ADOT
Multimodal Planning

Janice K. Brewer, Governor
John S. Halikowski, Director
Scott Omer, Division Director

206 S. 17th Ave, MD: 310B
Phoenix, AZ 85007

July 10, 2013

Rod Lane
Tucson District Engineer
Arizona Department of Transportation
1221 South 2nd Avenue
Tucson, AZ 85713

Dear Mr. Lane:

Subject: Request for Projects for Congestions Mitigation and Air Quality Funds (CMAQ)

The Arizona Department of Transportation is seeking applications for projects to be funded under the Congestion Mitigation and Air Quality (CMAQ) program for Federal Fiscal Years 2014-2018. These CMAQ funds are available for eligible transportation projects that reduce emissions in nonattainment and maintenance areas.

On June 25, 2013 the State Transportation Board adopted and approved the 2014-2018 Five-Year Transportation Facilities Construction Program that included a subprogram PM2.5 Air Quality Projects for use in the Nogales PM2.5 nonattainment area. This funding is currently programed at $3,198,000 for FY2014-2018 as listed on page 50 of the 2014-2018 Five-Year Transportation Facilities Construction Program. ADOT is requesting applications for the entire program amount with funding sub allocated annually as listed in the following table.

♦ DEVELOPMENT SUPPORT, PM 2.5 AIR QUALITY PROJECTS								
70614	214.03	Air quality analysis	CMAQ	$1,066	$0	$0	$0	$0
70616			CMAQ	$0	$533	$0	$0	$0
70616			CMAQ	$0	$0	$533	$0	$0
70617			CMAQ	$0	$0	$0	$533	$0
70618			CMAQ	$0	$0	$0	$0	$533
				$1,066	$533	$533	$533	$533
							SUMMARY TOTAL OF DEVELOPMENT SUPPORT, PM 2.5 AIR QUALITY PROJECTS SUBPROGRAM	$3,198

BACKGROUND

The CMAQ program was created under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and continued under the subsequent transportation funding bills, Transportation Equity Act for the 21st Century (TEA-21), Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), and reauthorized by Moving Ahead for Progress in the 21st Century (MAP-21) July 6, 2012. Under the recent provisions of MAP-21, any state with a PM 2.5 nonattainment or maintenance area must use 25 percent of its funds apportioned based on the weighted population of such area to address PM 2.5 emissions. MAP-21 also makes special mention of additional project types such as high-occupancy vehicle lanes, purchase of interoperable emergency communications equipment, and facilities serving electric or natural gas-fueled vehicles. These projects will be considered on a case by case basis pending additional guidance from FHWA on implementing MAP-21 CMAQ provisions.

PROJECT ELIGIBILITY

To be eligible for CMAQ funds a project must have an air quality benefit and/or reduce congestion. A selected project must be included in ADOT's current Statewide Transportation Improvement Plan (STIP), meet transportation conformity provisions in section 176(c) of the Clean Air Act Amendments and complete National Environmental Policy Act (NEPA) requirements for funding under Titles 23 and 49 of the United States Code. Additionally, all capital improvement projects must follow the *ADOT Local Public Agency Projects Manual* (ADOT, February2013).

PROJECT SELECTION

Existing federal guidance states that the CMAQ project selection process should be transparent, in writing, and publically available and that proposals for funding should include a precise description of the project size, scope, location and an assessment of the expected emission reduction benefits. More details on these guidelines can be found on the FHWA CMAQ Web site at:
http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/cmaq08gm.cfm

ADOT has developed the following document, *Draft CMAQ Guidelines and Procedures PM2.5 Nonattainment Areas* (ADOT, July 5, 2013), to describe the project selection process and emissions analysis methodologies that will be used for this CMAQ request for projects. ADOT is accepting applications for the Nogales PM2.5 nonattainment area. The CMAQ funding available for FY2014 is set $1,066,000 and all future years assumes MAP-21 will continue to provide annual funding of $533,000.

Project sponsors will complete the application form provided for the following project types that reduce particulate matter emissions, although other eligible projects may also be submitted for consideration as describe in ADOT's CMAQ guidance document.

- Dust Suppression
- Road and/or Shoulder Paving
- Equipment purchases: PM10 efficient street sweeper, water trucks
- Bicycle Pedestrian projects
- Diesel Retrofits

SCHEDULE

August 31, 2013	All completed project application materials must be received by 5pm. Email: MPDAirQuality@azdot.gov Fax: (602)-712-6412 Mail: ADOT CMAQ Program Manager 206 S. 17th Ave, MD: 310B Phoenix, AZ 85007
September 30, 2013	The CMAQ project selection team will be provided project information, emissions reduction estimates, and a cost benefit analysis for each project to score and select projects to receive CMAQ funding.

November 21, 2013	If necessary, the local sponsor will present the selected CMAQ projects to the SouthEastern Arizona Governments Organization (SEAGO) Transportation Advisory Committee to amend the Transportation Improvement Program (TIP).
December 31, 2013	ADOT will start notifying the local sponsors that the CMAQ funds are available and provide information on when projects can proceed.

RESOURCES

Additional materials for this call for projects that can be downloaded from ADOT's ftp site, please refer to Appendix B of the *Draft CMAQ Guidelines and Procedures PM2.5 Nonattainment Areas* (ADOT, July 5, 2013) document for instructions on how to locate the CMAQ Nogales subdirectory.

Enter web address: ftp://ftp.azdot.gov/
User name: adot
Password: adotftp

If you have any questions about the CMAQ program, eligibility of projects, the application process, or any of the attached documents, please call Beverly Chenausky at (602) 712-7487, or email your inquiry to MPDAirQuality@azdot.gov .

Sincerely,

Scott Omer
Director

Enclosures (3)

cc:
Bret Anderson, Alejandro Barcenas, Beverly Chenausky, Mark Hoffman, Michel Kies, Eric Massey, Jodi Rooney, Ed Stillings, Patrick Stone, Jesus Valdez, Chris Vertrees , Aaron White

ADOT
Multimodal Planning

Janice K. Brewer, Governor
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Scott Omer, Division Director

206 S. 17th Ave, MD: 310B
Phoenix, AZ 85007

July 10, 2013

Alejandro Barcenas
Public Works Director
City of Nogales
1450 North Hohokam
Nogales, Arizona 85621

Dear Mr. Barcenas:

Subject: Request for Projects for Congestions Mitigation and Air Quality Funds (CMAQ)

The Arizona Department of Transportation is seeking applications for projects to be funded under the Congestion Mitigation and Air Quality (CMAQ) program for Federal Fiscal Years 2014-2018. These CMAQ funds are available for eligible transportation projects that reduce emissions in nonattainment and maintenance areas.

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70814	214.08	Air quality analysis	CMAQ	$1,066	$0	$0	$0	$0
70815			CMAQ	$0	$533	$0	$0	$0
70816			CMAQ	$0	$0	$533	$0	$0
70817			CMAQ	$0	$0	$0	$533	$0
70818			CMAQ	$0	$0	$0	$0	$533
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SUMMARY TOTAL OF DEVELOPMENT SUPPORT, PM 2.5 AIR QUALITY PROJECTS SUBPROGRAM								$3,198

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Project sponsors will complete the application form provided for the following project types that reduce particulate matter emissions, although other eligible projects may also be submitted for consideration as describe in ADOT's CMAQ guidance document.

