

CMAQ Methodologies Workshop

December 6, 2010

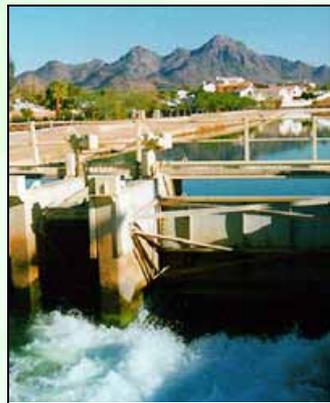
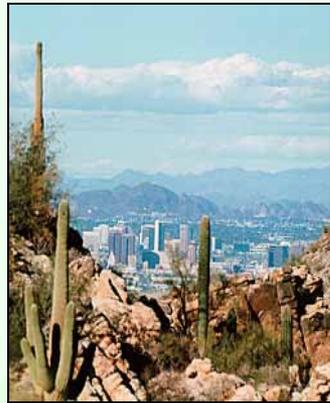




Congestion Mitigation and Air Quality Improvement (CMAQ) Program

- n Established by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)
- n Continued under the Transportation Equity Act for the 21st Century (TEA-21)
- n Reauthorized by the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU)
 - | \$8.6B authorized over the period 2005-2009

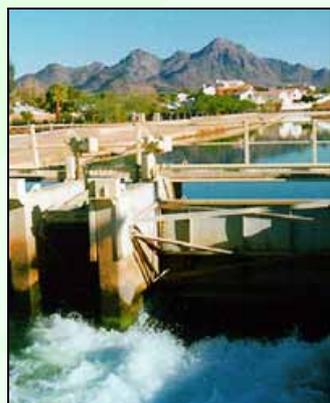
Purpose - *To fund transportation projects or programs that will contribute to attainment or maintenance of the National Ambient Air Quality Standards for ozone, carbon monoxide and particulate matter*



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CMAQ Funding

- | **CMAQ authorization levels are apportioned annually to states by a federal formula**
- | **Apportionment formula considers**
 - n County population from U.S. Census
 - n Clean Air Act designation and classification at time of apportionment
 - | Nonattainment or maintenance areas for carbon monoxide (CO) or ozone
 - | Higher priority given to:
 - n Nonattainment/maintenance areas for *both* CO and ozone
 - n Nonattainment areas classified as Moderate, Serious, Severe or Extreme for ozone

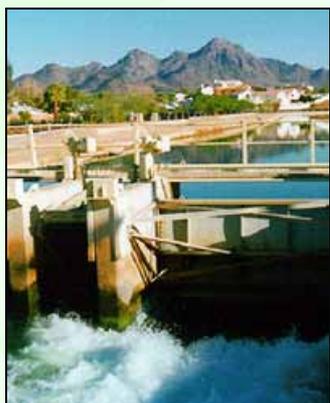
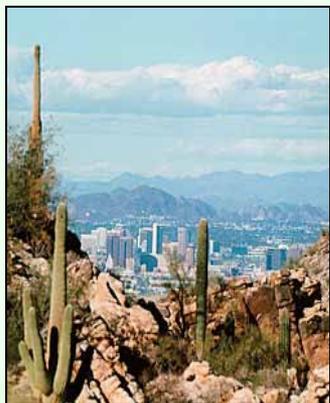


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CMAQ Funding

I Basis for Apportionment

- n Each state receives a minimum of 0.5% of total annual apportionment of federal CMAQ funds
- n SAFETEA-LU “equity bonus” guarantees states will receive back 90+ percent of their estimated tax contributions to the Highway Trust Fund
 - I Donor states, like Arizona, typically receive a higher apportionment of CMAQ (and other federal transportation) funds





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CMAQ Funding

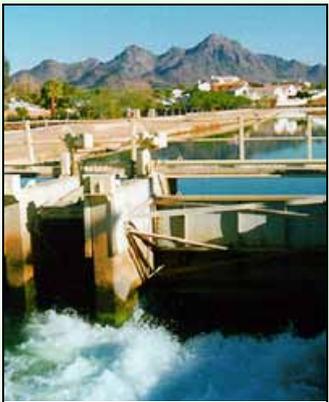
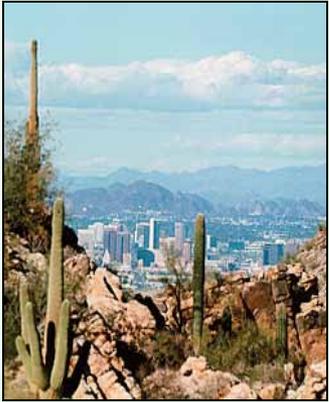
I Apportionment to Arizona

