MARICOPA ASSOCIATION of GOVERNMENTS

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November 19, 2010

TO: Members of the MAG Air Quality Technical Advisory Committee

FROM: Doug Kukino, Glendale, Chair

SUBJECT: MEETING NOTIFICATION AND TRANSMITTAL OF TENTATIVE AGENDA

Tuesday, November 30, 2010 - 1:30 p.m.
MAG Office, Suite 200 - Saguaro Room
302 North 1st Avenue, Phoenix

A meeting of the MAG Air Quality Technical Advisory Committee has been scheduled for the time and place noted above. Members of the Air Quality Technical Advisory Committee may attend the meeting either in person, by videoconference or by telephone conference call. Those attending by videoconference must notify the MAG site three business days prior to the meeting. If you have any questions regarding the meeting, please contact Chair Kukino or Lindy Bauer at 602-254-6300.

Please park in the garage underneath the building, bring your ticket, and parking will be validated. For those using transit, Valley Metro/Regional Public Transportation Authority will provide transit tickets for your trip. For those using bicycles, please lock your bicycle in the bike rack in the garage.

In 1996, the Regional Council approved a simple majority quorum for all MAG advisory committees. If the MAG Air Quality Technical Advisory Committee does not meet the quorum requirement, members who arrived at the meeting will be instructed a legal meeting cannot occur and subsequently be dismissed. Your attendance at the meeting is strongly encouraged. If you are unable to attend the meeting, please make arrangements for a proxy from your entity to represent you.

Pursuant to Title II of the Americans with Disabilities Act (ADA), MAG does not discriminate on the basis of disability in admissions to or participation in its public meetings. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Jason Stephens at the MAG office. Requests should be made as early as possible to allow time to arrange the accommodation.

TENTATIVE AGENDA

	COMMITTEE ACTION REQUESTED
1. Call to Order	
2. Call to the Audience An opportunity will be provided to members of the public to address the Air Quality Technical Advisory Committee on items not scheduled on the agenda that fall under the jurisdiction of MAG, or on items on the agenda for discussion but not for action. Members of the public will be requested not to exceed a three minute time period for their comments. A total of 15 minutes will be provided for the Call to the Audience agenda item, unless the Air Quality Technical Advisory Committee requests an exception to this limit. Please note that those wishing to comment on action agenda items will be given an opportunity at the time the item is heard.	2. For information.
3. Approval of the October 28, 2010 Meeting Minutes	3. Review and approve the October 28, 2010 meeting minutes.
4. Evaluation of Proposed PM-10 Certified Street Sweeper Projects for FY 2011 CMAQ Funding An evaluation of proposed PM-10 Certified Street Sweeper Projects for Federal Fiscal Year 2011 Congestion Mitigation and Air Quality Improvement (CMAQ) Funds has been conducted. The deadline for submitting projects was September 16, 2010. The FY 2011 Unified Planning Work Program and Annual Budget and FY 2011-2015 MAG Transportation Improvement Program contain $900,000 in FY 2011 CMAQ funding to encourage the purchase and utilization of PM-10 certified street sweepers. An additional $367,855 in CMAQ is available from sweeper projects that have been requested to be deleted and from savings on sweepers that	4. For information, discussion, and recommendation of a prioritized list of proposed PM-10 Certified Street Sweeper Projects for FY 2011 CMAQ funding to the MAG Management Committee.

have cost less than anticipated, for a total amount of $1,267,855. A minimum local cash match of 5.7 percent is required.

Seven projects requesting federal funds were evaluated. The MAG Air Quality Technical Advisory Committee is requested to recommend a prioritized list of proposed PM-10 Certified Street Sweeper Projects for FY 2011 CMAQ funding to the MAG Management Committee. Please refer to the enclosed material.

5. Evaluation of Proposed PM-10 Paving Unpaved Road Projects for FY 2014 CMAQ Funding

An evaluation of proposed PM-10 Paving Unpaved Road Projects for Federal Fiscal Year 2014 Congestion Mitigation and Air Quality Improvement (CMAQ) Funds has been conducted. The deadline for submitting projects was September 16, 2010.

The FY 2011-2015 MAG Transportation Improvement Program identifies $4,898,000 in FY 2014 CMAQ Funds for PM-10 Paving Unpaved Road Projects. It is requested that the Paving Unpaved Road Projects be ranked and forwarded to the Transportation Review Committee. Please refer to the enclosed material.

5. For information, discussion, and recommendation to rank the Proposed PM-10 Paving Unpaved Road Projects for FY 2014 CMAQ funding and forward to the MAG Transportation Review Committee.

6. Update on the EPA Proposed Partial Approval and Disapproval of the MAG 2007 Five Percent Plan for PM-10

On September 3, 2010, the Environmental Protection Agency (EPA) signed a notice to propose partial approval and disapproval of the MAG 2007 Five Percent Plan for PM-10 based on the timetable in the consent decree with the Arizona Center for Law in the Public Interest. The notice was published in the Federal Register on September 9, 2010, and comments were submitted by October 20,

6. For information and discussion.

2010. If EPA finalizes the partial disapproval on January 28, 2011, a conformity freeze on the MAG Transportation Improvement Program (TIP) and Regional Transportation Plan (RTP) would occur in approximately thirty days; only projects in the first four years could proceed. If the problem is not corrected within eighteen months, tighter controls on major industries would be imposed. If the problem is still not corrected within twenty-four months of the disapproval, the loss of federal highway funds ($1.7 billion) and a federal implementation plan would be imposed. Conformity would also lapse, which would place the $7.4 billion TIP at risk.

EPA has continued to respond to some of the questions from MAG, ADEQ, and Maricopa County regarding a Revised Five Percent Plan for PM-10. However, several questions remain unanswered. An update will be provided. Please refer to the enclosed material.

7. <u>Draft 2010 MAG CMAQ Methodologies</u>

The Maricopa Association of Governments has updated the 2009 Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement (CMAQ) Projects to include emission rates produced by the new EPA MOVES2010 mobile source emissions model and improvements to the methodology for evaluating Intelligent Transportation System Projects. These methodologies are used to evaluate the emission reductions and cost effectiveness of projects submitted for CMAQ funding by MAG member agencies. MAG will conduct a workshop on the Draft 2010 CMAQ Methodologies on December 6, 2010 at 1:30 p.m. at the MAG office. Please refer to the enclosed material.

7. For information and discussion.

8.	Call for Future Agenda Items The next meeting of the Committee has been tentatively scheduled for **Thursday, January 27, 2011** at 1:30 p.m. For your convenience, the Tentative Meeting Schedule for the MAG Air Quality Technical Advisory for January-November 2011 is provided. The Chairman will invite the Committee members to suggest future agenda items.	8. For information and discussion.

MINUTES OF THE
MARICOPA ASSOCIATION OF GOVERNMENTS
AIR QUALITY TECHNICAL ADVISORY COMMITTEE MEETING

Thursday, October 28, 2010
MAG Office
Phoenix, Arizona

MEMBERS ATTENDING

Michelle Wilson for Doug Kukino, Glendale, Chairman
Larry Person, Scottsdale, Vice Chair
Sue McDermott, Avondale
#Elizabeth Biggins-Ramer, Buckeye
*Jim Weiss, Chandler
#Jamie McCullough, El Mirage
Kurt Sharp, Gilbert
Cato Esquivel, Goodyear
#Scott Bouchie, Mesa
William Mattingly, City of Peoria
Karen Peters for Phil McNeely, Phoenix
#Antonio DeLaCruz, Surprise
Oddvar Tveit, Tempe
Grant Anderson for Mark Hannah, Youngtown
Ramona Simpson, Queen Creek
*American Lung Association of Arizona
Grant Smedley, Salt River Project
Brian O'Donnell, Southwest Gas Corporation
Mark Hajduk, Arizona Public Service Company
#Gina Grey, Western States Petroleum Association
*Valley Metro/RPTA
*Dave Berry, Arizona Motor Transport Association
Jeannette Fish, Maricopa County Farm Bureau
Steve Trussell for Russell Bowers, Arizona Rock Products Association
Amy Bratt, Greater Phoenix Chamber of Commerce
Amanda McGennis, Associated General Contractors
Spencer Kamps, Homebuilders Association of Central Arizona
*Mannie Carpenter, Valley Forward
*Erin Taylor, University of Arizona Cooperative Extension
Beverly Chenausky, Arizona Department of Transportation
Leonard Montenegro for Diane Arnst, Arizona Department of Environmental Quality
*Environmental Protection Agency
Bob Downing for Jo Crumbaker, Maricopa County Air Quality Department
#Michele Mellott for Duane Yantorno, Arizona Department of Weights and Measures
*Ed Stillings, Federal Highway Administration
*Judi Nelson, Arizona State University
Christopher Horan, Salt River Pima-Maricopa Indian Community

*Members neither present nor represented by proxy.
#Participated via telephone conference call.
+Participated via video conference call.

OTHERS PRESENT

Lindy Bauer, Maricopa Association of Governments
Dean Giles, Maricopa Association of Governments
Julie Hoffman, Maricopa Association of Governments
Feng Liu, Maricopa Association of Governments
Taejoo Shin, Maricopa Association of Governments
Randy Sedlacek, Maricopa Association of Governments
Matt Poppen, Maricopa Association of Governments
Ranjith Dandanayakula, Maricopa Association of Governments
Adam Xia, Maricopa Association of Governments
Cathy Arthur, Maricopa Association of Governments
Frank Schinzel, Maricopa County Air Quality
John Wayne Gonzales, City of Phoenix
Heather Hodgman, City of Apache Junction
Scott DiBiase, Pinal County
Dan Catlin, Fort McDowell
Matt Tsark, Strand Associates, Inc.
Jeff Gray, R & R Partners
Kayelen Rolfe, State of Arizona
Joonwon Joo, Arizona Department of Transportation
Mitch Wagner, Maricopa County Department of Transportation

1. Call to Order

A meeting of the MAG Air Quality Technical Advisory Committee was conducted on October 28, 2010. Larry Person, City of Scottsdale, Vice Chair, called the meeting to order at approximately 1:30 p.m. Antonio DeLaCruz, City of Surprise; Jamie McCullough, City of El Mirage; Elizabeth Biggins-Ramer, Town of Buckeye; Gina Grey, Western States Petroleum Association; Scott Bouchie, City of Mesa; and Michele Mellott, Arizona Department of Weights and Measures, attended the meeting via telephone conference call.

2. Call to the Audience

Mr. Person stated that according to the MAG public comment process, members of the audience who wish to speak are requested to fill out comment cards, which are available on the tables adjacent to the doorways inside the meeting room. Citizens are asked not to exceed a three minute time period for their comments. Public comment is provided at the beginning of the meeting for nonagenda items and nonaction agenda items. He noted that no public comment cards had been received.

3. Approval of the September 23, 2010 Meeting Minutes

The Committee reviewed the minutes from the September 23, 2010 meeting. Amanda McGennis, Associated General Contractors, moved and William Mattingly, City of Peoria, seconded and the motion to approve the September 23, 2010 meeting minutes carried unanimously.

4. Update on the EPA Proposed Partial Approval and Disapproval of the MAG 2007 Five Percent Plan for PM-10

Lindy Bauer, MAG, provided an update on the Environmental Protection Agency (EPA) proposed partial approval and disapproval of the MAG 2007 Five Percent Plan for PM-10. Ms. Bauer stated that MAG and the Arizona Department of Environmental Quality (ADEQ) requested a 60-day extension of the comment period for the proposed action on the Five Percent Plan. Comments were originally due by October 12, 2010. She added that EPA did grant an extension of the comment period to October 20, 2010. Ms. Bauer indicated that MAG, Maricopa County, and ADEQ submitted individual comments and joint letters which were included in the Committee agenda packets. In addition, a letter was signed by the members of the MAG Regional Council and submitted to EPA to make them aware of the consequences of the proposed action, in particular, the conformity freeze. Ms. Bauer thanked Pinal County, Arizona Rock Products Association, and the Associated General Contractors for submitting comments. She noted that comments have also been submitted by others including the Greater Phoenix Chamber and the Arizona Chamber. Ms. Bauer indicated that MAG will be accessing these letters from the docket once they are posted. She mentioned that EPA has not yet included the letters or comments into the docket. Ms. Bauer added that MAG also submitted extensive comments on the notice and pointed out the information that was incorrect.

Ms. Bauer stated that the highlight of October include two video conferences with EPA. She added that the first conference was conducted on October 1, 2010 which included the local air agencies that worked to develop the Plan. Ms. Bauer indicated that the purpose of this conference was to talk to EPA about the issues with the EPA Exceptional Events Rule and to provide some recommendations on how to fix the rule. She noted that the agencies on the video conference included the EPA Office at Research Triangle Park, Office of Air Quality Planning and Standards; EPA Region IX; and the

EPA Office of General Counsel. Ms. Bauer commented that the video conference provided an opportunity to present recommendations for fixing the rule. She added that during the call, EPA acknowledged that there are problems with the rule that have to be fixed. Ms. Bauer stated that EPA discussed the possibility of a policy memorandum in the short term. EPA also discussed potential long term solutions for fixing the rule; however, this solution will take some time. Ms. Bauer mentioned that an attorney with the EPA Office of General Counsel indicated that when EPA fixes the rule, it does not necessarily mean that EPA will go back and change their mind on the 2008 exceptional events and nonconcurrence. She stated that if the rule was flawed, EPA should go back retroactively and fix the problem with the high wind exceptional events. Ms. Bauer added that MAG made it clear that they are ready and committed to work with EPA on fixing the technical approvability issues that EPA has identified with the Plan.

Ms. Bauer stated that on October 8, 2010, Congressman Mitchell held a video conference with EPA at the MAG office. She noted that this meeting included representatives from the offices of Congressman Flake and Congressman Pastor in addition to the local agencies that worked to develop the Plan. Janet McCabe, Deputy EPA Administrator, was also on the video conference along with Research Triangle Park and EPA Region IX. Mayor Schoaf, Chairman, MAG Regional Council, presided over the meeting. She mentioned that Mayor Shoaf took the opportunity to talk to EPA about the MAG track record for air quality. Ms. Bauer added that Mayor Schoaf commented that this region was one of the first regions in the country to implement an alternative fuels program. She indicated that this region has the most stringent vehicle emissions testing program in the country. In addition, MAG is currently working on a pilot project for electric vehicle recharging stations. Ms. Bauer stated that this region has met the air quality standard for carbon monoxide and is now a maintenance area. In addition, the region has met the one-hour ozone standard and is now a maintenance area. Ms. Bauer commented that Mayor Schoaf emphasized that the eight-hour ozone standard for the .080 parts per million standard has also been met by this region with no exceedances since 2004. The region is also an attainment area for PM-2.5. She added that Mayor Schoaf mentioned that the MAG Regional Council allocated $23.2 million in CMAQ funds over the last 10 years to purchase PM-10 street sweepers and approximately $28.4 million in CMAQ for unpaved roads. Mayor Schoaf also emphasized that the Plan is effective and working and that MAG is committed to work with EPA on the approvability issues. Mayor Schoaf also requested at the meeting that EPA delay final action on the Plan since they need time to review all of the scientific information for exceptional events.

Ms. Bauer stated that Mayor Smith, Chairman, MAG Transportation Policy Committee, emphasized to EPA at the meeting that a conformity freeze is unacceptable for this region. She added that due to the changing economic conditions, MAG needs to be fluid so that it can adjust to changing conditions. Ms. Bauer noted that the MAG Regional Council has had to make changes to the MAG Transportation Improvement Program (TIP) because of the downturn that was unanticipated. She noted that MAG frequently makes changes to the TIP. Ms. Bauer commented that EPA responded by indicating that they now have a better understanding why this region was so concerned about the conformity freeze. She added that MAG also mentioned that they were proud of the work that has been done for air quality which is a credit to the Air Quality Technical Advisory Committee. Ms. Bauer mentioned that Ms. McCabe stated that MAG should be proud. Ms. McCabe indicated that prior to her current position, she worked in Indiana, and at that time they used the MAG Plan as a model when debating the merits of the IM 240 Program. Ms. Bauer commented that she wanted to convey that compliment to this Committee since this is due to their hard work. She added that EPA indicated that they would work cooperatively with MAG to try to avoid or minimize the time in the conformity freeze.

Ms. Bauer stated that an exceedance of the PM-10 standard occurred on October 15, 2010 at the Greenwood monitor. She noted that this was the first exceedance in 2010. Ms. Bauer added that the exceedance occurred on a day with thunderstorm activity. She indicated that a map of the air quality monitors was mailed to the Committee and an additional copy has been set at each place. Ms. Bauer asked all the MAG member agencies along with the private sector to be ever vigilant when they have projects that are near those monitors. She mentioned that it is nearing the time of year where there are stagnant conditions with minimal wind and an inversion holds the pollution near the ground. Ms. Bauer added that this region needs to have clean data at the monitors. She noted that if the PM-10 exceedances do not stop, it will cause big problems for this region.

Ms. Bauer stated that EPA has started answering some of the questions that were submitted. She noted that the answers from EPA were included in the agenda packet. Ms. Bauer added that EPA does want some changes to the 2008 Periodic Emissions Inventory which means it is not ready to be used. EPA has indicated that the five percent reductions start from the year in which the Plan is submitted. Ms. Bauer mentioned that MAG will present the Committee with a new schedule for completion of the Plan when additional information is available. She indicated that MAG has additional questions for EPA and EPA did not fully answer some of the questions. Ms. Bauer added that as soon as the information is available it will be conveyed to the Committee.

Ms. Bauer stated that EPA has indicated that it is common sense to analyze any additional new Best Available Control Measures (BACM) that are not in the Plan. She added that MAG has asked Sierra Research to update the BACM analysis. Ms. Bauer mentioned that this region already has an approved BACM analysis in the Serious Area Plan. She commented that Sierra Research will be taking that information along with the measures that are currently in place and will be analyzing other areas to see what additional measures are out there. Ms. Bauer stated that a big list of measures is not expected since the Plan already has extensive measures in place. She added that if the outstanding measures do not make sense for this region, justification could be provided as to why the measures should not be done locally.

Ms. Bauer mentioned that we need to keep in mind the economic downturn. She commented that the MAG transportation staff produced information on construction jobs. Ms. Bauer noted that over the last three years, 100,000 construction jobs have been lost. Currently the level of construction employment is at the mid 1995 levels. She reminded the Committee about being clean at the monitors. The hope is to have three years of clean data when the Plan is submitted. Ms. Bauer indicated that keeping clean at the monitors will help minimize how many measures will need to be added to the Plan. She noted that good common sense needs to be used when going through and revising this Plan keeping in mind the economy of this region as well as improving the air quality.

Ms. McGennis inquired if the inventory that is not ready for use is the 2008 Periodic Emission Inventory. Ms. Bauer responded yes. Ms. McGennis stated that the Five Percent Plan for PM-10 was submitted December 31, 2007. She added that Ms. Bauer stated that the five percent reductions start the year the Plan was submitted and inquired if this meant 2008. Ms. Bauer responded that was under the old Plan. She added that EPA is assuming a revision would be submitted in 2011, then the five percent reductions would start in 2011. Ms. Bauer mentioned that MAG has questions for EPA on the modeling and on the base that would be used to take those five percent reductions. Ms. McGennis stated that the map on the monitor locations has been helpful. She added that the Maricopa County Air Quality Department may start alerting people on the locations of the monitors when they receive

their dust permits. Ms. McGennis indicated that this would give people an idea of monitor locations when going out for a project. She requested that those with public works projects consider the monitors and make the bidders aware of the monitors in the surrounding area. Ms. Bauer stated that it was an excellent suggestion. She added that the MAG Regional Council was also provided the map at their October 27, 2010 meeting.

Grant Anderson, Town of Youngtown, asked if Ms. Bauer could clarify the fact that the conformity freeze is not tied to the violations at the monitors. Ms. Bauer responded that the conformity freeze is not tied to the violations at the monitors. The conformity freeze would be tied to the disapproval of the Plan if EPA goes forward with disapproval. Ms. Bauer noted that when EPA went through their technical approvability issues with the Plan in the September 9, 2010 notice, EPA first attacked the 2005 Periodic Emissions Inventory, the foundation of the Plan. She added that the inventory is the basis from which MAG developed the modeling projections including the Motor Vehicle Emissions Budget used for conformity. Ms. Bauer indicated that EPA proposed to disapprove all of those pieces of the Plan.

Mr. Anderson stated that this was more of a revelation that he originally thought since there has been continuos talk about monitor locations and suggestions to do better in those areas. He inquired what will prevent EPA from stating that because the Plan did not meet their criteria, no matter what is done at the monitors there will still be a conformity freeze. Mr. Anderson asked how the region can get out of a conformity freeze. He inquired if this could be done by being clean at the monitors or by changing the Plan to meet the requirements. Ms. Bauer responded that first and foremost the region needs to be clean at the monitors. She added that EPA disagrees with the four high wind exceptional events and therefore the region does not have its first year of clean data needed to be in attainment which lead to the disapproval of the Plan. Ms. Bauer indicated that EPA also identified technical approvability issues with the Plan. She mentioned that the first piece criticized by EPA was the 2005 Periodic Emissions Inventory which produces the pie chart that shows all the different sources and contributions. Ms. Bauer noted that this piece is the foundation of the Plan. She commented that two things need to be done: 1) be clean at the monitors and 2) fix the approvability issues. Ms. Bauer added that an approveable Plan as well as being clean at the monitors is needed in order to stop the PM-10 problem.

Mark Hajduk, Arizona Public Service Company, stated that a Plan needs to be in place and submitted to EPA for approval. He added that it seems as if EPA will soon be making a decision on disapproving the Plan which would kick in the conformity issues and sanctions. Mr. Hajduk commented that he is assuming that the region will not be able to have a revised Plan in place by the time EPA makes a decision. He asked if the approach will be damage control and try getting an extension to minimize the time between the decision by EPA and having a new Plan in place. Mr. Hajduk inquired if the Committee will be on an accelerated track to try to come up with a Plan. Ms. Bauer indicated that EPA would sign the disapproval notice on January 28, 2011 and 30 days after the notice is signed the region would go into a conformity freeze. She added that the conformity freeze would be lifted by submitting a new Plan that meets the Clean Air Act requirements and EPA finds the Motor Vehicle Emissions Budget in the Plan adequate for conformity. Ms. Bauer noted that MAG would then need to run conformity with the budget.

Ms. Bauer discussed the sanctions. She stated that the first sanction would fall 18 months from the effective date of disapproval if the problem is still not fixed. The second sanction would fall six

months later which is the loss of the federal highway funds. Ms. Bauer added that MAG needs to get the answers to the questions that were submitted to EPA. She noted that the region needs to find out how long it is going to take to fix the foundation piece which is the emissions inventory. Ms. Bauer commented that MAG will then provide a schedule to the Committee. She mentioned that the Committee should not expect a long list of measures. Ms. Bauer mentioned that we have to be prudent and use common sense when developing a plan.

Grant Smedley, Salt River Project, inquired if it is clear what is meant by an approveable Plan under the Clean Air Act. He asked if the disputed exceptional events will prevent the region from having an approveable Plan. Mr. Smedley added that since the baseline emissions inventory will have to be adjusted, the region will not know how the Plan will do until it gets implemented. He asked if EPA has included any information in that regard. Ms. Bauer responded that an approveable plan must have an accurate comprehensive emissions inventory. She noted that the items needed for an approveable plan are listed in the Clean Air Act. Ms. Bauer stated that the region has never seen an emissions inventory attacked by EPA. She added that the Maintenance Plan for Carbon Monoxide, which was approved by EPA, is based on old inventories. EPA indicated that those were the most accurate inventories at that point in time. Ms. Bauer commented that this is new for both MAG and Maricopa County. She mentioned that the region needs to work with EPA and find out how long it will take to fix the 2008 emissions inventory so that EPA is satisfied to use it as a base for the Plan. Ms. Bauer indicated that modeling projections will then have to be developed. MAG will also analyze the existing measures that are in place and see how far those benefits can be extended. She noted that MAG will also take a look at the update to the Best Available Control Measure analysis and will share all of the information with this Committee.

Spencer Kamps, Homebuilders Association of Central Arizona, inquired about the concerns that EPA has expressed over the 2008 emissions inventory. Ms. Bauer responded that the Committee agenda packet includes the concerns that EPA has expressed. She stated that EPA has indicated that they would like MAG to provide documentation on the vacant land areas. Ms. Bauer added that MAG is prepared to provide that information, and in fact, the approach that MAG is using is more comprehensive and accurate than what Clark County used. She noted that the information is currently being developed. In addition, EPA has indicated that they would like to see the actual compliance rate used in the rule effectiveness calculation methodologies. Ms. Bauer mentioned that Maricopa County will be working on that issue. She added that EPA has also mentioned that they are looking at potential changes with the road dust emissions.

Mr. Hajduk commented that at the previous meeting, it was mentioned that Roger Ferland, Quarles and Brady, LLP, was hired to represent MAG. He inquired if MAG will be taking legal action on some of the issues that were mentioned. Ms. Bauer responded that she has to be careful with her response given the open meeting law. She stated that no lawsuit has been filed by MAG. Ms. Bauer noted that MAG's legal counsel has provided good advice along the way and it is reflected in the letters that are included within the agenda packet.

Mr. Anderson inquired about the sanctions that would be placed on Indian Communities. Ms. Bauer responded that the Indian Communities are governed by the Federal Government. Mr. Anderson asked about the process. Ms. Bauer responded that the Indian Communities have been very cooperative in working with MAG. She added that the Gila River Indian Community went through an official federal process to be authorized to develop air quality plans. Ms. Bauer indicated that under the Clean Air

Act, Indian Communities can be treated like states. For example, the Gila River Indian Community has their own air quality plan in place and has shared their plan with this Committee. Ms. Bauer noted that they have been cooperative; however, they are under the authority of the Federal Government.

5. Status of Ongoing EPA Review of National Ambient Air Quality Standards for Particulate Matter

Matt Poppen, MAG, provided a presentation on the status of ongoing EPA review of National Ambient Air Quality Standards (NAAQS) for Particulate Matter. Mr. Poppen stated that the current particulate matter standards for PM-10 and PM-2.5 were adopted by EPA in October 2006. At that time EPA retained the 24-hour PM-10 standard at 150 micrograms per cubic meter (ug/m^3) and revoked the annual PM-10 standard which was 50 ug/m^3. He added that EPA also revised the 24-hour PM-2.5 standard from 65 to 35 ug/m^3 and retained the annual PM-2.5 standard at 15 ug/m^3. In addition, EPA also left the secondary standards set identical to the primary standards.

Mr. Poppen mentioned that EPA is required by the Clean Air Act to review each standard every five years for all pollutants that are part of the National Ambient Air Quality Standards. He commented that the current particulate matter standards are scheduled for a preliminary rulemaking in February 2011 and the final rulemaking would be October 2011. The latest EPA documents that are out for review with recommendations on the new particulate matter standards include the Policy Assessment for the Review of the PM NAAQS which came out in June 2010. Mr. Poppen added that the Clean Air Scientific Advisory Committee (CASAC), which has a strong role in advising these standards, also sent out the Review of Policy Assessment for the Review of the PM NAAQS in September 2010. He stated that he will be discussing these two documents.

Mr. Poppen presented a chart of the new NAAQS review process which was released in April 2009. He noted that EPA is currently in the Policy Assessment stage of the process. Mr. Poppen stated that the policy assessment integrates the risk exposure information and policy issues. He added that EPA will most likely be moving on to the internal review stage and getting ready to publish their proposed ideas on the standard.

