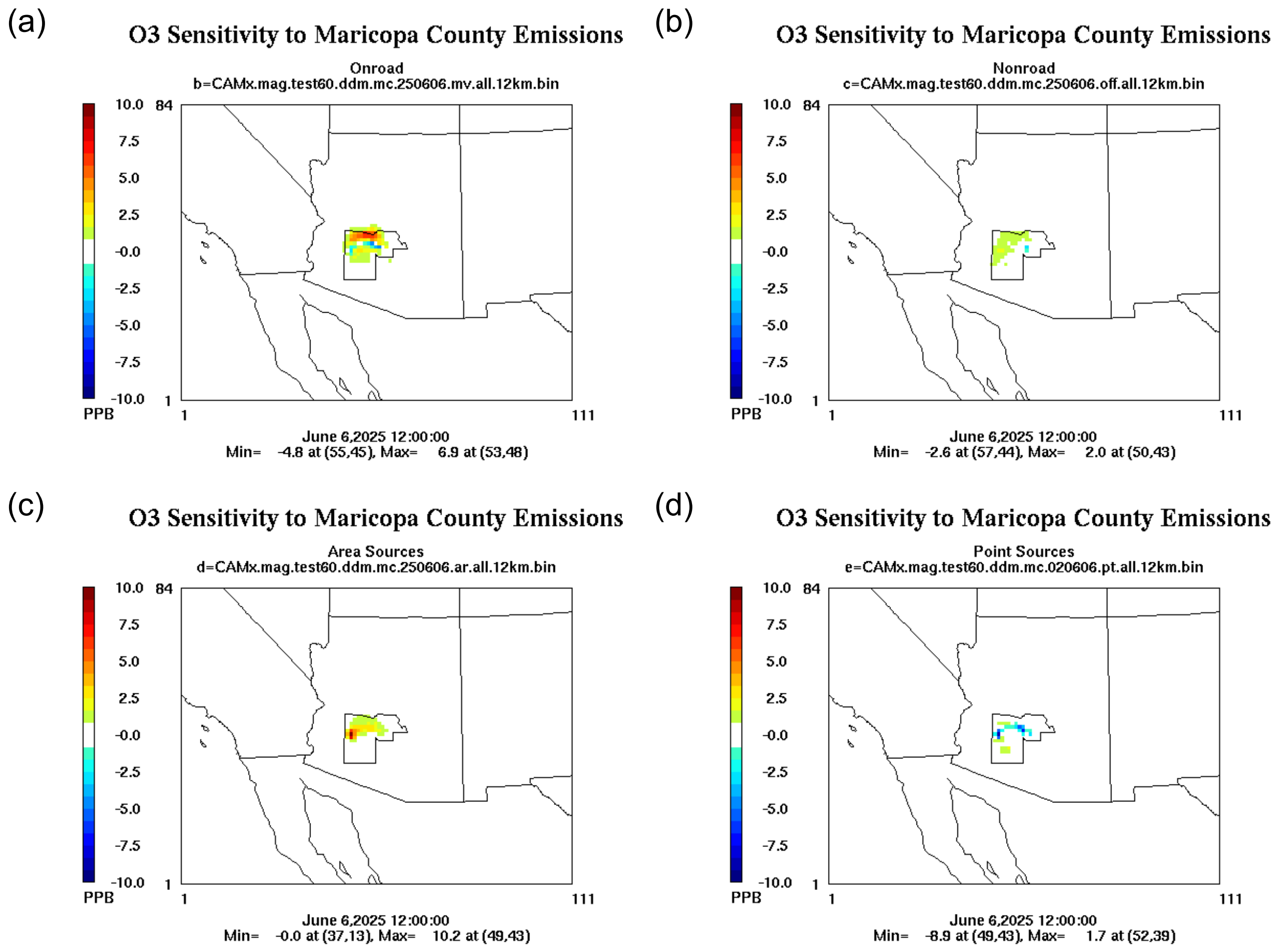


Figure VI-8. Ozone sensitivity plots to Maricopa County emissions: (a) onroad, (b) nonroad, (c) area sources, and (d) point sources at noon on a Thursday in June, 2025

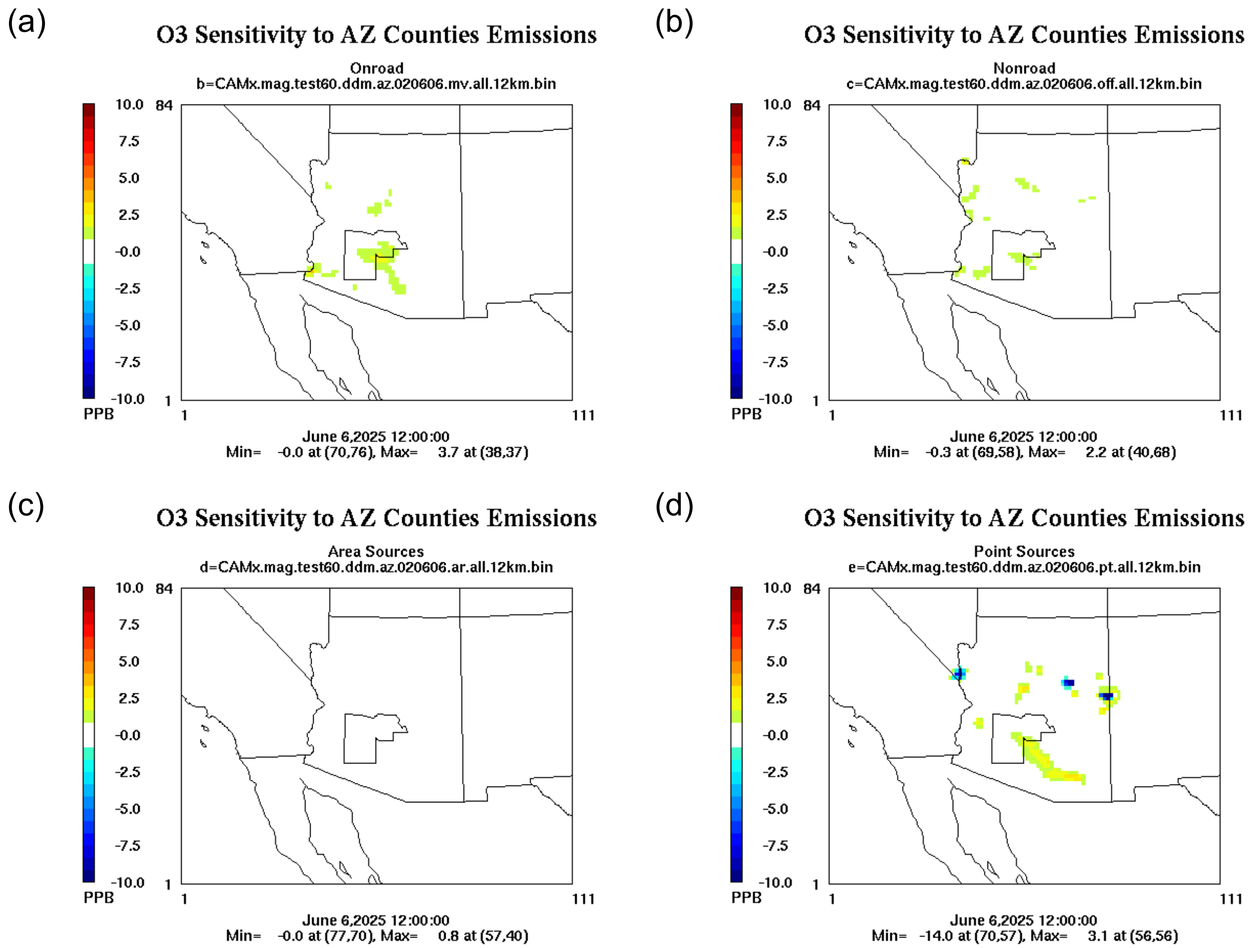


Figure VI-9. Ozone sensitivity plots to Arizona counties emissions: (a) onroad, (b) nonroad, (c) area sources, and (d) point sources at noon on a Thursday in June, 2025

