2004-2005 Carbon Monoxide Progress Report

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June 2005
INTRODUCTION

The Carbon Monoxide Progress Report is produced by Pima Association of Governments (PAG) for the Tucson Air Planning Area (TAPA). This report details the region’s present status with respect to carbon monoxide (CO) pollution. Information is provided on population and traffic projections, historic CO monitoring data, mobile monitoring for the Limited Maintenance Plan (LMP), and hot-spot intersection modeling. The report also provides an evaluation of selected emissions reduction programs and descriptions of several transportation control measures active in the Tucson region.

The 8-hour National Ambient Air Quality Standard (NAAQS) for CO is 9 parts per million (ppm), not to be exceeded more than once per year at each site. In the 1970s, the Tucson region frequently violated the NAAQS for CO, and the U.S. Environmental Protection Agency (EPA) designated the Tucson region as a "nonattainment area" for CO. Since 1984, no violations of the CO NAAQS have been recorded, and CO is not currently considered to be a health threat in the Tucson region.

On April 25, 2000, the EPA approved Arizona's request to redesignate the Tucson region as an attainment area for CO. A maintenance plan also was approved that sets forth the procedures and contingency measures which will be implemented in response to a probable or actual violation of the CO standard in the area in the future. The action was announced in the June 8, 2000, Federal Register and took effect on July 10, 2000.

Efforts resulting in redesignation of the TAPA to attainment status are detailed in the following section. Figure 1 illustrates the CO Maintenance Area.
Redesignation of the TAPA to Attainment: Limited Maintenance Plan

State Implementation Plan (SIP) Revision

On Oct. 6, 1995, the EPA issued guidance regarding an LMP option for CO nonattainment areas. The LMP option applies to areas whose monitored CO concentrations are equal to or less than 85 percent of the 8-hour CO NAAQS for at least 8 consecutive quarters. It also emphasizes monitoring over modeling to determine the area’s compliance. Since the last violation of the CO NAAQS was in 1984 and CO levels in the TAPA had been reduced, PAG discussed the applicability and interpretation of the LMP guidance with EPA and began to prepare a CO LMP for the TAPA.

The plan includes an attainment emissions inventory, verification of continued operation of the monitoring network, and a contingency plan. The member jurisdictions assured support for two additional monitors during the maintenance period (a permanent and a mobile microscale monitor). Through the Transportation Improvement Program (TIP), a CO monitor was purchased in 2001 and was placed at the new microscale site at the intersection of Golf Links Road and Kolb Road in 2002. A mobile monitor has been used since 2000 to monitor CO concentrations during the CO season (Oct. 1 - March 31) at select hot-spot intersections. Further discussion of the mobile monitoring results is on page 13.

The contingency plan provides a procedure to prevent violations of the NAAQS. A trigger event occurs when a verified CO level over 7.65 ppm for an 8-hour period (85 percent of the CO health standard) is recorded. If two such events occur at any one site in any CO season, a pre-violation action level is reached. This will prompt further field studies, technical evaluations and modeling. Recommendations and implementation of mitigation measures, if necessary, will then take place. Hot-spot events will likely be addressed with local mitigation measures, such as transportation system improvements. If the problem is area-wide in nature, measures such as increasing the oxygen content of fuel will be considered for implementation.

The PAG Regional Council adopted the LMP on June 26, 1996, and submitted it to the Arizona Department of Environmental Quality (ADEQ). It was submitted to EPA Region 9 on Aug. 21, 1996, for its review. The LMP was deemed complete by operation of law in February
1997. The EPA subsequently requested that PAG update and amend the LMP to include certain automotive fuel provisions for the TAPA. The LMP was then amended and re-submitted to EPA on Oct. 6, 1997, by ADEQ for approval as a SIP revision. In 1998, the state Legislature passed Senate Bill (SB) 1427, which revised the Arizona Revised Statutes [A.R.S. 49-401 and 49-406] to expand the authority of the state and local certified Metropolitan Planning Organizations (such as PAG) to develop plans and to implement and enforce control measures for maintenance areas. Sections 14 and 15 of SB1427 were submitted to EPA on Aug. 11, 1998. Additional sections of the A.R.S. needed revisions to ensure commitment of control measures in the TAPA as a maintenance area. Another SIP revision was submitted to EPA on Sept. 1, 1999. It included additional legislative actions from the first legislative session of 1999 concerning the definition of Area B (originally documented as a nonattainment area, now defined by township, section and range), and the extension of the Vehicle Emissions Inspection Program (VEIP) until Dec. 31, 2008. This completed the requirements necessary for redesignation of the TAPA to a maintenance area for CO. On Dec. 17, 1999, the proposed rule to redesignate the TAPA to attainment for CO and approval of the LMP was published in the Federal Register. On April 25, 2000, the EPA redesignated the Tucson region to attainment status and approved the LMP. On June 8, 2000, the redesignation and approval of the LMP was published in the Federal Register with an effective date of July 10, 2000. The LMP is a 10-year plan that will be submitted for renewal in 2008.

A technical correction was made to the Code of Federal Regulations (40 CFR Parts 52 and 81) on March 18, 2004, that includes a revision to the description of the boundaries for the designated area in recognition of the change in status of Saguaro National “Monument” to Saguaro National “Park.”
POPULATION PROJECTIONS

The Tucson urban area has expanded significantly over the last 30 years and continues to grow at over 2 percent a year. Official population projections are governed by an Executive Order, issued by the Governor of Arizona in 1995, which limits official population projections to once every five years, following a decennial or special census. Census 2000 population numbers are included in the following table; however, future projections have not yet been finalized.

Population figures and projections for each of the PAG cities and towns are set forth in Table I.

Table I. Historical Population and Projections for the Tucson Region

<table>
<thead>
<tr>
<th>Year</th>
<th>Data Source</th>
<th>Marana</th>
<th>Oro Valley</th>
<th>South Tucson</th>
<th>City of Tucson</th>
<th>Sahuarita</th>
<th>Unincorporated Pima County*</th>
<th>Total Pima County</th>
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<td>1990</td>
<td>S</td>
<td>3,000</td>
<td>7,544</td>
<td>6,790</td>
<td>425,090</td>
<td>290,282</td>
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<tr>
<td></td>
<td>C1</td>
<td>2,187</td>
<td>6,670</td>
<td>5,093</td>
<td>405,390</td>
<td>247,540</td>
<td>666,880</td>
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<td>1995</td>
<td>S</td>
<td>6,939</td>
<td>14,576</td>
<td>6,922</td>
<td>469,091</td>
<td>355,460</td>
<td>825,988</td>
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<td></td>
<td>SPC</td>
<td>5,309</td>
<td>19,657</td>
<td>5,570</td>
<td>445,299</td>
<td>2,159</td>
<td>766,172</td>
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<td>1996</td>
<td>P</td>
<td>5,960</td>
<td>21,405</td>
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<td>449,635</td>
<td>2,255</td>
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<td>9,732</td>
<td>15,308</td>
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<td>506,491</td>
<td>435,181</td>
<td>973,746</td>
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<tr>
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<td>C2</td>
<td>13,556</td>
<td>29,700</td>
<td>5,490</td>
<td>486,699</td>
<td>3,242</td>
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<td>2004</td>
<td>E</td>
<td>23,520</td>
<td>38,280</td>
<td>5,580</td>
<td>521,605</td>
<td>9,715</td>
<td>931,210</td>
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<td>2005</td>
<td>S</td>
<td>11,122</td>
<td>16,040</td>
<td>7,148</td>
<td>533,743</td>
<td>538,945</td>
<td>1,076,688</td>
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<td>U</td>
<td>26,813</td>
<td>39,428</td>
<td>5,615</td>
<td>530,733</td>
<td>12,144</td>
<td>952,628</td>
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<td>2010</td>
<td>S</td>
<td>12,512</td>
<td>16,772</td>
<td>7,263</td>
<td>558,578</td>
<td>661,450</td>
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<td>U</td>
<td>42,956</td>
<td>45,266</td>
<td>5,775</td>
<td>588,849</td>
<td>24,737</td>
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<tr>
<td>2015</td>
<td>S</td>
<td>13,902</td>
<td>17,504</td>
<td>7,381</td>
<td>589,211</td>
<td>763,106</td>
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<td>57,485</td>
<td>51,215</td>
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<td>656,536</td>
<td>34,694</td>
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</table>