Mr. Poppen discussed the current EPA recommendations on revising the Particulate Matter Standards. He stated that for primary PM-10, EPA has recommended to either retain or revise the current standard. Mr. Poppen added that EPA's comments in regard to retaining the standard stated that it depended on the evidence, whether it is necessary to revise the standard. He noted that EPA could not make that recommendation at the time. However, EPA stated that if the administrator felt that it was necessary to make a revision, EPA would recommend keeping the current indicator of PM-10 as well as the 24-hour averaging time. Mr. Poppen commented that EPA did recommend a new form. He added that the current form allows three exceedances over a period of three years, an average of one exceedance per year at a monitor in order to be in attainment. Mr. Poppen mentioned that the new form would be a three-year average at the 98th percentile. He indicated that the 98th percentile equates to the 8th highest reading in a year. Mr. Poppen stated that in order to attain the standard, the 8th highest reading over a three-year average would have to be below the standard. He commented that the new level would be between 85 and 65 ug/m^3 with the evidence supporting the upper bound level of 85 ug/m^3. Mr. Poppen added that EPA felt that 87 ug/m^3 was equivalent to the current standard in combination with the new form. He added that 87 ug/m^3 was a national average which would mean less protection in some areas and more protection in other areas.

Mr. Poppen stated that EPA recommended revising the primary PM-2.5 standard. He noted that Maricopa County is in attainment for this pollutant. Mr. Poppen added that EPA recommended to keep the indicator of PM-2.5 and both averaging times (annual and 24-hour standards). EPA has also recommended to keep the forms that are used to calculate the averaging time. Mr. Poppen mentioned that the forms include a three-year annual average and a three-year average for the 24-hour 98th percentile. He stated that EPA recommended a new annual level of 13 to 11 ug/m^3 which has a current level of 15 ug/m^3. EPA also recommended a level of 35 to 30 ug/m^3 for the 24-hour level which is currently set to 35 ug/m^3.

Mr. Poppen stated that CASAC reviewed EPA's recommendations and policy assessment and have sent their recommendations to EPA Administrator Jackson. He added that CASAC has recommended that the primary PM-10 standard be revised. CASAC recommended to keep the PM-10 indicator; however, they recommended a future use of PM course (10-2.5 ug/m^3) and not take into account anything below PM-2.5. Mr. Poppen commented that there is currently not enough data to set a standard on that indicator. He mentioned that CASAC also recommended that there should be a national effort to deploy more of these course monitors so that more data can be gathered. Mr. Poppen indicated that CASAC recommended to keep the averaging time of 24-hour. He noted that CASAC agreed with the 98th percentile form. CASAC disagreed with EPA on the level and recommended a level of 75 to 65 ug/m^3. Mr. Poppen added that CASAC disagreed with EPA that the science supports the 85 micrograms per cubic meter. He mentioned that for the primary PM-2.5 standards, CASAC agreed with EPA. Mr. Poppen noted that the only difference was that CASAC was unsure about the combination of the annual standard and the 24-hour standard that should be put in place to provide the best protection for the public.

Mr. Poppen discussed the impact of a revised primary PM-10 standard. He stated that based on the PM-10 nonattainment area monitors with complete data for 2007-2009, there would be eight monitors that exceed at the 85 or 75 ug/m^3 level. Mr. Poppen added that there would be ten monitors that exceed the 65 ug/m^3 level. He noted that the aforementioned statistics are conservative since they do not account for the exclusion of exceptional events.

Mr. Poppen presented a graph of the 2007-2009 three-year average 98th percentile PM-10 values. He stated that the graph shows the eight monitors that exceed the 85 ug/m^3 level. Mr. Poppen added that the monitors include Durango, Bethune School, West 43rd, Higley, South Phoenix, Greenwood, Central Phoenix, and the West Phoenix monitors. He indicated that the number listed in the bar is the 98th percentile reading. He commented that at the level of 65 ug/m^3, two additional monitors exceed the standard, Dysart and West Chandler.

Mr. Poppen stated that another way to look at the impact as opposed to the 98th percentile value is to look at the number of days that a monitor would exceed the standard. He added that in most cases with a continuos PM-10 monitor, the 98th percentile equates to the eighth highest reading in a year. In order to attain the standard, the monitor cannot exceed more than seven times a year, on a 3-year average, the level EPA sets. Mr. Poppen presented a table of the five highest exceeding monitors which show the number of times they exceed on an average using 2007-2009 data. He noted that the West 43rd Avenue monitor exceeds the 85 ug/m^3 level 60 times per year; the 75 ug/m^3 level 86 times per year; and the 65 ug/m^3 level 122 times per year. Mr. Poppen added that those numbers would need to be down to seven in order to attain the new standard.

Mr. Poppen stated that PM-10 control measures are working and PM-10 is trending downward, which can be seen under the new form proposed by EPA. He discussed the statistics for the West 43rd Avenue monitor. Mr. Poppen added that if the level is 85 ug/m^3, in 2007 it was in the 70th percentile; in 2008 it was in the 87th percentile; in 2009 the level was in the 92nd percentile; and in 2010 it almost met the 98th percentile based on data through October 12, 2010. Mr. Poppen presented a table of the West 43rd Avenue monitor which is the highest exceeding monitor. He indicated that the monitor exceeded the 85 ug/m^3 level in 2007 on 106 days, 46 days in 2008, 27 days in 2009, and 6 days in 2010 (through October 12, 2010). Mr. Poppen noted that the numbers in the brackets show the projected year end total for 2010. He stated that the numbers are higher because of the stagnant and inversion season the region will soon be entering. Mr. Poppen added that while 2010 has been a great year in terms of not having PM-10 exceedances of the current standard, the region would still not meet the new EPA standards being proposed.

Mr. Poppen stated that exceptional events will increase in frequency and importance under the new standard. He presented a table that shows the six days in 2010 that the West 43rd Avenue monitor exceeded the 85 ug/m^3 level. Mr. Poppen added that three of the days had high winds which include April 29, 2010, May 2, 2010, and October 2, 2010. He indicated that these three days would be good candidates for exceptional events under the new standard. Mr. Poppen commented that these days are not currently flagged as exceptional events since they are under the current standard of 150 micrograms per cubic meter. He noted the importance of the Exceptional Events Rule if the new standard goes forward.

Mr. Poppen commented on the impacts of the proposed primary PM-2.5 standards. He stated that Maricopa County currently attains the standard for PM-2.5. Mr. Poppen noted that the region would continue to attain the 24-hour PM-2.5 standard if lowered to a level of 30 ug/m^3 as suggested by EPA. Mr. Poppen discussed the table on the slide and added that the table shows the 24-hour averages. He indicated that the three-year averages are below 30 ug/m^3. Mr. Poppen mentioned that if EPA chooses to lower the annual standard to the lowest value of 11 ug/m^3, the South Phoenix monitor would currently exceed that standard based on 2007-2009 data. He noted that EPA does allow an overall averaging of all the PM-2.5 monitors; however, there are some caveats and spatial averaging may not apply in our case.

Mr. Poppen stated that the current secondary standards are the same as the primary standards; however, this would change under the new recommendations. He added that EPA is recommending a new secondary standard for protection against PM related visibility impairment which would include conditions such as haze and smog. The new standard would include a new indicator called light extinction. Mr. Poppen noted that the standard proposes measurement of light extinction by using speciated PM-2.5 mass and relative humidity. He stated that EPA developed Candidate Protection Levels for visibility protection. Mr. Poppen added that the levels could be set at the 20 to 30 deciview range or equivalently between 64 to 191 inverse megameters (Mm^{-1}). Mr. Poppen mentioned that those protection levels would be in combination with a PM-2.5 mass indicator. He noted that it is a complex standard. Mr. Poppen added that the research included in the EPA staff recommendations show that the Phoenix area currently has low light extinction levels as compared to other urban areas.

Mr. Poppen discussed an EPA table which shows the 90th percentile maximum daily one-hour light extinction design values. He stated that the easiest way to interpret this table is by the PM-2.5 mass level values that are along the top of the table and can be set anywhere from 10 to 60 ug/m^3. Mr. Poppen added that a level between 60 and 40 ug/m^3 does not provide much protection for visibility.

He noted that a lot of cities exceed the highest candidate protection level which is 191 Mm^{-1} when mass is set at 60 or 40 ug/m^3. Mr. Poppen indicated that when the mass level is at 10, 20, or 30 ug/m^3, visibility increases and the candidate protection levels are met by more cities. He mentioned that Phoenix already meets many of the visibility levels under the current controls for PM-2.5. Mr. Poppen commented that Phoenix is in better shape than many of the other urban areas studied. He stated that Phoenix only shows visibility improvements beyond current conditions when the PM-2.5 mass is set at the 10 ug/m^3 level. Mr. Poppen added that if EPA decides to implement the standard, Phoenix will be in good shape to meet whichever standard is decided by EPA since visibility is associated more with PM-2.5 than PM-10. He noted that the nitrates and sulfates which primarily diminish visibility are a small fraction of the PM problem in our region.

Mr. Poppen provided a summary of the presentation. He stated that a revised PM-10 standard at any level between 85 to 65 ug/m^3 is more stringent than the current standard in the Maricopa PM-10 nonattainment area. Mr. Poppen added that eight monitors would exceed a revised PM-10 standard at the 85 ug/m^3 level and ten monitors would exceed at the 65 ug/m^3 level. He mentioned that exceptional events will be extremely important given the new form of the PM-10 standard and how frequently the monitors record readings above the proposed levels. Mr. Poppen commented that PM course will become more important as a replacement indicator for PM-10 in the future. He stated that Maricopa County will likely attain a revised 24-hour PM-2.5 standard and may have issues with an annual standard if is set at the lowest level of 11 ug/m^3. Mr. Poppen added that a new secondary standard designed to limit light extinction may be adopted and the Phoenix area will be in good shape to meet that possible standard.

Beverly Chenausky, Arizona Department of Transportation, inquired about a recommendation that high winds would not count as a violation but the value would have to be used to determine the average for three years and be in attainment. She noted that the elevated readings would be used in the design value. Ms. Chenausky stated that it might have been a recommendation from one of the scientists, but she was not sure if it was mentioned in the documents. Mr. Poppen responded that he did not initially see that recommendation in the documents. He added that regions would want those values associated with high winds removed since it would lower their ability to keep readings that are over the EPA limit from reaching the 8th highest value on an annual average.

6. Call for Future Agenda Items

Mr. Person announced that the next meeting of the Committee has been tentatively scheduled for Tuesday, November 30, 2010 at 1:30 p.m. With no further comments, the meeting was adjourned at 2:23 p.m.

Agenda Item #4

MARICOPA ASSOCIATION of GOVERNMENTS

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November 22, 2010

TO: Members of the MAG Air Quality Technical Advisory Committee

FROM: Dean Giles, Air Quality Planning Program Specialist

SUBJECT: EVALUATION OF PROPOSED PM-10 CERTIFIED STREET SWEEPER PROJECTS FOR FY 2011 CMAQ FUNDING

The Maricopa Association of Governments staff has evaluated proposed PM-10 Certified Street Sweeper Projects for emission reductions and corresponding cost-effectiveness for FY 2011 Congestion Mitigation and Air Quality Improvement (CMAQ) Funds. Seven projects requesting approximately $1.27 million in federal funds were received. The evaluation of these projects and supplemental information are included in the attachment. The proposed projects have been listed in order of cost-effectiveness based on the amount of CMAQ funding requested. Following consideration of this information, the MAG Air Quality Technical Advisory Committee will be requested to recommend a prioritized list of PM-10 Certified Street Sweeper Projects for FY 2011 CMAQ funding to the MAG Management Committee.

BACKGROUND

The MAG 2007 Five Percent Plan for PM-10 contains the committed measure "PM-10 Efficient Street Sweepers". The FY 2011 Unified Planning Work Program and FY 2010-2015 MAG Transportation Improvement Program contain $900,000 in FY 2011 CMAQ funding to encourage the purchase and utilization of PM-10 certified street sweepers. An additional $367,855 in CMAQ is available from sweeper projects that have been requested to be deleted and from savings on sweepers that have cost less than anticipated, for a total amount of $1,267,855. The purpose of the CMAQ program is to fund projects and programs in nonattainment and maintenance areas that assist in achieving air quality standards. A minimum local cash match of 5.7 percent on the CMAQ eligible portion of the project is required.

On August 6, 2010, MAG solicited PM-10 certified street sweeper projects in the Maricopa County PM-10 Nonattainment Area from member agencies. Eligible street sweepers are defined as those which have been certified by the South Coast Air Quality Management District as meeting that agency's Rule 1186 certification standards. Project requests were due by September 16, 2010.

EVALUATION AND PROJECT RANKING

According to the Draft FY 2010 MAG Federal Fund Programming Principles, project applications are to be reviewed by the MAG Street Committee. On October 12, 2010, the Street Committee conducted

a review of the PM-10 Certified Street Sweeper project applications. The attachment contains a summary of the discussion from the October 12, 2010 Street Committee meeting.

MAG staff estimated the emission reductions and cost-effectiveness using the CMAQ funding requested, based on a methodology that is consistent with the MAG 2007 Five Percent Plan for PM-10. Federal CMAQ guidance requires that the estimated emission reductions for each project submitted for CMAQ funding be considered during project selection. The FY 2011 PM-10 Certified Street Sweeper Project requests, evaluation, and supplemental information are provided in the attachment. The proposed projects have been listed in descending order of cost-effectiveness based on the amount of CMAQ funding requested.

Following consideration of this information, the MAG Air Quality Technical Advisory Committee will be requested to make a recommendation on a prioritized list of proposed projects for FY 2011 CMAQ funding to the MAG Management Committee. After the MAG Regional Council approval of projects for funding, MAG will issue a formal authorization to proceed with the purchase of the proposed street sweepers in a letter to the project sponsor. To assist MAG in reducing the amount of obligated federal funds, MAG is requesting that street sweepers be purchased and reimbursement be requested by the project sponsor within one year plus ten calendar days from the date of the MAG authorization letter.

If you have any questions or need additional information, please contact me at (602) 254-6300.

Attachment

List of Proposed PM-10 Certified Street Sweeper Projects for FY 2011 CMAQ Funding

$1,267,855 in CMAQ Funding is Available for Sweeper Projects

										Supplemental Information			
						The requested certified street sweeper will:				Have local resources been committed for additional staff or equipment to support the sweeper project?			
Agency	Federal Cost	Local Cost	Total Cost *	Daily Emission Reduction (Kilograms/ day)	Cost-Effectiveness (CMAQ dollar cost per annual metric ton reduced)	Replace non-certified sweeper	Expand	Increase Frequency	Replace older certified sweeper	Yes	No	Please indicate in what geographical area(s) the requested certified street sweeper will operate	Number of certified street sweepers owned and operated by your agency. ++
Phoenix-Central +	$203,432	$12,297	$215,729	120	$663				✔	✔		Camelback Rd north to Pinnacle Peak Rd, 51st Avenue to 72nd Street	36
Phoenix-North	$203,432	$12,297	$215,729	73	$1,085				✔	✔		Shea Blvd to the northern most city boundary, 67th Avenue to 72nd Street	36
Queen Creek +	$83,427	$5,043	$88,470	26	$1,255		✔	✔		✔		Town Center: Ellsworth Loop from Rittenhouse to Empire; Rittenhouse from Hawes to Village Loop; Ocotillo from Hawes to Ellsworth.	4
Scottsdale +	$180,480	$10,909	$191,389	51	$1,380				✔	✔		Pima Road to 64th Street / McKellips Road to Chaparral Road	7
Chandler +	$234,435	$14,171	$248,606	19	$4,774				✔	✔		S. of Frye rd to Chandler Hgts rd & E. of Price rd to Alma School rd. S. of Chandler Hgts rd to Hunt Hwy & E. of Ariz Ave to Valvista rd	10
Mesa +	$218,915	$13,232	$232,147	39	$11,033				✔		✔	Price Rd. to Signal Butte Rd. and Baseline to Thomas	7
Guadalupe	$143,734	$8,688	$152,422	3	$37,133			✔			✔	Avenida del Yaqui, Calle Guadalupe and Residential Streets	1
Total	**$1,267,855**												

* Total cost for the CMAQ eligible portion of the project, excludes ineligible equipment.
\+ Proposed sweeper projects for Phoenix - Central, Queen Creek, Scottsdale, Chandler and Mesa indicate sweeping adjacent to a PM-10 monitor.
++ The total number of certified street sweepers owned and operated by the agency, regardless of funding source.

STREET SWEEPERS

Agency	Issues
Chandler	
Guadalupe	
Mesa	
Phoenix	
Phoenix	
Queen Creek	This cost estimate for the sweeper seemed relatively low in comparison to the others. Is this the correct estimate/cost?
Scottsdale	

Agenda Item #5

MARICOPA ASSOCIATION of GOVERNMENTS

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November 22, 2010

TO: Members of the MAG Air Quality Technical Advisory Committee

FROM: Dean Giles, Air Quality Planning Program Specialist

SUBJECT: EVALUATION OF PROPOSED PM-10 PAVING UNPAVED ROAD PROJECTS FOR FY 2014 CMAQ FUNDING

The Maricopa Association of Governments staff has evaluated proposed PM-10 Paving Unpaved Road Projects for emission reductions and corresponding cost-effectiveness for FY 2014 Congestion Mitigation and Air Quality Improvement (CMAQ) Funds. Fourteen unpaved road, alley, and shoulder projects requesting approximately $9.2 million in federal funds were evaluated. Attachment A provides the proposed projects listed in order of cost-effectiveness based on the amount of CMAQ funding requested. Attachment B provides the proposed projects listed in order of PM-10 emission reductions. Following consideration of this information, the MAG Air Quality Technical Advisory Committee will be requested to rank the PM-10 Paving Unpaved Road Projects for FY 2014 CMAQ funding to be forwarded to the MAG Transportation Review Committee.

BACKGROUND

The paving of dirt roads supports committed measures in the MAG Five Percent Plan for PM-10. An amount of $4,898,000 in FY 2014 CMAQ funding in the FY 2011-2015 MAG Transportation Improvement Program is available for the programming of PM-10 Paving Unpaved Road Projects. A minimum local cash match of 5.7 percent on the CMAQ eligible portion of the project is required. On August 6, 2010, MAG solicited PM-10 Paving Unpaved Road Projects in the Maricopa County PM-10 Nonattainment Area from member agencies. Project requests were due by September 16, 2010.

EVALUATION AND PROJECT RANKING

According to the Draft FY 2010 MAG Federal Fund Programming Principles, project applications are to be reviewed by the MAG Street Committee. On October 12, 2010 the Street Committee conducted a review of the PM-10 Paving Unpaved Road project applications. Attachment C contains a summary of the discussion from the October 12, 2010 and November 16, 2010 Street Committee meetings.

MAG staff estimated the emission reductions and cost-effectiveness using the CMAQ funding requested, based on a methodology that is consistent with the MAG 2007 Five Percent Plan for PM-10. Federal CMAQ guidance requires that the estimated emission reductions for each project submitted for CMAQ

funding be considered during project selection. The evaluation of the proposed FY 2014 PM-10 Paving Unpaved Road Projects is included in Attachment A and Attachment B. In Attachment A, the proposed projects have been listed in descending order of cost-effectiveness based on the amount of CMAQ funding requested. Also, in Attachment B, the proposed projects have been listed in descending order of PM-10 emission reductions.

Following consideration of this information, the MAG Air Quality Technical Advisory Committee will be requested to rank the proposed PM-10 Paving Unpaved Road Projects for FY 2014 CMAQ funding to be forwarded to the MAG Transportation Review Committee. The MAG Transportation Review Committee may consider the PM-10 Paving Unpaved Road Projects in December 2010. The recommendations may be considered by the MAG Management Committee, the Transportation Policy Committee, and the MAG Regional Council in January 2011.

If you have any questions or need additional information, please contact me at (602) 254-6300.

Attachment

Proposed PM-10 Paving Unpaved Road Projects For FY 2014 CMAQ Funding Listed in Order of Cost Effectiveness

Attachment A

$4,898,000 available in FY 2014

Agency	Location	Work Type	FY	Length (miles)	Emission Reduction Weighted TOG(kg/day)	Emission Reduction Weighted NOx(kg/day)	Emission Reduction Weighted PM10(kg/day)	Emission Reduction Weighted Total(kg/day)	Cost Effectiveness ($/met.ton)	CMAQ Funds Requested
Maricopa County	Various Low Volume Roads : White Wing Rd, Cotton Ln to Sarival Ave; 167th Ave, Dixileta Dr to Windstone Tr; 168th Ave, Dixileta Dr to Windstone Tr; Dove Valley Rd, 171st Ave to Sarival Ave; Montgomery Rd, 171st Ave to Sarival Ave	Pave Dirt Roads	2014	4.00	0.00	0.00	345.28	345.28	$596	$1,117,455
Scottsdale	Pave Dirt Roads: Via Dona Rd, Scottsdale Rd to Pima Rd; Hayden Rd, Dynamite to Via Dona; Pinnacle Vista Dr, 64th St to 69th St; Quail Track Dr, 60th St to 62nd St; Windmill Dr, North of Arroyo Honda to south of Stage coach Pass; Peak View (Via Dona), 66th St to 69th St	Pave Dirt Roads	2014	3.74	0.00	0.00	244.96	244.96	$953	$1,267,904
Phoenix	Various alleys located between Cholla St to Sweetwater Ave from 35th Ave to 23rd Ave; Bethany Home Rd to Maryland Ave from 35th Ave to 23rd Ave; and Camelback Rd to Maryland Ave from 7th St to 24th St.	Pave Dirt Alleys	2014	30.20	0.00	0.00	114.78	114.78	$1,659	$1,033,934
Peoria#2	67th Ave, Hatfield Rd to Happy Valley Rd; Jomax Rd, Terrmar Blvd to 83rd Ave; Jomax Rd	Pave Dirt Shoulders	2014	2.92	0.00	0.00	10.97	10.97	$2,501	$149,030
Chandler	In the area bounded by Dobson Rd, Warner Rd, Alma School Rd and Knox Rd, and Alma School Rd, Knox Rd, Arizona Ave and Ray Rd.	Pave Dirt Alleys	2014	12.80	0.00	0.00	48.65	48.65	$2,806	$741,198
Fountain Hills	Fountain Hills Blvd, Segundo Dr to Pinto Dr	Pave Dirt Shoulders	2014	2.30	0.00	0.00	12.81	12.81	$3,671	$255,364
									Subtotal	**$4,564,885**
									Amount Available	**$4,898,000**
									Balance	**$333,115**
Tempe	Evergreen - The area bounded by Broadway Rd, the Price Fwy, Southern Ave, and the eastern city limits	Pave Dirt Alleys	2014	4.54	0.00	0.00	22.43	22.43	$3,958	$482,057
Peoria#1	Various locations on Castle Hot Springs Rd and New River Rd	Pave Dirt Shoulders	2014	23.32	0.00	0.00	44.74	44.74	$4,331	$1,052,186
Tempe	Escalante - The area bounded by University Dr, the Price Freeway, Apache Blvd, and Smith Rd.	Pave Dirt Alleys	2014	1.72	0.00	0.00	8.50	8.50	$4,372	$201,750

Proposed PM-10 Paving Unpaved Road Projects For FY 2014 CMAQ Funding Listed in Order of Cost Effectiveness

Attachment A

$4,898,000 available in FY 2014

Agency	Location	Work Type	FY	Length (miles)	Emission Reduction Weighted TOG(kg/day)	Emission Reduction Weighted NOx(kg/day)	Emission Reduction Weighted PM10(kg/day)	Emission Reduction Weighted Total(kg/day)	Cost Effectiveness ($/met.ton)	CMAQ Funds Requested
Buckeye#2	Various alleys in the area bounded by Monroe Ave/MC85, 1st St, Buckeye Canal, and 7th St.	Pave Dirt Alleys	2014	1.08	0.00	0.00	9.97	9.97	$6,869	$372,000
Buckeye#3	Various alleys in the area bounded by Monroe Ave/MC85, 9th St, Irwin Ave, and 5th St.	Pave Dirt Alleys	2014	1.07	0.00	0.00	8.43	8.43	$7,315	$335,000
Buckeye#1	Various alleys in the area bounded by Monroe Ave/MC85, 7th St, Central Ave, and 1st Ave.	Pave Dirt Alleys	2014	0.89	0.00	0.00	6.75	6.75	$9,282	$340,000
Litchfield Park	Litchfield Rd, Wigwam Blvd to Camelback Rd	Install curb and gutter	2014	1.10	0.00	0.00	3.33	3.33	$16,934	$306,475
Guadalupe	Various Alleys	Pave Dirt Alleys	2014	1.64	0.00	0.00	6.23	6.23	$46,009	$1,557,274
									Total	**$9,211,627**

Proposed PM-10 Paving Unpaved Road Projects For FY 2014 CMAQ Funding Listed in Order of PM-10 Emission Reductions

Attachment B

$4,898,000 available in FY 2014

Agency	Location	Work Type	FY	Length (miles)	Emission Reduction Weighted TOG(kg/day)	Emission Reduction Weighted NOx(kg/day)	Emission Reduction Weighted PM10(kg/day)	Emission Reduction Weighted Total(kg/day)	Cost Effectiveness ($/met.ton)	CMAQ Funds Requested
Maricopa County	Various Low Volume Roads : White Wing Rd, Cotton Ln to Sarival Ave; 167th Ave, Dixileta Dr to Windstone Tr; 168th Ave, Dixileta Dr to Windstone Tr; Dove Valley Rd, 171st Ave to Sarival Ave; Montgomery Rd, 171st Ave to Sarival Ave	Pave Dirt Roads	2014	4.00	0.00	0.00	345.28	345.28	$596	$1,117,455
Scottsdale	Pave Dirt Roads: Via Dona Rd, Scottsdale Rd to Pima Rd; Hayden Rd, Dynamite to Via Dona; Pinnacle Vista Dr, 64th St to 69th St; Quail Track Dr, 60th St to 62nd St; Windmill Dr, North of Arroyo Honda to south of Stage coach Pass; Peak View (Via Dona), 66th St to 69th St	Pave Dirt Roads	2014	3.74	0.00	0.00	244.96	244.96	$953	$1,267,904
Phoenix	Various alleys located between Cholla St to Sweetwater Ave from 35th Ave to 23rd Ave; Bethany Home Rd to Maryland Ave from 35th Ave to 23rd Ave; and Camelback Rd to Maryland Ave from 7th St to 24th St.	Pave Dirt Alleys	2014	30.20	0.00	0.00	114.78	114.78	$1,659	$1,033,934
Chandler	In the area bounded by Dobson Rd, Warner Rd, Alma School Rd and Knox Rd, and Alma School Rd, Knox Rd, Arizona Ave and Ray Rd.	Pave Dirt Alleys	2014	12.80	0.00	0.00	48.65	48.65	$2,806	$741,198
									Subtotal	**$4,160,491**
									Amount Available	**$4,898,000**
									Balance	**$737,509**
Peoria#1	Various locations on Castle Hot Springs Rd and New River Rd	Pave Dirt Shoulders	2014	23.32	0.00	0.00	44.74	44.74	$4,331	$1,052,186
Tempe	Evergreen - The area bounded by Broadway Rd, the Price Fwy, Southern Ave, and the eastern city limits	Pave Dirt Alleys	2014	4.54	0.00	0.00	22.43	22.43	$3,958	$482,057
Fountain Hills	Fountain Hills Blvd, Segundo Dr to Pinto Dr	Pave Dirt Shoulders	2014	2.30	0.00	0.00	12.81	12.81	$3,671	$255,364
Peoria#2	67th Ave, Hatfield Rd to Happy Valley Rd; Jomax Rd, Terrmar Blvd to 83rd Ave; Jomax Rd	Pave Dirt Shoulders	2014	2.92	0.00	0.00	10.97	10.97	$2,501	$149,030
Buckeye#2	Various alleys in the area bounded by Monroe Ave/MC85, 1st St, Buckeye Canal, and 7th St.	Pave Dirt Alleys	2014	1.08	0.00	0.00	9.97	9.97	$6,869	$372,000
Tempe	Escalante - The area bounded by University Dr, the Price Freeway, Apache Blvd, and Smith Rd.	Pave Dirt Alleys	2014	1.72	0.00	0.00	8.50	8.50	$4,372	$201,750

Proposed PM-10 Paving Unpaved Road Projects For FY 2014 CMAQ Funding Listed in Order of PM-10 Emission Reductions

Attachment B

$4,898,000 available in FY 2014

Agency	Location	Work Type	FY	Length (miles)	Emission Reduction Weighted TOG(kg/day)	Emission Reduction Weighted NOx(kg/day)	Emission Reduction Weighted PM10(kg/day)	Emission Reduction Weighted Total(kg/day)	Cost Effectiveness ($/met.ton)	CMAQ Funds Requested
Buckeye#3	Various alleys in the area bounded by Monroe Ave/MC85, 9th St, Irwin Ave, and 5th St.	Pave Dirt Alleys	2014	1.07	0.00	0.00	8.43	8.43	$7,315	$335,000
Buckeye#1	Various alleys in the area bounded by Monroe Ave/MC85, 7th St, Central Ave, and 1st Ave.	Pave Dirt Alleys	2014	0.89	0.00	0.00	6.75	6.75	$9,282	$340,000
Guadalupe	Various Alleys	Pave Dirt Alleys	2014	1.64	0.00	0.00	6.23	6.23	$46,009	$1,557,274
Litchfield Park	Litchfield Rd, Wigwam Blvd to Camelback Rd	Install curb and gutter	2014	1.10	0.00	0.00	3.33	3.33	$16,934	$306,475
									Total	**$9,211,627**

Project: Buckeye #1

Applicant	Buckeye
Project	Pave Dirt Alleys - Group One

Presentation

Scott Lowe, Public Works Director, did one presentation on three applications for paving dirt alleys. Each application totals about a mile of alleys. All alleys are located in the downtown historic area. The alleyways are mainly utility and residential. The garbage collection no longer takes place in the alley. They do have water and sewer running through the alley. The PM-10 monitor is about a mile away.