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Sincerely,

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ADOT
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Janice K. Brewer, Governor
John S. Halikowski, Director
Scott Omer, Division Director

206 S. 17th Ave, MD: 310B
Phoenix, AZ 85007

July 10, 2013

Jesus J. Valdez P.E.,
Public Works Director
Santa Cruz County
2150 North Congress Drive
Nogales, Arizona 85621

Dear Mr. Valdez:

Subject: Request for Projects for Congestions Mitigation and Air Quality Funds (CMAQ)

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Sincerely,

Scott Omer
Director

Enclosures (3)

cc:
Bret Anderson, Alejandro Barcenas, Beverly Chenausky, Mark Hoffman, Michel Kies, Rod Lane, Eric Massey, Jodi Rooney, Ed Stillings, Patrick Stone, Chris Vertree , Aaron White

ARIZONA DEPARTMENT OF TRANSPORTATION

DRAFT CMAQ GUIDELINES AND PROCEDURES

PM2.5 Nonattainment Areas

7/5/2013

Table of Contents

ADOT *Draft* Congestion Mitigation and Air Quality (CMAQ) Methodologies and Procedures

Overview

The CMAQ program was created under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and continued under the subsequent transportation funding bills, Transportation Equity Act for the 21st Century (TEA-21), Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), and reauthorized by Moving Ahead for Progress in the 21st Century (MAP-21) July 6, 2012. The purpose of the CMAQ program is to fund transportation projects or programs that will contribute to the attainment and maintenance of the national ambient air quality standards (NAAQS) for ozone, carbon monoxide, and particulate matter.[1] CMAQ funding is calculated using a weighted population formula for ozone and carbon monoxide nonattainment areas. While Arizona is under no statutory obligation to allocate CMAQ funds in the same way they are apportioned, ADOT has traditionally distributed all CMAQ funding to Maricopa Associations of Governments (MAG).

The recent MAP-21 legislation set priorities for use of CMAQ funding in particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) nonattainment areas.

> "For any State that has a nonattainment or maintenance area for particulate matter, an amount equal to 25 percent of the funds apportioned to each State under section 104(b)(4) for a nonattainment or maintenance area that are based all or in part of the weighted population of such area in fine particulate matter nonattainment shall be obligated to projects that reduce such fine particulate matter emissions in such area, including diesel retrofits."[2]

Arizona has two $PM_{2.5}$ nonattainment areas in which MAP-21 priority funding would apply, Santa Cruz County (Nogales) and Pinal County (Maricopa). The Federal Highway Administration (FHWA) calculated the $PM_{2.5}$ set aside funding for Arizona for 2013 in Figure 1. ADOT will administer the CMAQ program for the Nogales nonattainment and any other nonattainment area that is outside of MAG jurisdiction.

Figure 1: CMAQ Distribution Amounts for FY2013

STATE	CMAQ PROGRAM EXCLUSIVE OF TAP & 2% SPR	SET-ASIDE FOR PM 2.5 PROJECTS	CMAQ PROGRAM EXCLUSIVE OF TAP, 2% SPR, AND PM 2.5 SET-ASIDE	FLEXIBLE LIMITING AMOUNT THAT MAY BE OBLIGATED ON STP-ELIGIBLE PROJECTS
ARIZONA	49,607,953	1,238,981	48,368,972	0

[1] Federal Highway Administration, *The Congestion Mitigation and Air Quality (CMAQ) Improvement Program under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users FINAL PROGRAM GUIDANCE*. October 2008.

[2] Federal Highway Administration, *MAP-21 Moving Ahead for Progress in 21st Century, Section 1113 Congestion Mitigation and Air Quality Improvement Program (CMAQ) Questions & Answers*," September 27, 2012 (http://www.fhwa.dot.gov/map21/qandas/index.cfm)

CMAQ Program Requirements

To be eligible for CMAQ funds a project must first be included in ADOT's current Statewide Transportation Improvement Plan (STIP), meet transportation conformity provisions in section 176(c) of the Clean Air Act Amendments and complete National Environmental Policy Act (NEPA) as required for funding under Titles 23 and 49 of the United States Code. The CMAQ program also requires projects to have an air quality benefit and/or reduce congestion, eligible projects listed in the FHWA 2008 CMAQ Guidance Document include:

1. Transportation Control Measures
2. Extreme Low-Temperature Cold Start Programs
3. Alternative Fuels and Vehicles
4. Congestion Reduction & Traffic Flow Improvements
5. Transit Improvements
6. Bicycle and Pedestrian Facilities and Programs
7. Travel Demand Management
8. Public Education and Outreach Activities
9. Transportation Management Associations
10. Carpooling and Vanpooling
11. Freight/Intermodal
12. Diesel Engine Retrofits & Other Advanced Truck Technologies
13. Idle Reduction
14. Training
15. Inspection and Maintenance (I/M) Programs
16. Experimental Pilot Projects

MAP-21 also makes special mention of additional project types such as high-occupancy vehicle lanes, purchase of interoperable emergency communications equipment, and facilities serving electric or national gas-fueled vehicles. These projects will be considered on a case by case basis pending additional guidance from FHWA on implementing MAP-21 CMAQ provisions. The MAP-21 CMAQ program also has new performance-based features. The Secretary of Department of Transportation is required to provide guidance and establish measures for States to use to assess traffic congestion and on-road mobile source emissions. ADOT has included a State Planning and Research (SPR) work program item to review and revise ADOT's CMAQ process to expand eligible CMAQ projects and to incorporate all MAP-21 CMAQ provisions including the national performance goals.

Project Selection

Existing guidance states that the CMAQ project selection process should be transparent, in writing, and publically available and that proposals for funding should include a precise description of the project size, scope, location and an assessment of the expected emission reduction benefits. The project selection process should identify agencies involved in rating proposals, clarify how projects are rated, and name the committee or group responsible for making the recommendation to approving body. The process should also clearly

identify the basis for rating the projects, including emissions benefits, cost effectiveness, and any other ancillary selection factors such as congestion relief, greenhouse gas reduction, safety, system preservation, sustainable development and freight, reduced SOV reliance, and others.[3]

Suggested CMAQ Evaluation Process

Application: ADOT will solicit CMAQ projects through a formal letter from the Multimodal Planning Division Director that will include a copy of this document, application, and date the application is due. Interested applicants will complete an application and include the appropriate project type emissions calculation spreadsheets and return the completed application as instructed.

It is expected that the first round of CMAQ funding will include the following project types. Any additional CMAQ eligible projects will be evaluated on a case by case basis as necessary.

Dust Mitigation Projects:

- Dust Suppression
- Road Paving
- Paving Shoulders

Equipment Purchases:

- Street sweepers
- Water Trucks

Other Projects:

- Bike/Pedestrian
- Diesel Retrofits

Project Selection Team: ADOT MPD Air Quality staff, MPD Regional Planning Staff assigned to region, COG representative, ADEQ representative, MPD Programming staff, (optional members TBD).

Scoring: ADOT MPD Air Quality staff will calculate expected emissions reduction for each project application received and include a cost benefit estimate (cost per emissions reduced) in a table and provide this information to the project selection team. Each member of the project team will score each project as described in Figure 2.

[3] Federal Highway Administration, The Congestion Mitigation and Air Quality (CMAQ) Improvement Program under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users FINAL PROGRAM GUIDANCE. October 2008.

Figure 2: Suggested CMAQ Scoring Matrix

Factor Evaluated	Total Points Available = 50			
Air Quality Benefit	Unknown (5)	Low (10)	Medium (15)	High (20)
Cost-Effectiveness	Unknown (1)	Low (4)	Medium (10)	High (15)
Project is a measure, plan, or program from ADEQ submitted SIP	No (0)	Yes (10)		
Project cited in any Transportation Plan (CIP/SLRTP)	No (0)	Yes (5)		

Project Programming: The CMAQ program is a cost-reimbursable program and project costs must be initially borne by the sponsors prior to requesting reimbursement from ADOT. Any and all costs incurred by the sponsor prior to the: (1) execution of an agreement with the ADOT, (2) completion of federal environmental process documentation and/or (3) federal funding authorization for the project and/or the phase of work are not eligible for reimbursement.