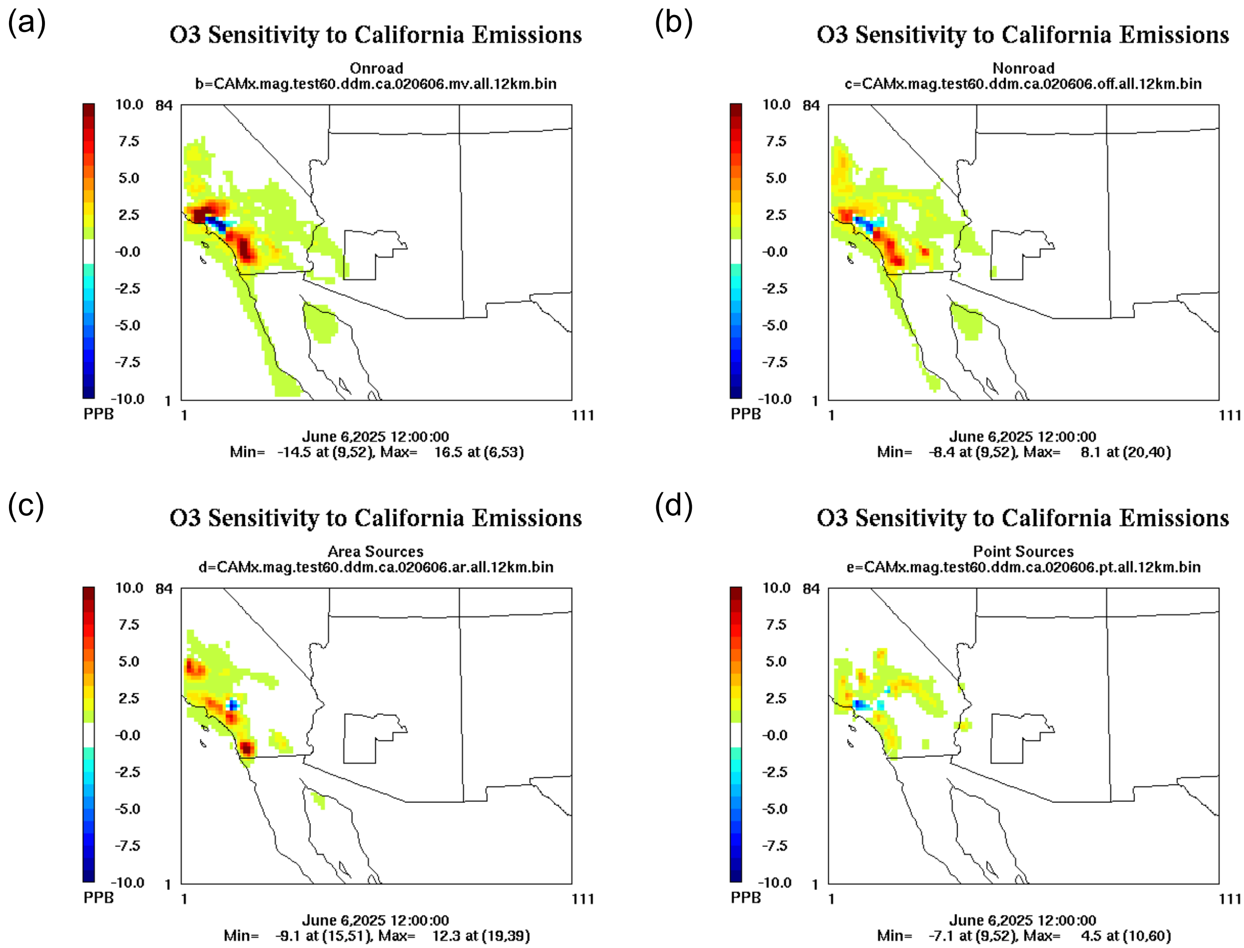
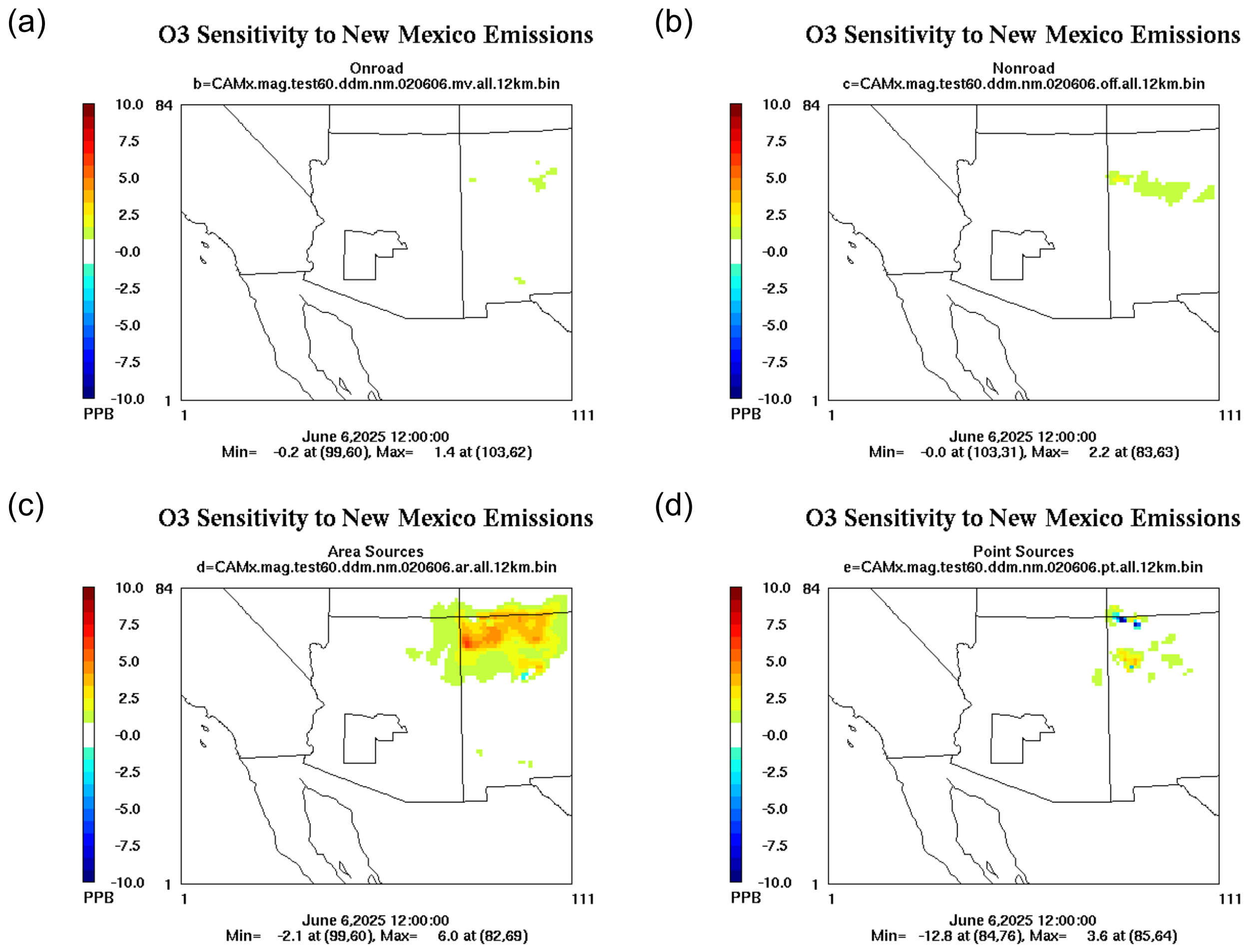


Figure VI-10. Ozone sensitivity plots to California emissions: (a) onroad, (b) nonroad, (c) area sources, and (d) point sources at noon on a Thursday in June, 2025



(e)

Figure VI-11. Ozone sensitivity plots to New Mexico emissions: (a) onroad, (b) non-road, (c) area sources, and (d) point sources at noon on a Thursday in June, 2025