S: Population Data Reported in 1987 CO SIP
C1: Population Data from the 1990 Census (April 1, 1990)
C2: Population Data from the 2000 Census (April 1, 2000)
SPC: Special Census (Fall 1995)
E: 2004 Estimates from Pima Association of Governments and Department of Economic Security approved December 2004
U: Unofficial data series based on Census 2000 short form data by Pima Association of Governments draft
* Includes Indian Reservations

The July 1, 2004, population estimate for Pima County is 931,210, of which 332,510 are residing in the unincorporated areas of the county. Over 1 million people are expected to live in Pima County by approximately 2008, with most of the growth expected to occur in the Towns of
Marana and Sahuarita. Between 2000 and 2004, these two jurisdictions experienced the respective growth rates of 73 percent, and 200 percent (including annexation activity). The southeastern portion of Pima County is also poised for explosive population growth pending sale of State Trust Land south of Interstate 10. These increases are of particular interest because of the related increase in regional vehicle miles traveled (VMT) associated with population growth in the outlying areas. Figure 2 displays the projected population and VMT trends from PAG Regional Planning Division (PAG RPD).

Figure 2. Growth in Estimated Population and Vehicle Miles Traveled in the Tucson Region for 2005 and 2025
The 2005-2009 Transportation Improvement Program (TIP) was approved by PAG’s Regional Council in June 2004. It was found to be in conformity with the applicable SIP. The PAG RPD uses the transportation forecasting model, TP + and Cube Voyager, to estimate system VMT in PAG’s transportation modeling region (Eastern Pima County). Table II represents the system VMT, as determined by PAG RPD using the PAG Travel Demand Model for the 2005-2009 TIP. Current modeling estimates for 2025 show VMT at 36,831,251.

Table II. PAG RPD Regional VMT Estimates
(Mileage given in miles per day, including local/off-system collectors)

<table>
<thead>
<tr>
<th>Year</th>
<th>VMT Totals</th>
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<tbody>
<tr>
<td>2005</td>
<td>19,744,064</td>
</tr>
<tr>
<td>2009</td>
<td>24,883,071</td>
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</table>

PAG has conducted traffic counts on regionally significant arterials and high volume intersections annually since 1998 for use in model validation and emissions estimates. The City of Tucson, Pima County, and the Arizona Department of Transportation (ADOT) provide additional traffic count data for this effort. Recently, new information has been incorporated into the modeling program including: a household travel demand study (2001), the 2000 decennial census and the 2002-2003 PAG Regional Travel Time and Travel Speed Study. The data from these studies have been used to refine PAG’s model.
AIR QUALITY MONITORING DATA

The air quality data from monitors that are currently operating in the region are presented in the table below, for the State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and the special purpose monitors. The data were obtained from the Appendix of the 2003 Air Quality Summary Report for Pima County, Arizona, published by the Pima County Department of Environmental Quality (PDEQ) in Aug. 2004. The official data for 2004 have not yet been published. Figure 3 shows the locations of each monitor.

Table III. Annual CO Maximum Averages (ppm)
NAMS/SLAMS and Special Purpose Network
(Data Provided by PDEQ)

The 1-hour NAAQS for CO is 35 ppm and the 8-hour NAAQS is 9 ppm

<table>
<thead>
<tr>
<th>Site</th>
<th>Year</th>
<th>1-Hour Max</th>
<th>8-Hour Max</th>
<th>8-Hour 2nd High</th>
<th># of Exceed.</th>
<th>% Data Recovery</th>
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<tr>
<td>DT</td>
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<td>10.8</td>
<td>5.0</td>
<td>4.5</td>
<td>0</td>
<td>92</td>
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<tr>
<td></td>
<td>1995</td>
<td>11.3</td>
<td>5.5</td>
<td>4.5</td>
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<td>95</td>
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<td></td>
<td>1996</td>
<td>9.9</td>
<td>4.6</td>
<td>4.4</td>
<td>0</td>
<td>98</td>
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<td></td>
<td>1997</td>
<td>8.2</td>
<td>4.8</td>
<td>4.4</td>
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<td></td>
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<td>10.6</td>
<td>4.3</td>
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<td>3.8</td>
<td>3.5</td>
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<td>2001</td>
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<td>3.2</td>
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<td>6.7</td>
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<td>3.1</td>
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<td>1997</td>
<td>7.2</td>
<td>3.4</td>
<td>2.6</td>
<td>0</td>
<td>99</td>
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<tr>
<td></td>
<td>1998</td>
<td>4.8</td>
<td>2.6</td>
<td>2.3</td>
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<td>2.3</td>
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<td>2003</td>
<td>4.4</td>
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Table III (…continued)
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<th>Site</th>
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<td></td>
<td>2002</td>
</tr>
<tr>
<td></td>
<td>2003</td>
</tr>
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</table>

ppm  Concentration in parts per million
DT  Downtown Site (SLAMS)
22/C  22nd Street/Craycroft Neighborhood Site (NAMS)
22/A  22nd Street/Alvernon Way Intersection Site
       (NAMS -microscale)
C/G  Cherry/Glenn (Special Purpose)
CP  Children’s Park (NAMS)
GL/K  Golf Links/Kolb (Special Purpose – microscale)
Figure 3. Map of CO Monitors and Mobile CO Monitors in the Tucson Region
Permanent Microscale Monitoring and Long-Term Trends

Two permanent microscale monitors are located in the Tucson region. The first microscale monitor is located at 22nd Street/Alvernon and began monitoring in 1975. Data from this monitor provide an historical record and show how the TAPA has reduced its CO levels over time. The site was relocated in October 2001 to a Tucson Water well site 50 meters west of the original location. In 2003, the site was moved again by 32 feet, 10 degrees north-northeast from the Tucson Water well site. The move was necessitated by an intersection improvement project and anticipated construction on the northwest corner. For 2004-2005, the site recorded lower CO readings during this year’s monitoring period than the previous year.

The second microscale monitor is sited at the southeast corner of Golf Links/Kolb and began monitoring in September 2002 to fulfill the LMP monitoring requirements. This new microscale monitor will continue to operate from October through April of each year. This site does not generally track with the 22nd Street/Alvernon site because the monitors are in opposite quadrants.

State and local transportation control measures such as the state VEIP, Arizona Oxyfuel Program, RideShare Program, and the Travel Reduction Program (TRP) have helped to stabilize or decrease CO levels despite the increase in regional VMT. Tighter national tailpipe emission standards have provided the primary reduction in mobile source CO emissions. The last violation of the CO standard occurred in 1984 at the intersection of 22nd Street/Alvernon, and the last exceedance occurred in 1988. In the winter of 2004-2005, the highest 8-hour CO concentration recorded at this site was 2.2 ppm. The 8-hour NAAQS is currently 9 ppm, not to be exceeded more than once per year at each site. Figure 2 shows the second maximum 8-hour concentration for this intersection over the last 30 years. The graph also shows the downward trend of CO concentrations at 22nd Street/Craycroft, which is designated as a neighborhood site.
Figure 4. Annual Second Maximum 8-Hour CO Concentration (ppm) at 22nd Street/Alvernon and 22nd Street/Craycroft (1973-2003)
Mobile Monitoring for the Limited Maintenance Plan

PDEQ also performed mobile monitoring at hot-spot intersections in the Tucson area during the 2004-2005 CO season. The LMP requires that this monitoring take place every year to assure Pima County's continued compliance with the CO NAAQS. The monitoring was done with a mobile CO monitor at three different locations. Monitor sites were selected from intersections with the highest volume and worst congestion.