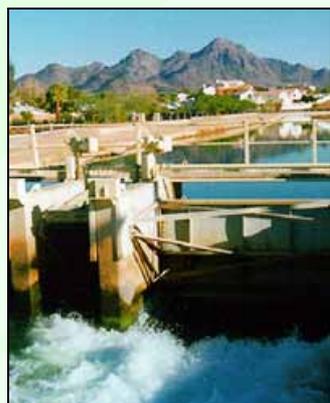
- n Based on Maricopa County's designation as a carbon monoxide maintenance area and an ozone nonattainment area
- n Maricopa County 2000 Census population x factor (1.0) for CO maintenance areas x factor (1.0) for ozone nonattainment areas x factor (1.2) for both CO and ozone

I Arizona was apportioned \approx \$54M in FY 2010

- n Represents about 2% of annual federal CMAQ appropriation plus increase due to Equity Bonus

I The MAG region receives the CMAQ funds allocated to Arizona





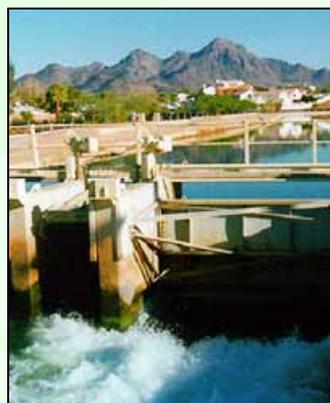
CMAQ Funding

I Apportionment Issues

- n Unknowns in new federal transportation reauthorization bill for FY10 and beyond
- n A number of new nonattainment areas for the more stringent eight-hour ozone standard to be promulgated by EPA by 12/31/10
- n Higher population levels for Maricopa County in the 2010 U.S. Census
- n Lower Arizona tax contributions to the Highway Trust Fund (due to the recession)



SAFETEA-LU Changes to the CMAQ Program (23 USC §149)



- | **Priority consideration should be given to**
 - n Diesel retrofits and other cost-effective emission reduction activities, taking into consideration air quality and health effects; and
 - n Cost-effective congestion mitigation activities that provide air quality benefits
- | **Savings clause** – Above is not intended to disturb the existing authorities and roles of governmental agencies in making final project selections
- | **Encourages interagency consultation on estimated emission reductions for proposed CMAQ programs and projects**

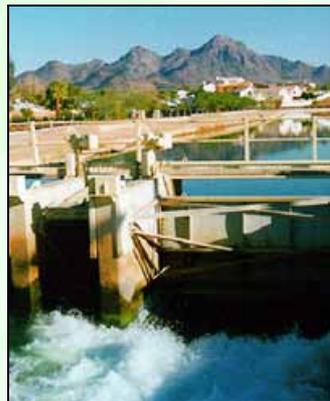
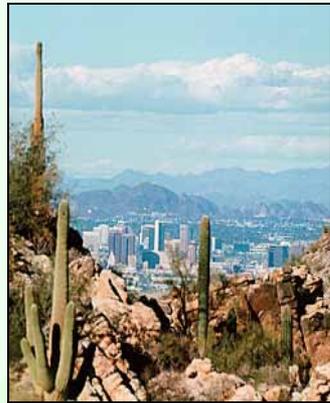


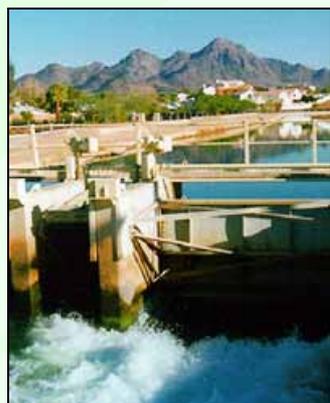
Eligibility for CMAQ Funding

I Programs/Projects

- n Must reduce transportation-related carbon monoxide, ozone precursor (TOG, NO_x), or particulate matter (PM-10, PM-2.5) emissions
 - I **SAFETEA-LU emphasizes cost-effectiveness**
- n Must be located in (or in proximity to and primarily benefiting) nonattainment or maintenance areas for ozone, carbon monoxide or particulate matter
- n Must come from a conforming TIP and transportation plan
- n Must meet NEPA and federal funding requirements under titles 23 and 49 of the U.S. Code

I **Priority should be given to transportation activities in approved air quality plans and Transportation Control Measures (TCMs)**





Eligibility for CMAQ Funding

n **Capital Investment**

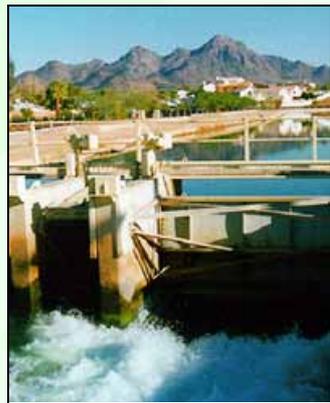
- | CMAQ funds may be used for new or expanded transportation projects and programs that reduce emissions

n **Operating Assistance**

- | Limited to three years
- | Applies to new transit services, intermodal facilities, and travel demand management strategies (including traffic operation centers); and the incremental cost of expanding existing transit services
- | Intent is to help start up viable new services that will demonstrate air quality benefits and eventually cover their own costs

n **Planning and Project Development**

- | NEPA studies (e.g., preliminary engineering) qualify
- | Planning studies that do not support specific project development do not qualify (e.g., major investment study)