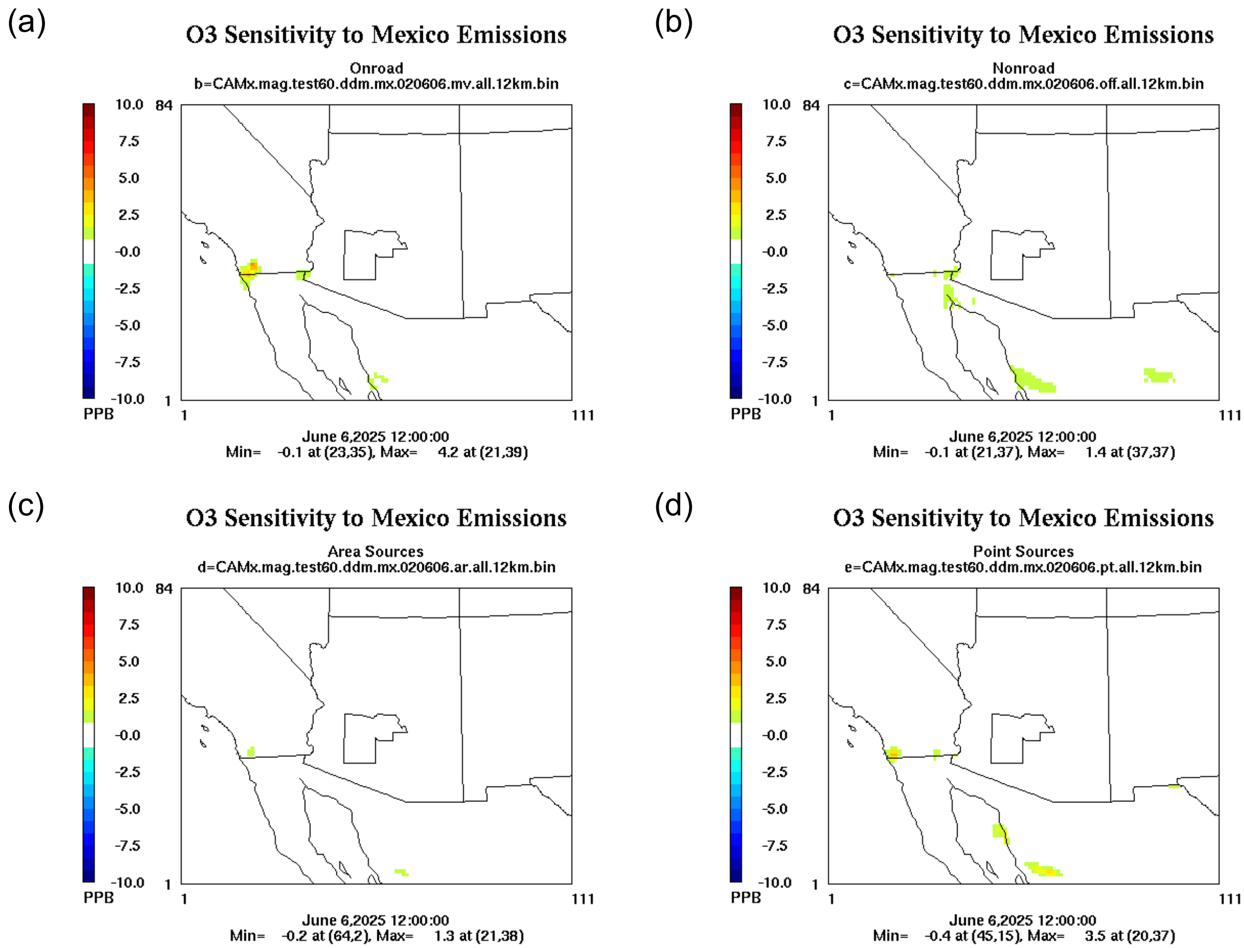


Figure VI-12. Ozone sensitivity plots to Mexico emissions: (a) onroad, (b) nonroad, (c) area sources, and (d) point sources at noon on a Thursday in June, 2025

VI-5. Weight of Evidence Analysis

This section provides a weight of evidence (WOE) analysis in support of the MAG Eight-Hour Ozone Maintenance Plan. The analysis is based on available monitoring data, numerical modeling results, and historical and forecasted socio-economic indices such as population and vehicle miles traveled (VMT). The report generally follows the framework of the WOE analysis used in the Eight-Hour Ozone Plan (MAG, 2007) for analysis of the trends of ozone and NOx concentrations in the Maricopa Eight-Hour Ozone Nonattainment Area (MNA) from 1996 to 2007. The emission trends of ozone precursors were based on emission estimates for 2005 and projected emissions for 2025. In addition, the eight-hour ozone maintenance demonstration tests used a different air quality model (CMAQ) and meteorological model (WRF) that are included in the WOE analysis. These analyses support the CAMx numerical modeling demonstration, based on the MM5 meteorology, that showed Maricopa County will maintain the eight-hour ozone standard in the future year of 2025 given expected growth rates and emission control measures.

VI-5-1. Trend of Ozone and NOx Concentrations

Eight-hour ozone concentrations in the MNA are improving as a result of existing emission control measures. Despite a continuous increase in the population of Maricopa County (Figure VI-13) and an increase in VMT (Figure VI-14), the MNA is exhibiting decreasing trends for ozone and its precursors. Figure VI-14 shows the relationship between the peak eight-hour ozone design value (DV) and population growth in Maricopa County.

The one-hour ozone monitoring data for the MNA were obtained from EPA. These ozone data are from the monitoring networks maintained by MCAQD and ADEQ. Air quality data for the MNA were also obtained from the monitoring network managed by the Pinal County Air Quality Department (PCAQD). Figure VI-15 and Table VI-9 illustrate the locations of the ozone monitoring sites used for the ozone and NOx concentration trend analysis. NOx was monitored at several locations in the MNA. Historical VOC data were only available for 2001 and 2002, hence a VOC trend could not be assessed.

Historical population data for Maricopa County were obtained from census surveys of Maricopa County (1990, 1995, 2000, and 2005), MAG-adopted population estimates for 2006 and 2007, and the MAG annual population updates. The VMT data were extracted from the MAG 2008 conformity analysis (2008, 2015, 2018, and 2028). A linear regression was performed on these four years to obtain the VMTs of the years shown in Figure VI-14.

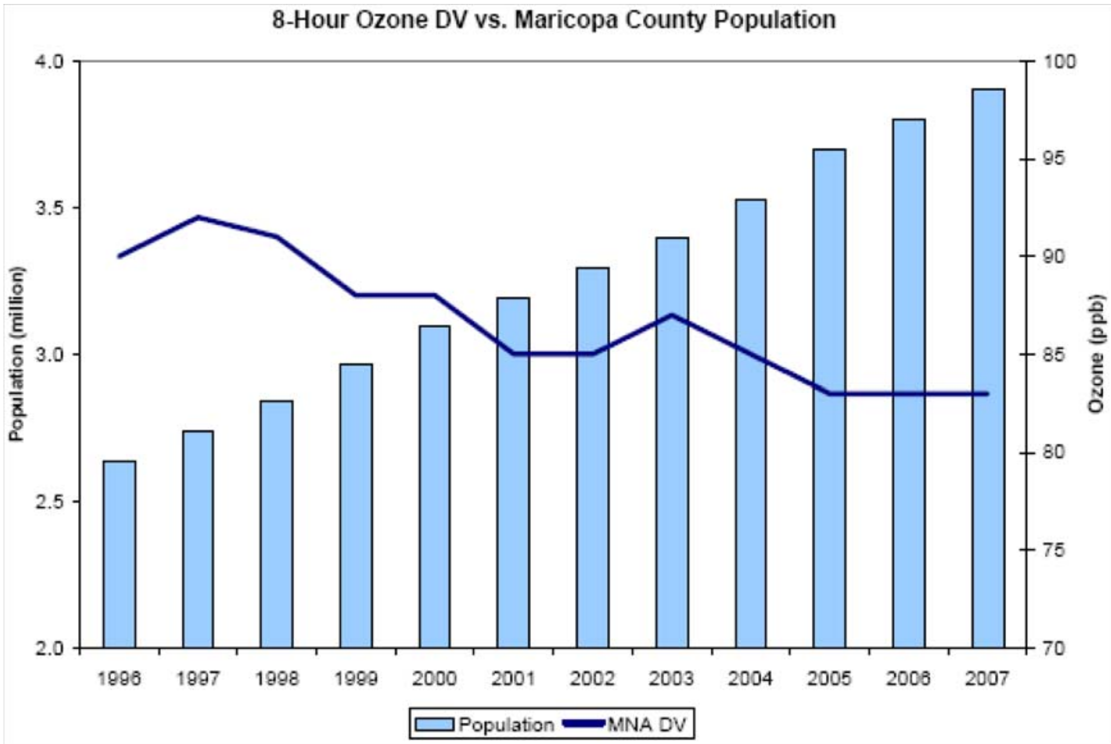


Figure VI-13. Population and peak eight-hour ozone DV from 1996 to 2007 in Maricopa County