Microscale and Mobile Monitoring Comparisons

The 8-hour rolling averages were determined for the mobile units during their respective sampling periods and the concurrent periods at the 22\textsuperscript{nd} Street/Alvernon monitor. The results are displayed in Table IV. This allows for a closer comparison between the hot-spot mobile sites and the PDEQ historical microscale CO site at 22\textsuperscript{nd} Street/Alvernon.

Table IV. 8-Hour CO Monitored Concentrations (ppm) for Hot-Spot Intersections (Monitor data provided by PDEQ)

<table>
<thead>
<tr>
<th>Site</th>
<th>8-hour max</th>
<th>8-hour 2\textsuperscript{nd} high</th>
<th>Concurrent readings at 22\textsuperscript{nd} St/Alvernon 8-hour max</th>
<th>Concurrent readings at Golf Links/Kolb 8-hour max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadway/Kolb</td>
<td>1.1</td>
<td>1.0</td>
<td>1.7</td>
<td>2.1</td>
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<td>0.7</td>
<td>0.7</td>
<td>2.0</td>
<td>2.1</td>
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<td>Speedway/Swan</td>
<td>1.6</td>
<td>1.5</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Golf Links/Kolb for entire sampling period</td>
<td>2.2</td>
<td>2.1</td>
<td></td>
<td></td>
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<tr>
<td>22\textsuperscript{nd} St/Alvernon for entire sampling period</td>
<td>2.2</td>
<td>2.1</td>
<td></td>
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</tbody>
</table>
The NAAQS level for an 8-hour average is 9 ppm. The highest reading recorded was less than a quarter of the standard. These low readings serve to reinforce that Tucson is not likely to be in danger of a CO exceedance.

Highlights from the PDEQ CO Monitoring Report regarding mobile monitoring results are extracted below.

**Broadway/Kolb**
The analysis of the data recovered from the monitor indicates that concentrations at the Broadway/Kolb site tracked CO measurements at the 22nd Street/Alvernon microscale site very closely. Overall, the 22nd Street/Alvernon site appears to show slightly higher levels of CO than this hot-spot intersection. However, the traffic patterns still compare quite well. This would tend to indicate that the 22nd Street/Alvernon site is still representative of other hot-spot intersections in the east central area of Tucson.

**Orange Grove/Oracle**
While the monitored levels at Orange Grove/Oracle were generally less than a third of the 22nd Street/Alvernon microscale site levels, it more closely tracked the 22nd Street/Alvernon site than it had in previous years. This close tracking possibly indicates that traffic patterns are becoming more similar across the Tucson metropolitan region.

**Speedway/Swan**
For the most part, the monitored data from Speedway/Swan tracked 22nd Street/Alvernon very well, also showing very similar traffic patterns.
MODELING OF CARBON MONOXIDE HOT-SPOT INTERSECTIONS

PAG conducts microscale CO modeling analyses as required by the LMP, using CAL3QHC Version 2. This model is used as a screening tool to highlight the levels of ambient CO concentrations that could be produced in those areas most susceptible to CO violations. Intersections are chosen based on their average daily traffic (ADT) and level of service (LOS), as well as for comparison with the intersections where microscale monitoring data are collected.

Model Settings

Free flow link speeds were set at 35 miles per hour (mph) for each link. Emission factors were derived using the MOBILE6.2 model, averaging high and low altitude scenarios for 2004, with the current Tucson region VEIP, Reid Vapor Pressure (RVP) of 10.8 pounds per square inch (psi) (actual 2003-2004 winter average), and oxyfuels at 1.8 percent by weight (100 percent ethanol blend). The idle factor was obtained by multiplying the 2.5 mph emission factor by 2.5 (standard methodology). The mixing height was set at 1,000 meters, with a stability class of 4 (D). Wind speed was set at 1 meter per second. Concentrations were calculated for multiple wind directions at 10° intervals for 360°. This allowed for the calculation of the highest CO concentration at the receptor using all wind directions (at 10° intervals). The receptor height was set at 1.8 meters. The background concentration used was 0.60 ppm. This concentration reflects the average 1-hour concentration at the 22nd Street/Craycroft monitor for the months of November through January of the last two CO seasons (2002-2003 and 2003-2004). The persistence factor to convert the 1-hour CO concentration derived from the model to reflect an 8-hour average was calculated to be 0.59. This was obtained from the 10 highest non-overlapping 8-hour averages at the 22nd Street/Alvernon monitor, using the ratio of the 8-hour average to the maximum 1-hour average concentration for that 8-hour period. Concentrations were calculated for the year 2004 modeling scenario. The background concentration calculated for this modeling effort is higher than last year’s, and the persistence factor is slightly lower than the 2003 value.
Intersection Analyses

PAG RPD staff prepared a list of the intersections with the highest ADT and the worst LOS for 2004 based on traffic counts and travel demand modeling analyses. PAG Air Quality Planning staff selected the three highest ADT and the three worst LOS intersections as candidates for CAL3QHC microscale modeling. The intersections that qualified for hot-spot modeling are shown in Table V.

Table V. Highest ADT and Worst LOS Intersections

<table>
<thead>
<tr>
<th>Rank</th>
<th>Highest ADT</th>
<th>Worst LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Broadway/Kolb</td>
<td>Speedway/Kolb</td>
</tr>
<tr>
<td>#2</td>
<td>Speedway/Wilmot</td>
<td>Grant/Swan</td>
</tr>
<tr>
<td>#3</td>
<td>Ina/Oracle</td>
<td>Speedway/Campbell</td>
</tr>
</tbody>
</table>

The highest ADT was at the Broadway/Kolb intersection, for the second year, with an ADT of 116,242 vehicles (a 13 percent increase from 2003). The Speedway/Kolb intersection showed the highest average delay per vehicle of 41.6 seconds (LOS E) during afternoon peak hour traffic (5:00 to 6:00 p.m.).

In addition, 22nd Street/Alvernon and Golf Links/Kolb were modeled. Both intersections have a CO microscale monitor and are modeled for historical purposes and for comparison to monitored values. However, the 22nd Street/Alvernon intersection was inadvertently omitted from the turning movement count list. PAG RPD confirmed that counts could be used for up to three years; therefore, last year’s counts were used for this analysis.

Table VI shows the modeling results for the 8-hour CO concentrations for the worst LOS, the highest ADT intersections, and the permanent microscale locations.
# Table VI. Modeled 8-Hour CO Concentrations (ppm) for Hot-Spot Intersections

<table>
<thead>
<tr>
<th>Intersections</th>
<th>8-Hour Average Concentration (ppm) (background of 0.60 ppm, persistence factor of 0.59)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speedway/Wilmot</td>
<td>4.5</td>
</tr>
<tr>
<td>Grant/Swan</td>
<td>4.2</td>
</tr>
<tr>
<td>Golf Links/Kolb</td>
<td>4.1</td>
</tr>
<tr>
<td>Broadway/Kolb</td>
<td>4.0</td>
</tr>
<tr>
<td>Speedway/Kolb</td>
<td>3.8</td>
</tr>
<tr>
<td>22nd St./Alvernon</td>
<td>3.8</td>
</tr>
<tr>
<td>Speedway/Campbell</td>
<td>3.5</td>
</tr>
<tr>
<td>Ina/Oracle</td>
<td>3.4</td>
</tr>
</tbody>
</table>
MOBILE SOURCE EMISSIONS INVENTORY

PAG completed an on-road mobile source emissions inventory in 2004. PAG RPD used the transportation forecasting model, TP+, to estimate the vehicle speeds and VMT on all arterial and freeway roadway links in the PAG transportation modeling region. PAG Air Quality Planning staff then created a speed/emission factor look-up table using the MOBILE6.2 emission factor model. The transportation model results and the speed/emissions factor tables were joined to create a spatial on-road mobile source emissions inventory for CO and four other criteria pollutants. Freeway and arterial roadway emission estimates were generated separately for both summer and winter for calendar year 2000.