Questions & Discussion

A question was raised on why there were three separate applications. Buckeye explained that it is much easier to lead three different projects. They feel that it would inconvenience their residents if all of the alleys were disrupted at once. As far as priority, it follows the names of the applications: one, two, three.

Questions #2: Are there utilities located in the alley, and are they owned by the Town? The underground utilities of natural gas, irrigation, and water & sewer, are owned by the Town and the gas line is owned by SW Gas. The City of El Mirage just went through a paving alley project and ran into problems with the utility depths.

Has the Town of Buckeye evaluated the depths of the utilities? Buckeye does know the location of all of the utilities and we can make determinations if they are in good enough shape to go through paving construction. They believe that the alleys are in good condition since utility trucks use the alley at the moment.

What do you think the lifecycle of the 2 inch concrete on native? Buckeye feels pretty confident on a long lifecycle due to the nature of the native soil being.

All three applications total 48 segments? That is correct. Additional information provided by MAG Staff: each application will be reviewed and scored by the AQ TAC individually.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Buckeye #2

Applicant	Buckeye
Project	Pave Dirt Alleys - Group Two

Presentation

Scott Lowe, Public Works Director, did one presentation on three applications for paving dirt alleys. Each application totals about a mile of alleys. All alleys are located in the downtown historic area. The alleyways are mainly utility and residential. The garbage collection no longer takes place in the alley. They do have water and sewer running through the alley. The PM-10 monitor is about a mile away.

Questions & Discussion

A question was raised on why there were three separate applications. Buckeye explained that it is much easier to lead three different projects. They feel that it would inconvenience their residents if all of the alleys were disrupted at once. As far as priority, it follows the names of the applications: one, two, three.

Questions #2: Are there utilities located in the alley, and are they owned by the Town? The underground utilities of natural gas, irrigation, and water & sewer, are owned by the Town and the gas line is owned by SW Gas. The City of El Mirage just went through a paving alley project and ran into problems with the utility depths.

Has the Town of Buckeye evaluated the depths of the utilities? Buckeye does know the location of all of the utilities and we can make determinations if they are in good enough shape to go through paving construction. We believe that they are in good condition since utility trucks use the alley at the moment.

What do you think the lifecycle of the 2 inch concrete on native? Buckeye feels pretty confident on a long lifecycle due to the nature of the native soil being.

All three applications total 48 segments? That is correct. Additional information provided by MAG Staff: each application will be reviewed and scored by the AQ TAC individually.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Buckeye #3

Applicant	Buckeye
Project	Pave Dirt Alleys - Group Three

Presentation

Scott Lowe, Public Works Director, did one presentation on three applications for paving dirt alleys. Each application totals about a mile of alleys. All alleys are located in the downtown historic area. The alleyways are mainly utility and residential. The garbage collection no longer takes place in the alley. They do have water and sewer running through the alley. The PM-10 monitor is about a mile away.

Questions & Discussion

A question was raised on why there were three separate applications. Buckeye explained that it is much easier to lead three different projects. They feel that it would inconvenience their residents if all of the alleys were disrupted at once. As far as priority, it follows the names of the applications: one, two, three.

Questions #2: Are there utilities located in the alley, and are they owned by the Town? The underground utilities of natural gas, irrigation, and water & sewer, are owned by the Town and the gas line is owned by SW Gas. The City of El Mirage just went through a paving alley project and ran into problems with the utility depths.

Has the Town of Buckeye evaluated the depths of the utilities? Buckeye does know the location of all of the utilities and we can make determinations if they are in good enough shape to go through paving construction. We believe that they are in good condition since utility trucks use the alley at the moment.

What do you think the lifecycle of the 2 inch concrete on native? Buckeye feels pretty confident on a long lifecycle due to the nature of the native soil being.

All three applications total 48 segments? That is correct. Additional information provided by MAG Staff: each application will be reviewed and scored by the AQ TAC individually.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Chandler

Applicant	Chandler
Project	Pave Dirt Alleys - 2 segments

Presentation

Luis Gamez from the City of Chandler made the presentation. The application is a request to pave 12.8 miles of dirt alleys. The closest PM-10 monitor is about 2.8 miles away from the alleys. The plan is to remove 4 inches of native, and then do 4 inches of asphalt millings, then do an asphalt mix to solidify the surface. The city does own the utilities and ROW. The ADT mainly consists of utility, city vehicles, and some residents. The City of Chandler normally does this type of paving alleys, and this is the first time they are asking for funding for this kind of project.

Questions & Discussion

The Town of Guadalupe indicated that they are interested in doing this type of paving with asphalt millings. Guadalupe was wondering if the Town is awarded less money, can they do something like this? Chandler explained that for a number of years that they have used left over asphalt millings to address dust. This project will go beyond that and use the asphalt as well and result in the paving of the alleys to be in place for a number of years.

Guadalupe asked if federal funds could be used to purchase just millings? It was clarified that CMAQ funds can only be used for paving, and not maintenance nor stand alone millings or gravel.

Chandler was asked if they could still do a portion of the project since it contained 2 segments with less money? Chandler responded that they could do a smaller amount of miles if a smaller amount of funding was approved.

It was noted that there is money allocated to design, is this necessary? Chandler recognized that through the federal process, documentation of design, ROW, utility, and Environmental has to be done, and the costs are related to that.

Is the cross section appropriate for the utility vehicles? Chandler believes that since it's an alley, it is appropriate, and recognizes that there could be cracks once it settles and is used.

Another question was raised on why Chandler isn't suggesting to go to full pavement? Do you have the cost breakdown of this paving method? Chandler didn't know at the time of the committee meeting, but stated that for the cost, they could get about 12-13 miles, whereas if they were doing a traditional asphalt mix, the cost would be much higher.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

MAG Staff verified the ADT for the proposed project, and it was changed from 50 to 10.

Project: Fountain Hills

Applicant	Fountain Hills
Project	Pave Shoulder: Fountain Hills Boulevard

Presentation

Randy Harrell from the Town of Fountain Hills. The request is to pave shoulders on Fountain Hills Blvd. About 1.4 miles of shoulders on both sides. The segment starts at Pinto Drive (just north of Shea Blvd) up to Segundo by the Town center. This road is quite steep in places, 12% at times. We have used gravel and millings, but through rain, they end up in the wash. This is also a high recreation corridor for bicyclists. We are not planning to add bike lanes at this time. The cross section is 2 inches on native since the millings and soil are pretty compact as it is.

Questions & Discussion

There were no questions or comments from the committee.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Guadalupe

Applicant	Guadalupe
Project	Pave Dirt Alleys

Presentation

Frank Fletez, from Tri-Core Engineering (the Town's hired Engineering Company) presented. The application consists of 9 segments/alleys all converging on Calley Guadalupe. We are not expecting any problems with ROW or Environmental. There are pole utilities in some of the alleys. These are mainly SRP lines; there may need to be adjustment of power boxes. Paving of these alleys, will also compliment the current project that is paving access points on Calle Guadalupe, and reduce the amount of debri and dust coming onto the main road. The Town has been active providing some millings, but there is just not enough. It is noted that the Town of Guadalupe is heavily pedestrian. Paving the alleys go along way not only to reduce the dust, but in the quality of life of the residents.

Questions & Discussion

It was commented that the costs of the project seem relatively high; these are twice as high as Buckeyes. The cross section in the application is noted as 2 inches of AB on 6 inches of AB.

Would/Can the Town of Guadalupe consider paving on native? We can consider revising the cross section. The Town has used the most recent information they have received from ADOT.

It was noted that the application states that the matching funds are currently not in the Town's CIP. Will the funds be programmed if awarded? If the Town recieves funding, the funds would then be programmed in the CIP.

11/16/2010 Street Committee Meeting

The representative from the Town of Guadalupe acknowledged that the project was costly relative to other alley paving projects, but indicated that the Town wished to go forward throught the selection process with the application as submitted.

Outstanding questions needing information for November meeting

MAG staff noted that if the Town needs to revise cost and/or cross section from the Street Committees comments and questions, they can do so.

Guadalupe is leaving the proposed project as is.

Project: Litchfield Park

Applicant	Litchfield Park
Project	Pave Shoulder: Litchfield Road: Wigwam Boulevard to Camelback Road

Presentation

Paul Ward, the contracted City engineer for Litchfield Park presented that the application request is for 1.1-1.2 miles of paving curb and gutter. This is an ex-Maricopa County road, originally built as a rural road with no curb and gutter. The City put in curb and gutter on the west side of the road, but not on the east side. It is noted that there is a meandering sidewalk on the east side. The pavement edge of the road is damaged, and what is happening is that vehicles drive on the side shoulder and then track dirt back onto the roadway. The ADT for Litchfield Park Rd is 17,500. The situation of vehicles tracking out dirt onto the road, then having other vehicles kick the dirt back up in the air, this is what we want to avoid. The better option to install curb and gutter on the edge of the roadway, and leave the dirt sholder as is.

Questions & Discussion

Has the paving program ever funded a stand alone curb and gutter project? We have funded other paving projects that have curb and gutter as a part of the project. MAG will verify with FHWA on the eligibility.

It was commented that the AQ TAC would most likely have to modify a unit in their cost benefit analysis for CMAQ funds. Litchfield Park noted that the benefit from doing curb and gutter is similar in nature of paving dirt shoulders from a track out perspective.

If FHWA doesn't allow the curb and gutter, would the City want to do paving of the shoulder. The City responded in that no, if it's not allow, the City does not want to pave the dirt shoulder.

11/16/2010 Street Committee Meeting

It was indicated that FHWA staff had determined that adding curb and gutter was eligible for CMAQ funding, so the project can move forward through the project selection process. It was also noted that the, the lack of a curb and gutter on one side of the road was inherited by the City when the roadway was tranfered to the City from Maricopa County.

Outstanding questions needing information for November meeting

MAG Staff has verified that a stand alone curb and gutter project is CMAQ eligible.

Project: Maricopa County

Applicant	Maricopa County
Project	Pave Dirt Roads - 5 Segments

Presentation

Tamika Simmons, the Regional Project Coordination for MCDOT presented. It was noted that the original presenter for Maricopa County went home sick, and Tamika was filling in, and would gather the questions from the Committee to MCDOT for answers. MAG staff aided in the presentation of the application. The total milage for 5 segments total 4 miles for the paving dirt roads. The ADT is 205 on each segment completed by a standard tube count. The County does own the ROW for the roads. The cross section is 2 inches of AC on native. The total budget for construction is $950,000 for about 4 miles of unpaved roads.

Questions & Discussion

Can the County review the 205 ADT that is listed as the same for each different segment/street?

There is a $100,000 listed for ROW. MCDOT responsed that it was believed that the ROW was needed for two segments.

The Town of El Mirage commented that the committee process needs to consider if the region wants to fund projects that need to purchase ROW.

A question was posed asking Maricopa County if they had an ordinance about private developments in the County creating dirt roads? If public policy is not in place to address limiting creation of private paving dirt roads, why should the region continue to fund paving of the dirt roads. Maricopa County commented that they are working on this issue in the agency, and noted that the roads in this application are not private; they are public.

It is noted that utilities is a significant portion of the overall budget and is more than design. This causes concern of the viability of the project.

11/16/2010 Street Committee Meeting:

Maricopa County provided revised traffic count information for all segments submitted in their application. It was indicated by th County that the project might require some minor right-of-way acquisitions, but this was expected to be very small - in the range of $100,000. It was also noted that the County had been paving dirt roads with CMAQ funds for a numbe of years and had found that that the standard costs used to be stable and reliable.

Outstanding questions needing information for November meeting

Can the County review the 205 ADT that is listed as the same for each different segment?

The County modified the ADT per segment.

Project: Peoria 1

Applicant	Peoria
Project	Paving Dirt Shoulders, Project 1 - Highways & Recreation Corridor

Presentation

Janet Ramsey, Public Works Dept. There are 2 segments in application #1. These are old county roads, and have little or no shoulders. The AWDT doesn't encompass the traffic on the weekend use. There is high number of users/vehicles that use the roads and also pull off the road. There are no utility conflict and we own all of the right of way. Additionally, in the cross section, it mentions 12 foot shoulders in the application. That is a mistake and it should be 5 foot shoulders.

Questions & Discussion

There were no questions or comments from the committee.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Peoria 2

Applicant	Peoria
Project	Paving Dirt Shoulders, Project 2 - Rural – Arterial Roads.

Presentation

Janet Ramsey, Public Works Dept. Project application #2 has non contiguous paving shoulder needs. The project on 67th Avenue is on the west side only, and the AWDT is 26,549 as of a 2008 engineering count. The AWDT is expected to be at this level and may rise with the opening of Happy Valley Rd. Segment #2 - Jomax Rd on the southside. There is no eminent development and no development on this side. Segment #3 is Jomax Rd from 103rd Drive heading West to Lake Pleasant Parkway. There is no potential for development at this time. There are large trucks and pullout traffic. The AWDT is realatively low, but this is an area with pullout problems.

Questions & Discussion

There were no questions or comments from the committee.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Phoenix

Applicant	Phoenix
Project	2014 CMAQ Alley Dust Proofing

Presentation

Chris Turner-Noteware, Civil Engineer in the Streets Department gave the presentation. The City of Phoenix annually allocates $800,000 for paving/dust-proofing alleys and roads. To date, Phoenix has paved over 426 miles of alleys, and there is still over 300 miles to be paved. Phoenix is submitting the application to continue the commitment to dustproof the alleys in the City. The 15 sements are divided into quarter mile sections; this application proposes paving 30.4 miles of alleys. The average distance from an AQ monitor is 2.9 miles, please note 5.1 miles are within 2 miles of a monitor. The typcial alley cross section is 11 feet wide, and proposes 3/4 inch Fractured Aggregate Surface Treatment (FAST), utilizing rubberized asphalt and precoated chips applied to compacted native. The AWDT is 10 vehicles per day. There is no utility, ROW, and environmental concerns at the time. The design is proposed to occur in 2012 for $60,000 of local funds. And construction in 2014 and uses $600,000 in local and $1,000,000 of requested federal funds. It is noted that the application requires a 15% construction administration (CA), and from the last 3 CMAQ projects the city self-administered, the CA averaged 1.3%. The City of Phoenix is committed to continue to work on the PM-10 issue. The city also chose to do a large project and application since they have received lower prices with the economy of scale.

Questions & Discussion

A question was raised by a non-certified agency if they could contract with the City of Phoenix rather than ADOT local governments in light of their construction administration costs? The local agency raised concern about design and construction administration requirements and fees (20% Design costs) from the ADOT Local Government section.

What is the lifespan of the treatment? At least 10 years.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Scottsdale

Applicant	Scottsdale
Project	Pave Unpaved Roads

Presentation

Jeremy Dye, Street Operations Manager, presented the application to pave 3.7 miles of unpaved roads. There are 6 segments totalling $1.4 million dollars. Each segment was selected as they are optimal roads concerning ROW, utilities, and ADT. Currently, each segment is part of the dust palative program, which is applied 4 times a year. The treatment degrades throughout the year depending on the weather. This pavement would eliminate the cost of upkeep. The ADTs were collected by tube counts. Once they are paved, they would be added to the pave road maintenance program. This would also help address the dust complaints we have in this area.

Questions & Discussion

What does the cross-section look like? We are planning on 3 inches of 1/2 inch of conventional asphalt on 6 inches of sub-grade material.

It was noted that the locations of the projects look quite far away from a monitor. They were 21 miles away from the nearest monitor.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Surprise

Applicant	Surprise
Project	Pave Unpaved Shoulders at various locations

Presentation

Nick Mascia, City Engineer - Public Works Dept, presented on 2 dirt roads that meet at a 90 degree angle. These are just NW of Grand Avenue. 1/4 mile in total length - Carlin and Mountain View Roads. Mountain View road is a commercial collector and Carlin Road comes out of subdivision traffic. These are used to access the commercial businesses off of Grand. This is 1 1/2 miles away from one of the PM-10 monitors. The traffic impact study suggested 90 ADT for these roads. The access used is from Sun City Grand. The ROW for Carlin is owned by the city, while Mountain View is not, this would need to be acquired.

Questions & Discussion

The ROW poses question on if we want these funds to be used for ROW. The city plans to acquire Mountain View with local funds.

It was pointed out that the pictures of the road look more like a dirt lot, and not a road.

What was the cross section the City is proposing to build? It looks as if Mountain View Rd has a median? Carlin will not have curb gutter, Mountain View would have the median and no curb and gutter.

Will you modify the cross section to what you are speaking about?

The road improvements are adjacent to future commercial development; does MAG/the region fund roadways that are currently not built due to development/commercial building. We normally block/barricade/install ditches on the roads where they dead end, and are not used due to gaps in developing the roads. Would this even qualify for these funds because it looks like this is new construction and not paving unpaved roads?

Surprise has barricaded and blocked traffic, but residents still find a way around.

El Mirage pointed out that they too have the same situation, and gaps have remained for 5 years.

Can you talk more about the current use of Carlin? Carlin Dr is a public road in the subdivision, but deadends at Mountain View.

These lots are obviously vacant, is the development going to construct the road? Surprise has talked with the owners and they have no intention of building the roads or developing the site in the near future. A Street Committee member echoed the concerns of constructing/paving a road that is part of a developers responsibility.

MAG Staff asked a question that if you were to go out there today, a person could actually drive on the unpaved road? Surprise responded that yes, you can see the tracks and they have tried barricades in the past.

What is the cross section of the north section of Mountain View road? 2 lane 2. From our understanding, you can not pave 4 lanes as it would be adding lane capacity, and that is not CMAQ eligible.

Surprise noted that they could pave the roadways and stripe it to 1 lane in each direction.

<u>11/16/2010 Street Committee Meeting:</u>

<u>It has been determined that the project is not eligible for CMAQ funding as the surface to be paved does not conform to the FHWA defintion of a public road, hence</u>

Outstanding questions needing information for November meeting

MAG Staff will work with FHWA to deterimine eligibility.

MAG Saff did a site visit on Friday, October 15, 2010 to review the current conditions. After the site visit and review by FHWA, it was determined that this proposed project is not eligible for CMAQ funding.

Application was removed from the process prior to the 2nd Street Committee meeting.

Project: Tempe 1

Applicant	Tempe
Project	Escalante Neighborhood Alley Stabilization

Presentation

Toby Crooks, Civil Engineer in the Streets Dept, presented. The City of Tempe has a paving alley program that uses reclaimed asphalt has a Tempe. Therea are 2 applications. The Escalante neighborhood is 2.1 miles away from a PM10 monitoring station. The typical width of the alley is 16 feet; it's wall to wall. The applications states that we will be removing 1-2 inches, and actually we will be removing 3-4 inches of dirt as the cross section indicates. It also states that we are contributing $50,000, but we are actually contributing $5,000 - it's a type - and the math still calculates to the total listed in the application. The typical cross section is 3 - 4 inches of reclaimed asphalt with emulsion polymer ontop. The typical traffic is trash trucks, utilities, sewer, and residents and landscapers. The Evergreen neighborhood is the same process; it is only 1.4 miles away from the monitor.

Questions & Discussion

A question was raised if they needed both projects to move forward? Tempe answered that they submitted 2 individual applications, and both are not needed to do the projects individually.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Project: Tempe 2

Applicant	Tempe
Project	

Presentation

Toby Crooks, Civil Engineer in the Streets Dept, presented. The City of Tempe has a paving alley program that uses reclaimed asphalt has a Tempe. Therea are 2 applications. The Escalante neighborhood is 2.1 miles away from a PM10 monitoring station. The typical width of the alley is 16 feet; it's wall to wall. The applications states that we will be removing 1-2 inches, and actually we will be removing 3-4 inches of dirt as the cross section indicates. It also states that we are contributing $50,000, but we are actually contributing $5,000 - it's a type - and the math still calculates to the total listed in the application. The typical cross section is 3 - 4 inches of reclaimed asphalt with emulsion polymer ontop. The typical traffic is trash trucks, utilities, sewer, and residents and landscapers. The Evergreen neighborhood is the same process; it is only 1.4 miles away from the monitor.

Questions & Discussion

A question was raised if they needed both projects to move forward? Tempe answered that they submitted 2 individual applications, and both are not needed to do the projects individually.

Outstanding questions needing information for November meeting

All questions were answered at the first Street Committee meeting.

Agenda Item #6

U.S. Environmental Protection Agency (EPA) Responses to Maricopa Association of Governments (MAG), Maricopa County Air Quality Department, and Arizona Department of Environmental Quality (ADEQ) Questions Regarding a Revised 189(d) Plan for the Maricopa PM-10 Nonattainment Area

Below we respond to questions posed to EPA by MAG, Maricopa County, and ADEQ in recent emails[1]. Please note that we respond to these questions in the context of an open rulemaking on the Maricopa County (Phoenix) PM-10 Nonattainment Area; Serious Area Plan for Attainment of the 24-Hour PM-10 Standard; Clean Air Act Section 189(d). Therefore, to the extent that these questions implicate that action, we are necessarily circumspect in our responses. Moreover, because most of the questions involve a hypothetical future plan, we may need to revise or expand our responses when more of the technical bases for such a plan have been developed. In other words, while these responses are intended to provide guidance to MAG and ADEQ at this preliminary stage of the development of a replacement plan under CAA section 189(d), they cannot be considered to be exhaustive or immutable.

In reviewing state implementation plan (SIP) submittals, it is EPA's role to approve state choices, provided they meet the requirements of the Clean Air Act (CAA) and applicable regulations. It is the state's responsibility to identify the necessary mix of control measures and programs intended to, among other CAA requirements, achieve timely attainment of air quality standards. As part of this process, the state is also required to hold a public hearing and determine appropriate responses to comments they received prior to submitting the SIP to EPA for action. While EPA can provide input regarding the CAA and EPA regulations and guidance during the SIP development process, we cannot otherwise direct the state to make specific choices or take specific actions.

Maricopa County Air Quality Department submitted two questions. EPA believes that our responses to MAG and ADEQ address Maricopa County's questions as well.

MAG Questions

1. What would be the earliest attainment year acceptable to EPA? What are Jan Taradash's ideas for extending the year of attainment?

   As stated in our proposed action on the 189(d) plan, the current attainment deadline is as expeditiously as practicable, but no later than June 6, 2012. [75 FR 54813-54814]. EPA has the authority under CAA section 172(d)(3) to extend that deadline for up to 5 additional years "considering the severity of nonattainment and the availability and feasibility of pollution control measures." When proposing an expeditious attainment date it is important for the State to consider that there can be no more than three exceedances at any one

[1] See email from Lindy Bauer, Maricopa Association of Governments to Colleen McKaughan dated September 21, 2010 with attachments and email from Eric Massey, Arizona Department of Environmental Quality to Colleen McKaughan dated October 1, 2010 with attachments. Responses to two questions in email from Jo Crumbaker, Maricopa County Air Quality Department, dated October 4, 2010, have been incorporated into responses for MAG and ADEQ.

monitor over a three-year period in order to show attainment. [40 CFR Part 50, Appendix K]. Thus there must be 3 years of clean data prior to the attainment date.

2. Should we continue to use 2007 emissions as the base year for the five percent per year calculations?

   Assuming you are asking what year the 5% emission reductions must begin, under CAA section 189(d), the annual 5% reductions of PM-10 or PM-10 precursors begin upon the date of submittal of the replacement plan. If the goal is to submit a replacement plan in early 2011, then the reductions need to begin in 2011.

3. Do any changes need to be made to MCAQD's 2008 Periodic Emissions Inventory for PM-10, June 2010 (2008 PEI)?

   There are three issues that need to be addressed in the 2008 PEI before it is used as the basis for a plan:

   Vacant land inventory: The vacant land inventory is based on MAG land use data. It is unclear what methodology MAG used to develop this data. These land use assumptions are essential to the accuracy of the windblown dust inventory and therefore to developing a strategy to attain the PM-10 standard on days with elevated winds. Clark County, Nevada has a comprehensive document explaining how their vacant land inventory was developed and verified. A similarly detailed effort would ensure the most accurate possible data for understanding the sources of windblown dust in the Maricopa area.

   Road dust emissions: EPA has proposed a new method for calculating PM-10 emissions from paved roads.[2] EPA's preliminary analysis indicates that this method results in significantly lower estimates of emissions of PM-10 from travel on paved roads. This new method should be carefully evaluated by Maricopa County Air Quality Department, MAG and ADEQ to determine if it is more representative of conditions in Phoenix than the method used in the 2008 PEI and in the conformity analysis for the recently updated transportation plans. If it is more representative, then it should be used rather than the method currently in AP-42. It is important to note, however that EPA must finalize this method and announce that it is an approved method in the Federal Register before states can use it for conformity purposes.

   Rule effectiveness calculation methodology: The Maricopa County Air Quality Department has not made the case that it is appropriate to use qualitative factors to estimate rule effectiveness for source categories that have significant compliance data readily available (e.g., earth moving sites, non-metallic mineral sites, vacant lots). The relevant EPA guidance[3] states that these qualitative factors are applicable only when sufficient data on sources is not available. Given the large number of inspections of sources subject to

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[2] See http://www.epa.gov/ttnchie1/ap42/ch13/

[3] "Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations." EPA-454/R-05-001, November 2005.

MCAQD Rules 310, 310.01 and 316, it appears that sufficient data is available and actual compliance data should be used.

4. Should the base year emissions be adjusted to be consistent with the 2008 PEI?

   Once the concerns addressed in our response to question #3 above have been addressed, the 2008 PEI should be the basis of the 2011 inventory from which the 5% per year reductions are taken. (Assuming the plan is submitted in early 2011.)

5. Can we use the same base case design days used in the 2007 Plan when we re-model the new attainment year?

   It would be acceptable to use the same base case design days in the new plan. Instead of developing new base case design days, efforts should be focused on developing an accurate temporally and spatially resolved controlled case for the attainment demonstration.

6. Can we continue to use AERMOD for modeling attainment in the Salt River Area and rollback for the other attainment demonstrations?

   Yes, but it is important that MAG and Region 9 agree upon a modeling protocol before the modeling begins.

7. Do we need to show an equivalent of one year's RFP as contingency credit for each year (i.e., 2007 through the attainment year) or can we show this credit only for future years (i.e., 2011 through the attainment year)?