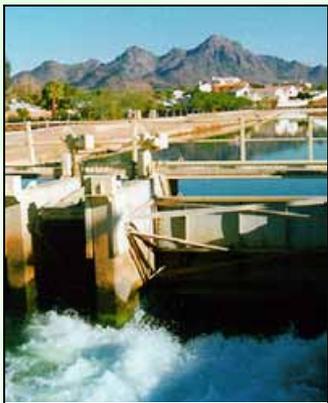
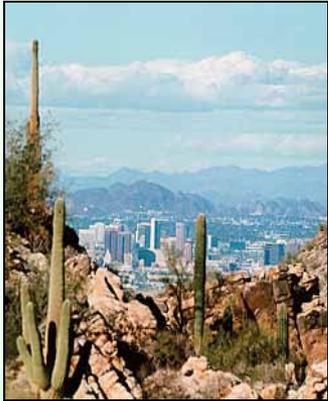
Examples of Programs/Projects Eligible for CMAQ Funding

- | Public transit
- | Bus or HOV lanes
- | Employer-based Transportation Management Plans and trip reduction ordinances
- | Traffic flow improvements that reduce emissions
- | Park and ride lots
- | Bicycle and pedestrian facilities
- | Rideshare and telecommuting programs
- | Public education and outreach activities
- | Vanpooling
- | Diesel retrofits
- | Idling reduction programs
- | Experimental pilot projects

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Programs/Projects *Not Eligible* for CMAQ Funding

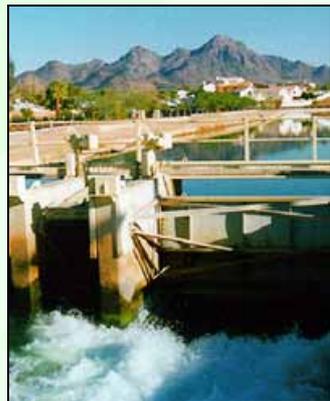
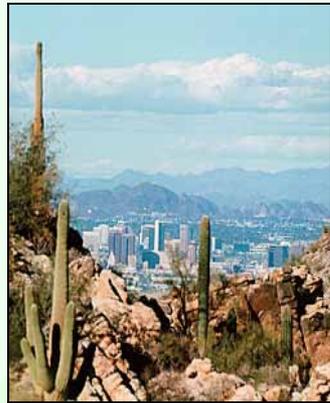
- n Light-duty vehicle scrappage programs
- n Highway capacity expansion projects (except HOV lanes)
- n Routine maintenance and rehabilitation of transportation infrastructure
- n Administrative costs of the CMAQ program
- n Stand-alone projects to purchase alternative fuels
- n Projects that do not meet the eligibility requirements of titles 23 and 49 U.S.C.

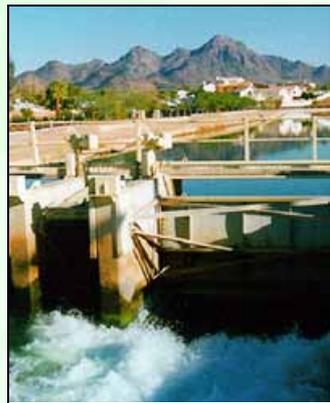
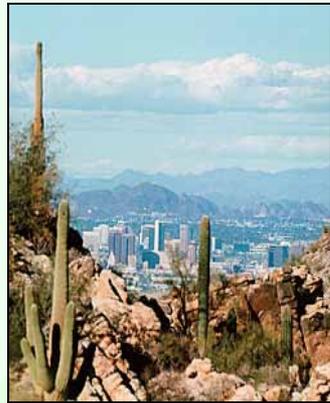