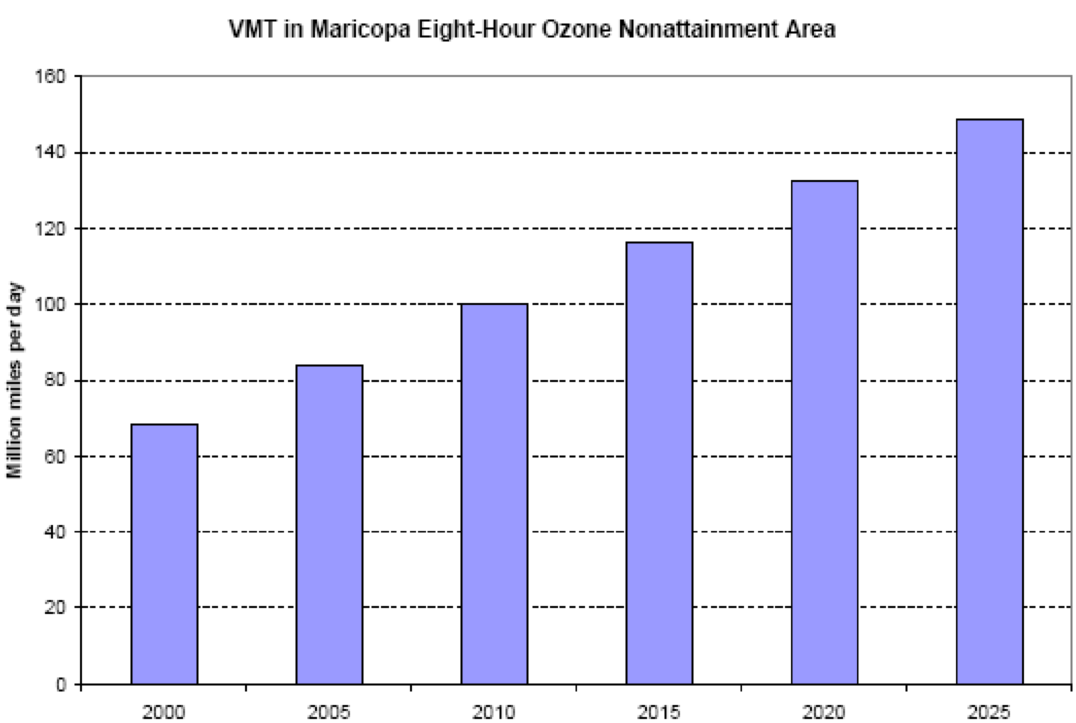


Figure VI-14. Past and Future VMT in the MNA

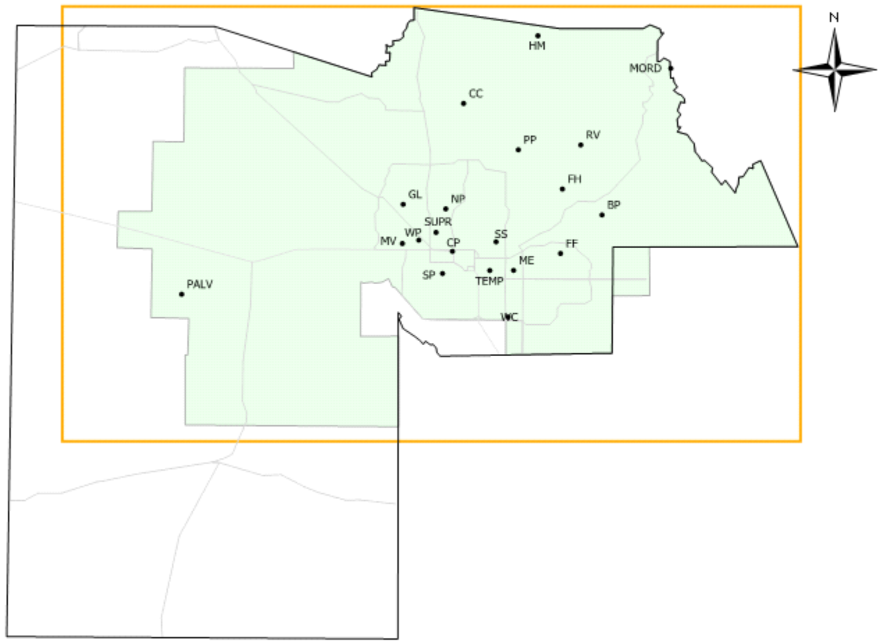


Figure VI-15. Location of ozone monitoring sites in Maricopa County. The green shaded area represents the eight-hour ozone nonattainment area, and the orange line denotes the boundary of the 4 km modeling domain. See Table VI-9 for a description of sites.

Table VI-9. Ozone monitoring site names and period of operation

Site Abbreviation	Site Name	Period of Operation
AJ	Apache Junction	2002 – present
BP	Blue Point	1997 – present
CC	Cave Creek	2001 – present
CP	Central Phoenix	1994 – present
FF	Falcon Field	1997 – present
FH	Fountain Hills	1997 – present
GL	Glendale	1994 – present
HM	Humboldt Mountain	1997 – present
ME	Mesa	1994 – 2002
MORD	Mount Ord	1997 – 2001
MV	Maryvale	1997 – 2003
NP	North Phoenix	1994 – present
PALV	Palo Verde	1996 – 2004
PP	Pinnacle Peak	1994 – present
RV	Rio Verde	1997 – present
SP	South Phoenix	1999 – present
SS	South Scottsdale	1994 – present
SUPR	Supersite	1996 – present
TEMP	Tempe	2000 – present
WC	West Chandler	2000 – present
WP	West Phoenix	1994 – present

VI-5-1-1. Trend in Eight-Hour Ozone Design Values

The number of monitors violating the eight-hour ozone standard in the MNA from 2000 to 2007 is shown in Figure VI-16. The violations have steadily decreased from seven in 2000 to one in 2004. There were no violations in the next three consecutive years from 2005 to 2007. As Chapter II of the Eight-Hour Ozone Maintenance Plan indicates, there were also no violations of the standard during the ozone season of 2008.

The peak eight-hour ozone design values (DVs) in the MNA from 1996 to 2007 are shown in Figure VI-17. Table VI-10 shows the peak DVs and associated monitoring sites. By 2005, the peak DV decreased to 83 ppb and occurred at two different monitors: North Phoenix and Humboldt Mountain. In 2006, the peak DV remained at 83 ppb at the North Phoenix site. In 2007, the peak DV still remained at 83 ppb, but it occurred at the Rio Verde site. All of these monitors are located north to northeast of central Phoenix, which is consistent with the prevailing south-westerly wind direction in the afternoon during the MNA ozone episodes.

Over the most recent five year period (2002-2007), the peak DV has been frequently reported at remote sites such as Humboldt Mountain and Rio Verde. This suggests that as the reactivity of the Phoenix urban plume has decreased over the years, the ozone formation rate has also slowed and the location of peak ozone has been pushed farther downwind.

The trend line for the peak DVs shows a decrease of nearly one ppb per year. During the period of 1999-2007, the decline in the DV trend line was nearly 10 percent. The correlation coefficient for the linear regression equation of the peak eight-hour ozone DV values is 0.84. This indicates that even though ozone concentrations do vary around the regression line, the regression line accounts for more than 80% of the variance in the running three-year DV for the time period of 1994 - 2007.

Figure VI-18 presents the eight-hour ozone DVs at each site that contributed to the peak DVs over the last ten years. The figure is arranged for the following three groups of monitoring sites: (1) Central urban sites (blue lines), (2) Outer non-urban sites (green lines) and, (3) Distant rural sites (orange / yellow lines). The downward trend in eight-hour ozone DV is clear for the central urban sites. There may be a possible downward trend in the eight-hour ozone DV for the outer non-urban sites just to the northeast of the central urban sites. However, the trend of eight-hour ozone DV at the most distant sites appears to be much more flat. These outermost sites are located in elevated terrain and have higher biogenic emissions than the central urban sites and outer non-urban sites. As stated earlier, the less reactive mix of urban emissions may be preserving reactive NOx for further reactions with biogenic emissions in the mountainous areas well downwind of Phoenix.

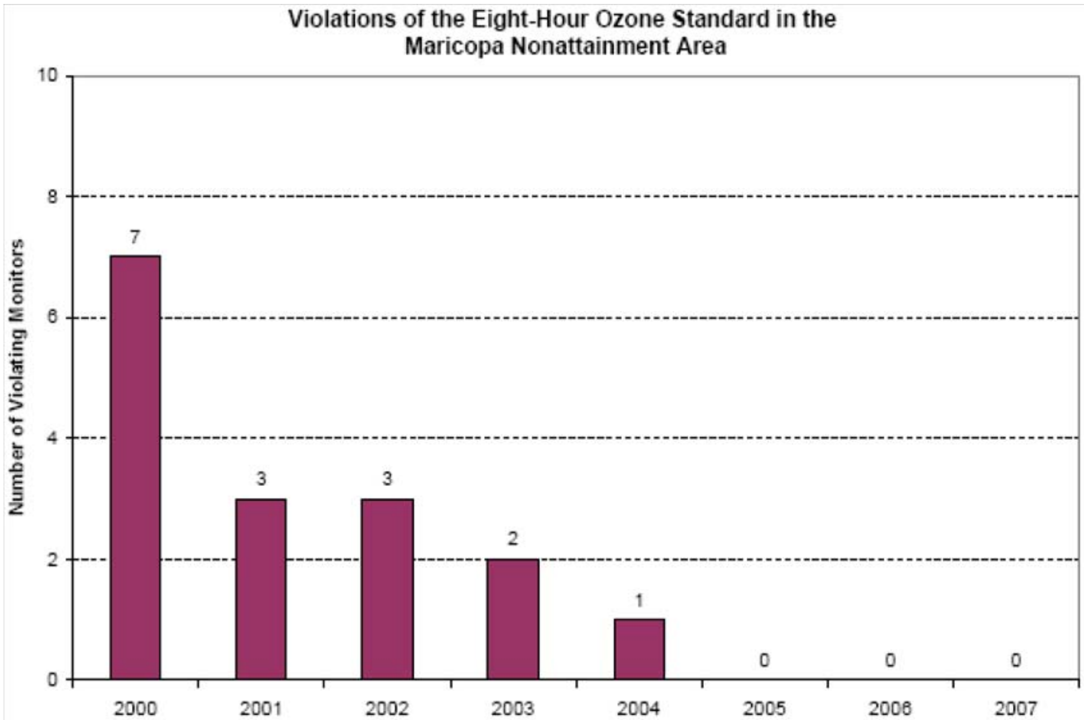


Figure VI-16. Trend in eight-hour ozone violations between 2000 - 2007 in the Maricopa Nonattainment Area