Methodology
Speed/emission factor tables were generated by running MOBILE6.2 in 5 mph increments (i.e., 5 mph represents speeds from 2.5 to 7.5, 10 mph represents speeds from 7.6 to 12.5, etc.). Speeds under 2.5 mph are considered to be idling and were not applicable to this task. High and low altitude scenarios were averaged to reflect the Tucson elevation. Official dispensation to use the average of high and low altitude emission factors was granted to Pima County on Dec. 12, 1996, in a memorandum from EPA Region 9 in San Francisco. All subsequent CO Progress Reports make use of this protocol for all emissions modeling.

Local data were used for MOBILE6.2 inputs for seasonal average temperatures, humidity, and sunrise and sunset times. In addition, the current Tucson VEIP, local vehicle registration data and diesel fractions also were used. The RVP was set at 8.2 psi for summer and 10.9 psi for winter (actual seasonal averages), and oxyfuels were set at 1.8 percent by weight (100 percent ethanol blend) for the winter season. Data also were collected by PAG RPD and ADOT in 2000 that were used to estimate local VMT fractions by vehicle type. Four different speed tables were created: summer freeway, summer arterial, winter freeway, and winter arterial.

Local streets were not included in the transportation model; therefore, it was assumed that 13 percent of freeway and arterial travel occurred on local streets. The local VMT were allocated proportionally to the arterial roadway segments.
The appropriate pollutant emission factors (grams/mile) were then allocated to each roadway link by vehicle speeds taken from the transportation model. VMT were calculated from the transportation model by multiplying the segment lengths by the segment traffic volume. The street network shapefile with the on-road attributes (VMT and pollutant emission factors) were then converted into an ArcInfo coverage. The coverage was then reprojected to UTM Zone12, NAD27 datum (meters) and intersected with a 500 meter fishnet coverage. This allowed for the calculations of total emissions (for each pollutant) by multiplying the link emission factors and the link VMT for each 500 meter grid cell. Figure 5 displays the map of on-road mobile CO emissions for an average winter day in 2000.
Figure 5. On-Road CO Emissions (tons) for an Average Winter Day in 2000
EVALUATION OF THE VEHICLE EMISSIONS INSPECTION (VEIP) AND OXYFUEL PROGRAMS

PAG Air Quality Planning staff produced an emission factor forecast for the years 2005, 2010, and 2015. MOBILE6.2 was used to illustrate the emission factors using the vehicle mix for Pima County (provided by ADOT) and an average area-wide vehicle speed of 29.5 mph. The “All Vehicle” category from the MOBILE6.2 model was used. Table VII. illustrates the emissions benefits, in grams of CO emitted per vehicle mile traveled, with and without the VEIP, including anti-tampering provisions (ATP) and the Oxyfuel Program – two transportation control measures adopted by the region. Pima County currently uses 1.8 percent by weight oxyfuel during the CO season (Oct. 1 - March 31), with an annual VEIP (also known as the State Inspection and Maintenance Program) for vehicles five years and older. The effect of increasing the oxyfuel content to 2.1 percent as a control measure also is illustrated. The benefits of the VEIP and Oxyfuel Programs diminish over time due to projected fleet turnover, as older vehicles are retired.

Table VII. MOBILE6.2 Emission Factors (grams/mile)

<table>
<thead>
<tr>
<th>Year</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
<th>Case 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>15.35</td>
<td>14.50</td>
<td>12.55</td>
<td>11.87</td>
<td>11.75</td>
</tr>
<tr>
<td>2015</td>
<td>12.31</td>
<td>11.79</td>
<td>9.67</td>
<td>9.33</td>
<td>9.28</td>
</tr>
</tbody>
</table>

Case 1  Winter Avg., no VEIP, no oxyfuel
Case 2  Winter Avg., no VEIP and 1.8% oxyfuel
Case 3  Winter Avg., with VEIP, no oxyfuel
Case 4  Winter Avg., with VEIP and 1.8% oxyfuel
Case 5  Winter Avg., with VEIP and 2.1% oxyfuel

The MOBILE6.2 emissions modeling results reflect the averaging of the high and low altitude scenarios in the calculation of emission factors.

These transportation control measures, currently in place in Pima County, are each analyzed further in the following section for the year 2005. The estimated overall CO emissions savings from each of these programs are summarized in Table VIII.
Arizona Vehicle Emissions Inspection Program (VEIP)

The Arizona VEIP, begun in 1977, includes both the Tucson and Phoenix metropolitan areas. In order to examine the effectiveness of this program, the controlled and uncontrolled emission rates for 2005 are compared. The analysis assumes that the Federal Motor Vehicle Control Program is in effect. These emission rates, with the VEIP in place, are compared to modeled emissions rates without these provisions.

The following calculations use an average of high and low altitude MOBILE6.2 emission factors and an average area wide vehicle speed of 29.5 mph. The most current Pima County vehicle registration data, provided by the Arizona Department of Motor Vehicles, were used for these analyses. The regional VMT value for the year 2005 is taken from the 2005-2009 Transportation Improvement Program estimates done by PAG RPD. Thus, the total VMT used for 2005 is 19,744,064 miles/day.

Sample Calculation (no oxyfuel):

2005:  
Emission rate without VEIP and ATP = 20.57 g/mile  
Emission rate with VEIP and ATP  = 17.63 g/mile  
Regional VMT = 19,744,064 miles/day

\[
CO \ Emissions \ Saved = \left[(20.57 - 17.63) \frac{g}{mile}\right] \left(19.74 \text{million miles / day}\right) \left(1.0 \times 10^{-6} \frac{\text{tons}}{g}\right) = 58.05 \text{ tons/day}
\]

Beginning in January 2002, an on-board diagnostics (OBD) test was incorporated into the VEIP. This test is performed on 1996 and newer cars and light duty trucks. It accesses engine operating data by connecting directly to a computer in the vehicle that continuously monitors the engine’s emission control systems, ultimately identifying problems before they lead to engine damage and emissions system failure.

In April 2005, Governor Napolitano signed House Bill (HB) 2357, which exempts motorcycles and collectible vehicles from emissions testing in Area B, with an effective date of July 1, 2009. This exemption is conditional upon approval of the exemptions by EPA.
Arizona Oxyfuel Program

The Oxyfuel Program has completed 15 full seasons in eastern Pima County. This program decreases CO tailpipe emissions in the winter months by adding ethanol and/or methyl tertiary butyl ether (MTBE) to all grades of motor fuel. It was first administered from Oct. 1, 1990, through March 31, 1991. The proportionate sales of the oxygenated additives for the last winter (2004-2005), as reported by the Department of Weights and Measures, was 0 percent MTBE and 100 percent ethanol. Ethanol has been the predominant additive over the last nine years.