CMAQ Project Selection Process

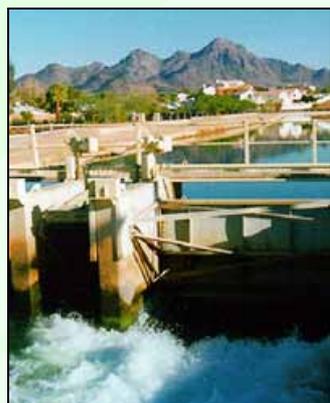
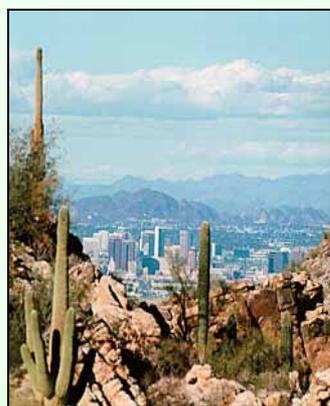
- n **All proposals for CMAQ funding must include:**
 - l Precise project/program description
 - n Size, scope, location and timetable
 - l An assessment of expected emission benefits
 - n Quantify emission benefits (reductions) and disbenefits (increases)
 - l For all pollutants for which the area is in nonattainment or maintenance, including precursor emissions
 - n Ensure that the benefits are credible and based on reproducible and logical analytical procedures
 - n If impossible to quantify the benefits, a qualitative assessment is acceptable
 - l Based on a reasoned and logical determination that the project decreases emissions and contributes to attainment or maintenance of the NAAQS





MAG CMAQ Methodologies

- n **Federal CMAQ guidance, October 20, 2008**
 - | Analytical procedures are needed to quantify the emission benefits and disbenefits of proposed CMAQ projects and programs
- n **MAG Quantitative Measures**
 - | Emission reductions or increases (in kilograms per day)
 - | Cost-effectiveness (in dollars per metric ton of emission reduced annually)
- n **Analytical procedures are described in the MAG “Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects”**
 - | First published in 1999; last updated in April 2009
 - | Latest draft, dated November 2010, was sent out with the notice for this workshop



MAG CMAQ Methodologies

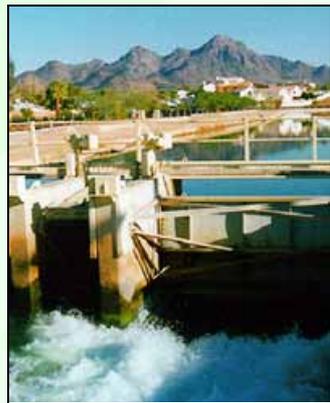
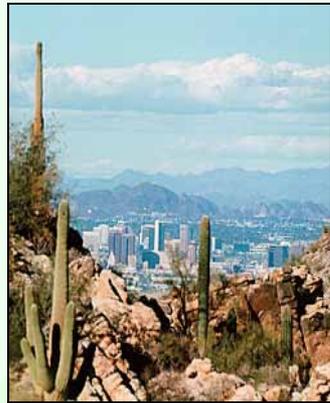
- n **MAG guidance on CMAQ project eligibility**
 - | Provided in Appendix C of the MAG Transportation Programming Guidebook
 - | www.mag.maricopa.gov/detail.cms?item=11431

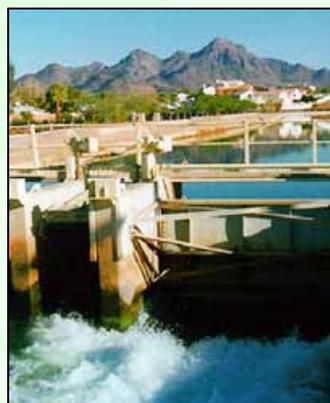
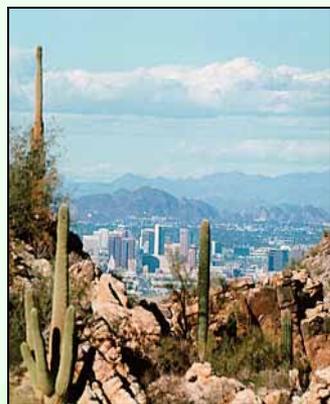
- n **Typically, the MAG CMAQ methodologies are applied each year to evaluate**
 - | CMAQ-eligible projects proposed for the last year of a new Transportation Improvement Program (TIP)
 - | CMAQ-eligible projects proposed for Fiscal Year-End Closeout funds
 - | PM-10 certified street sweepers proposed for purchase
 - | Proposed projects to pave unpaved roads, alleys and shoulders
 - | Projects implemented with CMAQ funds in the prior calendar year for the annual report required by FHWA



MAG CMAQ Methodologies

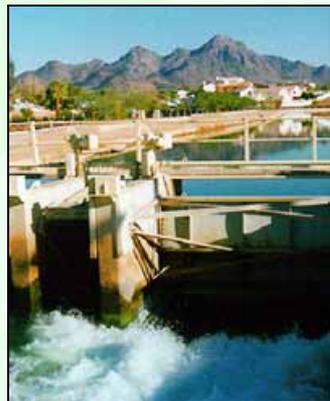
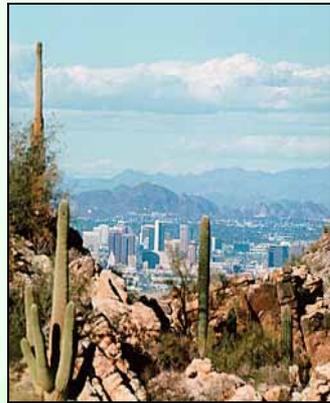
- n **Project types** (key factors used to quantify emission reductions)
 - | **Bicycle and pedestrian facilities** (vehicles and VMT reduced)
 - | **Bus and rail projects** (vehicles and VMT reduced)
 - | **Diesel retrofits** (new vs. old technology emission factors) and **Anti-idling programs** (idling reduced)
 - | **Intersection improvements** (delay reduced)
 - | **Park and ride facilities** (vehicles and VMT reduced)
 - | **Paving projects** (unpaved vs. paved road emission factors)