The federal funding share for most projects is 80% of the proposed cost of eligible projects (The federal funding share for eligible projects on the interstate highway system is 90% or 100%) it is presumed that ADOT can also use the sliding scale federal share of 93.7% for most projects. Sponsors must provide local matching funds that cannot be in the form of in-kind services or federal funds. Sponsors are responsible for project cost overruns. The sponsor must provide a resolution declaring the sponsor's commitment to provide the required local funding match and to assume responsibility for maintaining the project during its useful life and follow Arizona Department of Transportation Local Public Agency Projects Manual.[4]

CMAQ Emissions Calculation Procedures

Introduction

The suggested CMAQ emissions calculations procedures in this document are based on available and existing methodologies from other MPO's and DOT's in PM_{10} nonattainment areas. ADOT has an ongoing a planning study to update transportation conformity processes and develop an air quality management guidebook for use by transportation professionals. This study includes a task to identify control measures directly and indirectly related to on-road sources and develop emissions estimation techniques for CMAQ eligible types of projects. As this study is not expected to be completed until late 2013, ADOT staff will continue to review the state of the practice control measures and identify any additional CMAQ emissions estimation techniques.

[4] ADOT, *Arizona Department of Transportation Local Public Agency Projects Manual,* February, 2013.

General Notes on Analysis Methods

The EPA guidance "Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors" commonly referred to as "AP-42" or "AP-42 methods" is the source of many of the highlighted analysis techniques. In particular "Chapter 13-Other Sources" covers baseline emissions and several control measures relevant to these methodologies.

Throughout AP-42 all emission reductions are calculated using the following formulation:

E = A x EF x (1-ER/100)

Where:
E = emissions;
A = activity rate (Generally VMT)
EF = emission factor, and
ER =overall emission reduction efficiency, %

ADOT used references found in AP-42 and provided suggested inputs to help applicants complete the emissions analysis required for CMAQ funding. These guidelines include examples of common assumptions and values used in calculation PM_{10} and $PM_{2.5}$ emissions. Some assumptions may change after further discussions with the Arizona Department of Environmental Quality (ADEQ). As an example, the number of days with measurable rainfall in the Nogales PM10 nonattainment plan used a value of 45, while other sources suggest using a value of 60.[5] ADOT also used the Maricopa Association of Governments (MAG) *Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects*[6] as a guide for analyzing paving projects and the Idaho Department of Transportation CMAQ calculation methods as a guide for dust mitigation projects.

In using these approaches in cases where only PM_{10} reductions are available than an adjustment factor will be applied as a course estimate of $PM_{2.5}$ from PM_{10} impacts. AP-42 provides different emissions factors for various fugitive dust sources which varies based on silt content, climate, and other factors. AP-42 provides an estimate that 25% of PM_{10} fugitive dust by weight is $PM_{2.5}$ and uses this factor to represent particle size multiplier for paved road dust.[7] AP-42 provides a different estimate for unpaved roads referencing a study that suggests that a $PM_{2.5}$ particle size adjustment factor of .15 be used for unpaved roads.[8] The California Air Resources Board also provides emissions factors for $PM_{2.5}$ contributions of .208 for construction emissions, .212 for unpaved road dust, and .169 for paved road dust.[9]

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[5] United States Environmental Protection Agency, *AP-42, Background Documentation, Figure 13.2.1-2*, January 2011.
[6] http://www.azmag.gov/Documents/CMAQ_2011-04-05_Final-CMAQ-Methodologies_3-31-2011.pdf
[7] United States Environmental Protection Agency, *AP-42, Background Documentation, Section 13.2.1.5*, January 2011.
[8] Midwest Research Institute, "Fugitive Particulate Matter Emissions," for U.S. EPA, April, 1997.
[9] Houck, J., 1989. *Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California*, Final Report, OMNI Environmental Services, Inc., June 30.

Given this wide range of estimates of $PM_{2.5}$ emissions reductions from traditional PM_{10} emission reduction programs, ADOT will be using the following adjustment factors until further information is available.

- Dust Suppression on unpaved roads a $PM_{2.5}$ factor of .15
- Dust Suppression on construction sites a $PM_{2.5}$ factor of .20
- Sweeping Pave Roads a $PM_{2.5}$ factor of .25 if certified as PM_{10} efficient, if not a $PM_{2.5}$ factor of .21
- Paving Roads and other paving projects will apply a $PM_{2.5}$ factor of .25
- All other projects will conservatively use a $PM_{2.5}$ factor of .21

ADOT will calculate both PM_{10} and $PM_{2.5}$ emissions reduction estimates and provide these results to the project selection team to aide in evaluating a project's effectiveness in reducing particulate matter. ADOT will report both $PM_{2.5}$ and PM_{10} emissions reductions in the CMAQ Annual Report that is submitted to FHWA.

CMAQ Application Process

Applicants interested in receiving CMAQ funding for projects will be asked to fill out the application form included in Appendix A and include the necessary self-calculating excel spreadsheets for the project type. A detailed description of the calculation methodologies and example of using spreadsheet analysis tools is provided by project category.

Dust Mitigation Projects

Dust Suppression for Road Construction Projects and/or Unpaved Roads:

ADOT tested two surface treatments for unpaved roads as part of the project entitled "*Identification of Emissions Sources for Pinal County*". Field measurements of PM10 emission rates were made on two different state highways, routes, SR88 and SR288. The segment of state route 88 between mile point 220.1 and mile point 227.5 was treated with Envirotac II Acrylic copolymer at a rate of 1 gallon per 36 square feet, after 5 months the PM10 emissions were reduce by a factor of five. The segment of SR 288 between mile points 274.7 and 280.5 was treated by milling 6in of the base material that was treated with a 1:1 ratio of SS1 followed by an application of CRS II Emulsified liquid at a rate of 0.5 gallon per square yard and then 28 pounds per square yard of 3/8 in chips, after one year PM10 emissions were reduce by a factor of sixty. This study also looked as typical cost effectiveness results from other dust palliative applications as illustrated by Table 1.

Table 1: Dust Control Method Costs and Effectiveness ($ per mile of road treated)

Dust Control Category	Specific Product	Control Cost ($ per mile of road treated)	Control Effectiveness Range	Control Duration
Moisture Increase	Watering	$31	0% - 50%*	0.5-1 hours
	Calcium Chloride	$18,000	0% - 70%**	6 months
Particle Agglomeration	EK-35	$16,000	0% - 99%***	1 year
	Lignosulfonate	$12,000	0% - 90%*	2 months
	Soil Sement	$18,000	0% - 84%****	1 year
Soil Coverage	Gravel	$16,000	0% - 30%*	1 year
	Asphalt Paving	$311,000	90% - 99%	20 years

* Orlemann, 1983
** Morgan, 2005
*** MRI, 2002
**** California ARB, 2002

Given the wide range of effectiveness for dust palliatives, ADOT intends on adopting dust control methodologies from the Idaho Department of Transportation that lists emissions reduction control efficiency for water at 50% and chemical stabilizers at 70% (see Figure 3). [10] ADOT is also reviewing the appropriateness of the emissions factors assumption for unpaved roads and construction fugitive dust emissions as these factors may change in the future.

Example A: The City of Nogales requests $200,000 CMAQ funds to purchase chemical dust palliatives to be applied 2 times a year to stabilize 4 miles of a rural unpaved road with an ADT of 200. The product specifications state that one application will be effective for 180 days and the City is purchasing a one year supply of dust palliative. The applicant provides information for green sections of the "Dust Suppressant Calculation Sheet" in Figure 3 and the emissions benefits are calculated. This project produces an annual PM_{10} emissions reduction of 142,591.68 kilograms an adjustment factor of .15 used to estimate the associated $PM_{2.5}$ emissions reduction of 21,388.75 kilograms. The cost effectiveness is calculated for only PM_{10} as the $PM_{2.5}$ is an assumed percentage of the PM_{10} emissions reductions. The cost effectiveness of this project is estimated by dividing the total emissions by the total CMAQ funding to produce a cost effectiveness of $1.40 per Kg of PM_{10} emissions reduced.