In Jan. 2004, HB 2142 was introduced in the Arizona House of Representatives. The bill amends the A.R.S. 41-2122 in order to limit the use of MTBE in gasoline sold in Arizona beginning in January 2005 to 0.3 percent by volume. This limitation allows for trace amounts of MTBE that are found in gasoline, but prevents the use of MTBE as an oxygenated additive. This will ensure that Arizona’s drinking water sources will not be contaminated with MTBE, as other areas in the United States have been. Governor Napolitano signed the bill in May 2004. In April 2005, Governor Napolitano signed SB 1154, which restricts the use of non-ethanol oxygenates to 0.10% by weight in gasoline beginning Jan. 1, 2006.

The current oxygen content of winter motor fuels is 1.8 percent by weight. In the spring of 1993, the Arizona State Legislature approved a contingency plan for Pima County that would automatically raise the minimum oxygen content to 2.1 percent by weight in the event of a confirmed CO violation. This was replaced by legislative action in 1996. SB1002 from the 7th Special Session 1996 granted PAG the ability to increase oxyfuels under specified conditions. At any time earlier than 60 days before Sept. 30 of each year, PAG, with concurrence of the Director of the ADEQ, may give notice to the Director of the Arizona Department of Weights and Measures to increase the oxyfuel increment not less than 0.3 percent by weight of oxygen and not more than the maximum allowed by EPA. Before making that determination, a cost-benefit analysis must be done of all reasonable CO emission reduction measures that could be implemented in lieu of increasing the minimum oxygen content [A.R.S. 41-2125].

The evaluation of the Oxyfuel Program compares the CO reduction benefit derived from the current program (1.8 percent by weight oxygen) and a possible future program at 2.1 percent.
The same MOBILE6.2 input and calculation methods are used in this analysis as were used in the VEIP evaluation.

The following table reflects the CO savings in tons/day for the winter season, which lasts from Oct. 1 through March 31 of each year, as a result of the VEIP and Oxyfuel Programs.

**Table VIII. Modeled CO Savings per Day due to State Vehicle Emissions Inspection and Oxyfuel Programs**
(tons/day of CO)

<table>
<thead>
<tr>
<th>Year</th>
<th>VEIP (No Oxyfuels)</th>
<th>VEIP and 1.8% Oxyfuel</th>
<th>VEIP and 2.1% Oxyfuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>58.05</td>
<td>80.95</td>
<td>84.70</td>
</tr>
</tbody>
</table>

The effectiveness of the oxygenated fuels program will continue to decrease as older vehicles are retired from the Pima County fleet mix. One of the contributing factors is that most new cars are fitted with electronic fuel injection systems that automatically compensate for the proper air-to-fuel mixture to reduce CO emissions.

**Notes Regarding Reid Vapor Pressure (RVP)**
RVP is a measurement of the stabilized pressure exerted by a volume of liquid at 100°F and therefore also is considered a measure of gasoline volatility. Higher RVP and the warmer temperatures experienced by Tucson in the winter can result in more gasoline vapors being generated, therefore producing uncontrolled exhaust emissions or enrichment. Lowering the RVP of gasoline can reduce the uncontrolled enrichment, thus decreasing CO exhaust emissions.

A.R.S. 41-2122 contains a contingency measure that allows for the establishment of a lower RVP (down to 9 psi) under certain circumstances, if the CO NAAQS is violated. This only applies if the oxyfuels are already at their maximum level and a cost-benefit analysis of all other reasonable CO emission reduction measures that could be implemented in lieu of reducing RVP has been done. The lower RVP would then take effect beginning the winter following the CO NAAQS violation, and each winter thereafter. Following another violation of the NAAQS, the 1 psi waiver must be removed by ADEQ.
TRANSPORTATION CONTROL MEASURES
IN THE TUCSON AIR PLANNING AREA

Motor vehicles are the major source of CO emissions in the region. With increases in population and low-density developments, primarily on the edges of town, many more miles are being driven every year. Transportation control measures (TCMs) aim to reduce CO emissions by reducing vehicle miles traveled (VMT) and vehicle trips and by decreasing idle time on roadways. The TCMs outlined below are measures already occurring in the region. Historically, formal calculations of CO emissions credits have not been needed. Modeling of current and future CO emissions has consistently resulted in CO emissions that are significantly below the base year emissions rate, with the VEIP and oxyfuels programs in place. Nevertheless, various programs within the TAPA have contributed to the overall reduction in CO emissions and assist in maintaining the region’s attainment status with respect the ozone and particulate matter health standards. Some of these control measures are:

- Travel Reduction Program
- RideShare Program
- Clean Cities Program
- Voluntary No-Drive Days (Clean Air) Program
- Voluntary Vehicle Repair and Retrofit Program
- Teleworking
- Walking
- Bicycling
- Transit
- Tucson Area Intelligent Transportation Systems

Descriptions of the active programs in the region follow, with additional details provided for the Travel Reduction Program.
Travel Reduction Program

The Travel Reduction Program (TRP) is in its 17th year of operation. The TRP was created in 1988 when Pima County, the Cities of Tucson and South Tucson, and the Towns of Marana and Oro Valley each passed Travel Reduction Ordinances, and entered into an Intergovernmental Agreement (IGA) to implement the program. The Town of Sahuarita passed its ordinance in 1996, and the IGA was amended. The ordinances are reviewed every three years, with the next review due in 2008.

The purpose of the TRP is to improve regional air quality and reduce traffic congestion to TRP work sites by encouraging the use of alternate modes of transportation (carpooling, vanpooling, riding the bus, bicycling, and walking), the driving of clean fuel vehicles, and the establishment of altered work schedules and work-at-home programs. All employers with 100 or more full-time equivalent employees at a single or contiguous work site are required to participate in the TRP. Those employers with fewer than 100 employees may participate on a voluntary basis.

The TRP is evaluated annually based on two factors: reduction in the average weekly one-way motor vehicle miles traveled (VMT) and employee alternate mode usage (AMU). Employee driving habits are evaluated annually as each employer is required to administer a survey to their employees. Those employees not completing a survey are assumed to drive to work alone. The annual program survey results, for the first year and last five years of the TRP program, are shown in Table IX.

Table IX. Annual TRP Survey Results

<table>
<thead>
<tr>
<th>Year</th>
<th>Average AMU (%)</th>
<th>Average VMT</th>
<th>Number of Job Sites</th>
<th>Total Employees</th>
<th>Average Survey Response Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989*</td>
<td>17.6</td>
<td>47.3</td>
<td>148</td>
<td>77,230</td>
<td>68.5</td>
</tr>
<tr>
<td>2000</td>
<td>31.6</td>
<td>55.2</td>
<td>248</td>
<td>110,292</td>
<td>84.2</td>
</tr>
<tr>
<td>2001</td>
<td>31.0</td>
<td>56.2</td>
<td>269</td>
<td>111,086</td>
<td>87.7</td>
</tr>
<tr>
<td>2002</td>
<td>29.2</td>
<td>58.6</td>
<td>269</td>
<td>112,518</td>
<td>84.9</td>
</tr>
<tr>
<td>2003</td>
<td>28.6</td>
<td>58.1</td>
<td>271</td>
<td>108,705</td>
<td>86.0</td>
</tr>
<tr>
<td>2004</td>
<td>29.2</td>
<td>57.1</td>
<td>279</td>
<td>112,588</td>
<td>86.6</td>
</tr>
</tbody>
</table>

* 1989 is the base year for the TRP
VMT, as defined for the TRP, is the average one-way weekly vehicle miles traveled as calculated from the annual TRP survey. The average one-way weekly VMT by TRP participants decreased for the first few years of the program and then started to increase after 1993. The data indicate that TRP respondents are residing generally farther from their work site, though a small decrease in the commute distance was seen in 2003 and again in 2004. Nationally, the upward trend continues.