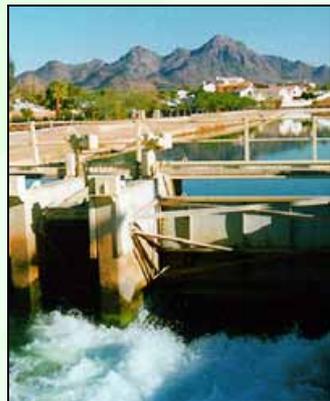
MAG CMAQ Methodologies

- n **Project types** (key factors used to quantify emission reductions)
 - | **PM-10 certified street sweepers** (emission factors before and after sweeping)
 - | **Rideshare programs** (vehicles and VMT reduced)
 - | **Traffic signal coordination** (speed increase)
 - | **Intelligent Transportation Systems** projects (speed increase)
 - | **Trip reduction program** (vehicles and VMT reduced)
 - | **Vanpool vehicles** (vehicles and VMT reduced)



MAG CMAQ Methodologies

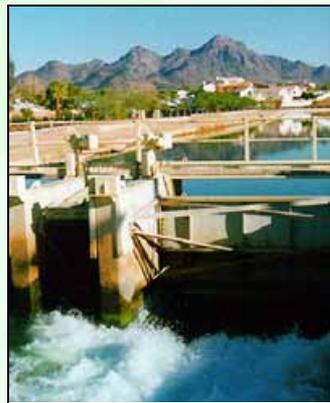
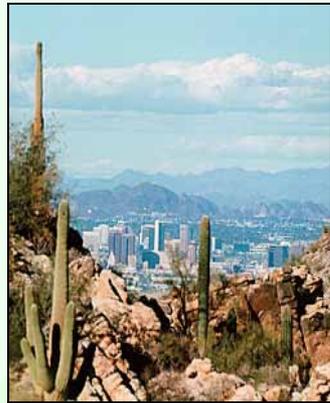
- n **In 2008, Sierra Research compared MAG CMAQ methodologies with other western communities**
- n **Conclusions**
 - | The MAG methodologies adequately address the key issues in the latest transportation legislation (i.e., SAFETEA-LU) with respect to:
 - n Evaluation and prioritization of diesel retrofit projects
 - n Prioritization of projects based on cost-effectiveness
 - n Allows funding of transportation systems management and operations projects that mitigate congestion and improve air quality
 - | **“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.”**



MAG CMAQ Methodologies

n **Sierra Recommendations**

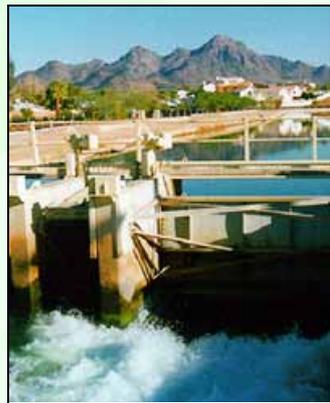
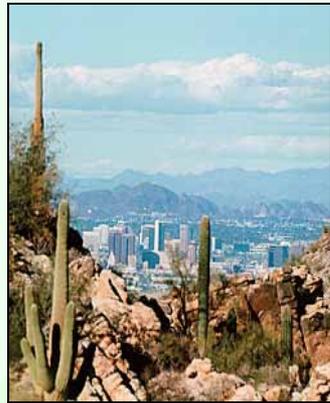
- | Update the methodologies to be consistent with assumptions in the 2007 MAG Ozone and PM-10 Plans
- | Review and update activity rates from local sources (e.g., On Board Bus and Household Travel Surveys, MAG Congestion Studies, Travel Demand Management Surveys, Trip Reduction Reports)
- | Continue to use a weight of zero for carbon monoxide in the cost-effectiveness calculation
- | Review more-detailed techniques developed by the Texas Transportation Institute to quantify control measures for the Texas SIP
- | Consider providing project sponsors with on-line access to the CMAQ methodologies