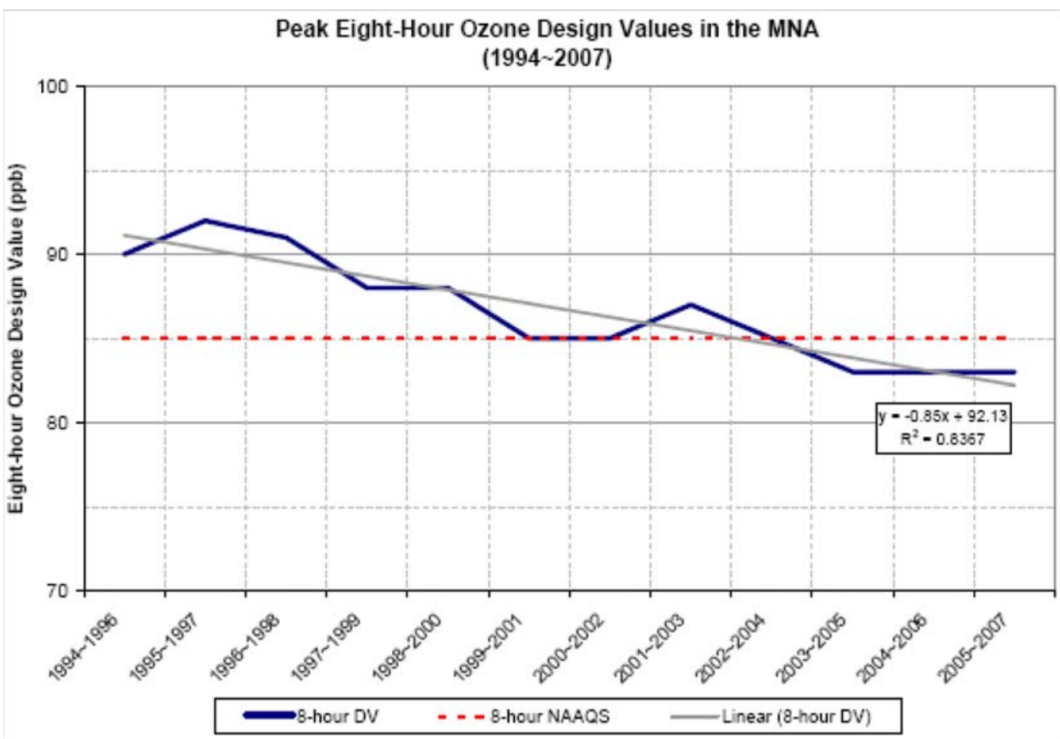


Figure VI-17. Trend in peak eight-hour ozone Design Value (DV) from 1994 through 2007 in the MNA

Table VI-10. Peak eight-hour ozone DV and the sites in the MNA

Average Period	Peak eight-hour ozone DV	Sites DV Max Occurred
1994 - 1996	90	Mesa (Site ID: 04-013-1003)
1995 - 1997	92	North Phoenix (Site ID: 04-013-1004)
1996 - 1998	91	North Phoenix (Site ID: 04-013-1004)
1997 - 1999	88	North Phoenix (Site ID: 04-013-1004)
1998 - 2000	88	Mount Ord (Site ID: 04-013-9701)
1999 - 2001	85	North Phoenix (Site ID: 04-013-1004) Pinnacle Peak (Site ID: 04-013-2005) Rio Verde (Site ID: 04-013-9706)
2000 - 2002	85	Humboldt Mountain (Site ID: 04-013-9508) North Phoenix (Site ID: 04-013-1004) Pinnacle Peak (Site ID: 04-013-2005)
2001 - 2003	87	Humboldt Mountain (Site ID: 04-013-9508)
2002 - 2004	85	Humboldt Mountain (Site ID: 04-013-9508)
2003 - 2005	84	Humboldt Mountain (Site ID: 04-013-9508)
2004 - 2006	83	North Phoenix (Site ID: 04-013-1004)
2005 - 2007	83	Rio Verde (Site ID: 04-013-9706)

The eight-hour ozone standard is based upon a three-year running average of the annual fourth highest daily maximum ozone concentration at each monitor. Figure VI-19 shows the trend line in the peak annual fourth highest eight-hour ozone concentration among all sites. Table VI-11 presents the same data along with the names of the sites and the dates of the peak annual fourth highest eight-hour ozone concentrations. The peak annual fourth high exhibits much more year-to-year variability, both in magnitude and the sites at which the annual peaks occur. This is attributable to the variability in episodic meteorology.

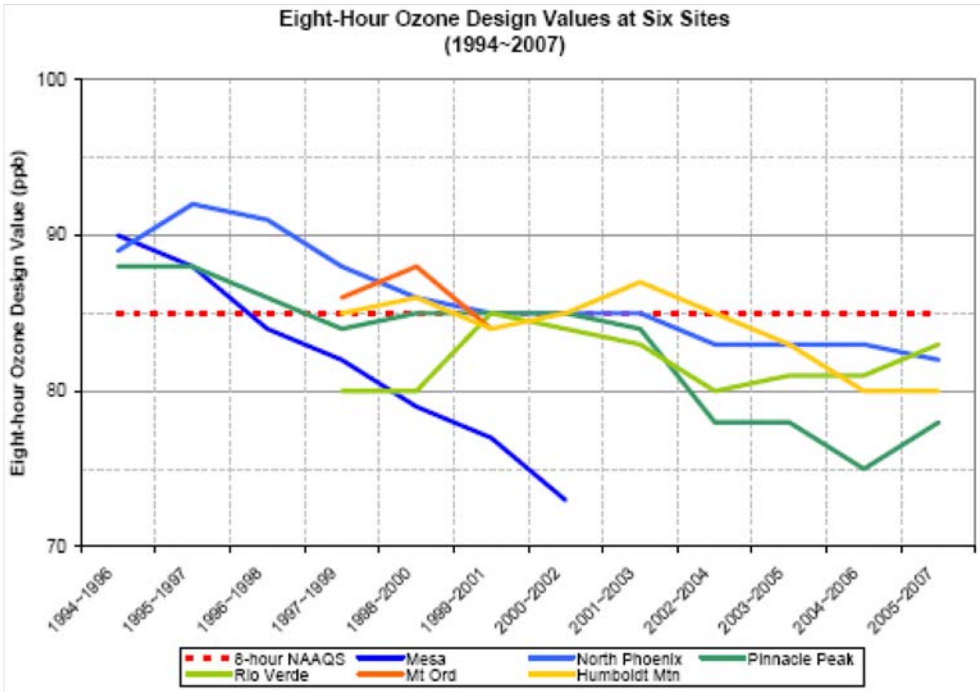


Figure VI-18. Annual eight-hour ozone DVs at the six monitoring sites contributing to the peak DV shown in Figure VI-17. Urban sites are colored blue; outer non-urban sites are colored green, and distant rural sites are colored orange.

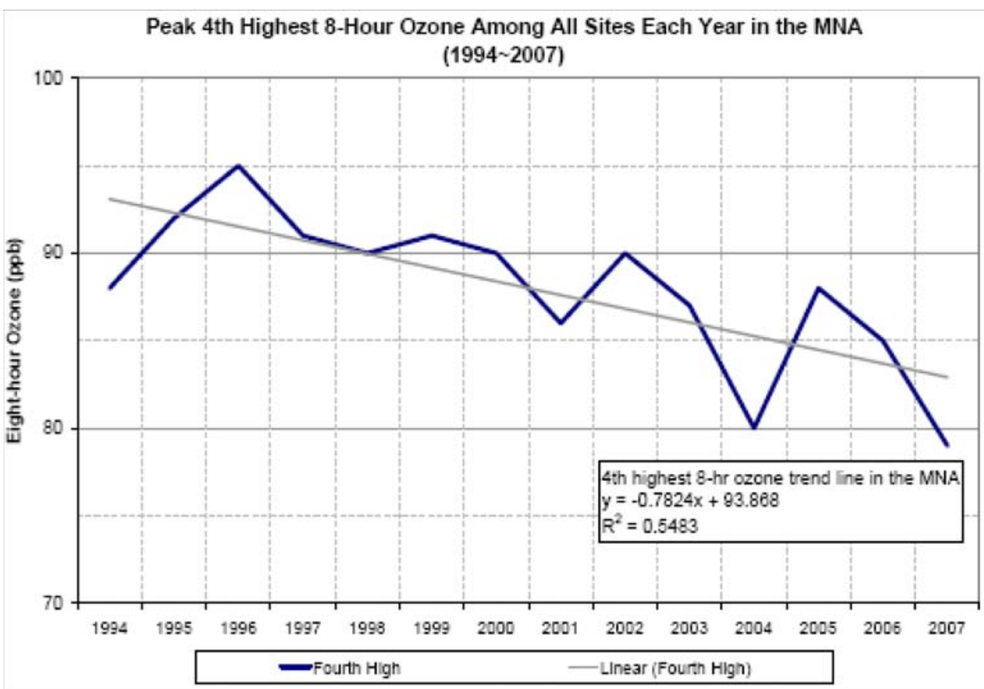


Figure VI-19. Trend in the annual peak (among all sites) fourth highest eight-hour ozone concentration between 1994 and 2007 in the MNA

Table VI-11. Annual peak fourth highest eight-hour ozone concentration and the sites in the MNA

Year	Peak 4th highest eight-hour Ozone	Site	Date Occurred
1994	88	Mesa	7/20/1994
1995	92	Fillmore	9/1/1995
1996	95	North Phoenix	5/21/1996
1997	91	North Phoenix	9/7/1997
1998	90	Humboldt Mountain	8/5/1998
1999	91	West Phoenix	10/12/1999
2000	90	Mount Ord	8/5/2000
2001	86	North Phoenix	7/2/2001
2002	90	Humboldt Mountain	6/3/2002
2003	87	Humboldt Mountain	7/30/2003
2004	80	North Phoenix	8/1/2004
2005	88	Fountain Hills	7/20/2005
2006	85	North Phoenix	7/17/2006
2007	79	Rio Verde	5/24/2007

The eight-hour ozone maximum of 95 ppb, which occurred in 1996, has not been repeated since. A eight-hour ozone minimum of 80 ppb occurred in 2004. This low value was attributed to an abnormally cool summer season. The trend line for the fourth highest annual ozone concentrations shows a decrease of 0.78 ppb per year. During the period 1996 – 2007, the decline in the trend line was about 9.4%. The correlation coefficient for this linear regression equation is 0.55. This correlation coefficient reflects the higher inter-annual variability of eight-hour ozone values. However, the downward trend of the regression line does explain approximately half of the variance in the ten-year record of eight-hour ozone values.