Note: This example is for dust mitigation for unpaved road, there is another emissions calculation sheet for dust mitigation for a construction project, see Appendix F.

[10] http://itd.idaho.gov/cmaq/app.htm?print

Figure 3: Dust Suppression Calculation Sheet

Unpaved Road Dust Suppression

	PM10 Emissions Factor (kg/mile)
Urban Unpaved	0.36
Rural Unpaved	0.7073

	Control Efficiency	Number of Days Effective
Water	50%	N/A
Chemical Stabilizers	70%	180

Daily Emissions Reductions

Road Name	Emissions Factor (kg/Mile)	X	Control Efficiency	X	Average Daily Traffic	X	Length of segment (miles)	=	Daily PM10 Emissions Reductions (kg/day)
Example A	0.7073	X	0.7	X	200	X	4.00	=	396.09

Number of Days with Emissions Reductions

Number of Days Effective per Application	X	Number of Applications per Year	=	Number of Days with Emissions Reductions (days/year)
180	X	2	=	360

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days with Emissions Reductions (days/year)	=	Annual PM10 Emissions Reductions (Kg/Year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (Kg/Year)
396.09	X	360	=	142,591.68	X	*0.15*	=	21,388.75

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
$ 200,000	÷	1	÷	142,591.68	=	1.402606379

Surface Improvement (Unpaved Roads)

Surface improvement control options alter the road surface. As opposed to "surface treatments", improvements are relatively permanent and do not require periodic retreatment. The most obvious surface improvement is paving an unpaved road. This option is quite expensive and is probably most applicable to relatively short stretches of unpaved road with at least several hundred vehicle passes per day. Furthermore, if the newly paved road is located near unpaved areas or is used to transport material, it is essential that the control plan address routine cleaning of the newly paved road surface. The control efficiencies achievable by paving can be estimated by comparing emission factors for unpaved and paved road conditions.

Other surface improvement methods involve covering the road surface with another material that has a lower silt content. Examples include placing gravel or slag on a dirt road. The control efficiency can be estimated by comparing the emission factors obtained using the silt content before and after improvement. The silt content

of the road surface should be determined after 3 to 6 months rather than immediately following placement. Control plans should address regular maintenance practices, such as grading, to retain larger aggregate on the traveled portion of the road. The paving of unpaved roads and unpaved parking areas can result in a control efficiency of 99 percent based on the comparison of paved road and unpaved road emissions factors.[11]

Road Paving:

Paved Road Baseline Emissions

For the paved roadway improvements the calculation begins with the calculation of the base emissions on the roadway from re-entrained dust:

Emissions Factor is $E_{ext} = [\ k\ (sL)^{0.91}\ x\ (W)^{1.02}\ ]\ (1 - P/4N)$
Annual Emissions Reduction = Roadway VMT_{Annual} * E_{ext}

Where:
E_{ext} = annual or other long-term average emission factor in the same units as *k,*
k = particle size multiplier for particle size range and units of interest – PM_{10} 1 g/VMT, $PM_{2.5}$ .25 g/VMT[12]
sL = road surface silt loading – 0.105 g/m^2 ADEQ Nogales PM10 SIP[13]
W = average weight (tons) of the vehicles traveling the road – 3 tons
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
For precipitation a value of 60 days/365 days per year is the value presented in the AP-42 references for the region containing Nogales, ADEQ used 45 days in nonattainment plan.
N = number of days in the averaging period (e.g., 365 for annual)

Example B (part 1): The City of Nogales is interested in applying for $650,000 in CMAQ funds to pave a 2 mile section of unpaved road that accesses an existing paved road, curb and gutter will also be added on both sides of the roadway. This road has an annual VMT of 200,000 with an ADT of 550 the City will also be providing curb and gutter on both sides of a road with paved shoulders, the paving has an expected lifecycle of 15 years. The City will fill out the green portion of the "Baseline Calculation Sheet" in Figure 4, this baseline will be used to calculate the PM_{10} emissions factors for use in both the "Paved Road and Alley Calculation Sheet" in Figure 5 for part 2 and the "Pave Shoulder and Curb & Gutter Calculation Sheet" in Figure 6 for part 3 of this example.

[11] Western Regional Air Partnership (WRAP), *Fugitive Dust Handbook*, September 7, 2006 (http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf)
[12] United States Environmental Protection Agency, *AP-42, Background Documentation, Table 13.2.1-1*, January 2011.
[13] ADEQ, *State Implementation Plan Nogales PM10 Nonattainment Area* , July 2012 http://www.azdeq.gov/environ/air/plan/download/sip_npm10na.pdf

Figure 4: Baseline Calculation Sheet

Paved Road Baseline Emissions

Emissions Factor: Eext = [k (sL)0.91 x (W)1.02] (1 – P/4N)

Particle Size	Particle Size Multiplier (k) (g/VMT)	Road Surface Silt Loading (sL) (g/m^3)	Average Weight of Vehicles (W) (ton)	Number of Wet Days (P) (>=0.254 mm)	Number of Days in Averaging Period (N)	Emission Factor (E_{ext})
PM10	1	0.105	3	45	365	0.382251788

Annual PM10 Emissions Reduction

Road Name	Roadway VMT_{Annual}	X	Emission Factor (E_{ext})	=	Annual Emissions Reduction (kg/year)
Example B	200,000	X	0.382251788	=	76.45035769
			Total Daily Emissions Reductions		76.45035769

For Paving Unpaved Roads or Alleys:

Daily Emission Reductions = (BEF – AEF) * Miles * 0.93 * ADT * 1 /1000 (Kg/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 with The MAG CMAQ guidance recommends a value for (BEF-AEF) of (660.16 – 1.47 grams/mile) = 658.69 g/mi

Miles = the length of the project (in centerline miles)

ADT = the average weekday traffic on the unpaved road or alley

0.93 = the factor to convert from weekday to annual average daily traffic on arterials.

Example B (part 2): After the "Baseline Calculation Sheet" is completed in Figure 4, the City will continue entering data in the green sections of the "Paved Road or Alley Calculation Sheet" in Figure 5. The grey portions of the spreadsheet automatically calculate the emissions and cost effectiveness of the project. This project produces an annual PM_{10} emissions reduction of 245,951.55 Kg with the estimated PM2.5 emissions reduction of 61,487.89 Kg, the cost effectiveness of $0.17 per Kg of PM_{10} reduced.

Figure 5: Paved Road or Alley Calculation Sheet

Paving Unpaved Roads or Alleys

Difference in Emissions Factors

	Emissions Factor Unpaved (g/mile)	-	Emissions Factor Paved (g/mile)	=	Difference in Emissions Factors (g/mile)
Road	660.16	-	1.47	=	658.69
Alley	417.45	-	1.47	=	415.98

Daily PM10 Emissions Reductions

Road Name	Difference in Emissions Factors (g/Mile)	X	Length of segment (miles)	X	Average Daily Traffic	X	Factor to convert from weekday to AADT on arterials	=	Emissions Reductions (kg/day)
Example B	658.69	X	2	X	550	X	0.93	=	673.83987
							Total Daily Emissions Reductions		673.83987

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year (days/year)	=	Annual PM10 Emissions Reductions (kg/year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
673.84	X	365	=	245,951.55	X	*0.25*	=	61,487.89

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
$ 650,000	÷	15	÷	245,951.55	=	0.17618646

Paving Shoulders and/or Curb and Gutter:

Paved road dust also depends on whether the road shoulder is paved and whether there is a source of dust fallout present. This measure reduces the generation of dust from vehicle excursion onto unpaved shoulders. For example, facilities with dust-generating storage piles, and truck traffic moving between these piles, are likely to have high particulate emission rates. This is particularly true for facilities with unpaved road shoulders.[14] Generally, roads with average daily traffic (ADT) of 500 to 3,000 should have an average shoulder width of at least four feet. Roads with an ADT that is greater than 3,000 require an average shoulder width of at least 8 feet. The reduction of road dust associated with paved shoulders depends on site-specific variables, including silt loading and traffic volumes.