MAG CMAQ Methodologies

n Revisions to the 2010 CMAQ methodologies

- | Emission factors are derived from the new EPA mobile source emissions model - MOVES2010a
 - n Network vs. off-network emission factors
 - n PM-10 emission factors are now sensitive to speeds
 - n Speed vs. emission factor curves have changed
- | Activity rates have been updated to reflect latest available local transit and TDM studies
- | Priority weights on PM-10 and ozone precursor emissions (TOG and NOx) are now equivalent
 - n Set equal to one
 - n CO weight is still zero
- | The ITS methodology has been revised to incorporate recommendations from Lee Engineering/Texas Transportation Institute (TTI)
 - n Based on the "Texas Guide to Accepted Mobile Source Emission Reduction Strategies" (MOSERS) developed by TTI in 2007



MAG CMAQ Methodologies

Lee Engineering/TTI recommendations

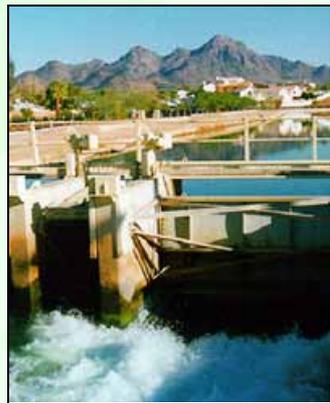
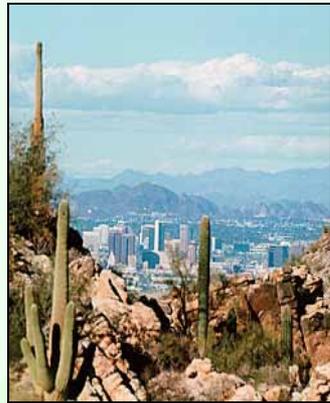
1. Group project elements by jurisdiction, level of improvement, and market package in the ITS Architecture
2. Calculate the emissions benefit for each Project in the build year
 - n Separate equations for incident management programs, regional/systemwide projects, and all other traffic flow improvements (including traffic signal coordination)
 - n Recommend that the speed-based equation be used for all ITS projects until the MAG nonrecurring congestion study is completed in 2011.
3. Allocate maximum emissions benefit of the Project to the elements in the same group based on the VMT for each element
4. Apply the current MAG priority weights and cost-effectiveness ranking procedure



MAG CMAQ Methodologies

n Emission Benefit Calculation

- | Reductions or increases in carbon monoxide (CO), total organic gases (TOG), nitrogen oxides (NOx), and particulate matter (PM-10) emissions (in kilograms per day)
- | Apply EPA MOVES emissions model and AP-42 equations (for reentrained dust from paved and unpaved roads) to obtain emission rates
- | Emission rates are calculated for the first year that the project is implemented

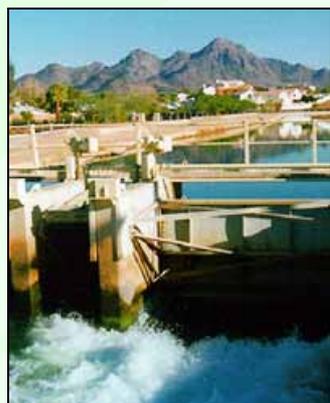




MAG CMAQ Methodologies

Cost-Effectiveness Calculation

- | Seasonal adjustments
 - n The CO emission rate is divided by four to represent the 3-month winter season
 - n The TOG and NOx emission rates are divided by two to reflect the six-month ozone season
 - n PM-10 is not adjusted seasonally, because violations can occur at any time of year

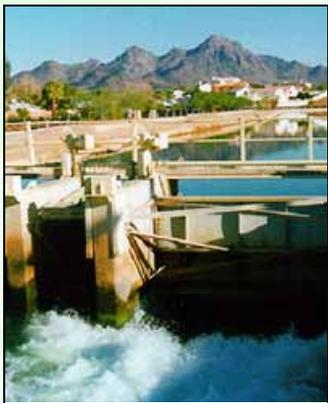
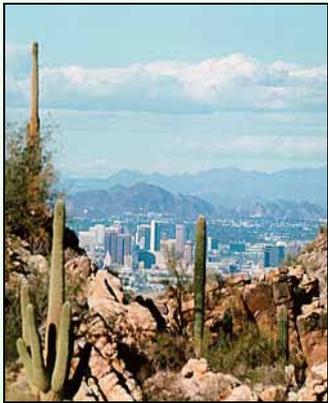


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MAG CMAQ Methodologies

Cost-Effectiveness Calculation

- | Priority weights
 - n The CO weight is set to zero, because the CO standard has been attained and monitored concentrations continue to fall
 - n The weights for TOG, NO_x, and PM-10 are set equal to 1.00
 - | The region is a nonattainment area for PM-10 and will be designated a nonattainment area for the new, more stringent eight-hour ozone standard to be promulgated by EPA later this year