AMU is calculated from the annual survey based on an employee’s use of an alternate mode at least one day per week. If the respondent marked on the survey that they arrived at the work site one or more days per week by carpooling, vanpooling, riding the bus, bicycling or walking, the employer received "credit" for one AMU. If the respondent did not use one of the previous modes but worked an alternate work schedule such as a compressed workweek, teleworked at least one day per week, or went directly to their work location other than the main job site (field workers), then the employer also received an AMU credit. Finally, if the respondent commuted using a clean fuel vehicle, such as compressed natural gas (CNG), propane, electric, hybrid or dual fuel, one or more days per week, the employer received an AMU credit. In 1989, the first year of program implementation, TRP regional AMU was 17 percent. By 2000, this figure reached above 31 percent, but a 2.4 percent decline has occurred since then. Figure 6 shows the annual AMU and one-way weekly vehicle miles traveled for all TRP employees from 1989-2004. The slight decreases since 2000 are attributed to various circumstances including changes in the structure of the survey in 2001 and 2003. In 2004, an increase of average survey response rate and average alternate mode usage and a decrease in average vehicle miles traveled helped the regional results recover across the board.

Figure 6 shows the annual percentage of VMT and AMU for the region since the first year of the TRP.
Savings resulting from the TRP are calculated based on the difference between the factored (with AMU) and unfactored miles (without AMU) for the year. Increasing alternate mode usage is directly associated with decreased gasoline use since fewer gallons of gasoline are needed for work commute trips. Savings also include days off due to compressed workweeks, trips avoided by field workers, and no driving days due to teleworking. In calculating the savings, an average fuel efficiency value of 20 miles per gallon was used. As AMU increases, driving costs decrease. For 2004, $0.375 per mile (United States Internal Revenue Service standard mileage rate for 2004) was used. Therefore, each mile “not driven” saved $0.375. The pollution savings are calculated based on an average emission rate of 1 pound of pollution for every 35 miles driven. The 2004 TRP savings based on the vehicle miles saved from alternate mode usage are shown in Table X.

Table X. 2004 TRP Savings from Alternate Mode Usage

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Miles Not Traveled</td>
<td>86.5 million miles</td>
</tr>
<tr>
<td>Gasoline Not Consumed</td>
<td>4.3 million gallons</td>
</tr>
<tr>
<td>Driving Costs Saved</td>
<td>32.4 million dollars</td>
</tr>
<tr>
<td>Pollution Prevented</td>
<td>2.5 million pounds</td>
</tr>
</tbody>
</table>
New TRP sites are added while some older sites are lost each year. There were 19 new employer sites participating in the TRP program in 2004, while 11 employer sites left the program (when the number of employees dropped below the 100 minimum or the site closed). In the business community, other circumstances such as the relocation of employer sites, downsizing, employee turnover, and the discontinuation of special programs (fieldwork, compressed workweek, or teleworking options) by employers also can affect VMT savings.

The TRP continues to be supported by the six jurisdictions, and now that the Pascua Yaqui Tribe and Tohono O'odham Nation have joined PAG, their employer sites are able to participate in the full TRP process as volunteers. The TRP is also greatly supported by the major employers and their employees. In 2004, the TRP continued coordination with the EPA to partner with employers to become Best Workplaces for Commuters and was recognized by EPA as a national success story for achieving the greatest percentage of employees in the Best Workplaces for Commuters program. The TRP also presented the programming methods for "Keying in on Electronic Surveying" in cooperation with Raytheon Missile Systems at the Association for Commuter Transportation International Conference in New Orleans, LA.

**RideShare Program**

The RideShare Program was established in 1974 and is administered by PAG. It offers a free computer-matching service for people interested in carpooling to work or college. At the close of 2004, the RideShare carpool database contained over 26,000 active registrants representing over 500 employment locations. The carpool database changes daily with the receipt of new applications for matching, requests for rematching, change to the registrant’s information and deletions. In 2004, RideShare averaged over 1,600 carpool lists sent to applicants each month. At the beginning of 2004, RideShare instituted an Internet-based application system for commuters seeking a carpool matching list. Since inception, more than 500 commuters have registered for carpool matching through the PAG Web page.

In 2002, RideShare launched the first regional guaranteed RideHome program for carpoolers. RideHome provides a safety net to the carpooler by offering four taxi rides per year for emergency purposes. In 2003, the RideHome was expanded to include Sun Tran bus riders from
the “Get On Board” program. In 2004, over 230 vouchers were distributed for use by commuters.

Data from the 2003 American Community Survey, released in March 2005, indicate that carpool use in the Tucson region is significantly higher than the national average (Tucson, 12.2%, and United States, 10.4%).

Clean Cities Program

The Clean Cities program is a national effort, sponsored by the U.S. Department of Energy (DOE), to increase clean fuel vehicle usage for the purpose of reducing the country’s dependence on foreign petroleum sources and improving air quality. The Tucson Regional Clean Cities Coalition received its DOE designation in Aug. 1999 as the 73rd such coalition in the nation (there are now 89 Clean Cities). The local 51-member coalition consists of representatives from major utilities, fuel providers, private companies, including vehicle dealers, fleet owners, and a variety of government agencies. The coalition is in the process of re-designation with the updating of another five-year plan, being sent for approval by DOE, which continues to be executed under the direction of a local steering committee with the assistance of full-time PAG staff dedicated to Clean Cities.

The DOE is currently broadening its Clean Cities Roadmap. The revised Roadmap will focus on four new elements: fuel blends, truck idling, fuel economy and hybrids. The DOE selected the Tucson Clean Cities Coalition to assist in the emphasis of promotion of fuel blends. The Clean Cities Manager actively sits on an outreach team for a National Idle-Reduction Policy, and the Coalition was instrumental in preparing and implementing a statewide idle reduction campaign for school districts.

The Clean Cities Program maintains a fuel-neutral position with respect to the promotion and use of all clean fuels. Currently, regional emphasis is placed on the use of CNG, biodiesel, ethanol (E85), electricity, propane, fuel blends, and truck/school bus idle reduction.

The region reported 2,439 clean fuel vehicles in 2003 and 3,063 in 2004. Clean fuel vehicles are gaining in acceptance and popularity as fleet managers and the general public become aware of
the benefits of owning and operating them. Also, with the rising cost of petroleum, fleets are experiencing a greatly reduced cost for cleaner burning fuels. State and Federal agencies and fuel providers also are mandated by the Energy Policy Act of 1992 to procure a percentage of their fleet as clean fuel vehicles annually.

A major obstacle to the proliferation of clean vehicles is having adequate clean fuel infrastructure. The electric vehicle infrastructure is adequate at this time with seven electric recharging stations throughout the metropolitan area, plus one in Casa Grande to facilitate travel between Tucson and Phoenix. However, due to the introduction of the hybrid vehicle, the all-electric non-neighborhood vehicles and electric charging stations have been significantly scaled back. Propane refueling stations are available throughout the region. The only drawback in the region has been the lack of public-access CNG refueling stations. The region has 11 restricted-access (business/government) CNG stations. Investment capital from a fuel provider and financial assistance in the form of grants from the State Energy Program provided funds to build the region’s first public-access CNG refueling station, which opened in September of 2003 at the Tucson International Airport. Two public-access biodiesel outlets also were opened in May 2003 and August 2004. In addition, Arizona’s first public ethanol (E85) pump opened in central Tucson in December 2004.