[14] United States Environmental Protection Agency, *AP-42, Background Documentation to Chapter 13.2.1*, January 2011.

The following approach was taken from the MAG Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects and provides a basic framework for analyzing these projects:

For Paving Unpaved Shoulders and/or Providing Curb and Gutter (C&G):
Daily Emission Reductions = Miles * ADT * 0.93 * RF * 1 /1000 (Kg/day)

Where:
Miles = the length of the project (in centerline miles)
ADT = the average weekday traffic on the road adjacent to the unpaved shoulders
0.93 = the factor to convert from weekday to annual average daily traffic
RF = Emission reduction factor in grams per vehicle mile of travel (vmt) for PM_{10}:

Low volume arterials (<10,000 ADT)
- 0.76 g/vmt, if paving shoulders and providing C&G on both sides of the road;
- 0.57 g/mvt, if paving shoulders on both sides of the road without C&G;
- 0.38 g/vmt, if paving shoulder and providing C&G on one side of the road;
- 0.29 g/vmt, if paving shoulder on one side of the road without C&G;
- 0.19 g/vmt, if providing C&G on both sides of a road with paved shoulders; or
- 0.10 g/vmt, if providing C&G on one side of a road with a paved shoulder.

High volume arterials (> 10,000 ADT)
- 0.53 g/vmt, if paving shoulders and providing C&G on both sides of the road;
- 0.40 g/mvt, if paving shoulders on both sides of the road without C&G;
- 0.27 g/vmt, if paving shoulder and providing C&G on one side of the road;
- 0.20 g/vmt, if paving shoulder on one side of the road without C&G;
- 0.14 g/vmt, if providing C&G on both sides of a road with paved shoulders; or
- 0.07 g/vmt, if providing C&G on one side of a road with a paved shoulder.

Example B (part 3): Continuing with the example of a 2 mile road paving project that adds shoulders, curb and gutter the emission calculation sheet is provided in Figure 6. The City will input the Reduction Factor (RF) of .19 for a low volume road, the ADT of 550, the cost of $650,000, the number of days in year, and the life of project estimated at 15 years. The spreadsheet will calculate the cost effectiveness and emissions PM_{10} where the $PM_{2.5}$ emissions reduction is calculated by assuming the 25% of total PM_{10} is attributed to $PM_{2.5}$. This example produces an annual PM_{10} emissions reduction of 70.95 Kg with a cost effectiveness of $610.80 per Kg of PM_{10} reduced and an estimate of an annual $PM_{2.5}$ emissions reduction of 17.74 Kg.

Figure 6: Pave Shoulder and Curb & Gutter Calculation Sheet

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

Reduction Factor (RF) (g/vmt)

	Low volume arterials (<10,000 ADT)		High volume arterials (>=10,000 ADT)
If paving shoulders and providing C&G on both sides of the road	0.76		0.53
If paving shoulders on both sides of the road without C&G	0.57		0.4
If paving shoulders and providing C&G on one side of the road	0.38		0.27
If paving shoulders on one side of the road without C&G	0.29		0.2
If providing C&G on both sides of a road with paved shoulders	0.19		0.14
If providing C&G on one side of a road with paved shoulders	0.1		0.07

PM10 Daily Emissions Reductions

Project Name	RF	X	Average Daily Traffic	X	Length of segment (miles)	X	Factor to convert from weekday to AADT on arterials	=	Emissions Reductions (kg/day)
Example B	0.19	X	550	X	2	X	0.93	=	0.19437
							Total Daily Emissions Reductions		0.19437

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year (days/year)	=	Annual PM10 Emissions Reductions (Kg/Year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
0.19	X	365	=	70.95	X	0.25	=	17.74

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
$ 650,000	÷	15	÷	70.95	=	610.8013643

Equipment Purchases

Road Street Sweepers:

Paved road dust is fugitive dust that is deposited on a paved roadway and then re-entrained into the air by passing vehicles. Dust is deposited on the roadway by being blown from disturbed areas, tracked from unpaved shoulders or vehicles traveling on connecting unpaved roads, stirred up from unpaved shoulders by wind currents created from traffic movement, spilled by haul trucks, and deposited by water runoff or erosion. Vehicles cause dust from paved and unpaved roads to be re-entrained or re-suspended in the atmosphere. The forces created by the rolling wheels of vehicles remove fine particles from the road bed and also pulverize aggregates lying on the surface. Emissions of paved road dust are generally proportional to vehicle miles traveled. Re-entrained road dust emission rates are primarily affected by the silt loading on the road and amount of vehicle travel. Emission rates are lower per mile traveled on more trafficked roads.[15]

[15] United States Environmental Protection Agency, *EPA's Technical Support Document for the San Joaquin Valley, California, 2003 PM_{10} Plan and 2003 PM_{10} Plan Amendments*, January 27, 2004.

The Western Regional Air Partnership (WRAP) has compiled tested road dust control reductions. According to the WRAP *Fugitive Dust Handbook*, 86 percent efficient sweeping and a 14-day frequency can result in a control efficiency of 16 percent for local streets and a control efficiency of 26 percent for arterial/collector streets.[16]

Table 2 illustrates the anticipated emissions effectiveness of paved road dust reduction control measures based on research compiled within the AP-42 background documentation. It is important to note that not all sweepers are certified to reduce $PM_{2.5}$, which is necessary if the quoted reductions are to be achieved. Percent reduction will depend on the specifications of the equipment purchased.

Table 2: Emissions Effectiveness of Paved Road Dust Reduction Control Measures

Control Measure: Paved Roadway Sweeping	Effectiveness
Sweeping Alone	**16-50%**
Water Flushing	**30-70%**
Sweeping and Water Flushing	**35-90%**

These PM_{10} emissions factors calculated in Figure 7 can then be used to estimate the $PM_{2.5}$ emissions using the 25% PM_{10} to $PM_{2.5}$ factor found in AP-42. A list of South Coast Air Quality Air Quality Management District (SCAQMD) Certified Street Sweepers under SCAQMD Rule 1186 August 30, 2012 (Appendix E) http://www.aqmd.gov/rules/doc/r1186/r1186_equip.pdf

Example C: The County of Santa Cruz is requesting $320,000 in CMAQ funding for a purchase of a street sweeper. The County has 4 roads with a total of 65 miles that will be swept twice a month, the County provided a listing of each road name, length, and ADT as provided in green sections of worksheet. The control efficiency of this sweeper was determined to be 30% due to the limited sweeping schedule and the type of sweeper that was purchased (not on the SCAQMD certified PM10 efficient street sweeper list a $PM_{2.5}$ factor of .21 is used instead of .25), It is expected that this sweeper will be used for 18 years . The "Sweeping Calculation Sheet" in Figure 7 is used to calculate emission reductions and cost effectiveness for PM_{10}. This example produces an annual PM_{10} emission reduction of 115,381.23 Kg with a cost effectiveness of $0.15 per Kg of PM_{10} reduced and an annual $PM_{2.5}$ emission reduction of 24,230.061 Kg.

Note: This example is for purchasing a Street Sweeper another emissions calculation sheet is available for purchasing a water truck based on palliative use, see Appendix F.

[16] Western Regional Air Partnership (WRAP), *Fugitive Dust Handbook*, September 7, 2006 (http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf).