Background Ozone

Background ozone is generally referred to as ozone entering the nonattainment area from outside its boundaries. The nonattainment area ozone levels are thus the sum of the background ozone and locally produced ozone. The local ozone contribution can be estimated by subtracting the eight-hour ozone DV determined at an upwind site from the maximum eight-hour ozone DV. Generally, sites on the southern edge of the MNA would be considered "upwind" sites according to the summertime ozone climatology for the MNA; however there are no ozone monitoring sites that are near the southern edge of the MNA.

Most of the monitoring sites that are located well outside of the Phoenix urban area are climatologically downwind and record some of the highest eight-hour ozone DVs, except for one site - the Palo Verde site in the western MNA. This site is located about 30 miles west of central Phoenix. Figure VI-20 is identical to Figure VI-17, except that it contains the Palo Verde DV trendline added for its period of record. Note that the Palo Verde DV remains about 10 ppb lower than the ozone peak for the MNA, and while decreasing over the period, its rate is less than half of the peak rate. This could suggest that the MNA peak ozone levels are comprised of a regional ozone contribution between 75 and 80 ppb, with an additional 8 to15 ppb due to the urban ozone plume.

Given the proximity of Palo Verde to the Phoenix metropolitan area, it is quite possible that its ozone levels and DV trend over the past six years are influenced by the urban ozone plume. Therefore, ozone data from a monitoring site distant from the Phoenix metropolitan area was examined. Monitoring data for this site, the CastNET site at the Chiricahua National Monument in southeastern Arizona, was extracted from EPA's website (http://www.epa.gov/castnet) and processed to calculate its equivalent DV for each summer ozone season (May 1 through September 30).

Figure VI-21 shows the comparison between the peak MNA ozone DV and the Chiricahua ozone DV along with trend lines. Ozone levels at the Chiricahua site are lower than those at Palo Verde, but examination of Figure VI-21 shows that Chiricahua site's "background" eight-hour ozone levels are still relatively high being very close to 70 ppb. Furthermore, ozone levels have been increasing slowly at the Chiricahua site. Likely causes for this might include increases in ozone from: (1) Tucson; (2) Mexico and border towns such as Nogales and Agua Prieta; or (3) Regional buildup over the entire border area from Texas to California.

Assuming that the Chiricahua site is representative of rural background ozone levels, then it can be implied that local ozone production in Maricopa County has decreased from a 20 ppb increment in 1996 to a 10 ppb increment in 2007 according to the Chircahua trend line. This represents a reduction of 50% in the local ozone component above background ozone levels in the MNA during this period.

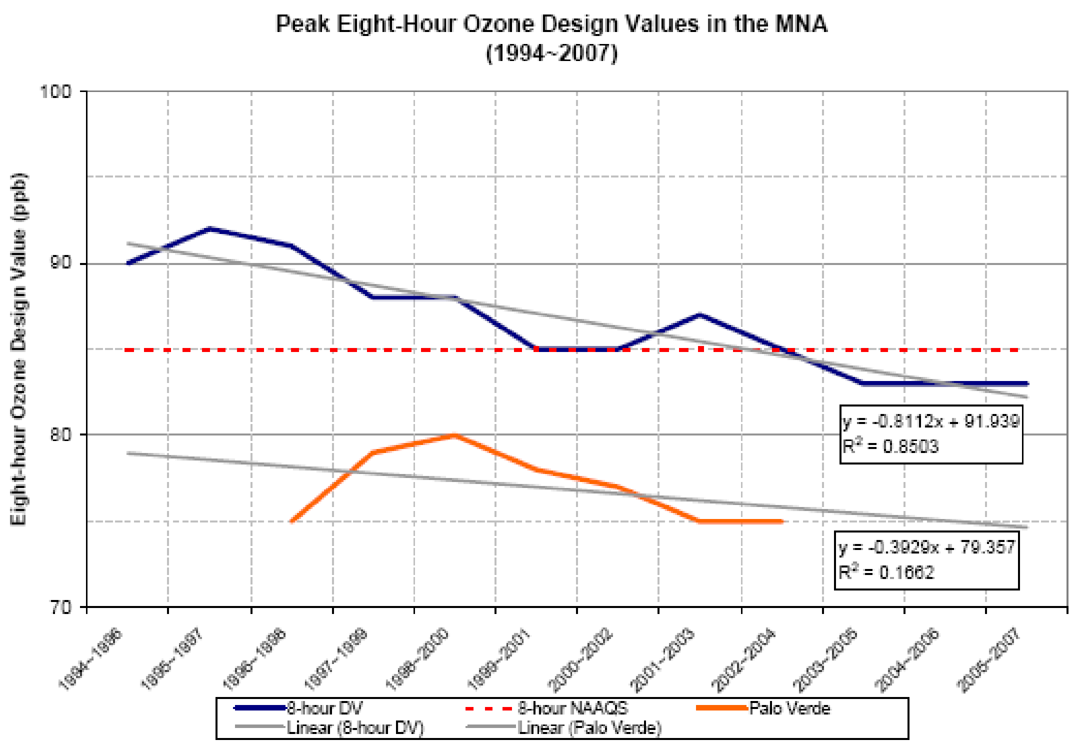


Figure VI-20. Trends in peak MNA DV (blue) and DV at the Palo Verde (Orange) site

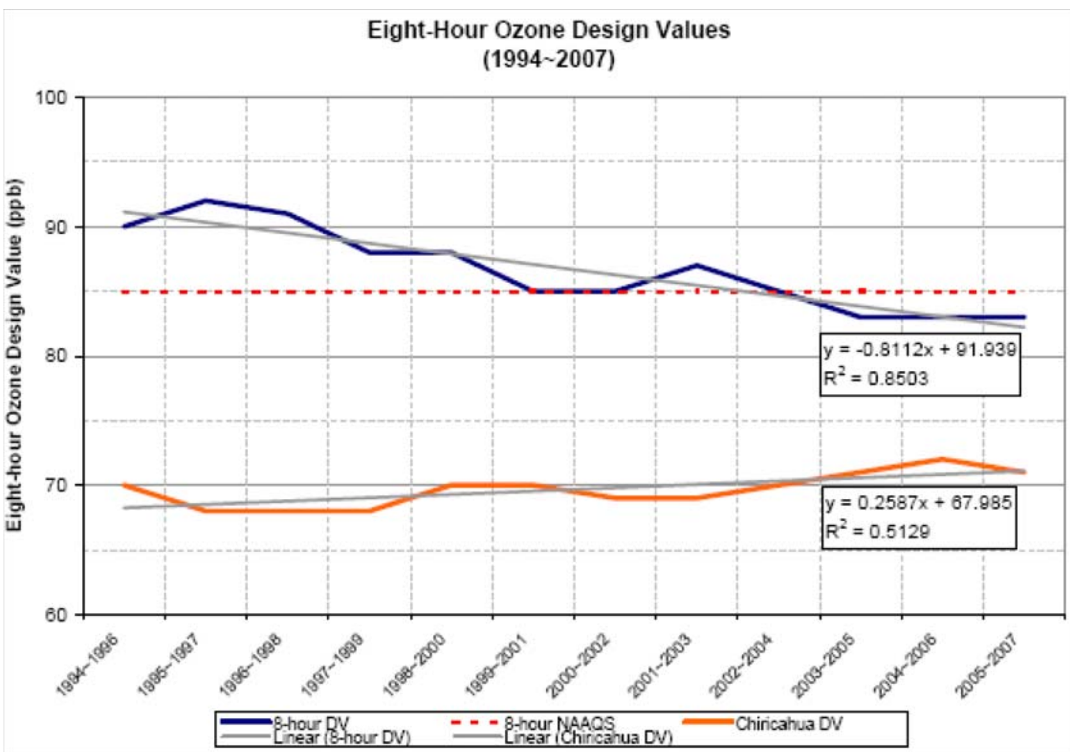


Figure VI-21. Trends in peak MNA DV (blue) and DV at the CastNET Chiricahua (Orange) site

VI-5-1-2. Trend in NOx Concentrations

Ozone precursors include oxides of nitrogen (NOx) and a class of hydrocarbons referred to as volatile organic compounds (VOCs). NOx concentrations have been historically monitored at several locations in the MNA, while VOCs are measured at two PAMS sites located at Supersite and Queen Valley. Historical VOC data were only available for 2001 and 2002, hence a VOC trend could not be assessed.