   Assuming you are asking if you need to include contingency measures for past years or future years, it needs to address only future years. The new plan must show reductions in excess of what is needed for the reasonable further progress (RFP) milestone years and attainment year.

8. Does the modeling domain for the high wind day (i.e., February 15, 2006) need to be expanded?

   It may be appropriate to expand the domain for the high wind day, given that the W. 43rd Avenue monitor is relatively close to the current modeling domain boundary and given the land use differences just outside the current domain. This kind of issue should be worked out through discussions with EPA on the modeling protocol.

9. What milestone years should be assumed in demonstrating RFP?

   See our answer to question #7 and the General Preamble Addendum at 59 FR 42016. The current plan's RFP line starts from 2007, the submittal year, with the only milestone three years later in the attainment year (2010). A similar approach would work for the new plan, although it is possible that additional milestone years will be required in the new plan.

10. Since there is an EPA-approved BACM analysis in the Serious Area PM-10 Plan, what is the regulatory basis for preconditioning approval of the revised plan on an "analysis of BACM controls in other geographic areas"?

The statement on p. 54820 of the notice of proposed rulemaking simply recognizes that because the area cannot attain by 2010, additional measures will be needed. The reference to best available control measures (BACM) is common sense—when assessing additional measures, the State should be considering such measures adopted in other nonattainment areas. As stated in our proposed action, we could however effectively "precondition" approval on certain measures as authorized by CAA section 179(d)(2) which provides that, following the failure of an area to attain, the subsequent SIP revision "shall include such additional measures as EPA may reasonably prescribe, including all measures that can be feasibly implemented in the area in light of technological achievability, costs, and any non-air quality and other air quality-related health and environmental impacts."

11. The 53 committed control and contingency measures in the 2007 Five Percent Plan address all major sources of PM-10 emissions; what other measures need to be added for the Plan to be approvable?

Measures may need to be added that ensure the area will expeditiously attain the standard. The determination of new or strengthened measures should be derived from an analysis of the causes of the continuing exceedances and an assessment of feasible controls for the sources responsible.

12. Will EPA be providing comments on the Supplemental Exceptional Event submissions for the 4 days in 2008 that are currently out for public comment? If the information submitted is found to be acceptable in providing a basis for approving the exemption requests for these days, would it influence any of the 5% Plan disapprovals? How does EPA plan to address the 2009 days flagged as Exceptional Events?

Yes, EPA will address any information supplied to us as a comment on our proposed action. Even if we were to agree with these four exceptional events claims, there are still significant issues that need to be resolved with the rest of the current 5% Plan.

We have not yet received any documentation for the 2009 exceptional event claims.

13. We are very concerned with the short time period between the September 3, 2010 proposed action and the January 28, 2011 final action. What showing would the State of Arizona have to make to extend the current January 28, 2011 deadline?

Response will be provided next week.

14. On May 25, 2010, EPA prepared a document, Phoenix PM-10 Plan: Transportation Conformity Implications and Timelines. In our description of the conformity freeze, EPA indicated that "The MVEB submitted in the new 5% plan should be consistent with both the RFP and attainment demonstrations. Note that EPA can act on the RFP budgets separately from the attainment budgets if the attainment target set in the plan is deemed adequate. If the State can develop an

RFP plan that meets EPA requirements, this approach allows for transportation planning to continue while EPA and the State work to resolve concerns about the attainment demonstration." Please describe how this would work and what it would mean. What is the earliest point in the process that EPA could find a new budget adequate and lift the conformity freeze?

Response will be provided next week.

15. When MAG submits a revised Five Percent Plan with a new conformity budget, would EPA be able to issue an adequacy finding within 90 days or would the conformity budget have to be approved as part of the Plan approval?

    When Arizona submits a revised 5% plan, EPA will review the submitted MVEB to see if it is consistent with the requirements of the Clean Air Act. If it is consistent, EPA will propose to find it adequate. This process typically takes between 90 and 120 days.

16. How long will it take EPA to take action on the revised Five Percent Plan after it is submitted?

    Response will be provided next week.

17. Does the 5% PM-10 annual emission reduction requirement extend indefinitely until there are three years of ambient measurements without a violation of the PM-10 NAAQS?

    Yes. Section 189(d) of the Clean Air Act requires 5% reductions in PM-10 or PM-10 precursors from the date of plan submission until the standard is attained.

ADEQ Questions

<u>GENERAL</u>

1. Is this Serious Area eligible for a 5-year extension for the attainment deadline pursuant to Clean Air Act Sections 172(a)(2) "considering the severity of nonattainment and the availability and feasibility of pollution control measures," and 188(e) due to "the nature and extent of nonattainment, the types and numbers of sources or other emitting activities in the area (including the influence of uncontrollable natural sources...) and the technological and economic feasibility of various control measures"?

   See the response to MAG question number 1 for response with respect to Section 172 (a)(2). We do not believe any additional extensions are permissible under 188(e).

2. What is the first milestone year by which RFP should be demonstrated as required by Section 110(c): 3 years after 2007? Or the third year of control measures required by the Revised Plan?

   See the response to MAG question number 9.

3. If EPA were to prescribe other control measures pursuant to CAA Section 179(d)(2) what would EPA prescribe to ensure the Plan is approvable?

See response MAG question number 10.

4. Would the Emissions Budget for all source categories have to be completed in order for EPA to make an adequacy finding for the Motor Vehicle Emissions Budget (MVEB)?

   The budgets must meet all of the adequacy criteria contained in the conformity rule. (40 CFR 93.118(e)(4)). In order to meet 40 CFR 93.118(e)(4)(iv) the plan must address all emission categories. In addition, the EPA must ensure that the MVEB is consistent with the attainment, RFP and 5% reduction demonstrations.

5. Does EPA have examples of descriptions used by other jurisdictions to demonstrate the State's ability to implement enforcement of the statutory provisions that EPA identified in the partial approval/disapproval? EPA specifically identified A.R.S. §§ 49-457 (Agricultural Best Management Practices [Ag BMP] program), -457.01 (Leaf blower restriction/training), -457.03 (Off-road vehicles) and -457.04 (Off-highway vehicle [OHV] and all-terrain vehicle dealers, etc.).

   States and responsible local agencies must demonstrate that they have the legal authority to adopt and enforce provisions of the SIP and to obtain information necessary to determine compliance. SIPs must also describe the resources that are available or will be available to the state and local agencies to carry out the plan, both at the time of submittal and during the 5-year period following submittal. The 189(d) plan submitted by MAG and ADEQ in 2007 does a good job of identifying the legal authority for the entities responsible for implementing control measures. The plan also does a good job describing the resources available to carry out <u>some</u> of the control measures. For example, measures implemented by local jurisdictions typically include a section entitled "Level of Personnel and Funding Allocated for Implementation". This type of information should be provided for all control measures.

<u>AGRICULTURAL BEST MANAGEMENT PRACTICES</u>

6. In an April 14, 2010, letter to the Agricultural Best Management Practices (Ag BMP) Committee Chairman Dan Thelander, EPA recommended that the Ag BMP Committee continue considering modifications to the "cropland" BMP category. Can EPA specify if it was referring to land leveling, transplanting and the shuttle system as additional BMPs? Alternatively, was EPA pointing out that that all of the current BMPs need re-examination to ensure that there is sufficient specificity for the purposes of enforceability and that the measures are implemented at a BACM level?

   Our April 14, 2010 letter advised the Ag BMP Committee "to continue considering modifications to the portions of the Maricopa BMP Rule that apply to cropland." Our intent was to broadly refer to all the existing requirements in the rule that apply to cropland and areas associated with cropland. We advised the Committee to consider modifications to existing requirements since, as stated in the April 14, 2010 letter, "several other areas have developed rules to control PM10 from agricultural sources since the Environmental Protection Agency (EPA) approved Maricopa's BMP program as meeting

the Federal Clean Air Act (CAA) requirements for Best Available Control Measures (BACM) in 2002." As we stated in our proposed action, the other agencies that have adopted these controls, as well as EPA, have acquired additional expertise about how to control emissions from these sources and implement regulations for them. As a result, we no longer believe that the requirements in the rule that we approved in 2002 for the Maricopa area fully meet CAA requirements [75 FR 54812 – 54813].

7. Are there particular definitions in Arizona Administrative Code R18-2-610 that EPA expects the Ag BMP Committee to review for specificity? Is there EPA guidance available regarding what level of specificity is acceptable?

   Comparable programs in other areas such as the San Joaquin Valley have provided more specificity to meet CAA requirements through an application submittal and approval process (see 75 FR 54813, footnote 15). Once we finalize our action, we would like to work with the Ag BMP Committee, ADEQ, USDA, and all interested stakeholders to further refine what level of specificity is needed to meet CAA requirements and how the BMP program can be revised accordingly.

8. Is EPA open to alternatives to an "application submittal and approval process" for implementing the BMPs or would EPA consider a "notice and go" approach that could be less resource intensive for ADEQ? Would adding specificity and enforceability to the existing program (where appropriate) resolve EPA's concerns?

   We understand that ADEQ has limited resources, and will work with the Ag BMP Committee, ADEQ, USDA, and all interested stakeholders to develop an approach that will satisfy CAA requirements while addressing that concern. Once we finalize our action, we would like to have more specific discussions about how the Ag BMP Committee can address EPA's concerns.

9. What guidance does EPA have for the Ag BMP Committee on how confidential agricultural business information can be protected while providing the greater level of specificity and as it relates to the application process?

   The regulations governing EPA's treatment of confidential business information are in 40 C.F.R. Part 2, Subpart B.

Environmental Protection Agency Responses to Maricopa Association of Governments, Maricopa County Air Quality Department and Arizona Department of Environmental Quality Three Remaining Questions Regarding a Revised 189 (d) Plan for the Maricopa PM-10 Nonattainment Area

13. We are very concerned with the short time period between the September 3, 2010 proposed action and the January 28, 2011 final action. What showing would the State of Arizona have to make to extend the current January 28, 2011 deadline?

That deadline was negotiated with ACLPI and is now embodied in a U.S. District Court order. Given the facts of this case, we do not anticipate that either ACLPI or the court would agree to an extension.

14. On May 25, 2010, EPA prepared a document, Phoenix PM-10 Plan: Transportation Conformity Implications and Timelines. In our description of the conformity freeze, EPA indicated that "The MVEB submitted in the new 5% plan should be consistent with both the RFP and attainment demonstrations. Note that EPA can act on the RFP budgets separately from the attainment budgets if the attainment target set in the plan is deemed adequate. If the State can develop an RFP plan that meets EPA requirements, this approach allows for transportation planning to continue while EPA and the State work to resolve concerns about the attainment demonstration." Please describe how this would work and what it would mean. What is the earliest point in the process that EPA could find a new budget adequate and lift the conformity freeze?

After further consideration of this idea, we have determined that it is not going to be workable for Phoenix. The RFP and attainment demonstrations are too closely linked in this case. Your replacement plan will need to include a Motor Vehicle Emissions Budget (MVEB) for PM-10 that is consistent with your attainment, RFP and 5% demonstrations in the new plan. Consistent with 40 CFR 93.120(a), new MVEBs based on revised RFP, attainment and 5% plans are needed to end the conformity freeze.

See the answer below regarding the MVEB adequacy finding process. It is important to note that a conformity freeze ends not upon an adequacy finding, but rather upon the use of that new adequate budget in a conformity finding on the current transportation plans.

16. How long will it take EPA to take action on the revised Five Percent Plan after it is submitted?

We look forward to working with you to develop a plan that can be approved as quickly as possible. CAA section 110(k)(1) requires EPA to act on a submitted plan within 12 months of the plan being found to be complete. Plans become complete by operation of law if EPA does not make a completeness finding within 6 months.

As a practical matter, rulemakings on complicated matters such as these often take 6- 8 months.

Note that if, at the time EPA proposes action on a revised plan, there are sufficient measured exceedances to preclude attainment by the attainment date projected in the plan, EPA will not be able to propose full approval of the plan.

Agenda Item #7

Draft

Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects

Maricopa Association of Governments

November, 2010

Table of Contents

Page

INTRODUCTION 1
Reviews of the CMAQ Methodologies 1
CMAQ Project Review Process 3
Overview of Key Assumptions 4
Application of Methodologies 6

BICYCLE AND PEDESTRIAN FACILITIES 7
Bicycle and Pedestrian Facilities Example 10

BUS AND LIGHT RAIL PROJECTS 11
New Bus Service 12
New Bus Service Example 14
New Light Rail Service 15
New Light Rail Service Example 17

DIESEL RETROFITS AND ANTI-IDLING PROGRAMS 18
Diesel Retrofits 19
Diesel Retrofits Example 21
Diesel Anti-Idling Programs 21
Truck Stop Electrification Example 22
Auxiliary Power Units Example 23

INTERSECTION IMPROVEMENTS 23
Additional Turning Lanes Example 24
Roundabout Example 25

PARK AND RIDE FACILITIES 26
Park and Ride Lot Example 28

PAVING PROJECTS 28
Paving Unpaved Roads Without Paved Shoulders Example 31
Paving Unpaved Roads, Shoulders and Curb and Gutter Example 32

PM-10 CERTIFIED STREET SWEEPERS 33
PM-10 Certified Street Sweepers Example 39

RIDESHARE PROGRAMS 40
Regional Rideshare Program Example 43

TELEWORK PROGRAM 44
Telework Program Example 46

TRAFFIC FLOW IMPROVEMENTS 47
Traffic Signal Coordination 51
Traffic Signal Coordination Example 53
Intelligent Transportation Systems 54
Intelligent Transportation Systems Example 55

TRIP REDUCTION PROGRAM 56
Trip Reduction Program Example 58

VANPOOL VEHICLES 59
Vanpool Vehicles Example 61

REFERENCES 63

INTRODUCTION

The purpose of the Congestion Mitigation and Air Quality Improvement (CMAQ) Program is to provide federal funding for projects designed to assist nonattainment and maintenance areas in complying with the National Ambient Air Quality Standards. The most recent federal guidance for the CMAQ program, effective October 20, 2008, indicates that the emissions benefits and disbenefits for CMAQ project proposals should be quantified, if possible, for all pollutants for which the area is in nonattainment or maintenance status, including appropriate precursor emissions. The Maricopa Association of Governments (MAG) has developed methodologies for quantifying emissions benefits and disbenefits and calculating the cost-effectiveness of proposed CMAQ projects. MAG has updated the CMAQ methodologies periodically since 1999 to address changes in federal guidance, new project types, and improved technical methods and assumptions.

Reviews of the CMAQ Methodologies

In 2002, MAG contracted with Sierra Research to review CMAQ methodologies and identify the most promising project evaluation techniques used by MPOs in the western U.S. On April 29, 2002, MAG conducted a half-day workshop describing the CMAQ methodologies in use by the western MPOs and the findings and recommendations of the Sierra Research study. In general, Sierra concluded that "the methods established by MAG for computing the cost-effectiveness of proposed CMAQ projects are easily the most sophisticated encountered in the review of western communities." The Sierra Research recommendations and input from the 2002 workshop were incorporated into the 2004 MAG CMAQ methodologies (MAG, 2004b).

On June 28, 2005, MAG conducted a second workshop to discuss additional revisions to the CMAQ methodologies. The input from this workshop was incorporated into the MAG CMAQ methodologies that have been applied since August 2005 (MAG, 2005).

In 2008, MAG contracted with Sierra Research to review CMAQ approaches used elsewhere and recommend improvements to the 2005 MAG methodologies (MAG, 2008). The major findings of this study are summarized below.

(1) MAG's CMAQ methodologies adequately address the key issues in the latest federal transportation legislation (SAFETEA-LU, 2005). As recommended by SAFETEA-LU, MAG's CMAQ process includes an evaluation and prioritization of diesel retrofit projects, prioritizes projects based on cost-effectiveness, and allows funding of transportation systems management and operations projects that mitigate congestion and improve air quality.

(2) Like MAG, the California Air Resources Board (CARB) has eliminated carbon monoxide (CO) emissions from their calculations of cost-effectiveness for CMAQ projects.

(3) The level of detail used by the Texas Department of Transportation in evaluating CMAQ projects (TTI, 2007) is higher than currently required by the MAG methodologies. For

example, the TTI methodology for ITS projects quantifies the emission reductions attributable to alleviating peak and off-peak recurrent and non-recurrent congestion. The TTI methodologies require extensive data collection on the part of entities requesting CMAQ funds. Sierra points out that the TTI methods are also used to quantify control measures for Texas SIPs.

(4) California communities can download automated database programs to quantify twelve types of CMAQ projects. Several other communities have established spreadsheets that automate the calculation of benefits and cost-effectiveness for project sponsors. Colorado has automated the procedures used to prepare the annual CMAQ reports. Sierra recommends that MAG consider automating its CMAQ methodologies.

(5) The MAG CMAQ methodologies should be updated to be consistent with assumptions in the Eight-Hour Ozone Plan (MAG, 2007a) and Five Percent Plan for PM-10 (MAG, 2007b).

(6) Sierra recommends that the local sources from which activity rates have been derived (e.g. On Board Bus and Household Travel Surveys, MAG Congestion Studies, Travel Demand Management Surveys, Maricopa County Trip Reduction Program Reports) be reviewed and updated where appropriate.

(7) The 2008 Sierra Research report concludes that: "Overall, the methods established by MAG for computing the cost-effectiveness of proposed CMAQ projects are still the most sophisticated of the states and communities surveyed, particularly for fugitive dust emission calculations."

As recommended by Sierra Research in (5) above, the emission factors for total organic gases (TOG), nitrogen oxides (NOx) and PM-10 were updated in the 2009 CMAQ methodologies to be consistent with assumptions in the 2007 MAG Ozone and PM-10 Plans. On March 31, 2009, MAG conducted a workshop to discuss the findings of the latest Sierra Research review and proposed changes to the CMAQ methodologies. Input from workshop participants was incorporated into the 2009 CMAQ methodologies.

To implement Sierra's recommendation (3), MAG contracted with Lee Engineering and Texas Transportation Institute (TTI) in early 2010 to update the CMAQ methodology for intelligent transportation system (ITS) projects (Lee, 2010). The ITS project evaluation methodology recommended by Lee/TTI has been implemented in the 2010 CMAQ methodologies. In addition, the 2010 MAG CMAQ methodologies utilize emission rates from the latest EPA onroad mobile source emissions model, MOVES2010.

In the 2010 CMAQ methodologies, MAG has also updated the activity rates from the Transportation Demand Management, Annual Report (Valley Metro, 2010) and Trip Reduction Program, Annual Report (MCAQD, 2009), as recommended in (6). Since Sierra Research concluded in (7) that MAG continues to have the most sophisticated methods among the states and communities surveyed, no other major changes have been made to the 2010 methodologies.

MAG intends to conduct a workshop in the Fall of 2010 to discuss the proposed changes in the Draft 2010 CMAQ methodologies. Input from participants will be incorporated into the methodologies.

The 2010 CMAQ methodologies assume that the priority weight for carbon monoxide is zero. Participants attending the MAG CMAQ workshop in 2005 suggested that a weight of zero be assigned to carbon monoxide emissions when calculating cost-effectiveness and this was implemented in the 2005 methodologies. As indicated in the 2008 Sierra Research study, CARB also assigns a weight of zero to CO emissions when evaluating CMAQ projects. Since the Maricopa County area has not violated the CO standard since 1996 and monitored CO concentrations continue to decline, zeroing out the CO emissions in the CMAQ cost-effectiveness calculation remains appropriate. However, CO emission reductions must still be calculated for funded projects in the annual CMAQ report required by FHWA. If EPA were to lower the CO standard in the future, the priority weight could change. For these reasons, CO emissions are included in the equations and examples shown in this document, even though the priority weight is zero.

In the 2010 CMAQ methodologies, the priority weights for all other pollutants (i.e., TOG, NOx, and PM-10)[1] used in calculating cost-effectiveness are set to one. Seasonal adjustment factors are applied to the MOVES emission rates (i.e., TOG and NOx are divided by two to reflect the six-month ozone season)[2]. The use of MOVES emission rates will result in cost-effectiveness scores that differ from those calculated using previous versions of the MAG CMAQ methodologies.

CMAQ Project Review Process

Each year MAG programs available CMAQ funds. As part of the programming process, jurisdictions are requested, through the MAG Management Committee, MAG Transportation Review Committee, and MAG modal committees, to submit requests for federally funded projects. After the receipt of project requests, MAG evaluates CMAQ projects for possible inclusion in the Transportation Improvement Program. The MAG modal committees are furnished with the CMAQ assessment, along with the Congestion Management System rating score, for project evaluation purposes. Recommendations from the MAG modal committees are forwarded to the Transportation Review Committee for programming consideration.

The CMAQ project assessment may be in the form of a quantitative analysis resulting from the methodologies or a qualitative evaluation. CMAQ guidance allows a qualitative evaluation to be made when a quantitative analysis is not possible, although MAG makes every effort to quantify the

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[1]PM-2.5 emissions are not included in the MAG CMAQ methodologies, because EPA designated the Phoenix-Mesa Metropolitan Statistical Area as an attainment area for PM-2.5 in September 2004.

[2]A seasonal adjustment factor is not applied to PM-10, because violations of the PM-10 standard can occur during any season of the year.

emissions reduction impact of each project. Qualitative assessments may be based on a reasonable review of how a project or program will decrease emissions. Committed transportation control measures identified in the air quality plans receive priority in CMAQ project programming.

The CMAQ methodologies provide options for local input, while striving to keep the overall data requirements from being overly complex and burdensome. In general, agencies submitting CMAQ projects may provide local data to replace default values in any of the methodologies, as long as there is supporting written documentation. The values to be substituted and the supporting documentation (i.e., traffic engineering modeling; city-specific survey data) must accompany the request for CMAQ funding.

The methodologies included in this report were developed in response to federal guidance (FHWA, 2008) requiring the quantification of emission reductions for proposed CMAQ projects, whenever possible. Other potential project benefits such as human health, safety, land use, and congestion mitigation impacts are not addressed. It is also important to note that emission reductions and cost-effectiveness are not the only factors considered in evaluating and selecting candidates for CMAQ funding.

Overview of Key Assumptions

The methodologies for quantifying the emission reductions and cost-effectiveness of typical CMAQ projects are described below. In general, the methodologies estimate (1) emission reductions in kilograms per day, which are the sum of reductions in TOG, NOx, and PM-10; and (2) the cost-effectiveness of each project in dollars per metric ton of emissions reduced per year. Because the CMAQ methodology uses the latest EPA emissions models and regional planning assumptions, the emission reductions may not be consistent with previous CMAQ analyses or air quality plans that used earlier EPA models and assumptions. Some projects do not reduce PM-10 emissions and only CO, TOG, and NOx benefits are calculated. In other cases, only PM-10 emissions are reduced. If a proposed project combines two project types (e.g., paving a dirt road and adding a bicycle lane), the combined impact of the two portions of the project is included in the total emissions reduction.

MAG will run the latest version of the EPA mobile source emissions model, MOVES, to estimate CO, TOG, NOx, and PM-10 emission factors for the implementation year of the project. The MOVES factors will be based on the latest Maricopa County vehicle registration data and market shares of fuel types. The PM-10 emissions output by MOVES include tailpipe exhaust, tire wear and brake wear emissions. The average speed of area-wide traffic is assumed to be 30 miles per hour, unless specified otherwise in the methodologies.

PM-10 emission rates for unpaved and paved roads used in this document are derived from AP-42 equations (EPA, 2006). The emission rate used in the methodology for paving unpaved roads is 660.16 grams per mile. This value is consistent with the 2008 Periodic Emissions Inventory for PM-10 (MCAQD, 2010).

The paved road PM-10 emission rates are also consistent with assumptions in the 2008 Periodic Emissions Inventory: 0.18 grams mile for freeways; 1.69 grams per mile for low traffic arterials (carrying less than 10,000 vehicles per day); 0.65 grams per mile for high traffic arterials (≥10,000 vehicles per day); 0.91 grams per mile for all arterials; and an average of 0.65 grams per mile for all road types (freeways plus arterials). In the Salt River Area, the paved road PM-10 emission rate is 3.44 grams per mile for all arterials (MAG, 2008).[3]

The Salt River Area is bounded by Van Buren Street on the north, 7th Street on the east, Baseline Road on the south, and 59th Avenue on the west. The higher paved road emission rate in the Salt River Area is due to the heavier weight (i.e., 4.1 tons) of vehicles traveling on paved roads in this industrial area, compared with the average regionwide vehicle weight of 3.18 tons.

Carbon monoxide emission reductions are calculated for the range of temperatures on the winter episode day in the EPA-approved carbon monoxide maintenance plan (MAG, 2003). As previously indicated, the priority weight for CO is zero and the CO emission reduction benefits are only calculated for the annual CMAQ report. No seasonal adjustment (i.e, division by four) is applied when estimating CO emissions for the annual CMAQ report.

TOG and NOx emissions are calculated for the range of temperatures on the June episode day in the Eight-Hour Ozone Plan (MAG, 2007a). In the calculation of total emissions and cost-effectiveness for projects requesting CMAQ funding, TOG and NOx reductions are divided by a seasonal factor of two to account for the six-month ozone season. No seasonal adjustment (i.e, division by two) is applied when estimating TOG and NOx emissions for the annual CMAQ report.

The temperatures used in estimating PM-10 emissions with MOVES represent hourly average temperatures in the year 2008. No seasonal factor is applied, because exceedances of the daily PM-10 standard can occur at any time of year. Because of the seasonal and priority weight assumptions discussed above, total emission reductions (i.e., the sum of CO, TOG, NOx and PM-10) for CMAQ projects do not represent an average day during the year.

In the CMAQ methodologies, the cost-effectiveness of a project is calculated by dividing the annualized total project cost by the annual emission reduction. The annual emission reduction is obtained by converting the total weighted reduction in CO, TOG, NOx and PM-10 emissions in kilograms per day to metric tons per year. The total cost is amortized over the expected project life using a three percent discount rate, which represents the opportunity cost of using public dollars to fund a project, versus investing the same funds in a certificate of deposit earning three percent per year over the life of the project. The general approach for calculating cost-effectiveness and the discount rate is consistent with that used by the California Air Resources Board (CARB, 2005).

The remainder of this document describes the methodologies and assumptions used to estimate emission reductions and cost-effectiveness for typical CMAQ projects. The description of the

[3]All of these paved road emission rates assume paved shoulders with curb and gutter.

methodology for each project type is divided into three sections. The first section describes the modeling methodology, assumptions, and defaults. The second lists the data that are requested from the entity proposing the project. If any of the required data are not provided, default assumptions are substituted. The third section provides the formulas used in the analyses. Data from the first and second sections are input to the formulas to estimate the emission reduction and cost-effectiveness of a proposed project. At least one example calculation is provided for each project type. The examples, representing generic CMAQ projects, are provided to demonstrate how the methodology will be applied. The emission reductions and cost-effectiveness calculated for actual CMAQ projects will be dependent upon local inputs and may vary substantially from the examples.

This document describes methodologies for the following project types, in alphabetical order: Bicycle and Pedestrian Facilities, Bus and Light Rail Projects, Diesel Retrofits and Anti-Idling Programs, Intersection Improvements (including Roundabouts), Park and Ride Facilities, Paving Projects, PM-10 Efficient Street Sweepers, Rideshare Programs, Telework Program, Traffic Flow Improvements, Trip Reduction Program, and Vanpool Vehicles.[4]

These represent the most common CMAQ project types in the MAG region. CMAQ-eligible projects that do not fall into one of these categories will also be quantified, if feasible, on a case-by-case basis. If CMAQ funding for one phase (e.g., planning or design) of an eligible project is requested, the emission reduction benefit will be calculated for the first year that the project is expected to be completed. If additional CMAQ funds have been or will be requested to complete a project (e.g., a light rail segment), the requesting entity will be asked to estimate the total CMAQ funds to be used in calculating the cost-effectiveness for the project.