Figure 7: Sweeping Calculation Sheet

Paved Road Sweeping

Particle Size	Emission Factor (E_{ext})
PM10	0.382251788

Control Measure	
Sweeping Alone	16 - 50%
Flusher Truck	30 - 70%
Combined	35 - 90%

PM10 Emissions Reductions Over Entire Network

Road Name	Emissions Factor (kg/mile)	X	Control Efficiency	X	Average Daily Traffic	X	Lane Miles to be Cleaned (miles)	=	Emissions Reductions (kg/day)
Example C Road 1	0.000382252	X	30	X	100,000	X	20.00	=	22,935.11
Example C Road 2	0.000382252	X	30	X	75,000	X	20.00	=	17,201.33
Example C Road 3	0.000382252	X	30	X	120,000	X	10.00	=	13,761.06
Example C Road 4	0.000382252	X	30	X	50,000	X	15.00	=	8,600.67
							Emissions Reductions Over Entire Network		62,498.17
							Total Lane Miles to be Cleaned		65.00

Percent of Total Lane Miles to Be Cleaned per Day

Lane Miles Cleaned per Day	÷	Total Lane Miles to Be Cleaned	=	Percent of Total Lane Miles to Be Cleaned per Day
5	÷	65.00	=	8%

Daily Emissions Reductions

PM10 Emissions Reductions Over Entire Network (kg)	X	Percent of Total Lane Miles to Be Cleaned per Day	=	Daily PM10 Emissions Reductions (kg/day)
62,498.17	X	8%	=	4,807.55

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year that Roads are Cleaned (days/year)	=	Annual PM10 Emissions Reductions (kg/year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
4807.55	X	24	=	115,381.23	X	*0.21*	=	24,230.06

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (Kg/Year)	=	Cost Effectiveness ($/Kg)
$ 320,000	÷	18	÷	115,381.23	=	$ 0.15

Water Trucks:

The purchase of water trucks may also be eligible for CMAQ funding. This option is being considered by ADOT pending further guidance from Federal Highway Administration (FHWA) on eligible expenses. It is expected that the emissions calculation methodologies will mirror what was developed for dust palliatives in that it is expected that a commitment to stabilize dirt surfaces will be a condition of reimbursement for purchase of a water truck.

Other Projects

Bicycle and Pedestrian Projects (PM only):

The methodology for calculating improvements emissions from a bike or pedestrian project assumes that a dirt surface will be paved requiring the "Baseline Calculation Sheet "(Figure 4) to be included. The project must also demonstrate that there will be a reduction in auto travel to be eligible for CMAQ funding. At this time this calculation will only determine an emissions reduction for PM_{10} and $PM_{2.5}$ attributed to removing an unpaved surface.

> Example D: The City of Nogales wants to provide a bicycle path along an arterial with VMT of 200,000, it is assumed that 15 bikes a day will use this trail, the CMAQ funds requested in $200,000. The "Baseline Calculation Sheet" in Figure 4 and the "Bicycle and Pedestrian Calculation Sheet" in Figure 8 will be used. This example produces an annual PM_{10} emissions reduction of 8.05022 Kg with a cost effectiveness of $4,347.71 per Kg of PM_{10} reduced. A $PM_{2.5}$ emissions factor of .21 is used with an estimated annual $PM_{2.5}$ emission reduction of 1.69 Kg.

Figure 8: Bicycle and Pedestrian Calculation Sheet

Bicycle and Pedestrian

Particle Size	Emission Factor (E_{ext})
PM10	0.382251788

Single Occupancy Vehicle (SOV) Miles Replaced ** NOTE: For Average Trip Length use local data, or 1.8 as default

Expected Average Daily Bike Traffic	÷	Average Auto Occupancy	X	Average Trip Length (miles/trip)	=	Daily SOV Miles Replaced (miles/day)
15	÷	1.8	X	3	=	81

Daily Emissions Reductions (SOV Vehicle Emissions Saved)

Daily SOV Miles Replaced (miles/day)	X	PM10 Emissions Factor (kg/mile)	=	Daily PM10 Emissions Reductions (kg/day)
81	X	0.000382252	=	0.030962395

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year (days/year)	=	Annual PM10 Emissions Reductions (kg/year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
0.030962395	X	365	=	8.050222665	X	*0.21*	=	1.69

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
$ 700,000	÷	20	÷	8.050222665	=	4347.705828

Diesel Retrofits:

The EPA recommends using the National Mobile Inventory Model (NMIM) to estimate emissions reductions from retrofit projects for SIPs and conformity analyses. However, with the release of EPA's emissions model MOtor Vehicle Emission Simulator (MOVES) this model has become obsolete. The EPA developed a "Retrofit Converter Tool" that may be used with the on-road retrofit strategy panel in MOVES that allows users to enter details about diesel trucks and buses that have installed emissions control equipment. ADOT staff is in the process of developing the necessary resources and expertise for running MOVES and would need additional time to evaluate these types of projects. Any retrofit projects must use the technology on EPA's Verification list at http://www.epa.gov/cleandiesel/verification/verif-list.htm to be eligible for CMAQ funds. If specific manufacturer details are provided for the retrofit technology, see Appendix F, then ADOT staff can estimate emissions with the EPA Diesel Emission Quantifier Tool http://epa.gov/cleandiesel/quantifier/deq-checklist.htm .

Construction Equipment Related Emissions/ Exhaust

In 2009 ADOT conducted a yearlong study on emissions impacts of widening SR92 in Sierra Vista. One of the goals of this study was to determine the impact of a road construction project on $PM_{2.5}$ emissions.[17] A summary of the emission results from this study is in Table 3. While a large portion of $PM_{2.5}$ is generated from exhaust from diesel engines, fugitive dust still contributes a larger percent of emissions for a road construction project. ADOT is still researching ways to estimate road construction dust and emissions factors for potential CMAQ projects. The Sierra Vista study estimated the construction activity for a 4 mile road widening project that added 2 travel lanes and a center auxiliary lane. This project produced 29 kg of PM_{10}, 6 kg of $PM_{2.5}$, and 30 kg of NOx, assumptions could be made that similar types of projects would produce similar emissions.

Table 3: Emissions from SR92 Road Widening Year 2009

Emissions Source	PM10 kg	PM2.5 kg
Construction Equipment Exhaust	553 (8%)	537 (37%)
Fugitive Dust	6,490 (92%)	924 (63%)

In addition to measuring emissions from a typical road construction project, this study looked at existing mitigation controls for $PM_{2.5}$ including retrofitting construction equipment as included in Table 4. A full literature review on construction equipment emissions can be found in Appendix A of the report.

[17] ADOT, *Construction Activity, Emissions, and Air Quality Impacts: Real-World Observations from an Arizona Road-Widening Case Study* http://www.azdot.gov/mpd/PDF/2010-STI-ADOT-Construction-Study-Final-Report-10-25-10.pdf , October 2010.

Additional Projects for Next Round of CMAQ funding

To provide CMAQ funding to $PM_{2.5}$ areas as quickly as possible, ADOT only developed methodologies for those CMAQ eligible projects that were of greatest interest to stakeholders in the nonattainment area. These methodologies are based on reducing fugitive dust in which $PM_{2.5}$ is a subset of PM_{10} emissions. Both pollutants will be estimated for project evaluation and reporting. Several CMAQ projects that reduce congestion, improve traffic flow/speeds or reduce tailpipe emissions require the use of complex emissions model(s) that require additional resources and data before ADOT staff can adequately estimate emissions for these types of CMAQ projects. As previously mentioned, ADOT has included as part of their State Planning and Research (SPR) program a work element to review and revise ADOT's CMAQ process to expand eligible CMAQ projects requiring emissions modeling and a work element to develop mobile source emissions inventory methodologies to aide ADOT in delivering the CMAQ program.