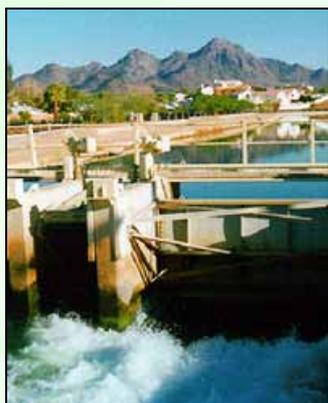
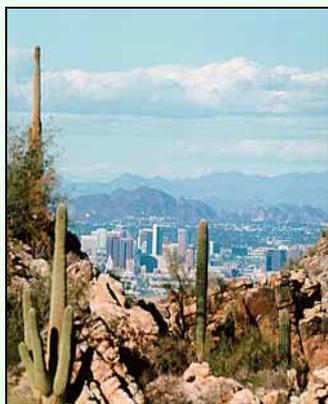


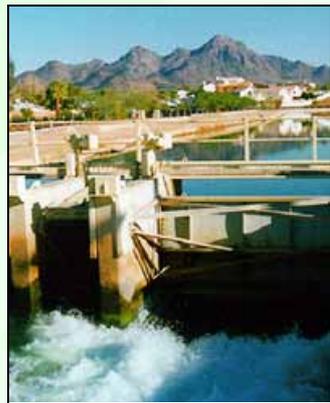
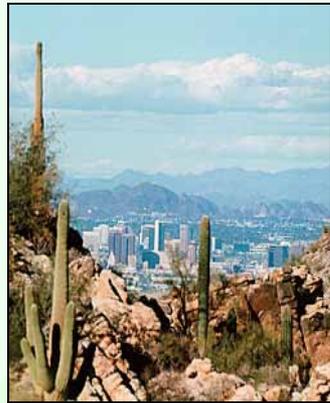
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MAG CMAQ Methodologies

MAG CMAQ Spreadsheet Model

- | Calculates CO, TOG, NOx and PM-10 emission reductions in kilograms per day
- | Applies seasonal factors and weights to the emissions reduced for each pollutant
- | Converts emission reductions to metric tons per year
- | Amortizes CMAQ cost over the life of the project, assuming a 3% annual discount rate
- | Divides the annualized CMAQ cost by the annual emissions reduction to obtain cost-effectiveness (in dollars per metric ton)





MAG CMAQ Methodologies

n **Cost-effectiveness**

- | The more emissions reduced per CMAQ dollar spent, the higher the ranking of the CMAQ project

n **Time constraints on calculations**

- | Typically, MAG staff has about two weeks to apply the methodologies, calculate cost-effectiveness, and rank all CMAQ project requests



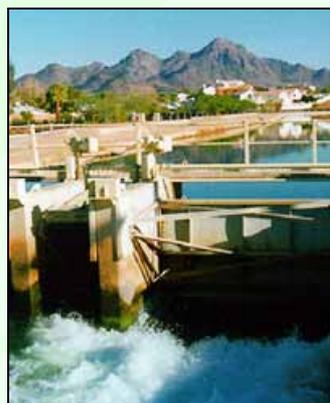
MAG CMAQ Methodologies

n Example #1

l Traffic Signal Coordination Project

- n Before: Interconnected, pre-timed signals with actively managed timing
- n After: Advanced computer-based control system
- n CMAQ cost = \$135,000
- n Length of project = 3 miles
- n Speed before project = 25 mph
- n ADT = 10,000

l Reduces CO, TOG, NOx, and PM-10





MAG CMAQ Methodologies

n Traffic Signal Coordination Project

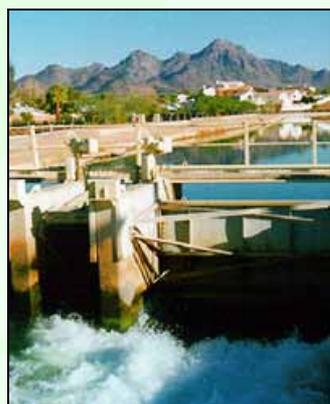
- From Table 6 – Category Four: Project will increase speeds by 8 percent; from 25 mph to 27 mph

Daily Emission Reduction =

$$\begin{aligned} & ((3 \text{ miles} \times 10,000 \text{ ADT} \times 0.91)/1000) \times \\ & ((0.0 \times 4.94/4 + 1.0 \times 0.17/2 + 1.0 \times 0.65/2 + 1.0 \times 0.06) - \\ & (0.0 \times 4.74/4 + 1.0 \times 0.16/2 + 1.0 \times 0.61/2 + 1.0 \times 0.05)) \\ & = 0.96 \text{ kg/day} \end{aligned}$$

CMAQ Cost-Effectiveness =

$$\begin{aligned} & 0.2184 \times \$135,000 \times 1000 / (0.96 \times 365) = \\ & \$84,144/\text{metric ton} \end{aligned}$$