Application of Methodologies

The CMAQ methodologies calculate cost-effectiveness, a measure that is used in prioritizing projects that are candidates for future CMAQ funds. The methodologies are also used to quantify daily emission reductions for annual CMAQ reports submitted to FHWA. If emission reduction credit for a CMAQ-funded project in the Transportation Improvement Program has not been taken in a State Implementation Plan (SIP), the benefits of the project may also be used in transportation conformity. Since the annual CMAQ report and conformity analyses require emission reductions by individual pollutant, the priority weights (*w1, w2, w3, w4*) and seasonality factors (e.g., dividing VOC and NOx by two) are not used in these applications.

[4]In 2010, the Ozone Education Program was combined with the Regional Rideshare Program.

BICYCLE AND PEDESTRIAN FACILITIES

"Encouragement of Bicycle Travel" and "Development of Bicycle Travel Facilities" are committed control measures in the Serious Area CO Plan (MAG, 2001) and Serious Area PM-10 Plan (MAG, 2000a). Bicycle facilities have the potential to reduce commute and other non-recreational trips. Bicycle paths are facilities which are physically separated from motor vehicle traffic. Bicycle lanes are striped for preferential or exclusive use of bicycles. CO, TOG, NOx, and PM-10 emission reductions occur when bicycle trips replace single occupant vehicle trips.

"Encouragement of Pedestrian Travel" is also a committed control measure in the MAG Serious Area CO and PM-10 Plans. Pedestrian facilities provide or improve pedestrian access. Emissions are reduced when vehicle trips are replaced by walking.

The CO, TOG, NOx, and PM-10 emission factors are calculated for the implementation year of the project. The project life for bicycle lanes on roads or shoulders will be twenty years; for sidewalks, bicycle paths, and pedestrian paths, thirty years; and for overpasses and underpasses, fifty years.

The number of vehicle trips replaced by bicycle or pedestrian trips will be estimated based on the average weekday traffic (***ADT***) on the adjacent or nearest parallel arterial to the bicycle or pedestrian facility, where the ADT is provided by the entity requesting CMAQ funding for the project. The maximum allowable ADT will be 30,000 vehicle trips per weekday.[5] The ADT will be converted to annual average daily traffic (***AADT***) by multiplying by 0.91. The vehicle trips reduced will be calculated by multiplying the AADT by the sum of the adjustment factor (***A***) and the activity center credit (***C***).

The adjustment factor (***A***) in Table 1 is dependent upon the length of the bicycle/pedestrian project and the AADT on the road parallel to the bicycle/pedestrian project. Given the relative importance of bridges and underpasses that connect bicycle/pedestrian paths, the adjustment factor used for bridges and underpasses will be based on the sum of the lengths of the two paths connected.

The usefulness of a bicycle/pedestrian facility is also dependent upon its location. Usage estimates for bicycle/pedestrian facilities will take into consideration the number of activity centers near the proposed facility. The credit (***C***) for activity centers located along a bicycle/pedestrian facility is shown in Table 2.

The VMT reduced by bicycle/pedestrian facilities is estimated by multiplying the vehicle trips reduced by the average trip length. Consistent with assumptions in MAG transportation modeling concerning pedestrian trips to transit centers, a pedestrian trip length of one-half mile will be assumed. Based on data in *Bicycle Demand and Benefit Model* (Alta Transportation Consulting, 2000), an average bicycle trip length of four miles will be assumed. For multi-use paths, it will be assumed that half of the trips are bicycle and half are pedestrian. Therefore, an average trip length of 2.25 miles will be applied for multi-use paths.

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[5]Derived from CARB, 2005.

The MOVES model will be run assuming a speed of 30 miles per hour to estimate CO, TOG, NOx, and PM-10 emission factors for light duty vehicles. The off-network (MOVES Road Type 1) emission factors in grams per vehicle (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, OFF_{PM}) will be multiplied by the vehicle trips replaced by bicycle/pedestrian trips. The arterial (MOVES Road Types 3 and 5) emission factors in grams per mile (ARF_{CO}, ARF_{TOG}, ARF_{NOx}) will be multiplied by the VMT reduced by bicycle/pedestrian trips.

For PM-10, the paved road emission factor for arterials (***PEF***) will be added to the arterial emission factor (ARF_{PM}) before being multiplied by the VMT reduced by bicycle/pedestrian facilities. The paved road emission factors for all arterials is 0.91 grams per mile.

If a bike lane project includes shoulder paving, additional credit for reducing PM-10 emissions will be assigned to the project. The emission factors and equations used in calculating PM-10 reductions due to shoulder paving are described in the section on Paving Projects.

Table 1. Adjustment Factors[6]

ANNUAL AVERAGE DAILY TRAFFIC (AADT)	LENGTH OF PROJECT (one direction)	**ADJUSTMENT FACTOR (*A*)**
AADT ≤ 12,000 vehicles per day	≤ 1 mile	0.0019
	> 1 mile and ≤ 2 miles	0.0029
	> 2 miles	0.0038
12,000 < AADT ≤ 24,000 vehicles per day	≤ 1 mile	0.0014
	> 1 mile and ≤ 2 miles	0.0020
	> 2 miles	0.0027
AADT > 24,000 vehicles per day	≤ 1 mile	0.0010
	> 1 mile and ≤ 2 miles	0.0014
	> 2 miles	0.0019

Table 2. Activity Center Credits[7]

Examples of Activity Centers: bank, church, hospital, health care facility, park and ride lot, office park, post office, public library, shopping area or grocery store, schools, university or junior college.		
Number of activity centers	**ACTIVITY CENTER CREDIT (*C*)**	
	Within ½ mile	Within ¼ mile
at least three	0.0005	0.001
more than three but less than seven	0.001	0.002
seven or more	0.0015	0.003

[6]Adapted from CARB, 2005.

[7]Ibid.

The formulas below are used to calculate the emission reductions and cost-effectiveness for bicycle and pedestrian facilities.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Average weekday traffic (***ADT***) on the nearest parallel arterial.
- Number of activity centers (i.e. bank, church, hospital, health care facility, light rail station, park and ride lot, office park, post office, public library, shopping area, grocery store, university or junior college) within ¼ mile and ½ mile of the bicycle/pedestrian project.
- Length of bicycle/pedestrian path (for a bridge/underpass; the combined length of the paths connected by the bridge/underpass).
- Whether the project is located inside or outside the Salt River Area.

Formulas:

$$\textit{Vehicles Reduced } (\boldsymbol{VR}) = \boldsymbol{AADT} * (A + C)$$

where: ***A*** = the adjustment factor from Table 1
C = the activity center credit from Table 2
AADT = the average weekday traffic (***ADT***) on the adjacent or nearest parallel arterial (maximum = 30,000 ADT) multiplied by 0.91

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = \boldsymbol{VR} * \textit{trip length}$$

where: ***trip length*** = the length of a bicycle trip is assumed to be 4.0 miles and the length of a pedestrian trip is assumed to be 0.5 miles. For a multi-use path, it is assumed that the average trip length is 2.25 miles.

$$\textit{Daily Emissions Reduction} = [VR * (\frac{w1*OFF_{CO}}{4} + \frac{w2*OFF_{TOG}}{2} + \frac{w3*OFF_{NOx}}{2} + w4*OFF_{PM})] +$$

$$[VMTR * (\frac{w1*ARF_{CO}}{4} + \frac{w2*ARF_{TOG}}{2} + \frac{w3*ARF_{NOx}}{2} + w4*(ARF_{NM} + PEF))] * \frac{1}{1000} = \frac{kilograms}{day}$$

where: ***OFF*** = the off-network light duty vehicle emission factor for each pollutant
ARF = the arterial light duty vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for non-freeways (0.91 g/mi)
w1-w4= weighting factors for CO, TOG, NOx, and PM-10, respectively

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 20 years for bicycle lanes on a road or shoulder; 30 years for a sidewalk, bicycle path, or pedestrian path; and 50 years for an overpass or underpass.

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ\ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Bicycle and Pedestrian Facilities **EXAMPLE**

A city proposes to build a 1.5 mile bike lane by paving an unpaved shoulder with curb and gutter in 2015 at a total cost of $650,000, where $65,000 will be paid with local funds. The bike lane will be adjacent to an arterial outside the Salt River Area with average weekday traffic of 18,000 vehicles per day. There are three activity centers (a grocery store, a library, and a park and ride lot) less than one-quarter mile from the path. There are four additional activity centers (two office parks, a church, and a post-office) between one-quarter and one-half mile from the proposed project for a total of seven activity centers within one-half mile.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $585,000.
- Project length (***miles***) = 1.5 miles.
- Average weekday traffic (***ADT***) on adjacent arterial = 18,000.
- Activity centers within ¼ mile = 3 OR activity centers within ½ mile = 7.
- Shoulder paving with curb and gutter outside the Salt River Area = 0.75 g/mi.

Calculations:

The primary Adjustment Factor (**A**) is derived from Table 1. Since the ***ADT*** is 18,000, the annual average daily traffic is 16,380 (0.91 x 18,000). From Table 1, the adjustment factor for a path adjacent to a roadway with between 12,000 and 24,000 AADT and between one and two miles in length is 0.0020. The Activity Center Credit (**C**) is obtained from Table 2. There are two choices of activity center credit for this project, since there are three activity centers within one-quarter mile (0.001) and seven centers within one-half mile (0.0015). The higher value, 0.0015, is chosen. Additional credit will be given to the project for reducing PM-10 by paving an unpaved shoulder. The emission reduction credit for paving an unpaved shoulder with curb and gutter outside the Salt River Area is 0.75 grams per vehicle mile of travel (from the section on Shoulder Paving Projects).

$$\textit{Vehicles Reduced } (\boldsymbol{VR}) = 18{,}000 * 0.91 * (0.0020 + 0.0015) = 57 \ \frac{vehicles}{day}$$

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = 57 * 4.0 = 228 \ \frac{vehicle\text{-}miles}{day}$$

$$\textit{Daily Emissions Reduction for Bike Lane} = [57 * (\frac{0.0*2.85}{4} + \frac{1.0*0.34}{2} + \frac{1.0*0.17}{2} + (1.0*0.002)] +$$

$$[228 * (\frac{0.0*2.04}{4} + \frac{1.0*0.13}{2} + \frac{1.0*0.42}{2} + (1.0*(0.04+0.91))] * \frac{1}{1000} = 0.29 \ \frac{kilograms}{day}$$

$$\textit{Daily Emissions Reduction for Paving Shoulder} = (1.0*0.75*18{,}000*0.91*1.5)*\frac{1}{1000} = 18.43 \ \frac{kilograms}{day}$$

$$\textit{Total Daily Emissions Reduction} = 0.29 + 18.43 = 18.72 \ \frac{kilograms}{day}$$

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$\textit{Cost-Effectiveness} = \frac{0.0672 * 585{,}000 * 1000}{18.72 * 365} = 5{,}753 \ \frac{dollars}{metric\ ton}$$

BUS AND LIGHT RAIL PROJECTS

"Expansion of Public Transportation Programs" and "Mass Transit Alternatives" are committed control measures in the MAG Serious Area CO and PM-10 Plans. These measures reduce CO, TOG, NOx, and PM-10 emissions by reducing the vehicle miles of travel (VMT) driven in single occupant vehicles.

New Bus Service

Bus service on new routes and increased frequency on existing bus routes provide a new level of service and reduce VMT. The daily emissions reduction attributable to the new bus service will be estimated based on the difference between the emissions from the light duty vehicle trips replaced by the bus trips and the sum of the bus emissions from the new service and vehicle emissions from people driving to access the bus.

The vehicle miles of travel replaced (VMT_{REP}) by the new bus service will be estimated based on the fraction of riders on the bus who drove to their destination prior to introduction of the new bus service (F_1). This fraction will be multiplied by total bus riders and the average trip length replaced by the bus service (***trip length***$_1$). The VMT replaced by bus trips will be multiplied by onroad (Road Types 3 and 5) light duty vehicle emission factors from MOVES and fugitive dust emission factors from the latest periodic emissions inventory (MCAQD, 2010) for vehicles traveling on a paved road to estimate the emissions from trips replaced by transit.

The VMT added (VMT_{ADD}) by people driving to reach the new transit service will be estimated based on the fraction of riders on the bus who drive to transit (F_2). This fraction will be multiplied by total bus riders and the average trip length to reach transit (***trip length***$_2$). The VMT added by vehicle trips to reach transit will be multiplied by light duty vehicle emission factors from MOVES and paved road emissions factors from AP-42 to estimate the automobile emissions added by trips to reach transit. The vehicles reduced (***VR***) by the new bus service will be estimated as the number of riders who previously drove to their destination minus the number of riders that drove to the bus.

The emissions produced by the bus (***BUS***) are equal to the off-network emissions for one vehicle and the number of miles driven daily by the bus multiplied by the on-road exhaust emission factor plus the paved road dust emission factor for the bus. The off-network and exhaust emission factors for buses are estimated using MOVES. A paved road dust emission factor for a bus has been calculated assuming an average weight of 18 tons (i.e., 11 g/mi). It will also be assumed that a typical bus travels 100 miles per annual average day (VMT_{BUS}).

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Funding***.
- Fraction of riders who previously drove to their destination in a single occupant vehicle (F_1). For example, if 75 of 100 bus riders would have driven an SOV to their destination, F_1 would equal 0.75. Default = 0.50 (CARB, 2005).
- Fraction of riders who drive to reach transit (F_2). For example, if 5 of 100 riders of the new bus drive to reach the bus, F_2 would equal 0.05. Default = 0.03 (RPTA, 2008).
- Average length of vehicle trips (***trip length***$_1$). Default = 10.6 miles (from 2001 Maricopa Regional Household Travel Survey and 2002 transportation model validation, Feb.15, 2005).
- Total daily ridership of each new bus (***R***). For example, if the new bus is expected to carry 400 passengers per day, *R* would equal 400. Default = 307 (RPTA, 2010).

- Average length of trip driving from home to transit (***trip length***$_2$). Default = 5 miles (Valley Metro, 2001).

Formulas:

$$VMT\ Replaced\ (\boldsymbol{VMT_{REP}}) = R * F_1 * trip\ length_1$$

$$VMT\ added\ (\boldsymbol{VMT_{ADD}}) = R * F_2 * trip\ length_2$$

$$Vehicles\ Reduced\ (\boldsymbol{VR}) = R * (F_1 - F_2)$$

where: $\boldsymbol{R}$ = the average ridership on the bus per operating day
$\boldsymbol{F_1}$ = the fraction of riders on the bus who previously drove a single occupant vehicle
trip length$_1$ = the average trip length replaced for each rider who previously drove
$\boldsymbol{F_2}$ = the fraction of riders who drive to transit
trip length$_2$ = the average trip length driven to transit

$$Onroad\ Vehicle\ Emissions\ Reduced\ (\boldsymbol{VER_1}) = (\boldsymbol{VMT_{REP}} - \boldsymbol{VMT_{ADD}}) * (\frac{w1 * ONF_{CO}}{4} + \frac{w2 * ONF_{TOG}}{2} + \frac{w3 * ONF_{NOx}}{2} +$$

$$(w4 * (ONF_{PM} + PEF)) * \frac{1}{1000} * 0.91 = \frac{kilograms}{day}$$

$$Off\text{-}network\ Vehicle\ Emissions\ Reduced\ (\boldsymbol{VER_2}) = \boldsymbol{VR} * (\frac{w1 * OFF_{CO}}{4} + \frac{w2 * OFF_{TOG}}{2} + \frac{w3 * OFF_{NOx}}{2} +$$

$$w4 * OFF_{PM}) * \frac{1}{1000} * 0.91 = \frac{kilograms}{day}$$

where: $\boldsymbol{VMT_{REP}}$ = the vehicle travel replaced by bus service
$\boldsymbol{VMT_{ADD}}$ = the VMT added as a result of trips driven to reach transit
ONF = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network light duty vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)
0.91 = factor to convert from average weekday to annual average daily vehicle trips
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively

$$Bus\ Emissions(\boldsymbol{BE}) =$$

$$\left(\frac{w1*BEF_{CO}}{4}+\frac{w2*BEF_{TOG}}{2}+\frac{w3*BEF_{NOx}}{2}+(w4*(BEF_{PM}+PEF_{BUS})))*VMT_{BUS}*\frac{1}{1000}*0.91 = \frac{kilograms}{day}\right.$$

$$Daily\ Emissions\ Reduction = \boldsymbol{VER_1} + \boldsymbol{VER_2} - \boldsymbol{BE} = \frac{kilograms}{day}$$

where: ***BEF*** = the onroad bus emission factor for each pollutant (includes tire and brake wear for PM-10)
$\boldsymbol{PEF_{BUS}}$ = the paved road emission factor for a bus (11.00 g/mi)
$\boldsymbol{VMT_{BUS}}$ = the daily bus VMT

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+i)^{life}\ (i)}{(1+i)^{life}\ -1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 12 years (CARB, 2005)

$$Cost\text{-}Effectiveness = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ\ Cost} * 1000}{Daily\ Emissions\ Reduction * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

New Bus Service **EXAMPLE**

A city proposes to purchase a diesel bus to start a new bus route in 2015. The cost of the bus is $320,000. The city proposes to pay $32,000 and requests $288,000 of CMAQ funding.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $288,000.
- Fraction of riders who would drive in a single occupant vehicle to their destination ($\boldsymbol{F_1}$) = 0.5.
- Fraction of riders who drive in a single occupant vehicle to reach transit ($\boldsymbol{F_2}$) = 0.03.
- Average length of vehicle trips (***trip length***$_1$) = 10.6 miles.
- Total daily ridership on the new bus (***R***) = 307.
- Average length of trip from home to transit (***trip length***$_2$) = 5 miles.

Calculations:

$$VMT_{REP} = 307 * 0.5 * 10.6 = 1{,}627$$

$$VMT_{ADD} = 307 * 0.03 * 5 = 46$$

$$VR = 307 * (0.5 - 0.03) = 144$$

$$VER_1 = (1{,}627 - 46) * \left(\frac{0.0*2.04}{4} + \frac{1.0*0.13}{2} + \frac{1.0*0.42}{2} + (1.0*(0.04+0.65)) * \frac{1}{1000} * 0.91 = 1.39 \ \frac{kilograms}{day}\right.$$

$$VER_2 = 144 * \left(\frac{0.0*2.85}{4} + \frac{1.0*0.34}{2} + \frac{1.0*0.17}{2} + (1.0*0.002) * \frac{1}{1000} * 0.91 = 0.03 \ \frac{kilograms}{day}\right.$$

$$BE = 100 * \left(\frac{0.0*1.32}{4} + \frac{1.0*0.34}{2} + \frac{1.0*4.25}{2} + (1.0*(0.31+11.00)) * \frac{1}{1000} * 0.91 = 1.24 \ \frac{kilograms}{day}\right.$$

$$Daily\ Emissions\ Reduction = 1.39 + 0.03 - 1.24 = 0.18 \ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (CRF) = \frac{(1+0.03)^{12} * (0.03)}{(1+0.03)^{12} - 1} = 0.1005$$

$$Cost\text{-}Effectiveness = \frac{0.1005 * 288{,}000 * 1000}{0.18 * 365} = 440{,}548 \ \frac{dollars}{metric\ ton}$$

New Light Rail Service

Light rail represents another alternative mode to single occupant vehicle travel. Light rail service decreases emissions by reducing vehicle miles of travel. The daily emissions reduction attributable to the provision of new rail service or the improvement of existing service will be based on the estimated number of light rail passengers who previously drove in single occupant vehicles. Emissions from light rail passengers driving to access the light rail stations will be deducted from the benefit.

The MOVES model will be run for the CMAQ funding year to estimate the onroad light duty vehicle emission factors for CO, TOG, NOx, and PM-10 (ONF_{CO}, ONF_{TOG}, ONF_{NOx}, *and* ONF_{PM}). The paved road emission factor for all roads of 0.65 grams per mile will be added to ONF_{PM}. These

emission factors will be multiplied by the reduction in vehicle miles of travel. MOVES will also be run to estimate the off-network emission factors (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, and OFF_{PM}, which will be multiplied by the reduction in vehicles. These emission reductions will be summed to estimate the total emissions benefit of the Light Rail project.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Funding (total for the rail segment being funded)***.
- Fraction of riders who previously drove to their destination (F_1). For example, if 75 of 100 rail riders drove vehicles to their destination before introduction of the new rail service, F_1 would equal 0.75. Default = 0.50 (CARB, 2005).
- Fraction of riders who drive to reach rail (F_2). For example, if 5 of 100 riders drive to reach the rail line, F_2 would equal 0.05. Default = 0.03 (RPTA, 2008)
- Average length of vehicle trips (***trip length***$_1$). Default = 10.6 miles (from 2001 Maricopa Regional Household Travel Survey and 2002 transportation model validation, Feb.15, 2005)
- Total daily ridership on the rail line (***R***). For example, if the new line is expected to carry 30,000 passengers per day, *R* would equal 30,000.
- Average length of trip driving from home to rail (***trip length***$_2$). Default = 5 miles (Valley Metro, 2001).

Formulas:

$$\text{VMT Replaced } (VMT_{REP}) = R * F_1 * \text{trip length}_1$$

$$\text{VMT added } (VMT_{ADD}) = R * F_2 * \text{trip length}_2$$

$$\text{Vehicles Reduced } (VR) = R * (F_1 - F_2)$$

where: ***R*** = the ridership on the rail segment per average weekday
F_1 = the fraction of rail riders who previously drove in a single occupant vehicle
trip length$_1$ = the average trip length replaced for each rider who previously drove
F_2 = the fraction of riders who drive to the rail station
trip length$_2$ = the average trip length driven to the rail station

$$\text{Onroad Vehicle Emissions Reduced } (VER_1) = (VMT_{REP} - VMT_{ADD}) * \left(\frac{w1 * ONF_{CO}}{4} + \frac{w2 * ONF_{TOG}}{2} + \frac{w3 * ONF_{NOx}}{2} + (w4 * (ONF_{PM} + PEF)) * \frac{1}{1000} * 0.91 = \frac{kilograms}{day}\right.$$

$$\textit{Off-network Vehicle Emissions Reduced } (\boldsymbol{VER_2}) = \boldsymbol{VR} * \left(\frac{w1 * OFF_{CO}}{4} + \frac{w2 * OFF_{TOG}}{2} + \frac{w3 * OFF_{NOx}}{2} + w4 * OFF_{PM}\right) * \frac{1}{1000} * 0.91 = \frac{kilograms}{day}$$

$$\textit{Daily Emissions Reduction} = \boldsymbol{VER_1} + \boldsymbol{VER_2} = \frac{kilograms}{day}$$

where: $\boldsymbol{VMT_{REP}}$ = the vehicle travel replaced by the rail service
$\boldsymbol{VMT_{ADD}}$ = the VMT added as a result of trips driven to the rail station
ONF = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively
0.91 = factor to convert from average weekday to annual average daily vehicle trips

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 20 years

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ\ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

New Light Rail Service **EXAMPLE**

In 2013, Valley Metro Rail (VMR) requests $4,000,000 in CMAQ funds to augment the cost of constructing an additional 20-mile segment of the light rail system. VMR estimates that a total of $20 million in supplemental CMAQ funds will be needed to complete the new light rail segment. Transit modeling indicates that 30,000 passengers will ride the new segment on an average weekday during the first full year of operation in 2015.

Inputs Required from Entity Requesting CMAQ Funds:

- ***Total CMAQ Cost for new segment*** = $20,000,000.
- Number of light rail passengers per average weekday ***(R)*** = 30,000.
- Fraction of riders who previously drove to their destination in an SOV (F_1) = 0.50.
- Average length of vehicle trips diverted to rail (***trip length***$_1$) = 10.6 miles.
- Fraction of riders who drive to the rail station (F_2) = 0.03.
- Average length of trips driven to the rail station (***trip length***$_2$) = 5 miles.

Calculations:

$$VMT\ Replaced\ (VMT_{REP}) = 30{,}000 * 0.5 * 10.6 = 159{,}000$$

$$VMT\ added\ (VMT_{ADD}) = 30{,}000 * 0.03 * 5.0 = 4{,}500$$

$$Vehicles\ Replaced\ (VR) = 30{,}000 * (0.5 - 0.03) = 14{,}100$$

$$VER_1 = (159{,}000 - 4{,}500) * \left(\frac{0.0*2.00}{4} + \frac{1.0*0.12}{2} + \frac{1.0*0.41}{2} + (1.0*(0.04+0.65))\right) * \frac{1}{1000} * 0.91 = 134.27\ \frac{kg}{day}$$

$$VER_2 = 14{,}100 * \left(\frac{0.0*2.85}{4} + \frac{1.0*0.34}{2} + \frac{1.0*0.17}{2} + (1.0*0.002)\right) * \frac{1}{1000} * 0.91 = 3.30\ \frac{kg}{day}$$

$$Daily\ Emissions\ Reduction = 134.27 + 3.30 = 130.97\ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (CRF) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$Cost\text{-}Effectiveness = \frac{0.0672 * 20{,}000{,}000 * 1000}{130.97 * 365} = 28{,}115\ \frac{dollars}{metric\ ton}$$

DIESEL RETROFITS AND ANTI-IDLING PROGRAMS

FHWA has indicated that retrofits for diesel engines and anti-idling programs for diesel trucks are eligible for CMAQ funding if they reduce emissions primarily in a nonattainment or maintenance area (FHWA, 2008). Federal transportation legislation also authorizes use of CMAQ funds for these types of projects (SAFETEA-LU, 2005).

The term diesel retrofit includes any technology or system that achieves emission reductions beyond that required by the EPA regulations at the time of new engine certification (EPA, 2007). Diesel retrofit projects may include replacement of high-emitting vehicles/equipment with cleaner vehicles/equipment (including hybrid or alternative fuel models); repowering or engine replacement; rebuilding the engine to a cleaner standard; purchase and installation of advanced emissions control technologies (such as particulate matter traps or oxidation catalysts); or the use of a cleaner fuel. CMAQ funds may be used to retrofit onroad diesel vehicles or nonroad diesel vehicles/engines used in construction. Projects that retrofit diesel engines can significantly reduce tailpipe emissions; the pollutants reduced will vary depending upon the technology or system that is installed. For example, installation of catalyzed diesel particulate filters or diesel oxidation catalysts will reduce particulate matter (PM-10 and PM-2.5), while replacing an older engine with newer technology will reduce CO, TOG, NOx, and PM-10 emissions.

In addition, CMAQ may be used to fund the capital costs of anti-idling programs, including advanced truck stop electrification projects and installation of auxiliary power units (APUs) on heavy duty diesel trucks. Heavy duty diesel trucks typically idle 6-10 hours per day to power the sleeper cab air conditioning, heating, and appliances (FHWA, 2009). Projects that reduce idling of diesel vehicles can significantly reduce tailpipe emissions of NOx and PM-10.

Diesel Retrofits

CMAQ projects would typically involve retrofitting diesel engines manufactured between 1990 and 2007. If the retrofits are for onroad vehicles, MOVES will be run to estimate exhaust emission rates at 30 mph for each model year heavy duty diesel vehicle that is being retrofitted. Since ultra low sulfur fuel has been required for onroad diesel vehicles nationwide since October 2006, the sulfur level in the diesel fuel will be set at 15 ppm in MOVES. If the retrofits are occurring to nonroad engines, the latest version of the EPA NONROAD model will be run to determine the emission rates for each model year engine that is being retrofitted and the diesel sulfur level will be set to 500 ppm. The emission rates for the non-retrofitted vehicles/engines will be multiplied by the average annual vehicle miles traveled by all vehicles of that model year.

For vehicles/engines being retrofitted with diesel oxidation catalysts, the PM-10 exhaust emissions will be reduced by 30 percent. If the vehicles/engines are being retrofitted with catalyzed diesel particulate filters, the PM-10 exhaust emissions will be reduced by 90 percent (EPA, 2007).