Table 4: Emissions and Cost Effectiveness of Retrofitting Construction Equipment

Control	Implementation	Costs	Benefits	Sources
DOC	Installation required to add device to vehicle exhaust system (several hours)	Relatively inexpensive ($1000-$2000 per truck engine).	10% to 30% $PM_{2.5}$ reductions, 20% to 50% HC and CO reductions	(U.S. Environmental Protection Agency, 2003; STAPPA/ALAPCO, 2006; ICF International, 2007; Storey, 2009)
DPF (active or passive)	Installation to vehicle exhaust system (<5 hours)	More expensive than DOC ($5000-$10,000 per truck engine). Can increase the ratio of NO_2 to NO.	80% to 90% $PM_{2.5}$, 60% to 93% HC and CO reductions	(STAPPA/ALAPCO, 2006; ICF International, 2007; Storey, 2009)
SCR	Installs on most diesel engines; often requires urea tank, pump, injector, and pressure/temperature monitors.	SCR systems can cost $10,000-20,000 per truck engine plus additional parts and reductant (urea) supplies.	60% NOx reduction, potential HC, CO and $PM_{2.5}$ reductions in combination with DPF or DOC	(STAPPA/ALAPCO, 2006)
EGR	Install EGR system. May require installation of DPF and/or upgrades to engine cooling system.	Can cost $10,000-15,000 when DPF is also required. May require upgrades and increase maintenance costs.	30% to 40% NO_x reduction, potential HC, CO, and $PM_{2.5}$ reductions in combination with DPF or DOC	(STAPPA/ALAPCO, 2006)

APPENDIX A

DRAFT ADOT CMAQ APPLICATION FORM

ADOT CMAQ Project Application Form Non-MPO Area

Project Title: Date:

Location:

Air Quality Non-Attainment or Maintenance Area Name :

Pollutant Type: $PM_{2.5}$ ☐ PM_{10} ☐ Other ☐

Project Type: Dust Suppression ☐ Road or Alley Paving ☐ Shoulder Paving and/or Curb & Gutter ☐
Equipment Purchases (Sweeper/Water Truck) ☐ Diesel Retrofit ☐ Bike/Pedestrian ☐ Other ☐

Preliminary Cost Estimate

	Estimated Cost	Check if Unknown
Planning/Concept Development	$	
PRELIMINARY ENGINEERING/DESIGN	$	
Environmental Process	$	
Right of Way	$	
Construction	$	
TOTAL PROJECT COST (A+B below)	$	

Local Match Provided (A) *min 5.7%*: $ Federal CMAQ Funds Requested (B): $ Local Match %:

Federal Program Year: FY-_____ Source Match Type:

Required Supporting Information Checklist

☐ Project Description (road/facility name, and type/classification of roadway, as available)
☐ Project Area and Regional Maps (verify in nonattainment area)
☐ Project Termini (existing/new, phasing, beginning, end, and total length, as available)
☐ New Capacity/Equipment/Network
☐ Existing Capacity/Equipment/System/Network
☐ Part of Existing Transportation, Capital Improvement, and/or Air Quality Plan (description need for project scoring)
☐ Project Schedule (with appropriate milestones)
☐ Line Item Budget (hours, rate, total for each staff member or consultant per phase/deliverable unit price, and number of units)

Check Applicable Air Quality Analysis Spreadsheet Included

☐ Unpaved Road Dust Suppression Sheet ☐ Construction Dust Suppression Calculation Sheet
☐ Baseline Calculation Sheet (required for sweeping, bike/ped) ☐ Road Sweeping Calculation Sheet
☐ Bicycle and Pedestrian Calculation Sheet ☐ Paving Roads and Alleys Calculation Sheet
☐ Pave Shoulder and/or Curb & Gutter Calculation Sheet ☐ Diesel Retrofit (http://epa.gov/cleandiesel/verification/verif-list.htm)
☐ **(other)**_____

Individual and Organizational Sponsor Name, Address, Phone/Fax/E-Mail (required)

Sponsor Signature (required): Date:

MPD Contact Signature (required): Date:

ITD District Engineer Contact Signature (required): Date:

***Supplementary Project Information**: Please complete the following supporting information attach more pages as necessary*

Project Description:

Project Area and Regional Maps:

Project Termini:

New OR Existing Capacity/Equipment /Network:

If this is part of Existing Transportation, Capital Improvement, and/or Air Quality Plan please include listing of document and description of how the project is described in the document.

Project Schedule:

Line Item Budget:

ATTACH EMISSIONS SPREADSHEETS TO THIS APPLICATION FORM

APPENDIX B

CMAQ AIR QUALITY ANALYSIS RESOURCES

FTP root at ftp.azdot.gov

To view this FTP site in Windows Explorer, click **Page**, and then click **Open FTP Site in Windows Explorer**.