Figure VI-22 shows the NOx trend during the morning commute hours (5 - 8 AM) from 1999 to 2007 in the MNA. Hourly NOx concentrations at the Supersite were averaged over this period and then averaged over the summer season for each year (June through August). Three trends are provided: all summer days, weekdays, and weekend days. A regression line is shown for the trend for all summer days, and indicates a general reduction in ambient NOx concentrations on the order of 1.6 ppb per year, which translates to a 30-40% reduction over the period of 1999 - 2007. Unlike the ozone trends, NOx is much more variable year to year, and the regression line explains only about 20% of the variability. Morning hour NOx concentrations on weekend days are consistently 10 - 20 ppb lower than weekend days due to the lack of commuting activity on weekend days.

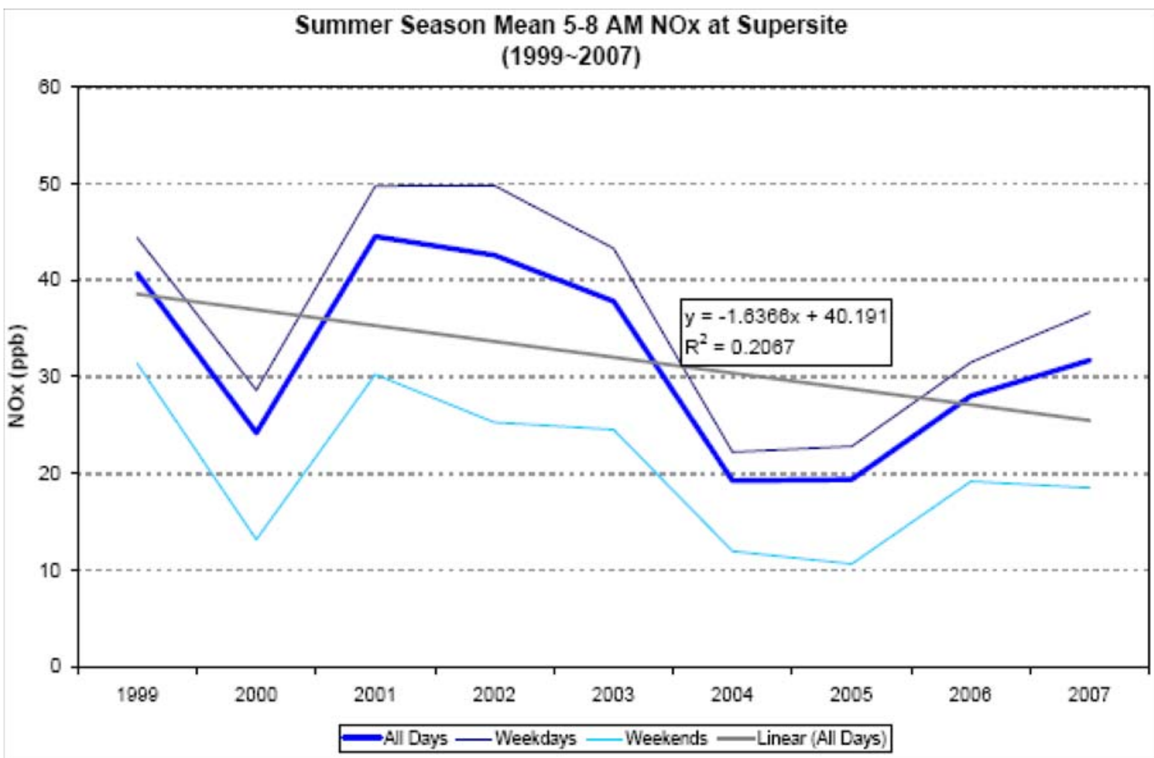


Figure VI-22. Trends in summer morning (5-8 AM) average NOx concentrations at Supersite from 1999 to 2007. Shown are trends for all days (including regression), weekdays, and weekend days.

VI-5-2. VOC and NOx Emission Comparison between 2005 and 2025

Figure VI-23 depicts the anthropogenic VOC and NOx emissions in 2005 and 2025 that were used in the eight-hour ozone maintenance modeling. Biogenic emissions are not included in the analysis because it was assumed that this source category's emissions will remain constant from 2005 to 2025. The emissions shown in Figure VI-23 present individual emission source totals over the 4 km CAMx modeling domain that were processed by EPS3.0.

The increase in VOC emissions from point sources is about 70%, which is mainly caused by the projected increment in industrial employment. As shown in Figure VI-23(b), the NOx emissions from point sources increase dramatically from 2005 to 2025 due to the modeling assumption that set the emission rate of power plants to the Potential to Emit (PTE) emission rate. The increase in VOC and NOx emissions from area sources (about 58%) is caused by the projected increment in population and employment in Maricopa County.

Nonroad VOC and NOx emissions declined between 2005 and 2025, even though the nonroad mobile equipment population and activity are projected to increase significantly. This is due to the lower emission factors for this source category that result from implementation of federal nonroad equipment emission standards that will be phased in before 2025. A similar pattern is seen in the onroad emissions, which decrease even though the projected VMT increases about 76 percent between 2005 and 2025, as shown in Figure VI-14. This decline occurs even though onroad emissions of VOC and NOx were increased by ten percent in 2025 to create a safety margin in the transportation conformity budgets. This downward trend reflects the impact of much cleaner vehicles due to stricter standards on tailpipe and evaporative emissions and innovative emission control technologies.

The total VOC emissions in 2025 increase by about 13 percent. This is due to a higher contribution of area source emissions to anthropogenic VOC emissions, which offsets the VOC emission reduction in onroad and nonroad sources. The overall anthropogenic NOx emissions decrease by about 6 percent from 2005 to 2025, since the reduction in nonroad and onroad emissions more than offsets the increase in NOx emissions from point and area sources.

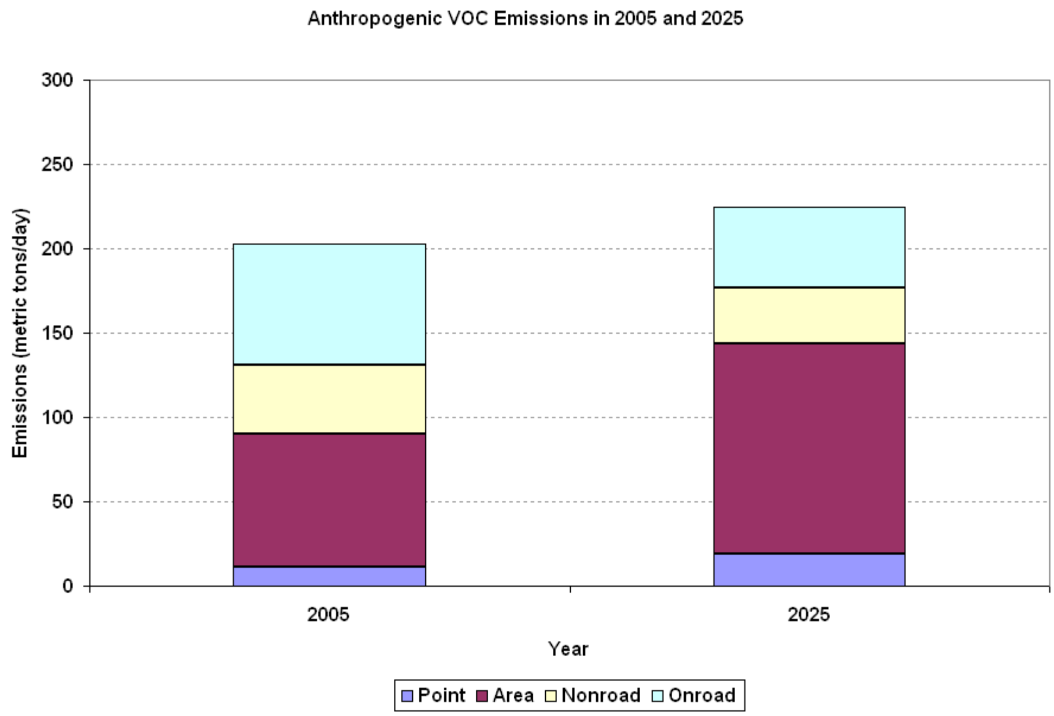


Figure VI-23(a). 2005-2025 anthropogenic VOC emissions on a weekday (Thursday in June)