If the engines are being replaced or rebuilt, the emissions of CO, TOG, NOx and PM-10 from the older model year vehicle/engine will be compared with the emissions generated by a heavy duty diesel onroad vehicle (using MOVES) or a nonroad engine (using NONROAD) manufactured in 2015. The difference between the emissions for the older model year and 2015 will represent the benefit of the diesel retrofit project. It is expected that the vehicles or engines that are retrofitted will be kept in service for at least five years.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Model year(s) of the vehicles to be retrofitted.
- Average annual mileage traveled by the vehicles being retrofitted.

Formulas:

$$Emissions\ Before\ Retrofit\ (EBR_i) = \boldsymbol{VMT_i} * \left(\frac{w1 * BEF_{CO}}{4} + \frac{w2 * BEF_{TOG}}{2} + \frac{w3 * BEF_{NOx}}{2} + (w4 * BEF_{PM10})\right)$$

$$Emissions\ After\ Retrofit\ (EAR) = \sum VMT_i * \left(\frac{w1 * AEF_{CO}}{4} + \frac{w2 * AEF_{TOG}}{2} + \frac{w3 * AEF_{NOx}}{2} + (w4 * AEF_{PM10})\right)$$

___where: $\boldsymbol{VMT_i}$ = the annual miles driven by vehicles of model year *i*
BEF = the heavy duty diesel emission factor for each pollutant in model year *i*, assuming ultra-low sulfur fuel (15 ppm) for onroad vehicles or low sulfur fuel (500 ppm) for nonroad vehicles/engines
AEF = the onroad heavy duty diesel factor for each pollutant in model year 2015
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively

$$Daily\ Emissions\ Reduction = \left(\sum \boldsymbol{EBR_i} - \boldsymbol{EAR}\right) * \frac{1}{1000} * \frac{1}{365} = \frac{kilograms}{day}$$

where: **1/365** = factor to convert annual emissions to daily emissions

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+i)^{life}\ (i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 5 years

$$Cost\text{-}Effectiveness = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ}\ Cost * 1000}{Daily\ Emissions\ Reduction * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Diesel Retrofits **EXAMPLE**

A city requests $160,000 in FY 2015 CMAQ funds to retrofit 40 heavy duty diesel vehicles in the onroad municipal fleet with catalyzed diesel particulate filters. The city will provide a $10,000 cash match for the project. The average model year of the vehicles to be retrofitted is 2005. The average annual miles driven by each vehicle is 20,000. The city commits to use the retrofitted vehicles for at least five more years. MOVES2010 estimates that the PM-10 exhaust emissions for a 2005 heavy duty vehicle running on ultra-low sulfur diesel fuel is 0.81 grams per mile. Because particulate filters are being installed, the PM-10 exhaust emissions from the vehicle fleet will be reduced by 90 percent.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $160,000.
- Average model year = 2005.
- Average annual miles driven per vehicle = 20,000.

Calculations:

$$\textit{Daily Emissions Reduction} = 20{,}000 * 40 * (1.00 * 0.81) * 0.90 * \frac{1}{1000} * \frac{1}{365} = 1.60 \frac{\textit{kilograms}}{\textit{day}}$$

$$\textit{Capital Recovery Factor } (\textbf{CRF}) = \frac{(1+0.03)^5 * (0.03)}{(1+0.03)^5 - 1} = 0.2184$$

$$\textit{Cost-Effectiveness} = \frac{0.2184 * 160{,}000 * 1000}{1.60 * 365} = 59{,}836 \frac{\textit{dollars}}{\textit{metric ton}}$$

Diesel Anti-Idling Programs

Projects that reduce idling emissions from heavy duty diesel vehicles in a nonattainment or maintenance area are eligible for CMAQ funding (FHWA, 2008). One example would be a public-private partnership to implement a truck stop electrification project. Emissions will be reduced because trucks will turn off their engines and receive compartment cooling/heating and other services (cable TV, high speed internet) from the electric stalls during rest stops.

Another example of an anti-idling program would be the installation of auxiliary power units (APUs) on a fleet of diesel trucks that operate primarily within a nonattainment or maintenance area. APUs are mobile idle reduction technology that provides air conditioning, heat, and power for sleeper cab

appliances, as well as battery charging and start assist for the main engine. They can be diesel or battery powered or a combination of both (FHWA, 2009).

To quantify the benefit of an anti-idling project, MOVES will be run to estimate idling emission rates for NOx and PM-10 for heavy duty diesel vehicles in the year of project implementation. The MOVES emission rates for heavy duty diesel vehicles operating at 2.5 miles per hour will be converted to grams per hour and multiplied by the estimated daily reduction in idling hours. The resultant emissions will represent the reduction benefit of a truck stop electrification project. For a CMAQ project involving auxiliary power units, the benefit will be calculated as the difference between the idling emissions for diesel trucks before and after installation of the APUs.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Diesel vehicle idling hours reduced on an annual average day (***IR***).

Formulas:

$$\textit{Daily Emissions Reduction} = \boldsymbol{DIR} * \left(\frac{w3 * DIEF_{NOx}}{2} + (w4 * DIEF_{PM10})\right) * \frac{1}{1000} = \frac{\textit{kilograms}}{\textit{day}}$$

where: ***DIR*** = diesel vehicle idling hours reduced by the project on an annual average day
DIEF = the heavy duty diesel idling emission factor (in grams per mile at 2.5 mph) for NOx and PM-10 (multiplied by 2.5 mph to convert to grams per hour)

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 5 years

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ}\ \textit{Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Truck Stop Electrification **EXAMPLE**

A city located within the PM-10 nonattainment area would like to enter into a legal agreement with

a private firm to build 50 electrified stalls at a truck stop along an Interstate facility in the city limits. The total cost of the project is estimated to be $1,000,000. The city will donate land appraised at $100,000 to accommodate the 50 electrified stalls. The city requests $500,000 in FY 2015 CMAQ funds. The private firm has committed to pay the remaining capital cost of the project. The city estimates that space utilization will be 90 percent and truck idling will be reduced by 8 hours per utilized space for a total of 360 hours reduced per annual average day.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $500,000.
- ***DIR*** = 360 hours of diesel vehicle idling reduced per annual average day.

Calculations:

$$\textit{Daily Emissions Reduction} = 360 * \left(\frac{0.0*15.73}{4} + \frac{1.0*6.37}{2} + \frac{1.0*48.93}{2} + (1.0*7.29)\right) * \frac{1}{1000} = 12.58\ \frac{kilograms}{day}$$

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+0.03)^5 * (0.03)}{(1+0.03)^5 - 1} = 0.2184$$

$$\textit{Cost-Effectiveness} = \frac{0.2184 * 500{,}000 * 1000}{12.58 * 365} = 23{,}782\ \frac{dollars}{metric\ ton}$$

Auxiliary Power Units **EXAMPLE**

A city located within the eight-hour ozone nonattainment area would like to install APUs equipped with 2003 Kubota engines on its fleet of diesel municipal buses. The city has 100 diesel buses that are all model year 2006 or older. Emissions will be reduced because the bus drivers will turn off their engines and receive compartment cooling during rest stops. The total cost of the project is estimated to be $700,000. The city requests $500,000 in FY 2015 CMAQ funds and estimates that bus idling will be reduced by 2 hours per bus per day for a total of 200 hours per annual average day.

The idle emission factors for the diesel buses before installing the APUs are 135 grams per hour for NOx and 3.68 grams per hour for PM-10 (FHWA, 2009). The 2003 Kubota engine has EPA-certified emissions levels of 4.7 grams per brake horsepower hour for NOx and 0.24 grams per brake horsepower per hour for PM-10 (40 CFR Part 89). Multiplying by a horsepower load factor of 5 (FHWA, 2009) produces APU emission rates of 23.5 grams per hour for NOx and 1.2 grams per hour for PM-10. These emissions are subtracted from the idling emissions for the buses without the APUs to obtain the net benefit of the APUs.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $500,000.
- ***DIR*** = 200 hours of diesel vehicle idling reduced per annual average day.

Calculations:

$$Daily\ Emissions\ Reduction = 200*((\frac{0.0*15.73}{4}+\frac{1.0*6.37}{2}+\frac{1.0*25.43}{2}+1.00*.6.09))*\frac{1}{1000} = 4.40\ kg/day$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^5 * (0.03)}{(1+0.03)^5 - 1} = 0.2184$$

$$Cost\text{-}Effectiveness = \frac{0.2184 * 500{,}000 * 1000}{4.40 * 365} = 67{,}995\ \frac{dollars}{metric\ ton}$$

INTERSECTION IMPROVEMENTS

Intersection improvements include projects which add left or right turn lanes or construct roundabouts to improve traffic flow. These improvements reduce vehicle delay and idling emissions. The entity requesting CMAQ funds will provide the total reduction in vehicle hours of delay per weekday, based on traffic operations modeling of the intersection improvement. Industry standard intersection analysis tools such as Highway Capacity Manual (HCM) software, NETSIM, SYNCHRO, and TRANSYT-7F should be used to simulate the delay before and after the changes to the intersection (FHWA, 2009). MAG will apply idling emission factors to the vehicle hours of delay reduced to determine the daily emissions reduction. This methodology assumes that reductions in delay are the principal source of emissions benefits attributable to an intersection improvement.

MOVES will be run to estimate the idle emission factors for CO, TOG, NOx, and PM-10 for all vehicle classes in the year of project implementation ($\boldsymbol{IEF_{CO}}$, $\boldsymbol{IEF_{TOG}}$, $\boldsymbol{IEF_{NOx}}$, and $\boldsymbol{IEF_{PM}}$). The idle emission factor will be estimated by running the model at 2.5 miles per hour and converting the resulting emission factor in grams per mile to grams per hour, using 2.5 miles per hour.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- The total weekday vehicle hours of delay reduced due to the intersection improvement (***DR***).

Formulas:

$$DR * [\frac{w1*IEF_{CO}}{4} + \frac{w2*IEF_{TOG}}{2} + \frac{w3*IEF_{NOx}}{2} + w4*IEF_{PM}] * 0.91 * \frac{1}{1000} = \frac{kilograms}{day}$$

where: ***DR*** = Reduction in total weekday vehicle hours of delay due to the improvement
IEF = the idling emission factor for all vehicle classes for each pollutant (in grams/hr)
0.91 = factor to convert from average weekday traffic to annual average daily traffic
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively

$$Capital\ Recovery\ Factor\ (CRF) = \frac{(1+i)^{life}\ (i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 20 years

$$Cost\text{-}Effectiveness = \frac{CRF * CMAQ\ Cost * 1000}{Daily\ Emissions\ Reduction * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Additional Turning Lanes **EXAMPLE**

A city proposes to add second left turn lanes westbound and northbound and a dedicated right turn lane eastbound at an intersection in 2015 at a cost of $2,000,000. The city proposes to pay $200,000 and requests $1,800,000 of CMAQ funding. A city consultant has simulated the traffic operations at the intersection before and after the capacity improvements using SYNCHRO and has determined that the total reduction in vehicle hours of delay will be 70 hours per average weekday in 2015.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $1,800,000.
- ***DR*** = 70 vehicle hours of delay reduced per weekday.

Calculations:

$$\textit{Daily Emissions Reduction} =$$

$$70*(\frac{0.0*19.44}{4}+\frac{1.0*2.77}{2}+\frac{1.0*6.26}{2}+(1.0*0.93))*0.91*\frac{1}{1000} = 0.35\ \frac{kilograms}{day}$$

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$\textit{Cost-Effectiveness} = \frac{0.0672 * 1{,}800{,}000 * 1000}{0.35 * 365} = 946{,}849\ \frac{dollars}{metric\ ton}$$

Roundabout EXAMPLE

ADOT proposes to build a roundabout in 2015 at a freeway interchange. Traffic operations modeling performed by an ADOT consultant indicates that the roundabout will reduce average vehicle delay by 120 hours per weekday. The cost of the project is $2,000,000. ADOT proposes to pay $200,000 and requests $1,800,000 of CMAQ funding.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $1,800,000.
- ***DR*** = 120 vehicle hours of delay reduced per weekday.

Calculations:

$$\textit{Daily Emissions Reduction} =$$

$$120*(\frac{0.0*19.44}{4}+\frac{1.0*2.77}{2}+\frac{1.0*6.26}{2}+(1.0*0.93))*0.91*\frac{1}{1000} = 0.59\ \frac{kilograms}{day}$$

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$\textit{Cost-Effectiveness} = \frac{0.0672 * 1{,}800{,}000 * 1000}{0.59 * 365} = 561{,}690\ \frac{dollars}{metric\ ton}$$

PARK AND RIDE FACILITIES

"Park and Ride Lots" is a committed control measure in the MAG 1999 Serious Area CO and PM-10 Plans. Park and ride facilities reduce vehicle trips and emissions by encouraging carpooling, vanpooling, and transit ridership. These projects reduce light duty vehicle exhaust emissions of CO, TOG, and NOx, and exhaust plus reentrained emissions of PM-10.

The methodology is based on the number of park and ride spaces to be built and the projected utilization rate in ten years when the facility is scheduled to open. It is assumed that each vehicle parked in the facility (spaces times the utilization rate) represents two commute trips. An average trip length is derived from regional commuting data collected by the Regional Public Transportation Authority and applied to the total commute trips. The average trip length driven to park and ride lots (from a MAG park-and-ride lot survey) is subtracted from the average commute trip length. The net trip length is applied to the total commute trips reduced to obtain the average weekday reduction in vehicle miles of travel (VMT).

The MOVES model will be run for the project implementation year to estimate the onroad light duty vehicle emission factors for CO, TOG, NOx, and PM-10 (ONF_{CO}, ONF_{TOG}, ONF_{NOx}, and ONF_{PM}). The paved road emission factor for all roads of 0.65 grams per mile will be added to ONF_{PM}. These emission factors will be multiplied by the reduction in vehicle miles of travel. MOVES will also be run to estimate the off-network emission factors (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, and OFF_{PM}), which will be multiplied by the reduction in the number of vehicles. These emission reductions will be summed to estimate the total emissions benefit of the Park and Ride project.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Number of spaces ***(S)***.
- Estimated utilization rate ***(U)***.

Formulas:

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = \boldsymbol{S * U * 2 * (15.4 - 3.5)}$$

$$\textit{Vehicles Reduced } (\boldsymbol{VR}) = \boldsymbol{S * U}$$

where: ***S*** = number of parking spaces provided in the park and ride facility
U = average weekday utilization rate
2 = number of vehicle commute trips per average weekday
15.4=average commute trip length by all modes (MCAQD, 2009)
3.5 =average miles driven to park and ride lots (from MAG park-and-ride lot survey)

$$VER_1 = VMTR * \left(\frac{w1 * ONF_{CO}}{4} + \frac{w2 * ONF_{TOG}}{2} + \frac{w3 * ONF_{NOx}}{2} + w4 * (ONF_{PM} + PEF)\right) * \frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$VER_2 = VR * \left(\frac{w1 * OFF_{CO}}{4} + \frac{w2 * OFF_{TOG}}{2} + \frac{w3 * OFF_{NOx}}{2} + (w4 * OFF_{PM}\right) * \frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$Daily\ Emissions\ Reduction = VER_1 + VER_2 = \frac{kilograms}{day}$$

where: ***ONF*** = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)
250/365 = factor to convert from a weekday to an annual average day
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively

$$Capital\ Recovery\ Factor\ (CRF) = \frac{(1+i)^{life}\ (i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 20 years

$$Cost\text{-}Effectiveness = \frac{CRF * CMAQ\ Cost * 1000}{Daily\ Emissions\ Reduction * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Park and Ride Lot **EXAMPLE**

A city requests $200,000 in CMAQ funds to construct a park and ride lot with 300 spaces in 2015. The city will use an additional $50,000 in local funds. The city estimates that 90 percent of these spaces will be utilized on a typical weekday.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $200,000.
- ***S*** = 300 spaces.
- ***U*** = 90% utilization.

$$VMT\ Reduced\ (\boldsymbol{VMTR}) = 300 * 0.90 * 2 * 11.9 = 6{,}426$$

$$Vehicles\ Reduced\ (\boldsymbol{VR}) = 300 * 0.90 = 270$$

$$\boldsymbol{VER_1} = 6{,}426*(\frac{0.0*2.00}{4}+\frac{1.0*0.12}{2}+\frac{1.0*0.41}{2}+(1.0*(0.04+0.65)))*\frac{1}{1000}*\frac{250}{365} = 4.20\ \frac{kilograms}{day}$$

$$\boldsymbol{VER_2} = 270*(\frac{0.0*2.85}{4}+\frac{1.0*0.34}{2}+\frac{1.0*0.17}{2}+(1.0*0.02))*\frac{1}{1000}*\frac{250}{365} = 0.05\ \frac{kilograms}{day}$$

$$Daily\ Emissions\ Reduction = 4.20 + 0.05 = 4.25\ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$Cost\text{-}Effectiveness = \frac{0.0672 * 200{,}000 * 1000}{4.25 * 365} = 8{,}664\ \frac{dollars}{metric\ ton}$$

PAVING PROJECTS

"Reduce Particulate Emissions from Unpaved Roads and Alleys," "Curbing, Paving or Stabilizing Shoulders on Paved Roads," and "Paving, Vegetating and Chemically Stabilizing Unpaved Access Points Onto Paved Roads" are committed measures in the MAG Serious Area PM-10 Plan (MAG, 2000a). Paving projects are effective in reducing PM-10 and therefore, represent potential candidates for CMAQ funds. Typical projects requesting CMAQ funds are for paving unpaved shoulders, curbs and gutters, unpaved roads, unpaved alleys, and unpaved access points. These projects reduce PM-10, but not CO, TOG, or NOx.

The emission rate (*BEF*) for unpaved roads based on the Maricopa County 2008 Periodic Emissions Inventory is 660.16 grams per mile (MCAQD, 2010). The paved road emission rate (*AEF*) on low volume arterials (<10,000 vehicles per day) with unpaved shoulders outside the Salt River Area is 3.51 grams per mile (MAG, 2007c). The difference between the paved and unpaved emission rate (656.65 g/mi) represents the reduction in PM-10 emissions due to paving dirt roads outside the Salt River Area. Inside the Salt River Area, the emission rate for vehicles traveling on paved roads without shoulders is 6.88 grams per mile and the emission reduction due to paving dirt roads is 653.28 grams per mile.

For unpaved alleys, the unpaved road emission rate is 417.46 grams per mile (MCAQD. 2010). The difference between the paved and unpaved (3.51 g/mi) emission rate, 413.95 grams per mile, represents the emission reduction for paving dirt alleys anywhere in the PM-10 nonattainment area.

The benefits of paving unpaved shoulders and/or installing curbs and gutters (C&G) are derived from the MAG Silt Loading Study (MAG, 2007c). Outside the Salt River Area, the reduction factor (RF) for paving shoulders with C&G on both sides of the road is 1.81 g/vmt for roads with less than 10,000 vehicles per day and 1.49 g/vmt for roads with 10,000 or more vehicles per day. In the Salt River Area, the RF for paving shoulders with C&G on both sides of a road is 3.44 g/vmt.[8] As shown in the formulas below, the RFs vary based on the extent of shoulder and/or C&G paving.

To be consistent with the Serious Area PM-10 Plan (MAG, 2000a), paving unpaved access points are assumed to reduce emissions by 343 grams per access point per day. No credit for access points will be assigned if there are no access points identified on the CMAQ project application.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Project length (*in centerline miles*).
- Average weekday traffic (***ADT***) for paving unpaved roads, alleys or shoulders.
- The number of access points to be paved (*access points*), if paving unpaved access points.
- Whether the project includes paving the shoulder and/or providing curb and gutter on one or both sides of the road.
- For road and shoulder paving projects, whether the project is located inside or outside the Salt River Area.

Formulas:

For Paving Unpaved Shoulders and/or Providing Curb and Gutter (C&G):

$$\textit{Daily Emissions Reduction} = w4 * RF * \textbf{miles} * ADT * 0.91 * \frac{1}{1000} = \frac{kilograms}{day}$$

where: ***RF*** = Reduction factor for:
Low volume roads (<10,000 ADT) outside the Salt River Area =
1.81 g/mi, if paving shoulders and providing C&G on both sides of the road;
1.36 g/mi, if paving shoulders on both sides of the road without C&G;
0.91 g/mi, if paving shoulder and providing C&G on one side of the road;

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[8]Paving unpaved shoulders with C&G in the Salt River Area reduces paved road emissions by 50 percent; therefore, **RF** due to paving shoulders with C&G in the Salt River Area is 6.88 g/vmt x 0.50 = 3.44 g/vmt. (MAG, 2008).

0.68 g/mi, if paving shoulder on one side of the road without C&G;
0.45 g/mi, if providing C&G on both sides of a road with paved shoulders; or
0.23 g/mi, if providing C&G on one side of a road with a paved shoulder.

High volume roads (≥ 10,000 ADT) outside the Salt River Area =
1.49 g/vmt, if paving shoulders and providing C&G on both sides of the road;
1.12 g/mvt, if paving shoulders on both sides of the road without C&G;
0.75 g/vmt, if paving shoulder and providing C&G on one side of the road;
0.56 g/vmt, if paving shoulder on one side of the road without C&G;
0.37 g/vmt, if providing C&G on both sides of a road with paved shoulders; or
0.19 g/vmt, if providing C&G on one side of a road with a paved shoulder.

All roads inside the Salt River Area =
3.44 g/vmt, if paving shoulders and providing C&G on both sides of the road;
2.58 g/mvt, if paving shoulders on both sides of the road without C&G;
1.72 g/vmt, if paving shoulder and providing C&G on one side of the road;
1.29 g/vmt, if paving shoulder on one side of the road without C&G;
0.86 g/vmt, if providing C&G on both sides of a road with paved shoulders; or
0.43 g/vmt, if providing C&G on one side of a road with a paved shoulder.

miles = the length of the project (in centerline miles)
ADT = the average weekday traffic on the road adjacent to the unpaved shoulders
0.91 = the factor to convert from weekday to annual average daily traffic
w4 = the PM-10 weighting factor

For Paving Unpaved Roads or Alleys:

$$\textit{Daily Emissions Reduction} = \boldsymbol{w4} * (\boldsymbol{BEF} - \boldsymbol{AEF}) * \boldsymbol{miles} * \boldsymbol{ADT} * 0.91 * \frac{1}{1000} = \frac{\textit{kilograms}}{\textit{day}}$$

where: ***BEF*** = the PM-10 emission factor for vehicles traveling on unpaved roads or alleys
AEF = the PM-10 emission factor for vehicles traveling on paved roads or alleys
miles = the length of the project (in centerline miles)
ADT = the average weekday traffic on the unpaved road or alley
0.91 = the factor to convert from weekday to annual average daily traffic
w4 = the PM-10 weighting factor

For Paving Unpaved Access Points:

$$\textit{Daily Emissions Reduction} = \boldsymbol{w4} * \frac{343\ \textit{grams}}{\textit{access point-day}} * \boldsymbol{access\ points} * \frac{1}{1000} = \frac{\textit{kilograms}}{\textit{day}}$$

where: ***access points*** = the number of access points to be paved
w4 = the PM-10 weighting factor

For All Paving Projects:

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{\boldsymbol{life}}\,(i)}{(1+i)^{\boldsymbol{life}} - 1}$$

where: $\boldsymbol{i}$ = discount rate of 3 percent
$\boldsymbol{life}$ = effectiveness period of 20 years

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ\ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Paving Unpaved Roads Without Paved Shoulders **EXAMPLE**

A jurisdiction proposes to pave a 1.5 mile section of unpaved road in 2015 which has an average weekday traffic volume of 120 vehicles per day. No paved shoulders or curb and gutter will be provided. The project application does not specify how many access points will be paved. The project is located outside of the Salt River Area. The total cost of the project is $675,000. The jurisdiction proposes to pay $75,000 and requests $600,000 in CMAQ funds.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $600,000.
- Project length (***miles***) = 1.5 miles.
- Average weekday traffic (***ADT***) on the unpaved road = 120.
- No access points are being paved.
- The project is located outside of the Salt River Area.

Calculations:

$$\textit{Daily Emissions Reduction} = 1.0 * 656.65 * 1.5 * 120 * 0.91 * \frac{1}{1000} = 107.56\ \frac{\textit{kilograms}}{\textit{day}}$$

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$Cost\text{-}Effectiveness = \frac{0.0672 * 600{,}000 * 1000}{107.56 * 365} = 1{,}027 \frac{dollars}{metric\ ton}$$

Paving Unpaved Roads, Shoulders and Curb and Gutter **EXAMPLE**

A city proposes to pave one mile of an unpaved road in 2015 which has a traffic volume of 120 vehicles per average weekday. The project will also pave the shoulders and provide curb and gutter on both sides of the road. The paving project is located outside of the Salt River Area. The project application indicates that four access points will be paved. The total cost of the project is $675,000. The city proposes to pay $75,000 and requests $600,000 of CMAQ funding.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $600,000.
- Project length (***miles***) = 1 mile.
- Average weekday traffic (***ADT***) on unpaved road = 120.
- Access points being paved = 4.
- The project is located outside of the Salt River Area.

Calculations:

Calculate the daily emissions reduction from paving the unpaved road:

$$Daily\ Emissions\ Reduction = 1.0 * 656.65 * 1.0 * 120 * 0.91 * \frac{1}{1000} = 71.71 \frac{kilograms}{day}$$

Calculate the daily emissions reduction from paving the shoulder and providing curb and gutter on both sides of the road:

$$Daily\ Emissions\ Reduction = 1.0 * 1.81 * 1.0 * 120 * 0.91 * \frac{1}{1000} = 0.20 \frac{kilograms}{day}$$

Calculate the daily emissions reduction from paving four unpaved access points:

$$Daily\ Emissions\ Reduction = 1.0 * 343 * 4 * \frac{1}{1000} = 1.37 \frac{kilograms}{day}$$

The total daily emissions reduction from paving the unpaved road with a shoulder and curb and

gutter and paving four unpaved access points:

$$\textit{Total Daily Emissions Reduction} = 71.71 + 0.20 + 1.37 = 73.28 \ \frac{kilograms}{day}$$

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$\textit{Cost-Effectiveness} = \frac{0.0672 * 600{,}000 * 1000}{73.28 * 365} = 1{,}507 \ \frac{dollars}{metric\ ton}$$

PM-10 CERTIFIED STREET SWEEPERS

"PM-10 Efficient Street Sweepers" is a committed measure in the Serious Area PM-10 Plan (MAG, 2000a). Street sweepers certified in accordance with South Coast Air Quality Management District Rule 1186 reduce PM-10 on paved roads, which reduces reentrainment of PM-10 by vehicles traveling on the road. Therefore, the purchase of PM-10 certified street sweepers is eligible for CMAQ funds. Emission reductions for this type of project will be calculated for PM-10 only.

The emission reductions are addressed as two separate components: the reduction in reentrained dust from vehicles traveling on the roadways cleaned by the sweeper and the reduction in dust from the actual sweeping process. These components will be combined to determine the total emissions reduction associated with a PM-10 certified street sweeper. Each component is described in a separate section below.

Reduced Reentrained Dust from Vehicles Traveling on Roadways. If the sweeper is being purchased to replace an existing conventional sweeper, the emission reduction will be based on a comparison of the emissions from the base silt loading on a paved road after using a conventional sweeper versus emissions from the reduced silt loading attributable to a PM-10 certified sweeper. The reduced silt loading results in lower emissions of reentrained dust from vehicles traveling on the road. If the sweeper is being purchased to replace an older PM-10 certified sweeper, the emission reduction will be based on a comparison of the utilization rates of the new PM-10 certified sweeper versus the older certified sweeper.

If the street sweeper is being purchased to increase the frequency of sweeping, the emission reduction will be based on a comparison of emissions using a PM-10 certified sweeper with the new cycle length (***daysnew***) versus the same sweeper with the existing cycle length (*days*). If the street sweeper is being purchased to expand coverage, the emission reduction will be based on the difference between the emissions from an unswept road (using the initial emission factors in Tables

4 and 5) and the emissions after sweeping with a PM-10 certified unit for the expanded area (***milesnew***).