The Tucson Region Clean Cities Coalition’s Steering Committee meets bi-monthly to network, exchange information and pursue the goals and objectives of the Clean Cities Plan that was adopted in 1999. Staff provides support to the steering committee, coordinating and participating at community outreach events to promote clean vehicles and fuels and acting as a clearinghouse for the Clean Cities Program to advocate use of clean fuel vehicles. The committee also supports members by assisting with grant applications. In 2004, the Tucson Unified School District was one of three school districts in the country to receive $75,000 in conjunction with EPA’s Clean School Bus USA initiative to retrofit diesel school buses with particulate traps and ultra-low sulfur diesel.

In May 2005, the Tucson Clean Cities Manager won the Clean Cities Coordinator of the Year award for her work with the school bus idling program, implementing a clean fuel driver training program at Amphitheater School District, assisting in opening biodiesel and ethanol fueling
stations, and hosting a number of media and Advancing the Choice events to tout the benefits of alternative fuels to fleet owners, legislators and the public.

**Voluntary No-Drive Days (Clean Air) Program**

PDEQ’s Voluntary No-Drive Days (Clean Air) Program is a state-mandated program that began in 1988 to address CO violations in Pima County. The goals of the national award-winning program are to increase awareness of air quality issues and encourage actions to reduce air pollution. The Clean Air Program uses several methods to achieve its goals including:

**Community Outreach** – speakers bureau, Air Pollution Advisories, Smoking Vehicle Hotline (622-5700), PDEQ Web site (www.deq.pima.gov), near real-time air quality information Web site (www.airinfo.org) with hotline (882-4AIR) in English and Spanish, outreaches at community events and major employers, advertising and media relations;

**School and Youth Programs** – classroom presentations, teacher training, development and distribution of air quality curricula, Annual Art Contest, Kids for Clean Air Club (over 3,000 members); and working with ADEQ on a School Bus Idling Reduction Program;

**Annual Public Events** - sponsorship or co-sponsorship of events such as Walk Our Children to School Day, Car Care Checkup, Clean Air Fair and Earth Day.

During the 2003 - 2004 fiscal year, the Voluntary No-Drive Days (Clean Air) Program provided Clean Air Program presentations and air quality curricula training, responded to calls made to the Smoking Vehicle Hotline, and distributed educational brochures and items to the public.

**Voluntary Vehicle Repair and Retrofit Program**

The purpose of PDEQ’s Voluntary Vehicle Repair and Retrofit (V2R2) Program is to reduce vehicle-related emissions by providing a financial incentive to the owners of older and higher emitting vehicles to repair the vehicles to pass the state emissions test. The V2R2 Program was established through state legislation in 1998, and the Program began repairing vehicles in Pima County in 1999. On average, emissions are reduced by 81 percent per vehicle. To date, over
2,600 vehicles have been repaired with a corresponding reduction of approximately 866 tons of emissions per year for the life of the repairs.

To qualify for the V2R2 Program, the vehicle must meet all of the following legislatively-set criteria:

- Fail the state emissions test
- Be 12 years of age or older
- Have been registered in the state of Arizona during the last 12 months without a break in registration for more than 60 days
- Be titled in Arizona
- Be operational and in good mechanical condition

In addition, the vehicle owner must pay the first $150 of repairs. If the vehicle meets these criteria and is entered into the Program, PDEQ will pay up to an additional $550 for emissions-related repairs or up to an additional $650 for emissions-related repairs and retrofit kit installation. Funding for the V2R2 Program is provided through a grant from ADEQ.

**Teleworking**

Computer technology and telecommunication advances make working away from a central workplace more feasible. Reductions in traffic congestion and pollution are some of the potential benefits of teleworking. Teleworking is viewed as an effective tool in reducing vehicle miles traveled. Increased awareness of the environmental impacts of vehicle pollution also has helped to foster the desire to drive less.

Locally, the PDEQ Clean Air Campaign measures teleworking in two ways: availability and incidence. Results from the 2004 campaign tracking study are as follows:

**Availability of Teleworking:** The option of teleworking is available to 12 percent of respondents employed outside the home, up from 11 percent in 2003.

**Incidence of Teleworking:** Of those with the option to telecommute, 67 percent say they have teleworked personally. This is an increase from 2003 (58 percent).

The 2004 TRP survey reported 43 sites with 1,285 employees teleworking at least one day of the week. Of these companies, IBM (34 percent) and the University of Arizona (25 percent) have
the highest telework percentages. In December 2004, PAG staff worked with University Medical Center to develop the “TeleWork Case Study: University Medical Center – Tucson” to provide a summary of how telework positively affects both employees and the organization.

PAG's Travel Reduction Program and the PDEQ Clean Air Campaign continue to provide assistance to employers in Pima County with the implementation of company teleworking programs. These programs can provide customized teleworking materials, case studies, policies, procedures, and onsite employee training.

**Walking**

Pedestrian travel has become an increasingly important issue in the Tucson region. Approximately 5 percent of all regional trips are by walking. Investment in pedestrian facilities is now a major component of the transportation planning process in every jurisdiction for a variety of health, safety and mobility benefits.

In 2000, PAG completed the first ever Regional Pedestrian Plan, which is a policy document used to help develop and improve pedestrian facilities throughout the Tucson region. The plan has a special focus on improving pedestrian safety, accessibility, and connectivity along the existing roadway network. The plan contains specific recommendations addressing the following issues:

- Design standards for sidewalks, ramps, crosswalks and traffic signals
- Compliance with the Americans Disability Act (ADA) accessibility guidelines
- Inclusion of pedestrian facilities in local land use development policy
- Pedestrian safety education and enforcement
- Sidewalk inventory and mapping
- Promotional activities for pedestrian travel, and
- Inclusion of pedestrian planning in all transportation planning processes

In late 2003, PAG completed an inventory and map of sidewalks along all collectors and arterials within the Tucson region, which identifies missing sidewalk gaps as well as existing sidewalk segments that are both ADA-accessible and not accessible. During the second phase of this project, a sidewalk project ranking system was developed by PAG staff with the guidance of local pedestrian planners and advocates, including representatives from the disabled community.
Local and regional transportation plans call for a substantial investment in pedestrians facilities, such as sidewalks and signalized crossings. The sidewalk ranking system is currently being used to identify high-priority pedestrian facility improvements as a component of PAG’s upcoming Regional Transportation Authority 20-year multi-modal plan. The plan also will include additional investments for pedestrian safety programs to promote pedestrian safety and health benefits.

**Bicycling**

The City of Tucson has had designated bicycle facilities since 1971 and has had a staffed and active bicycle program in place since 1988. The first comprehensive plan for bicycling was developed by PAG in 1974 and is updated about every five years. PAG has had a designated staff position to act as “Regional Bicycling Coordinator” since 1973. The consistent addition of bikeways, including bike routes, bike lanes, shared-use paths (primarily pedestrian use), and roadway shoulders has helped in maintaining constant bike usage in the face of an ever-increasing urban area population.

Bicycles are permitted on all public roadways in the PAG region, except Interstates 10 and 19 in the Tucson metropolitan area. Bicycles also are permitted on all public trails, except in Federal wilderness areas and on trails reserved for pedestrians. Bicycles are not allowed on sidewalks in the City of Tucson, except for postal and police bicycles.

In 1993, the City of Tucson first received designation as a Bicycle Friendly City by the League of American Bicyclists. In 2004, the League categorized Tucson as a Silver-level Bicycle Friendly Community, making it one of only four communities in the nation to receive the level and one of 12 communities to be ranked as a Bicycle Friendly City. In 2004, an effort was organized to achieve a regional Platinum Bicycle Friendly Community rating in 2006.