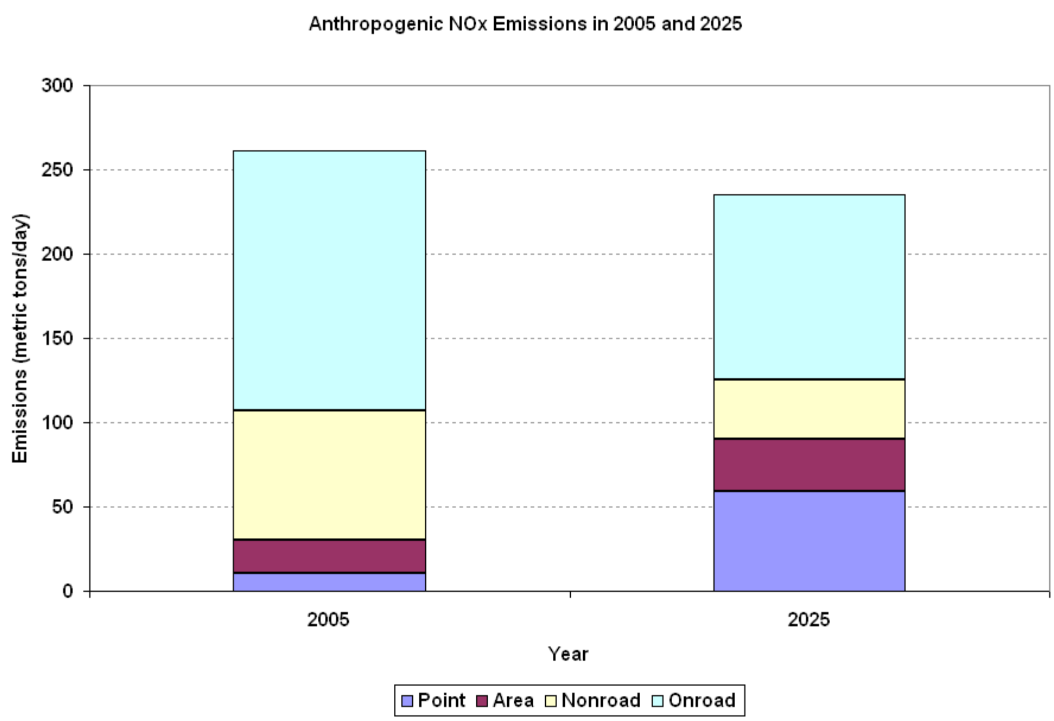


Figure VI-23(b). 2005-2025 anthropogenic NOx emissions on a weekday (Thursday in June)

VI-6. Additional Modeling

MAG followed the *EPA Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2007) and used multiple air quality models / meteorological data sets to supplement the results of the modeled maintenance test presented in Section V. Meteorological data sets were prepared using multiple meteorological models such as MM5 and the NCAR Weather Research and Forecasting (WRF). These meteorological data sets were then input to multiple photochemical air quality models such as the CAMx and Community Multi-scale Air Quality (CMAQ) model.

This analysis focuses on the sensitivity of the estimated relative response factor (RRF) and the resulting future design values for monitored and unmonitored areas, and variations in modeling results from using different model combinations. Before inputting the WRF meteorological data sets to multiple photochemical air quality models, the WRF's modeling performance was evaluated (see Appendix VI-iii). Also three additional modeling applications using CAMx/WRF, CMAQ/MM5, and CMAQ/WRF were examined in order to determine whether their results were suitable for use in the eight-hour ozone maintenance demonstration. These model performance evaluation results are documented in Appendix VI-iv. Finally, all maintenance tests were made using EPA's Modeled Attainment Test Software (MATS, Version 2.0.1) with the minimum allowable threshold value set to 70 ppb. Detailed maintenance demonstration results are presented in Section V for the CAMx/MM5 modeling and in Appendix VI-v for the CAMx/WRF, CMAQ/MM5, and CMAQ/WRF modeling.

Tables VI-12 and VI-13 summarize the results of the eight-hour ozone maintenance demonstration and unmonitored area analysis that used multiple air quality and meteorological models for the three eight-hour ozone episodes. In general, the maximum future design values occurred in the June episode for the monitoring sites and in the August episode for the unmonitored area. An exception was that the maximum future design value for the unmonitored area, using CAMx/WRF, occurred in the June episode. The North Phoenix (NP) site was predicted to have the maximum future design value for all episodes, except for the CMAQ/MM5 application. The CMAQ/MM5 modeling, predicted that the Fountain Hills (FH) site would have the maximum future design value for the July and August episodes.

A review of the sensitivity of the air quality models used in the eight-hour ozone maintenance demonstration showed that the CAMx model tends to predict higher future design values than the CMAQ model for both monitored and unmonitored areas. The June and July episodes had relatively small variations in the maximum future design values, while the August episode had a relatively large variation in the maximum future design value.

Table VI-12. Summary of maintenance test results (maximum future design values)

Episode	Air Quality Model/Meteorological Model			
	CAMx/MM5	CAMx/WRF	CMAQ/MM5	CMAQ/WRF
June	81.0 ppb at North Phoenix	81.1 ppb at North Phoenix	79.1 ppb at North Phoenix	79.3 ppb at North Phoenix
July	79.4 ppb at North Phoenix	79.4 ppb at North Phoenix	77.3 ppb at Fountain Hills	77.8 ppb at North Phoenix
August	79.9 ppb at North Phoenix	78.0 ppb at North Phoenix	76.6 ppb at Fountain Hills	74.2 ppb at North Phoenix

Table VI-13. Summary of unmonitored area analysis results (maximum future design values)

Episode	Air Quality Model/Meteorological Model			
	CAMx/MM5	CAMx/WRF	CMAQ/MM5	CMAQ/WRF
June	81.3 ppb	79.8 ppb	79.3 ppb	78.9 ppb
July	79.1 ppb	77.8 ppb	79.1 ppb	75.3 ppb
August	83.4 ppb	80.8 ppb	80.0 ppb	75.4 ppb

A review of the sensitivity of the meteorological models used in the eight-hour ozone maintenance demonstration showed that both air quality models had relatively small variations in the maximum future design values when using the two different meteorological data sets (MM5 and WRF). This phenomenon was more pronounced in the CAMx model than in the CMAQ model, and in the monitored area rather than the unmonitored area.

Both air quality models with WRF meteorological data inputs predicted higher maximum future design values for monitoring sites than those with MM5 meteorological data inputs for the June and July episodes, while the August episode had the opposite result. Air quality modeling with MM5 meteorological data inputs consistently produced higher maximum future design values for the unmonitored area values for all three episodes than when the WRF meteorological data was used for air quality modeling.

VI-7. Conclusions

The modeling results, discussed in the previous sections, confirm that the eight-hour ozone concentrations in the MNA will be maintained in 2025 with a margin of 4 ppb below the standard (85 ppb) for all three eight-hour ozone episodes. In the worst case scenario (i.e., August 2025 with CAMx/MM5), the unmonitored area analysis also indicates that the standard will be maintained in 2025 with a margin of at least 2 ppb below the standard.

REFERENCES

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MAG, 2007. “Eight-Hour Ozone Plan for the Maricopa Nonattainment Area,” June 2007.

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VII. CONCLUSIONS

As discussed in Section V, the maintenance of the eight-hour ozone standard was successfully demonstrated for the three episodes of 2025 which have different meteorological regimes. The maintenance demonstration for monitored sites and unmonitored area indicates that the future eight-hour ozone design values throughout the MNA will be less than 0.085 ppm (85 ppb) for all three episodes in the ozone season of 2025. The peak design values for monitoring sites in 2025 are 0.081 ppm for the June episode, 0.079 ppm for the July episode, and 0.079 ppm for the August episode, occurring at the North Phoenix monitoring site.

The unmonitored area analysis also indicates that the MNA will successfully maintain the eight-hour ozone standard in 2025. The maximum future design values in the unmonitored areas are 0.081 ppm for the June episode, 0.079 ppm for the July episode, and 0.083 ppm for the August episode.

Corroboratory analyses such as absolute model forecasts, indicator species, photochemical source apportionment, decoupled direct method, and weight of evidence analysis were conducted in support of the maintenance demonstration results in accordance with EPA's recommendation. The corroboratory analysis results discussed in Section VI also substantiated that the MNA would maintain the eight-hour ozone standard of 0.085 ppm in 2025. Key findings from these corroboratory analyses are as follows:

- Both CAMx and CMAQ modeling with either MM5 or WRF meteorology confirmed that the eight-hour ozone standard of 0.085 ppm or 85 ppb would not be violated in 2025. The year 2025 peak design values for monitored sites were predicted not to exceed 0.081 ppm or 81 ppb for all three episodes. The highest predicted value for unmonitored sites (during the August episode) was 0.083 ppm.

- Controlling emissions in the future year is more favorable under conditions of the local meteorological regime (i.e., July episode), as opposed to conditions of the transported meteorological regime (i.e., June episode), in terms of reducing the magnitude, frequency, and relative amount of high ozone concentrations.

- The region of the greatest ozone production in the urban plume is VOC sensitive in 2025, which means that VOC controls are effective in reducing ozone concentrations in the urban plume, but NOx controls are only effective in reducing ozone concentrations outside the urban plume. However, the urban plume is getting smaller and appears to be in transition toward NOx sensitivity in a future year beyond 2025.

- The contribution of onroad and nonroad sources to total anthropogenic emissions decreases in 2025 due, primarily, to more stringent federal emission control technologies.

- The downward trend in eight-hour ozone concentrations in the MNA is occurring as a result of the implementation of numerous federal, state, Maricopa County, and local government control measures. This decline in monitored ozone levels is occurring in spite of continuous increases in population and VMT in the MNA.