The emission factor for reentrained dust varies depending upon how often a street is swept. It will be assumed that requested PM-10 certified street sweepers use the same sweeping schedule as the conventional street sweepers they replace. To be consistent with the Five Percent Plan for PM-10, it will be assumed that the silt loading on a street returns to its initial level nine days after the street is swept by a PM-10 certified sweeper and six days after being swept by a conventional sweeper. The initial unswept emission factors used in the 2008 PM_{10} Periodic Emissions Inventory (MCAQD, 2010) are 0.18 grams per mile for freeways and 0.91 grams per mile for arterials. The latter represents a 2008 VMT-weighted average of the low ADT (1.69 g/vmt) and high ADT (0.65 g/vmt) emission factors for arterials outside the Salt River Area.

In the Salt River Area, Sierra Research recommends a paved road PM-10 emission factor of 3.44 grams per mile for all arterials (MAG, 2008). The Salt River Area has boundaries of Van Buren Street on the north, 7th Street on the east, Baseline Road on the south, and 59th Avenue on the west. The higher paved road emission rate in the Salt River Area is due to the heavier weight (i.e., 4.1 tons) of vehicles traveling on paved roads in this industrial area, compared with the average vehicle weight of 3.0 tons in the rest of the region. Emission reduction credit for PM-10 street sweepers to be purchased with CMAQ funds for use in the Salt River Area will be calculated using this higher paved road emission rate.

The PM-10 certified sweepers are assumed to reduce the initial silt loading by 86 percent (i.e. the silt loading is reduced to 14 percent of the initial level), while conventional sweepers reduce the initial silt loading by 55 percent. The schedule for the percent of initial silt loading on days after PM-10 certified street sweeping is as follows: day of sweeping - 14 percent, 1 day after - 24 percent, 2 days after - 34 percent, 3 days after - 44 percent, 4 days after - 54 percent, 5 days after - 64 percent, 6 days after - 74 percent, 7 days after - 84 percent, 8 days after - 94 percent, and nine days or more after - 100 percent of initial silt loading. Similarly, the silt loading at varying days after sweeping with a conventional sweeper is as follows: day of sweeping - 45 percent, 1 day after - 55 percent, 2 days after - 65 percent, 3 days after - 75 percent, 4 days after - 85 percent, 5 days after - 95 percent, and 6 days or more after - 100 percent of initial silt loading.

The paved road emission factor for reentrained dust is exponentially related to the silt loading[9]. Therefore, the change in emission factors over time after sweeping does not follow the same linear relationship as percent reductions in silt loadings. The PM-10 emission factors for sweeping freeways and non-freeways with a PM-10 certified unit are listed in Table 3 for various days following street sweeping. Similar factors for a conventional sweeper are provided in Table 4. In Tables 3 and 4, the emission factors for sweeping non-freeways in the Salt River Area are based on a higher initial unswept emission rate recommended by Sierra Research (MAG, 2008).

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[9]The AP-42 equation for paved road PM-10 emission factors is calculated by raising the silt loading to the power of 0.65.

Based on sweeping frequency, the emission factors in Tables 3 and 4 will be combined to create a weighted average emission factor as shown in the formulas below. Separate weighted emission factors will be estimated to reflect the impact of sweeping with PM-10 certified sweepers and conventional sweepers. The difference between these two emission factors is the incremental reduction in emissions achieved by replacing a conventional street sweeper with a PM-10 certified unit.

The difference between the initial unswept emission factor and the PM-10 certified sweeper emission factor when applied to the new area being swept (*milesnew*) represents the reduction in emissions achieved by expanding the area of sweeping. The difference between the PM-10 certified emission factors for the old (*days*) and new (*daysnew*) cycle lengths represents the reduction achieved by increasing the frequency of sweeping.

To calculate the benefits of a new PM-10 certified sweeper that will replace an older PM-10 certified unit, the utilization rate of the new and older sweepers will be compared. The project applicant will provide the percent of time that the older unit was not utilized during the previous year due to maintenance and repair downtime. The average daily benefit of the new sweeper based on the emission factors in Table 3 will be reduced by the difference between 95 percent (the assumed utilization rate for a new sweeper) and the utilization rate (1.0 - percent downtime) for the older sweeper.

Reduced Emissions During the Sweeping Process. The reduction in PM-10 from the actual sweeping process will be based upon the California Air Resources Board estimate that a PM-10 certified street sweeper entrains 0.05 pounds per mile less PM-10 than a conventional sweeper during the sweeping process (CARB, 2005). For this analysis, the emissions reduction is converted to kilograms per vehicle mile, resulting in an emission reduction factor of 0.023 kilograms per vehicle mile traveled by the PM-10 certified sweeper. This estimate will be combined with the estimate of miles traveled per day by the PM-10 certified sweeper to produce a total reduction in emissions in kilograms for an average day. This reduction will only be applied when a PM-10 certified sweeper will replace a conventional sweeper.

Table 3. PM-10 Emission Factors as a Function of Days After Sweeping with a PM-10 Certified Sweeper

	Freeway	Non-freeway	Salt River Area Non-freeway
Day of sweeping (k=1)	0.05 g/vmt	0.25 g/vmt	0.96 g/vmt
1 day after sweeping (k=2)	0.07 g/vmt	0.36 g/vmt	1.36 g/vmt
2 days after sweeping (k=3)	0.09 g/vmt	0.45 g/vmt	1.71 g/vmt
3 days after sweeping (k=4)	0.11 g/vmt	0.53 g/vmt	2.02 g/vmt

4 days after sweeping (k=5)	0.12 g/vmt	0.61 g/vmt	2.30 g/vmt
5 days after sweeping (k=6)	0.13 g/vmt	0.68 g/vmt	2.57 g/vmt
6 days after sweeping (k=7)	0.15 g/vmt	0.75 g/vmt	2.83 g/vmt
7 days after sweeping (k=8)	0.16 g/vmt	0.81 g/vmt	3.07 g/vmt
8 days after sweeping (k=9)	0.17 g/vmt	0.87 g/vmt	3.30 g/vmt
9 days after sweeping (k>9)	0.18 g/vmt	0.91 g/vmt	3.44 g/vmt

Table 4. PM-10 Emission Factors as a Function of Days After Sweeping with a Conventional Sweeper

	Freeway	Non-freeway	Salt River Area Non-freeway
Day of sweeping (k=1)	0.11 g/vmt	0.54 g/vmt	2.05 g/vmt
1 day after sweeping (k=2)	0.12 g/vmt	0.62 g/vmt	2.33 g/vmt
2 days after sweeping (k=3)	0.14 g/vmt	0.69 g/vmt	2.60 g/vmt
3 days after sweeping (k=4)	0.15 g/vmt	0.75 g/vmt	2.85 g/vmt
4 days after sweeping (k=5)	0.16 g/vmt	0.82 g/vmt	3.10 g/vmt
5 days after sweeping (k=6)	0.17 g/vmt	0.88 g/vmt	3.33 g/vmt
6 days after sweeping (k>6)	0.18 g/vmt	0.91 g/vmt	3.44 g/vmt

Inputs Required from Entity Requesting CMAQ Funds:

PM-10 certified street sweepers are eligible for purchase with CMAQ funds if they replace an existing unit that has not been certified by South Coast Rule 1186, replace a Rule 1186 certified unit that is at least eight years old, increase the frequency of sweeping, expand the area that is swept, or a combination of these functions. Input requirements for each of these functions are described below. If the requested unit will perform more than one function, the requestor will need to provide all of the inputs described under each function. Note that the sweeping cycle (***days*** or ***daysnew***) referred to below represents the number of calendar days that elapse before the same lane of road is re-swept by the same sweeper.

For all sweeper requests:

- ***CMAQ Cost***.
- Average weekday traffic (***ADT***) per lane on streets to be swept by the PM-10 certified sweeper.

- Whether the requested unit will sweep freeways or non-freeways.

If the new sweeper will replace a non-certified sweeper:

- Current number of days per sweeping cycle (***days***) for the unit being replaced.
- Lane miles (***miles***) swept per cycle by the unit being replaced.

If the new sweeper will replace an older PM-10 certified sweeper:

- Percent of time the older certified sweeper was not utilized during the previous year as a result of maintenance and repair downtime.
- Current number of days per sweeping cycle (***days***) for the unit being replaced.
- Lane miles (***miles***) swept per cycle by the unit being replaced.

If the new sweeper will be used to increase the frequency of sweeping:

- Planned number of days per sweeping cycle (***daysnew***) for the lanes to be swept.
- Current number of days per sweeping cycle (***days***) for the lanes to be swept.
- Lane miles (***miles***) of roads to be swept per cycle.

If the new sweeper will be used to expand the area to be swept:

- Planned number of days per cycle (***daysnew***) on roads in the expanded area.
- Lane miles (***milesnew***) of roads to be swept per cycle in the expanded area.

Formulas:

Reduced Reentrained Dust from Vehicles Traveling on Roadways:

Emission factor for roads swept with PM-10 certified street sweepers:

$$PM\text{-}10\ Certified\ Sweeper\ Emission\ Factor\ (\boldsymbol{PEF}) = \frac{\sum_{k=1}^{\boldsymbol{days}} (PM\text{-}10\ certified\ emission\ factor)_k}{\boldsymbol{days}}$$

Emission factor for roads swept with conventional street sweepers:

$$Conventional\ Sweeper\ Emission\ Factor\ (\boldsymbol{CEF}) = \frac{\sum_{k=1}^{\boldsymbol{days}} (conventional\ emission\ factor)_k}{\boldsymbol{days}}$$

where: $(PM\text{-}10\ certified\ emission\ factor)_k$ = the emission factor on day k from Table 3
$(conventional\ emission\ factor)_k$ = the emission factor on day k from Table 4
days = current number of days per sweeping cycle

Replacing a Conventional Sweeper:

$$Daily\ Emissions\ Reduction = w4 * \mathbf{miles} * \mathbf{ADT} * 0.91 * (\mathbf{CEF} - \mathbf{PEF}) * \frac{1}{1000} = \frac{kilograms}{day}$$

Replacing an Older PM-10 Certified Sweeper:

$$Daily\ Emissions\ Reduction = w4 * \mathbf{miles} * \mathbf{ADT} * 0.91 * \mathbf{PEF} * (0.95 - URATE_{old}) * \frac{1}{1000} = \frac{kilograms}{day}$$

Increasing the Frequency of Sweeping:

$$Daily\ Emissions\ Reduction = w4 * \mathbf{miles} * \mathbf{ADT} * 0.91 * (\mathbf{PEF} - \mathbf{PEF}_{new}) * \frac{1}{1000} = \frac{kilograms}{day}$$

Expanding the Coverage of Sweeping:

$$Daily\ Emissions\ Reduction = w4 * \mathbf{milesnew} * \mathbf{ADT} * 0.91 * (\mathbf{IEF} - \mathbf{PEF}_{new}) * \frac{1}{1000} = \frac{kilograms}{day}$$

where: ***w4*** = the PM-10 weighting factor
miles = lane miles of street to be swept per cycle
ADT = average weekday traffic per through lane to be swept by the requested sweeper
0.91 = factor to convert from weekday traffic to annual average daily traffic
$\boldsymbol{URATE_{old}}$ = percent utilization of the older PM-10 certified sweeper during the past year
$\boldsymbol{PEF_{new}}$ = PM-10 certified sweeper emission factor calculated with ***days*** = ***daysnew***
IEF = the initial silt loading emission factor in Table 3 (i.e., 9 days after sweeping) or Table 4 (i.e., 6 days after sweeping)
milesnew = lane miles of streets be swept per cycle in the expanded area

Reduced Emissions During the Sweeping Process (This reduction is only applied if the requested sweeper replaces a non-certified unit):

$$\textit{Daily Emissions Reduction for the Sweeping Process} = w4 * \left(\frac{\textbf{miles}}{\textbf{days}}\right) * 0.023 = \frac{\textit{kilograms}}{\textit{day}}$$

where: **0.023** = kilograms per vehicle mile reduction in reentrained dust from the sweeping process itself.
w4 = the PM-10 weighting factor

$$\textit{Capital Recovery Factor } (\textbf{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 8 years (MAG, 1998)

$$\textit{Cost-Effectiveness} = \frac{\textbf{CRF} * \textbf{CMAQ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

PM-10 Certified Street Sweepers **EXAMPLE**

A city proposes to purchase a PM-10 certified street sweeper in 2015 to replace a non-certified sweeper. The replacement unit will not be used to increase the frequency of sweeping or the area swept. The cost of CMAQ-eligible equipment on the sweeper is $150,000. The city proposes to pay $15,000 and requests $135,000 of CMAQ funding. The certified sweeper will be used on streets (non-freeways) outside the Salt River Area with average weekday traffic per through lane of 5,000 vehicles. Each lane mile of street is currently swept once every 14 days. During this 14-day cycle, 200 lane miles are swept using the non-certified sweeper being replaced.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $135,000.
- Average weekday traffic per through lane swept with the conventional sweeper to be replaced (***ADT***)= 5,000 vehicles/day.
- Current number of days in the sweeping cycle using the conventional sweeper to be replaced (***days***) = 14 days.
- Lane miles of streets swept per sweeping cycle with the conventional sweeper to be replaced (***miles***) = 200 lane miles.

Calculations:

$$CEF = \frac{0.54 + 0.62 + 0.69 + 0.75 + 0.82 + 0.88 + (8 * 0.91)}{14} = 0.827$$

$$PEF = \frac{0.25 + 0.36 + 0.45 + 0.53 + 0.61 + 0.68 + 0.75 + 0.81 + 0.87 + (5 * 0.91)}{14} = 0.704$$

$$\textit{Daily Emissions Reduction for Reentrainment} = 1.0*200*5000*0.91*(0.827 - 0.704)*\frac{1}{1000} = 111.93 \frac{kilograms}{day}$$

$$\textit{Daily Emissions Reduction for the Sweeping Process} = 1.0 * \frac{200}{14} * 0.023 = 0.33 \frac{kilograms}{day}$$

$$\textit{Total Daily Emissions Reduction} = 111.93 + 0.33 = 112.26 \frac{kilograms}{day}$$

$$CRF = \frac{(1+0.03)^8 * (0.03)}{(1+0.03)^8 - 1} = 0.1425$$

$$\textit{Cost-Effectiveness} = \frac{0.1425 * 135{,}000 * 1000}{112.26 * 365} = 469 \frac{dollars}{metric\ ton}$$

RIDESHARE PROGRAMS

"Employer Rideshare Program Incentives" and "Preferential Parking for Carpools and Vanpools" are committed control measures in the MAG 1999 Serious Area CO and PM-10 Plans. Ridesharing in carpools and vanpools reduces emissions by decreasing the total vehicle miles of travel (VMT) for commute trips. MAG programs CMAQ funding for the Regional Rideshare Program operated by RPTA and partial funding for the Capitol Rideshare Program conducted by the Arizona Department of Administration. The Ozone Education Program which was previously evaluated as a separate CMAQ-funded project has been integrated into the Regional Rideshare Program.

Based on the TDM survey conducted in 2009 (Valley Metro, 2010), an average of 11 percent of all work trips are made by carpools and vanpools. The average trip length of commute trips by all modes in 2009 was 15.4 miles (MCAQD, 2009) and the average vehicle occupancy was 1.28 (Cummings, 2010).

The MOVES model will be run for the CMAQ funding year to estimate the onroad (Road Types 2-5) light duty vehicle emission factors for CO, TOG, NOx, and PM-10 (ONF_{CO}, ONF_{TOG}, ONF_{NOx}, *and* ONF_{PM}). The paved road emission factor for all roads of 0.65 grams per mile will be added to

ONF_{PM}.. MOVES will also be run to generate off-network (Road Type 1) light duty vehicle emission factors for each pollutant (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, *and* OFF_{PM}). The onroad emission factors will be multiplied by vehicle miles of travel, while the off-network emission factors will be multiplied by the vehicles reduced. These emission reductions will be summed to estimate the total benefit of the Rideshare Program.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Percent of carpooling participation attributable to the Regional Rideshare Program (***P***).

Formulas:

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = \frac{\mathbf{0.11} * \boldsymbol{W} * \boldsymbol{P}}{\mathbf{1.28}} * \mathbf{15.4}$$

$$\textit{Vehicles Reduced } (\boldsymbol{VR}) = \frac{\boldsymbol{VMTR}}{\mathbf{15.4} * \mathbf{1.6}}$$

where: **0.11** = percent of total commute trips by carpooling and vanpooling (Valley Metro, 2010)
W = daily home-based work person trips = 1.6 * total employment in Maricopa County for CMAQ funding request year (MAG trip attraction equation)
P = percent of carpooling attributable to the Regional Rideshare Program
1.28 = average vehicle occupancy for all modes (Cummings, 2010)
15.4 = Average commute trip length by all modes (MCAQD, 2009)

$$\boldsymbol{VER_1} = \boldsymbol{VMTR} * [\frac{w1 * ONF_{CO}}{4} + \frac{w2 * ONF_{TOG}}{2} + \frac{w3 * ONF_{NOx}}{2} + w4 * (ONF_{PM} + PEF)] * \frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$\boldsymbol{VER_2} = \boldsymbol{VR} * [\frac{w1 * OFF_{CO}}{4} + \frac{w2 * OFF_{TOG}}{2} + \frac{w3 * OFF_{NOx}}{2} + w4 * OFF_{PM}] * \frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

where: ***ONF*** = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively
250/365 = factor to convert from an average weekday to an annual average day

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+i)^{life}\ (i)}{(1+i)^{life} - 1}$$

where: $\boldsymbol{i}$ = discount rate of 3 percent
$\boldsymbol{life}$ = program period of 1 year

$$Cost\text{-}Effectiveness = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ}\ Cost * 1000}{Daily\ Emissions\ Reduction * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Regional Rideshare Program **EXAMPLE**

RPTA requests $594,000 in FY 2015 CMAQ funds for the Regional Rideshare Program and indicates that the Regional Rideshare Program is responsible for ten percent of employee participation in carpooling. Based on interpolation of 2010 and 2020 projections adopted by the MAG Regional Council in May 2007, the total employment for Maricopa County in 2015 is expected to be 2,473,000.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $594,000.
- ***P*** = 10%.

Calculations:

$$\boldsymbol{VMTR} = \frac{0.11 * (1.6 * 2{,}473{,}000) * 0.10}{1.28} * 15.4 = 523{,}658$$

$$\boldsymbol{VR} = \frac{523{,}658}{15.4 * 1.6} = 21{,}252$$

$$VER_1 = 523{,}658*(\frac{0.0*2.00}{4}+\frac{1.0*0.12}{2}+\frac{1.0*0.41}{2}+(1.0*(0.04+0.65)))*\frac{1}{1000}*\frac{250}{365} = 342.53\ \frac{kilograms}{day}$$

$$VER_2 = 21{,}252*(\frac{0.0*2.85}{4}+\frac{1.0*0.34}{2}+\frac{1.0*0.17}{2}+(1.0*(0.02)))*\frac{1}{1000}*\frac{250}{365} = 4.00\ \frac{kilograms}{day}$$

$$Daily\ Emissions\ Reduction = 342.53 + 4.00 = 346.53\ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^1 * (0.03)}{(1+0.03)^1 - 1} = 1.03$$

$$Cost\text{-}Effectiveness = \frac{1.03 * 594{,}000 * 1000}{346.53 * 365} = 4{,}837\ \frac{dollars}{metric\ ton}$$

TELEWORK PROGRAM

"Encouragement of Telecommuting, Teleworking and Teleconferencing" is a committed control measure in the MAG 1999 Serious Area CO and PM-10 Plans. The program encourages employers to set up and institutionalize telecommuting options for employees. The program provides consulting services to implement or expand corporate telecommuting programs, including advice on information technology and telecommunications connectivity. The current outreach effort targets CEOs of companies to obtain top-level commitment. The program also aims to increase general public awareness of telecommuting via TV programs, press releases, and advertisements in corporate publications. The Telework Program reduces emissions by decreasing the total vehicle miles of travel (VMT) for commute trips.

Based on data collected in 2009, 11 percent of daily commute trips are replaced by telecommuting or compressed work schedules (Valley Metro, 2010) and the average trip length avoided by telecommuting and compressed work schedules is 19.1 miles (derived from Valley Metro, 2010 and MCAQD, 2009).

The MOVES model will be run for the CMAQ funding year to estimate the onroad (Road Types 2-5) light duty vehicle emission factors for CO, TOG, NOx, and PM-10 (ONF_{CO}, ONF_{TOG}, ONF_{NOx}, *and* ONF_{PM}). The paved road emission factor for all roads of 0.65 grams per mile will be added to ONF_{PM}.. MOVES will also be run to generate off-network (Road Type 1) light duty vehicle emission

factors for each pollutant (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, and OFF_{PM}). The onroad emission factors will be multiplied by vehicle miles of travel, while the off-network emission factors will be multiplied by the vehicles reduced. These emission reductions will be summed to estimate the total benefit of the Telework Program.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Percent of telecommuting attributable to the Telework Program (***P***).

Formulas:

$$\textit{Commute Trips Avoided } (\boldsymbol{CTA}) = \frac{\mathbf{0.11} * \boldsymbol{W}}{\mathbf{1.28}}$$

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = \boldsymbol{CTA} * \boldsymbol{P} * \mathbf{19.1}$$

$$\textit{Vehicles Reduced } (\boldsymbol{VR}) = \frac{\boldsymbol{CTA}}{\mathbf{1.6}} * P$$

where: **0.11** = share of commute trips replaced by telecommuting and compressed work schedules on an average weekday (Valley Metro, 2010)
W = daily home-based work person trips = 1.6 * total employment in Maricopa County in the CMAQ funding request year (from MAG trip attraction equation)
1.28 = average vehicle occupancy for all modes (Cummings, 2010)
P = percent of suppressed telecommuting/compressed work schedule trips attributable to the Telework Program
19.1 = average commute trip length in miles for telecommuters and employees with compressed work schedules (derived from Valley Metro, 2010 and MCAQD, 2009)
1.6 = factor to convert trips avoided (*CTA*) to vehicles reduced (***VR***)

$$\boldsymbol{VER_1} = \boldsymbol{VMTR} * \left[\frac{w1*ONF_{CO}}{4} + \frac{w2*ONF_{TOG}}{2} + \frac{w3*ONF_{NOx}}{2} + w4*(ONF_{PM}+PEF)\right]*\frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$\boldsymbol{VER_2} = \boldsymbol{VR} * \left[\frac{w1*OFF_{CO}}{4} + \frac{w2*OFF_{TOG}}{2} + \frac{w3*OFF_{NOx}}{2} + w4*OFF_{PM}\right]*\frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$\textit{Daily Emissions Reduction} = \boldsymbol{VER_1} + \boldsymbol{VER_2} = \frac{kilograms}{day}$$

where: ***ONF*** = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively
250/365 = factor to convert from an average weekday to an annual average day

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = program period of 1 year

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \textit{CMAQ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Telework Program **EXAMPLE**

The Regional Public Transportation Authority (RPTA) requests $300,000 in FY 2015 CMAQ funds for the Telework Program. RPTA indicates that the share of telecommuting attributable to the Telework Program is 20 percent. Based on interpolation of 2010 and 2020 projections adopted by the MAG Regional Council in May 2007, the total employment for Maricopa County in 2015 is expected to be 2,473,000.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $300,000.
- ***P*** = 20%.

Calculations:

$$\boldsymbol{CTA} = \frac{0.11 * (1.6 * 2{,}473{,}000)}{1.28} = 340{,}038$$

$$\boldsymbol{VMTR} = 340{,}038 * 0.20 * 19.1 = 1{,}298{,}945$$

$$\boldsymbol{VR} = \frac{340{,}038}{1.6} * 0.20 = 42{,}505$$

$$VER_1 = 1{,}298{,}945 * \left(\frac{0.0*2.00}{4} + \frac{1.0*0.12}{2} + \frac{1.0*0.41}{2} + (1.0*(0.04+0.65)) * \frac{1}{1000} * \frac{250}{365} = 849.65 \ \frac{kilograms}{day}\right.$$

$$VER_2 = 42{,}505 * \left(\frac{0.0*2.85}{4} + \frac{1.0*0.34}{2} + \frac{1.0*0.17}{2} + 1.0*0.02 * \frac{1}{1000} * \frac{250}{365} = 8.01 \ \frac{kilograms}{day}\right.$$

$$Daily\ Emissions\ Reduction = 849.65 + 8.01 = 857.66 \ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (CRF) = \frac{(1+0.03)^1 * (0.03)}{(1+0.03)^1 - 1} = 1.03$$

$$Cost\text{-}Effectiveness = \frac{1.03 * 300{,}000 * 1000}{857.66 * 365} = 987 \ \frac{dollars}{metric\ ton}$$

TRAFFIC FLOW IMPROVEMENTS

"Coordinate Traffic Signal Systems," "Develop Intelligent Transportation Systems," and "Reduce Traffic Congestion at Major Intersections" are committed control measures in the MAG 1999 Serious Area CO and PM-10 Plans. These measures reduce emissions by increasing vehicle speeds or reducing vehicle idling.

The 2005 CMAQ methodologies (MAG, 2005) stated that MAG would run the FHWA ITS Deployment Analysis System (IDAS) software to estimate the CO, TOG, and NOx emission reductions for Traffic Signal Coordination, Freeway Management System (FMS), and other Intelligent Transportation System (ITS) projects that are proposed for CMAQ funding. Unfortunately, application of IDAS did not provide the level of sensitivity needed to evaluate the emissions benefits of the types of traffic flow improvement projects typically proposed for MAG CMAQ funding.

In 2008, Sierra Research indicated that the level of detail used by the Texas Department of Transportation in evaluating CMAQ projects (TTI, 2007) is higher than currently required by the MAG methodologies. For example, the Texas Transportation Institute (TTI) methodology for ITS projects quantifies the emission reductions attributable to alleviating peak and off-peak recurrent and non-recurrent congestion.

To improve the methodologies used to evaluate traffic flow improvement projects proposed for CMAQ funding, MAG contracted with Lee Engineering and Texas Transportation Institute in early 2010. The new CMAQ methodologies recommended by Lee/TTI are described below (Lee/TTI, 2010). The recommended methodologies include four steps.

Step 1. Group individual project elements by Project.

Elements are individual projects in the MAG Transportation Improvement Program (TIP) that, when combined, lead to implementation of a Project that reduces emissions. An example of three elements that lead to implementation of a Project is shown in Table 5.

Table 5 - Example of Three Elements Grouped into a Single Project

TIP Project	Description	FY
FED-08	Purchase and Install Malfunction Management Units in all Traffic Control Cabinets	2008
FED-09	Install Video Detection System	2009
FED-10	Design and Construct Fiber Optic Cable Installations	2010

Elements can also include planning and design projects. Note that elements are typically implemented over a number of years in the TIP. Rather than estimating benefits for each element, in the example above the three elements would be analyzed as one Project with benefits assigned to a geographic area (i.e., city, town, Indian community, or regionwide). It is possible to have elements that support multiple Projects (e.g., fiber optics). If elements do not belong to a single project group, they will be grouped by jurisdiction and the element with the highest emission benefits will be used.

Lee/TTI recommended that MAG use an element grouping scheme that first grouped the elements by jurisdiction, then by level of improvement, then by market package, as identified in the Regional ITS Architecture. Lee/TTI identified four levels of improvement: 1 = Citywide, 2 = Arterial, 3 = Intersection, and 4 = Central. Level 4 improvements represent elements that could have regional implications such as the connection to a regional Traffic Management Center. Lee/TTI also used the MAG Regional ITS Architecture to sub-group elements by market package. The final grouping, shown in Appendix A, will be updated to include new ITS projects, when they are submitted for CMAQ funding.