In November 2004, bikeways in the metro area totaled 511 miles and are currently estimated at more than 550 miles. The adopted 2000 PAG Regional Plan for Bicycling calls for 800 miles of bikeways by 2010 and 1200 miles of bikeways by 2020. In addition, it is local government policy to include bike lanes on all new street construction and reconstruction projects.
The 2000 PAG Tucson Household Travel Survey indicates that on a given day, approximately 2 percent of the region’s residents used bicycle travel for their home-to-work commute, and it is estimated that slightly more than 3 percent of all travel is by bicycle. The 2000 PAG Regional Plan for Bicycling recommends a variety of measures to increase this usage to 5 percent by the year 2010 and 10 percent by the year 2020, as well as achieving a total bicycle travel share of 5 percent of all trips by the year 2020.

**Transit**

Sun Tran and its 515 employees are building on 30 years of service to the Tucson region. Sun Tran provides fixed route transit service within the City of Tucson, with limited service into Pima County, the City of South Tucson, the Town of Marana, the Town of Oro Valley and the Pascua Yaqui Tribe. The system's 37 fixed routes cover a 226 square mile area.

Sun Tran demonstrates its commitment to the environment by using clean-burning fuel technologies. Beginning in the summer of 2005, Sun Tran will take delivery of 38 new replacement buses. The 40-foot low-floor coaches will be fueled with ultra-low sulfur diesel which emits significantly fewer particulates than traditional diesel-fueled vehicles. By the end of 2005, the fleet will be 92 percent alternatively fueled.

Currently, 72 percent of the Sun Tran fleet operates on CNG with 89 dedicated CNG buses and 47 dual-fueled. Sun Tran’s fueling facility, one of the largest CNG refueling facilities in the country, is able to fuel up to 136 CNG buses daily. It is estimated that the entire Sun Tran fleet will be converted to run on clean burning fuels and engines by 2008.

Sun Tran serves 19 free Park & Ride lots centers across the region. To support multi-modal transportation, all buses have bike racks that allow passengers to bike and ride.

The City of Tucson has faced growing budgetary problems but is dedicated to providing a base transit service. The City of Tucson has not reduced its transit service levels nor has it increased fares since July of 2000. This stability has been a major factor in boosting Sun Tran’s ridership. Outpacing national transit trends, the system is experiencing its third consecutive year of ridership growth, with a 2.5 percent increase year-to-date through March 2005 over the same
period during the previous fiscal year. In FY 02-03, Sun Tran posted a 6.7 percent ridership increase, followed by growth of 2.5 percent in FY 03-04. Total ridership for FY 03-04 was 15.4 million passenger trips.

Tucson Area Intelligent Transportation Systems (ITS)

In 1994, the Tucson area received a federal grant to study the application and benefits of Intelligent Transportation Systems (ITS) in eastern Pima County. The update of the region’s ITS Strategic Deployment Plan recently has been completed. ITS uses real-time travel-related information to integrate all components of a traditional transportation system (roads, transit, traffic control devices, vehicles, and drivers) into an interconnected network. ITS results in increased overall efficiency of the transportation system by enhancing mobility, thereby improving air quality.

The Cities of Tucson and South Tucson, ADOT, Pima County, and the Towns of Marana, Oro Valley, and Sahuarita are in partnership to provide “seamless” traffic signal operations across jurisdictional boundaries. This has resulted in the interconnection of traffic signals, in and adjacent to the City of Tucson, into centrally coordinated operations. On behalf of the region, the City of Tucson currently monitors and controls over 450 traffic signals from the City of Tucson Transportation Control Center. This system has been expanded to encompass all the traffic signals in the Greater Tucson Metropolitan Area, making Tucson one of the few metropolitan areas of its size with 100 percent of its signals controlled from a single center.

The region currently uses multiple signal timing patterns in order to maximize traffic flow. Such improvements tend to be most effective in locally congested areas where progressive flows can reduce stops and signal delay. The increase in flow and decrease in stop and idle time can lead to a significant reduction in CO emissions.

Installation of Phase I elements of the Tucson metro area Freeway Management System (FMS) has been completed. The initial phase of the FMS uses 13 closed circuit television cameras with the ability to tilt, zoom, and pan 359 degrees for use in monitoring traffic flow and detecting incidents. The cameras have been strategically placed along the mainline at approximately one-
mile spacing so that they can be used to observe traffic on the approaching arterials as well as Interstates 10 and 19. Eight variable message signs also are used to provide real-time information for drivers. It is anticipated that this equipment will be of great benefit in helping reduce response times and maintain traffic flow during traffic incidents as well as the upcoming Interstate10 corridor construction project, thus decreasing congestion and vehicle emissions.
ADDITIONAL INFORMATION

Information on related local plans, projects and programs can be accessed locally from the selected reference list below:

**PAG Reports**

- 2000 On-Road Mobile Source Emissions Inventory – Sept. 2004
- 2001-2025 Regional Transportation Plan (RTP) Amended – Jan. 2004
- 2002-2003 PAG Regional Travel Time and Travel Speed Study – Dec. 2003
- 2030 Regional Transportation Plan (RTP) Vision and Goals – April 2003
- Digest of the Air Quality and Climate Variability Forum – Aug. 2003
- Intermodal Management Systems Plan – March 2005
- PAG Regional Aviation Systems Plan – June 2002
- PAG Regional Pedestrian Plan – July 2000
- PAG Regional Plan for Bicycling – July 2000
- Telework Case Study: IBM – Tucson – June 2003
- Telework Case Study: UMC – Tucson – April 2005
- Traffic Volumes in Metropolitan Tucson and Eastern Pima County – 2004
- Transit Element of the 2030 Regional Transportation Plan – Oct. 2003
- Transportation Improvement Program (TIP) FY 2005-2009 – June 2004
- Tucson Metropolitan Community Information Data Summary – March 2003

**Other Reports**

- Comprehensive Operations Analysis for Sun Tran - July 1997
- PDEQ 2003 Annual SLAMS/NAMS Network Review for Pima County, Arizona – June 2004
- PDEQ Limited Maintenance Plan Carbon Monoxide Monitoring Report – April 2005
- Pima County Air Quality Study and Evaluation of the 2003 - 2004 Clean Air Campaign – May 2004

Additional brochures on alternate transportation modes are available – see PAG Publications List.
A.R.S. – Arizona Revised Statutes
ADA – American Disability Act
ADEQ – Arizona Department of Environmental Quality
ADOT – Arizona Department of Transportation
ADT – Average Daily Traffic
AMU – Alternate Mode Usage
ATP – Anti-Tampering Provisions
CFR – Code of Federal Regulations
CNG – Compressed Natural Gas
CO – Carbon Monoxide
DOE – United States Department of Energy
E85 – Fuel Blend of 85% Ethanol and 15% Gasoline
EPA – United States Environmental Protection Agency
FMS – Freeway Management System
HB – House Bill
IGA – Intergovernmental Agreement
ITS – Intelligent Transportation System
LMP – Limited Maintenance Plan
LOS – Level of Service
MPH – Miles Per Hour
MTBE – Methyl Tertiary Butyl Ether
NAAQS – National Ambient Air Quality Standards
NAD27 – North American Datum of 1927
NAMS – National Air Monitoring Stations
OBD – On-Board Diagnostics
PAG – Pima Association of Governments
PDEQ – Pima County Department of Environmental Quality
PPM – Parts Per Million
RPD – Regional Planning Division
RTP – Regional Transportation Plan
RVP – Reid Vapor Pressure
SB – Senate Bill
SIP – State Implementation Plan
SLAMS – State and Local Air Monitoring Stations
TAPA – Tucson Air Planning Area
TCM – Transportation Control Measure
TIP – Transportation Improvement Program
TRP – Travel Reduction Program
UTM – Universal Transverse Mercator Coordinate System
V2R2 – Voluntary Vehicle Repair and Retrofit
VEIP – Vehicle Emissions Inspection Program
VMT – Vehicle Miles Traveled