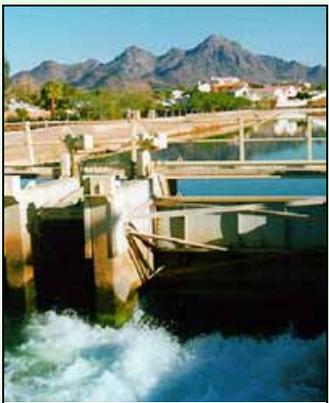
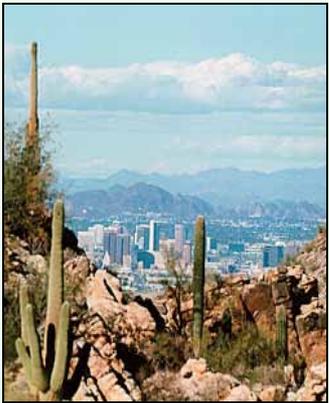
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MAG CMAQ Methodologies

n Example #2

l PM-10 Certified Street Sweeper

- n To replace an older certified sweeper
 - l Must be at least 8 years old
- n CMAQ cost = \$135,000
- n ADT per though lane swept = 5,000
- n Days between sweeping cycles = 14
- n Lane miles swept per cycle = 200
- n Percent of time the older sweeper was not utilized during the previous year due to maintenance and repair downtime = 20%





MAG CMAQ Methodologies

n PM-10 Certified Street Sweeper

Average daily emissions for a PM-10 certified sweeper with a 14 day sweeping cycle = **0.704 g/mi**

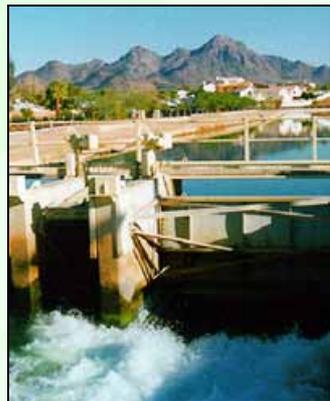
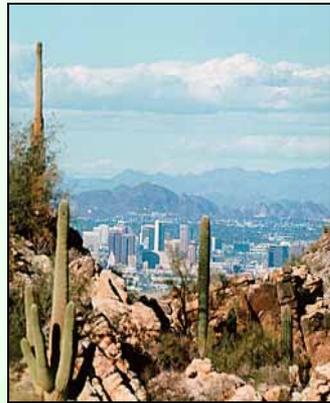
Daily Emission Reduction

$$(1.0 \times 200 \text{ miles} \times 5,000 \text{ ADT} \times 0.91 \times 0.704 \times (0.95 - 0.80))/1000 = 96.1 \text{ kg/day}$$

CMAQ Cost-Effectiveness

$$0.1425 \times \$135,000 \times 1000/(96.1 \times 365) =$$

\$548/metric ton

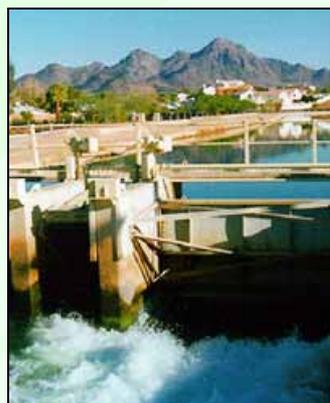
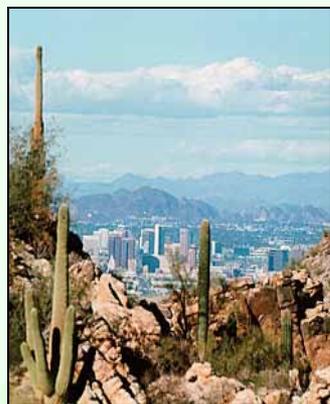




MAG CMAQ Methodologies

n Ranking of Example Projects by Cost-effectiveness (\$/metric ton)

- | Purchase a PM-10 certified sweeper - \$469
- | Pave unpaved road with curb and gutter - \$1,507
- | Trip reduction program - \$4,252
- | Regional rideshare program - \$4,837
- | Bike lane with shoulder paving - \$5,753
- | Park and ride lot - \$8,664
- | Intelligent Transportation Systems project - \$16,899
- | Truck stop electrification project - \$23,782
- | New light rail service - \$28,115
- | Purchase one vanpool vehicle - \$52,642
- | Retrofit diesel vehicles w/catalysts & particulate traps - \$59,836
- | Auxiliary power units on diesel buses - \$67,995
- | Traffic signal coordination project - \$84,144
- | Bike lane without shoulder paving - \$371,393
- | New diesel bus for a new route - \$440,548
- | Roundabout - \$561,690
- | Add turning lanes - \$946,849



A blue rectangular box with a white border containing the text "ENVIRONMENTAL PROGRAMS" in white, uppercase, sans-serif font. The background of the box is a light blue sky with white clouds.

ENVIRONMENTAL
PROGRAMS

For more information

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