The MAG ITS Program will be responsible for assigning a proposed CMAQ project (element) to the appropriate Project Group. The MAG Environmental Division will calculate the emission benefits of the proposed ITS project, according to the Lee/TTI recommended approaches described below.

Step 2. Calculate the emissions benefit for each Project in the build year (i.e, the final year of grouped elements).

In calculating the emission benefits for traffic signal coordination projects, Lee/TTI recommends that MAG continue to use the speed-based approach used in previous CMAQ methodologies. For other types of traffic flow improvements, Lee/TTI recommends use of the following new equations, derived from *The Texas Guide to Accepted Mobile Source Emission Reduction Strategies*, also called the MOSERS report (TTI, 2007).

For Incident Management Programs on Freeways:[10]

$$\textit{Daily Emission Reduction (grams/day)} = E_{REG} * F_{NR} * \sum_{1}^{n} F_{EFF_i} * \frac{ADT_i}{ADT_T} \quad (MOSERS\ 1)$$

where: $\boldsymbol{ADT_i}$ = Average daily traffic for each affected link
$\boldsymbol{ADT_T}$ = Total average daily traffic for affected system (vehicles/day)
$\boldsymbol{E_{REG}}$ = Regional freeway emissions (grams)
$\boldsymbol{F_{Eff}}$ = Project effectiveness factor for each affected freeway[11]
$\mathbf{F_{NR}}$ = Nonrecurring emissions (decimal)[12]

For Regional/Systemwide Projects (e.g., Freeway Management System):[13]

$$\textit{Daily Emission Reduction (grams/day)} = A + B + C + D \qquad (MOSERS\ 2)$$

A = Change in emissions from alleviating peak hour nonrecurrent congestion

$$A = E_P * F_{NR,P} * F_{ITS} * F_{EN,P}$$

B = Change in emissions from alleviating off-peak hour nonrecurrent congestion

$$B = E_{OP} * F_{OPH} * F_{NR,OP} * F_{ITS} * F_{EN,OP}$$

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[10]Equation in Section 7.3 of the MOSERS report.

[11]From Section 7.3 of the MOSERS report: "The FHWA Southern Resource Center, August 1999, reports a 50% effectiveness rate for detection and response; 25% for motor assistance patrol; 15% for surveillance."

[12]From Section 7.3 of the MOSERS report: "According to the FHWA Southern Resource Center, August 1999 report, 4.9 percent of freeway emissions are caused by nonrecurring congestion."

[13]Equation 2 in Section 7.4 of the MOSERS report.

C = Change in emissions from alleviating peak hour recurrent congestion

$$C = E_P * F_{ITS} * (1 - F_{NR,P}) * F_{ER,P}$$

D = Change in emissions from alleviating off-peak hour recurrent congestion

$$D = E_{OP} * F_{OPH} * F_{ITS} * (1 - F_{NR,OP}) * F_{ER,OP}$$

where:

E_{OP} = Emissions generated by congestion on affected roadway system during the off-peak period for each pollutant (CO, TOG, NOx, PM-10) in grams
E_P = Emissions generated by congestion on affected roadway system during the peak period for each pollutant (CO, TOG, NOx, PM-10) in grams
$F_{EN,OP}$ = Percent of nonrecurrent congestion eliminated on roadways with ITS deployment, off-peak period (decimal)
$F_{EN,P}$ = Percent of nonrecurrent congestion eliminated on roadways with ITS deployment, peak period (decimal)
$F_{ER,OP}$ = Percent of recurrent congestion eliminated on roadways with ITS deployment, off-peak period (decimal)
$F_{ER,P}$ = Percent of recurrent congestion eliminated on roadways with ITS deployment, peak period (decimal)
F_{ITS} = Percent of roadway system coverage with ITS deployment (decimal)
$F_{NR,OP}$ = Percent of roadway system emissions caused by nonrecurring congestion in the off-peak period (decimal)
$F_{NR,P}$ = Percent of roadway system emissions caused by nonrecurring congestion in the peak period (decimal)
F_{OPH} = Percent of off-peak hour emissions affected by ITS deployment (decimal)

For All Other Traffic Flow Improvement Projects:[14]

$$\textit{Daily Emission Reduction (grams/day)} = \sum_{1}^{n} [L_i * ADT_i * (EF_B - EF_A)_i] \quad (MOSERS\ 3)$$

[14]Equation 1 in Section 7.4 of MOSERS report.

where:

ADT_i = Average daily traffic for each affected roadway
EF_A = Speed-based running exhaust emission factor after implementation (CO, TOG, NOx, or PM-10) in grams per mile
EF_B = Speed-based running exhaust emission factor before implementation (CO, TOG, NOx, or PM-10) in grams per mile
L_I = Length of each freeway affected by ITS (miles)
N = Number of affected corridors

Lee/TTI recommended that MOSERS 3 equation be used for all ITS projects until the MAG study on nonrecurring congestion is completed (in late summer 2011). The MAG study will provide local values for many of the variables in MOSERS equations 1 and 2 (e.g., F_{NR}, the percent of roadway system emissions caused by nonrecurring congestion). Until these local data become available, MAG will apply the MOSERS 3 equation to evaluate all ITS projects that are proposed for CMAQ funding. The MAG Environmental Division will calculate the emissions reduction benefit for each element of the Project Group in order to identify the element with the maximum benefit.

Step 3. Allocate the maximum emissions benefit of the Project to elements in the same group based on the vehicle miles of travel (VMT) calculated for each element.

The emission reductions will be allocated to each element in proportion to the VMT calculated for that element. It is important to note that this approach allocates unrealistically high emission benefits to plans and studies because they typically cover large geographic areas and have high VMT levels. To offset this effect, five percent of the maximum benefit of the Project will be allocated to planning and study elements.

Step 4. Apply the current MAG pollutant weighting and develop cost effectiveness ranking.

Lee/TTI recommended that cost effectiveness be calculated in the same way as in the 2009 MAG CMAQ methodologies (MAG, 2009). The Lee/TTI recommendations are described for each type of traffic flow improvement project in the sections below.

Traffic Signal Coordination

MOVES will be run to calculate the daily CO, TOG, NOx, and PM-10 emission reductions attributable to traffic signal coordination projects. The information in Table 6 was obtained from the California Air Resources Board (CARB, 2005). The length of the project, the ADT, the pre-project speed, and the category in Table 6 that best represents the proposed project will be provided by the agency requesting CMAQ funding.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Length of project (***miles***).

- Current average weekday traffic (***ADT***).
- Pre-project speed.
- The category into which the proposed project should be classified (see Table 6).

Table 6. Traffic Signal Coordination - Post-Project Speeds

Category	Before Condition	After Condition	Increase in Speed
one	Non-interconnected, pre-timed signals with old timing plan	Advanced computer-based control	25%
two	Interconnected, pre-timed signals with old timing plan	Advanced computer-based control	17.5%
three	Non-interconnected signals with traffic-actuated controllers	Advanced computer-based control	16%
four	Interconnected, pre-timed signals with actively managed timing	Advanced computer-based control	8%
five	Interconnected, pre-timed signals with various forms of master control and various qualities of timing plans	Optimization of signal timing plans. No change in hardware	12%
six	Non-interconnected, pre-timed signals with old timing plan	Optimization of signal timing plan	7.5%

Formulas:

$$\textit{Daily Emissions Reduction} = \textbf{miles} * \textbf{ADT} * \textbf{0.91} *$$

$$[(\frac{w1*BEF_{CO}}{4}+\frac{w2*BEF_{TOG}}{2}+\frac{w3*BEF_{NOx}}{2}+w4*BEF_{PM10})-(\frac{w1*AEF_{CO}}{4}+\frac{w2*AEF_{TOG}}{2}+\frac{w3*AEF_{NOx}}{2}+w4*BEF_{PM10}]*\frac{1}{1000}=\frac{kg}{day}$$

where: ***miles*** = the length of the project
ADT = the average weekday traffic
0.91 = the factor for converting ADT to annual average daily traffic (AADT)
BEF = the emission factor for all vehicle classes at the pre-project speed
AEF = the emission factor at the post-project speed (from Table 6)
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{\boldsymbol{life}}\ (i)}{(1+i)^{\boldsymbol{life}} - 1}$$

where: $\boldsymbol{i}$ = discount rate of 3 percent
$\boldsymbol{life}$ = effectiveness period of 5 years (CARB, 2005)

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ\ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Traffic Signal Coordination **EXAMPLE**

A city proposes to install a system in FY 2015 that synchronizes the traffic lights on three miles of street. The city will be replacing interconnected, pre-timed signals with actively managed timing with an advanced computer-based control system. The cost of the system is $150,000. The city proposes to pay $15,000 and requests $135,000 of CMAQ funding. The average speed on the three miles of street is estimated to be 25 mph. Since the project falls within category four in Table 6, the post-improvement speed will be eight percent higher than 25 mph or 27 mph. The weekday traffic on the road is estimated to be 10,000 vehicles per day.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $135,000.
- Length of project (***miles***) = 3.
- Average weekday traffic (***ADT***) = 10,000.
- The pre-project speed = 25 mph.
- The category into which the proposed project is classified (from Table 6) = four

Calculations:

$$\textit{Daily Emissions Reduction} = 3 * 10{,}000 * 0.91 * [(\frac{0.0*4.94}{4} + \frac{1.0*0.17}{2} + \frac{1.0*0.65}{2} + 1.0*0.06) -$$

$$\frac{0.00*4.74}{4} + \frac{1.0*0.16}{2} + \frac{1.0*0.61}{2} + 1.0*0.05)] * \frac{1}{1000} = 0.96\ \frac{\textit{kilograms}}{\textit{day}}$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^5 * (0.03)}{(1+0.03)^5 - 1} = 0.2184$$

$$Cost\text{-}Effectiveness = \frac{0.2184 * 135{,}000 * 1000}{0.96 * 365} = 84{,}144\ \frac{dollars}{metric\ ton}$$

Intelligent Transportation Systems

The installation of Intelligent Transportation Systems (ITS) alerts drivers concerning congestion incidents. Incident management projects permit more efficient re-routing of traffic and reduce vehicle idling which, in turn, reduces emissions. Freeway Management System projects improve the traffic flow on the regional system of freeways. Other ITS projects improve the traffic flow on arterials. Until local values for the MOSERS 1 and 2 equations are obtained, Lee/TTI recommends that MOSERS 3 be applied to calculate the emission reduction benefits of all proposed ITS projects.

The MAG ITS Program will assign the proposed ITS project (element) to the appropriate Project Group. The MAG Environmental Division will calculate the emission benefits of each element in the Project Group in order to identify the maximum benefit among the elements. The maximum benefit will be apportioned based on the share of VMT associated with the proposed project element relative to the total VMT of all elements in the Group. If there are multiple corridors involved in an ITS project, then the formula would be applied to each corridor and the emissions benefits would be summed.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***
- Length of project (***miles***).
- Average weekday traffic (***ADT***).
- The pre-project speed.
- The post-project speed.

Formulas:

$$Daily\ Emissions\ Reduction = \boldsymbol{miles} * \boldsymbol{ADT} * \mathbf{0.91} *$$

$$\left[\left(\frac{w1*BEF_{CO}}{4} + \frac{w2*BEF_{TOG}}{2} + \frac{w3*BEF_{NOx}}{2}\right) - \left(\frac{w1*AEF_{CO}}{4} + \frac{w2*AEF_{TOG}}{2} + \frac{w3*AEF_{NOx}}{2}\right)\right] * \frac{1}{1000} = \frac{kilograms}{day}$$

where: ***miles*** = the length of the project
ADT = the average weekday traffic
0.91 = the factor for converting ADT to annual average daily traffic (AADT)
BEF = the emission factor for all vehicle classes at the pre-project speed
AEF = the emission factor for all vehicle classes at the post-project speed
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = effectiveness period of 5 years

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ\ Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Intelligent Transportation Systems **EXAMPLE**

A city proposes to design and construct fiber optic cable installations in FY 2015. The MAG ITS Program determines that the project is an element of a larger Project Group for the same city that includes ITS projects that have already been approved for CMAQ funding in FY 2013 and FY 2014. The city estimates that the implementation of all elements in the Project Group will increase weekday vehicle speeds from 25 to 27 mph on 30 miles of arterials. The affected arterials carry an average of 10,000 vehicles per average weekday. The cost of the project is $150,000. The city proposes to pay $15,000 and is requesting $135,000 in CMAQ funding.

The MAG Environmental Division determines that this project element represents half of the total VMT for all elements in the Project Group. Therefore, the emission reduction benefits of this proposed project are reduced by 50 percent in the calculations below.
Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $135,000.
- Length of project (***miles***) = 30.
- Average weekday traffic (***ADT***) = 10,000.
- The pre-project speed = 25 mph.
- The post-project speed = 27 mph.

Calculations:

$$Daily\ Emissions\ Reduction = 30 * 10{,}000 * 0.91 * [(\frac{0.0*4.94}{4} + \frac{1.0*0.17}{2} + \frac{1.0*0.65}{2} + 1.0*0.06) -$$

$$\frac{0.00*4.74}{4} + \frac{1.0*0.16}{2} + \frac{1.0*0.61}{2} + 1.0*0.05)] * \frac{1}{1000} * 0.5 = 4.78\ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^5 * (0.03)}{(1+0.03)^5 - 1} = 0.2184$$

$$Cost\text{-}Effectiveness = \frac{0.2184 * 135{,}000 * 1000}{4.78 * 365} = 16{,}899\ \frac{dollars}{metric\ ton}$$

TRIP REDUCTION PROGRAM

"Trip Reduction Program" is a committed control measure in the MAG 1999 Serious Area CO and PM-10 Plans. The Trip Reduction Program requires employers with 50 or more employees at a work site in Area A to achieve target reductions in single occupant vehicle (SOV) trips through use of alternate transportation modes. Alternate transportation modes include carpooling, vanpooling, taking the bus, bicycling, and walking. Reductions in SOV trips due to telecommuting or compressed work schedules also qualify for credit in the trip reduction program. The program reduces emissions by decreasing the total vehicle miles of travel (VMT) for commute trips.

The Maricopa County Trip Reduction Program (TRP) maintains detailed information on participating organizations and their employees and students. In 2009, TRP data (MCAQD, 2009) indicates that 32 percent of employees work for TRP organizations and 24 percent of the commute trips taken by these employees are by alternate modes (or the commute trip is eliminated, in the case of telecommuting and compressed work weeks). In addition, the 89,000 Maricopa County students participating in the TRP in 2009 made 54 percent of their trips by alternate modes. The 2009 TRP data also indicates that the average one-way trip length for TRP participants (both employees and students) is 14.7 miles. The average vehicle occupancy for all modes in 2009 was 1.28 (Cummings, 2010).

The MOVES model will be run for the CMAQ funding year to estimate the onroad (Road Types 2-5) light duty vehicle emission factors for CO, TOG, NOx, and PM-10 (ONF_{CO}, ONF_{TOG}, ONF_{NOx}, *and* ONF_{PM}). The paved road emission factor for all roads of 0.65 grams per mile will be added to ONF_{PM}.. MOVES will also be run to generate off-network (Road Type 1) light duty vehicle emission factors for each pollutant (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, *and* OFF_{PM}). The onroad emission factors will be multiplied by vehicle miles of travel, while the off-network emission factors will be multiplied by the vehicles reduced. These emission reductions will be summed to estimate the total benefit of the Trip Reduction Program.

Inputs Required from Entity Requesting CMAQ Funds:

- *CMAQ Cost.*
- Percent of alternate mode use attributable to the Trip Reduction Program (*P*).
- Total employment in Maricopa County in the CMAQ funding year (*TE*).
- Students participating in the TRP program in the CMAQ funding year (*ST*).

Formulas:

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = \frac{((0.24 * (1.6 * TE) * 0.32) + (0.52 * (0.27 * ST))) * P}{1.28} * 14.7$$

$$\textit{Vehicles Reduced } (\boldsymbol{VR}) = \frac{VMTR}{1.6 * 14.7}$$

where: **0.24** = percent of TRP employee commute trips using alternate modes, including telecommuting and compressed work schedules (Cummings, 2010)
1.6 = factor to convert employment to weekday work trips (from MAG trip attraction equation)
TE = Total Maricopa County employment in funding year (from MAG projections)
0.32 = percent of employees participating in the TRP (Cummings, 2010)
0.52 = percent of TRP student trips using alternative modes (Cummings, 2010)
0.27 = factor to convert students into weekday trips (one-sixth of work trip rate of 1.6)
ST = students in Maricopa County participating in the TRP in the funding year (default = 89,000 in 2009)
P = percent of alternate mode use attributable to the TRP
1.28 = average vehicle occupancy (Cummings, 2010)
14.7 = average one-way trip length to work or school (MCAQD, 2009)

$$VER_1 = VMTR * [\frac{w1 * ONF_{CO}}{4} + \frac{w2 * ONF_{TOG}}{2} + \frac{w3 * ONF_{NOx}}{2} + w4 * (ONF_{PM} + PEF)] * \frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$VER_2 = VR * [\frac{w1 * OFF_{CO}}{4} + \frac{w2 * OFF_{TOG}}{2} + \frac{w3 * OFF_{NOx}}{2} + (w4 * OFF_{PM})] * \frac{1}{1000} * \frac{250}{365} = \frac{kilograms}{day}$$

$$\textit{Daily Emissions Reduction} = VER_1 + VER_2 = \frac{kilograms}{day}$$

where: ***ONF*** = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)
w1-w4 = weighting factors for CO, TOG, NOx, and PM-10, respectively
250/365 = factor to convert from an average weekday to an annual average day

$$\textit{Capital Recovery Factor } (\boldsymbol{CRF}) = \frac{(1+i)^{life}\,(i)}{(1+i)^{life} - 1}$$

where: ***i*** = discount rate of 3 percent
life = program period of 1 year

$$\textit{Cost-Effectiveness} = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ}\ \textit{Cost} * 1000}{\textit{Daily Emissions Reduction} * 365} = \frac{\textit{dollars}}{\textit{metric ton}}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Trip Reduction Program **EXAMPLE**

Maricopa County requests $910,000 in FY 2015 CMAQ funds for the Trip Reduction Program. The Arizona Department of Environmental Quality contributes $948,000 to the program. The County estimates that the share of alternative mode use attributable to the Trip Reduction Program is 25 percent. The County also indicates that the number of students expected to participate in the TRP in 2015 is 100,000. Based on interpolation of 2010 and 2020 projections adopted by the MAG Regional Council in May 2007, the total employment for Maricopa County in 2015 is expected to be 2,473,000.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $910,000.
- ***P*** = 25%.
- ***TE*** = 2,473,000.
- ***ST*** = 100,000.

Calculations:

$$\textit{VMT Reduced } (\boldsymbol{VMTR}) = \frac{((.24*(1.6*2{,}473{,}000)*.32) + (.52 * (.27*100{,}000))*.25}{1.28} * 14.7 = 912{,}784$$

$$Vehicles\ Reduced\ (\boldsymbol{VR}) = \frac{912{,}784}{1.6 * 14.7} = 38{,}809$$

$$\boldsymbol{VER_1} = 912{,}784 * \left(\frac{0.0*2.00}{4} + \frac{1.0*0.12}{2} + \frac{1.0*0.41}{2} + (1.0*(0.04+0.65))\right) * \frac{1}{1000} * \frac{250}{365} = 597.06\ \frac{kilograms}{day}$$

$$\boldsymbol{VER_2} = 38{,}809 * \left(\frac{0.0*2.85}{4} + \frac{1.0*0.34}{2} + \frac{1.0*0.17}{2} + (1.0*0.002)\right) * \frac{1}{1000} * \frac{250}{365} = 6.83\ \frac{kilograms}{day}$$

$$Daily\ Emissions\ Reduction = 597.06 + 6.83 = 603.89\ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^1 * (0.03)}{(1+0.03)^1 - 1} = 1.03$$

$$Cost\text{-}Effectiveness = \frac{1.03 * 910{,}000 * 1000}{603.89 * 365} = 4{,}252\ \frac{dollars}{metric\ ton}$$

VANPOOL VEHICLES

"Encouragement of Vanpooling" is a committed control measure in the MAG 1999 Serious Area CO and PM-10 Plans. Vanpools reduce emissions by decreasing the total vehicle miles of travel for commute trips.

Valley Metro estimates that the average vanpool vehicle travels 66 miles (on average - round trip) per day on 255 commute days per year. This is equivalent to 16,830 commute miles annually per van. Valley Metro also estimates that the average vanpool carries nine people, including the driver. The average commute trip length per vanpool rider is 24.1 miles one-way (MCAQD, 2009). Therefore, the daily commute miles (round trip) saved per vanpool occupant is 48.2. Assuming that all nine of the vanpool occupants would have driven in single-occupant vehicles (SOV), the vehicle miles of travel replaced by a vanpool is 93,789 ((9 x 48.2 x255) - 16,830). The comparable number of vehicles reduced by each vanpool annually is 2,040 (8 passengers times 255 commute days).

The MOVES model will be run for the year that the CMAQ funds are requested to estimate the onroad (MOVES Road Types 2-5) light duty vehicle emission factors for CO, TOG, NOx, and PM-10 (ONF_{CO}, ONF_{TOG}, ONF_{NOx}, and ONF_{PM}) and the off-network vehicle emission factors (MOVES Road Type 1) for each pollutant (OFF_{CO}, OFF_{TOG}, OFF_{NOx}, and OFF_{PM}). The paved road emission factor (*PEF*) for all roads of 0.65 grams per mile will be added to ONF_{PM}. Emission factors for onroad vans ($VONF_{CO}$, $VONF_{TOG}$, $VONF_{NOx}$, and $VONF_{PM}$) and off-network vans ($VOFF_{CO}$,

$VOFF_{TOG}$, $VOFF_{NOx}$, and $VOFF_{PM}$) will also be estimated using MOVES. The ONF and VONF emission factors will be multiplied by the appropriate vehicle miles of travel. The OFF and VOFF emission factors will be multiplied by the number of vehicles reduced. The difference between the commute emissions reduced and the vanpool emissions will represent the net benefit of vanpools.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost.***

Formulas:

$$\textit{VMT Emissions Reduced } (\boldsymbol{VMTR}) = \boldsymbol{VMT} * \left(\frac{w1*ONF_{CO}}{4} + \frac{w2*ONF_{TOG}}{2} + \frac{w3*ONF_{NOx}}{2} + w4*(ONF_{PM}+PEF)\right) * \frac{1}{1000}$$

$$\textit{Vehicle Emissions Reduced } (\boldsymbol{VR}) = \boldsymbol{vehicles} * \left(\frac{w1*OFF_{CO}}{4} + \frac{w2*OFF_{TOG}}{2} + \frac{w3*OFF_{NOx}}{2} + (w4*OFF_{PM}\right) * \frac{1}{1000}$$

where: ***VMT*** = the vehicle miles of travel replaced by the vanpool each year (93,789)
vehicles = the light duty vehicles replaced by the vanpool each year (2,040)
ONF = the onroad light duty vehicle emission factor for each pollutant
OFF = the off-network light duty vehicle emission factor for each pollutant
PEF = the paved road PM-10 emission factor for all road types (0.65 g/mi)

$$\textit{Vanpool Emissions } (\boldsymbol{VE}) = \left[(\boldsymbol{miles}_{vanpool} * \left(\frac{w1*VONF_{CO}}{4} + \frac{w2*VONF_{TOG}}{2} + \frac{w3*VONF_{NOx}}{2} + w4*VONF_{PM}\right)) + \right.$$

$$\left. (days_{vanpool} * \left(\frac{w1*VOFF_{CO}}{4} + \frac{w2*VOFF_{TOG}}{2} + \frac{w3*VOFF_{NOx}}{2} + w4*VOFF_{PM}\right))\right] * \frac{1}{1000}$$

where: $\boldsymbol{miles}_{\mathbf{vanpool}}$ = the miles driven annually by a van used as a vanpool (16,830)
ONF = the onroad emission factors for a van for each pollutant
$\boldsymbol{days}_{\mathbf{vanpool}}$ = the days driven annually by a van used as a vanpool (255)
OFF = the off-network emission factors for a van for each pollutant

$$\textit{Daily Emissions Reduction} = N * (\boldsymbol{VMTR} + \boldsymbol{VR} - \boldsymbol{VE}) * \frac{1}{365} = \frac{kilograms}{day}$$

where: ***N*** = the number of vans being purchased
1/365 = factor to convert annual emissions to daily emissions

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+i)^{life}\ (i)}{(1+i)^{life} - 1}$$

where: $\boldsymbol{i}$ = discount rate of 3 percent
$\boldsymbol{life}$ = effectiveness period of 4 years

$$Cost\text{-}Effectiveness = \frac{\boldsymbol{CRF} * \boldsymbol{CMAQ}\ Cost * 1000}{Daily\ Emissions\ Reduction * 365} = \frac{dollars}{metric\ ton}$$

where: ***CMAQ Cost*** = the CMAQ funding requested for the project.

Vanpool Vehicles **EXAMPLE**

RPTA proposes to purchase a fifteen-passenger van to be used in a vanpool. The cost of the van is $25,000. RPTA requests $25,000 of FY 2015 CMAQ funding.

Inputs Required from Entity Requesting CMAQ Funds:

- ***CMAQ Cost*** = $25,000.

Calculations:

$$VMT\ Emissions\ Reduced\ (\boldsymbol{VMTR}) = 93{,}789 * (\frac{0.0*2.00}{4} + \frac{1.0*0.12}{2} + \frac{1.0*0.41}{2} + (1.0*(0.04+0.65)) * \frac{1}{1000} = 89.57\ \frac{kilograms}{year}$$

$$Vehicle\ Emissions\ Reduced\ (\boldsymbol{VR}) = 2{,}040 * (\frac{0.0*2.85}{4} + \frac{1.0*0.34}{2} + \frac{1.0*0.17}{2} + (1.0*0.002) * \frac{1}{1000} = 0.52\ \frac{kilograms}{year}$$

$$Vanpool\ Emissions\ (\boldsymbol{VE}) = 16{,}830 * (\frac{0.0*2.74}{4} + \frac{1.0*0.19}{2} + \frac{1.0*0.67}{2} + (1.0*(0.05+0.65))) +$$

$$255 * (\frac{0.0*4.07}{4} + \frac{1.0*0.45}{2} + \frac{1.0*0.25}{2} + (1.0*(0.002))) * \frac{1}{1000} = 19.11\ \frac{kilograms}{year}$$

$$Daily\ Emissions\ Reduction = 1 * (89.57 + 0.52 - 19.11) * \frac{1}{365} = 0.35\ \frac{kilograms}{day}$$

$$Capital\ Recovery\ Factor\ (\boldsymbol{CRF}) = \frac{(1+0.03)^4 * (0.03)}{(1+0.03)^4 - 1} = 0.2690$$

$$Cost\text{-}Effectiveness = \frac{0.269 * 25{,}000 * 1000}{0.35 * 365} = 52{,}642\ \frac{dollars}{metric\ ton}$$

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TENTATIVE MEETING SCHEDULE FOR THE
MAG AIR QUALITY TECHNICAL ADVISORY COMMITTEE

JANUARY - NOVEMBER 2011

Saguaro Conference Room

Thursday, January 27, 2011 - 1:30 p.m.

Thursday, February 24, 2011 - 1:30 p.m.

Thursday, March 24, 2011 - 1:30 p.m.

Thursday, April 28, 2011 - 1:30 p.m.

TUESDAY, May 24, 2011 - 1:30 p.m.

Thursday, June 30, 2011 - 1:30 p.m.

Thursday, July 28, 2011 - 1:30 p.m.

Thursday, August 25, 2011 - 1:30 p.m. IF NECESSARY

Thursday, September 22, 2011 - 1:30 p.m.

Thursday, October 27, 2011 - 1:30 p.m.

TUESDAY, November 29, 2011 - 1:30 p.m.

Note: This schedule is subject to change. Flexibility is needed to meet federal Clean Air Act mandates and changes in guidance from the Environmental Protection Agency.