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Password: adotftp

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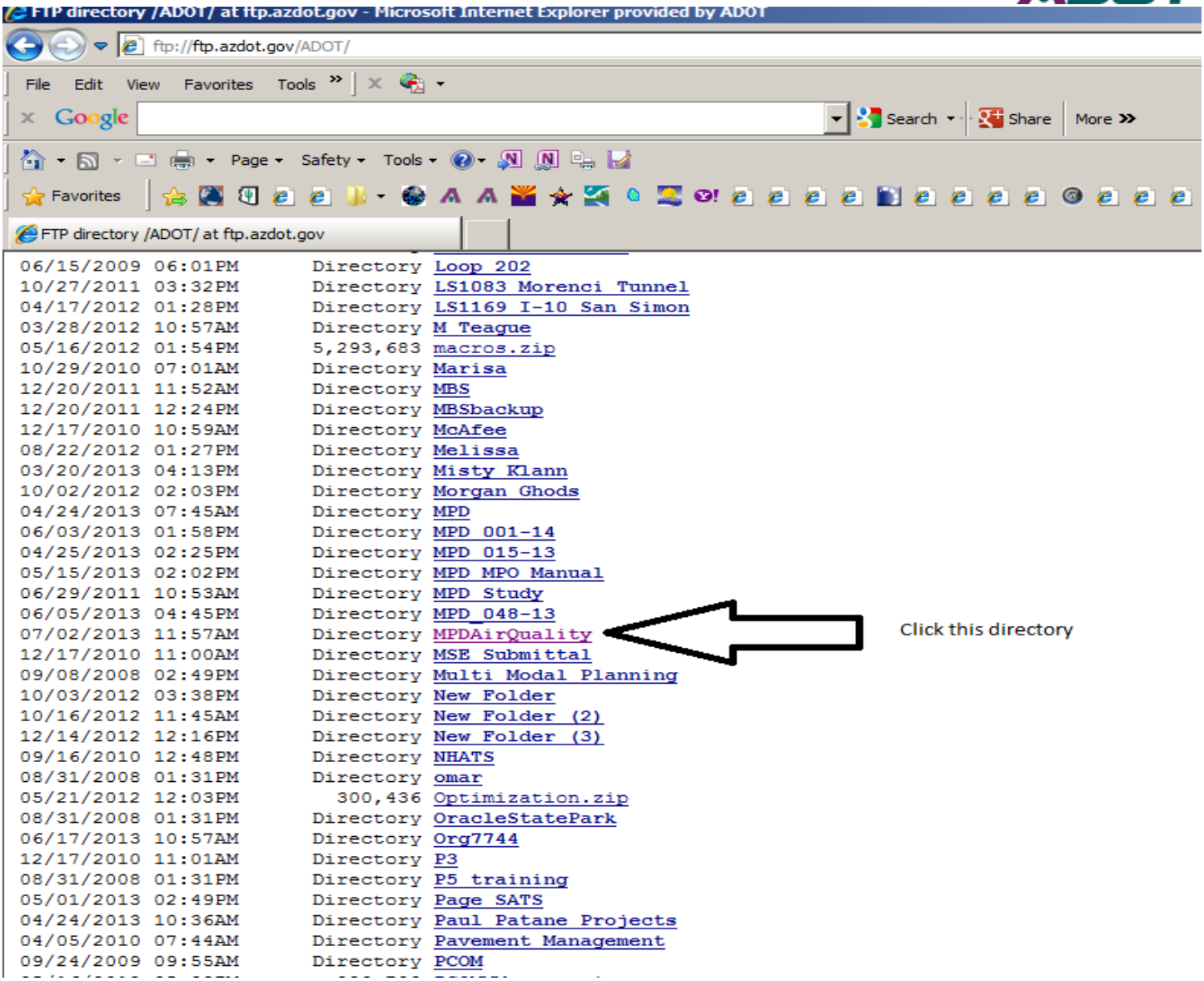
Click this Directory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Google
Search
Share
More
Page
Safety
Tools
Favorites
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12/17/2010 11:01AM Directory P3
08/31/2008 01:31PM Directory P5 training
05/01/2013 02:49PM Directory Page SATS
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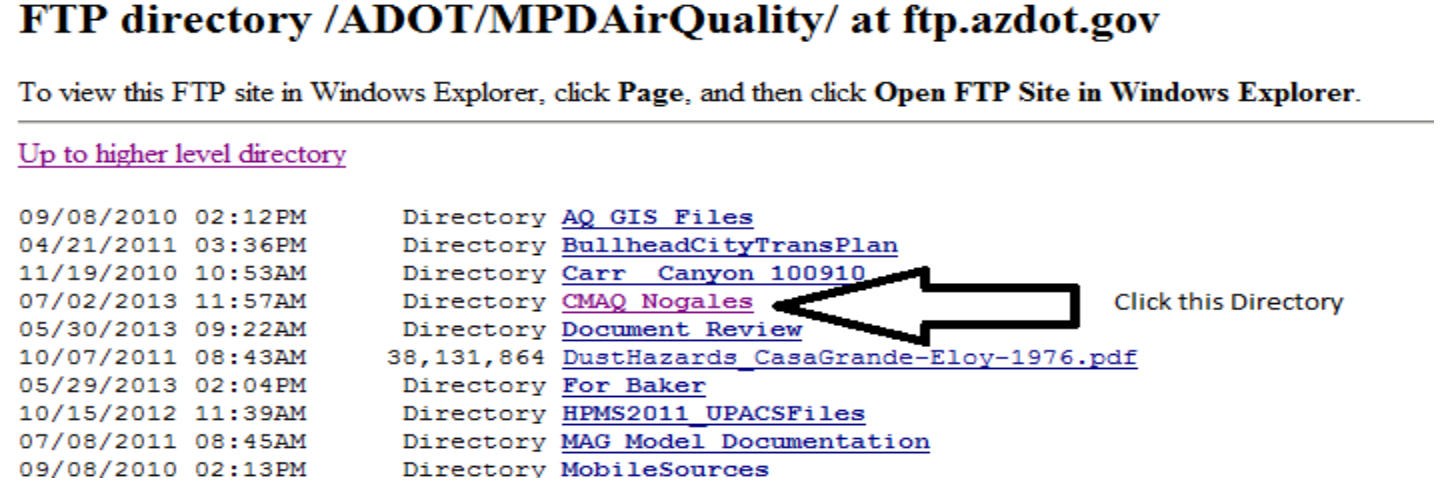
09/24/2009 09:55AM Directory PCOM
Click this directory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Click this Directory

APPENDIX C

CMAQ AIR QUALITY SCORING TEMPLATE

CMAQ Project Scoring Form Non-MPO Areas

Name: _____ Date: _____

Score Sheet

Project Title	1. Air Quality Benefit	2. Cost Effectiveness	3. Project is included as (TCM/RACM) in Air Quality Plan	6. Project cited in any Transportation Plan (CIP/SLRTP)

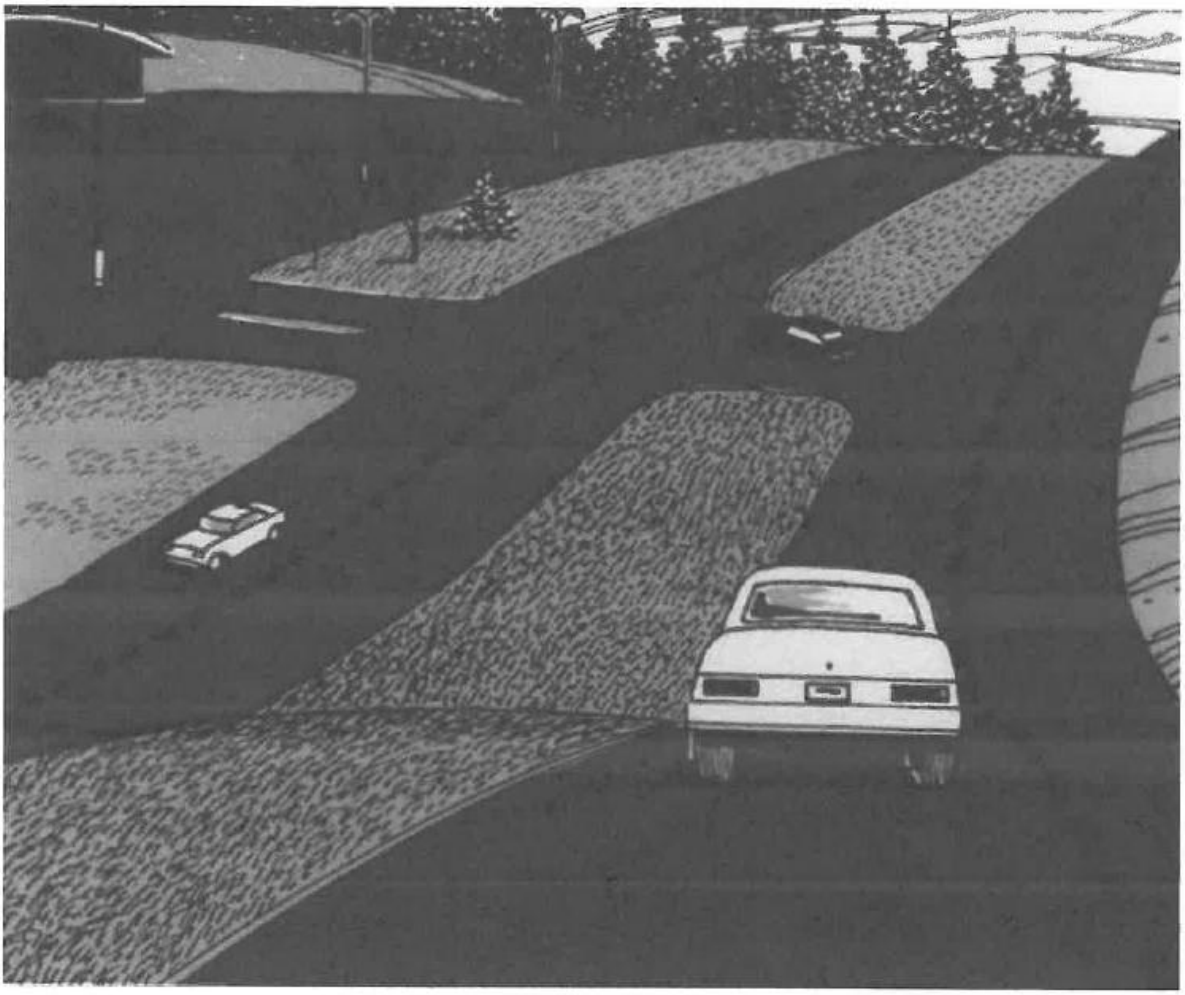
Title	**Score**	**Scoring Descriptions**
Air Quality Benefit	5 10 15 20	• Unknown or no emissions reductions available • Low emissions reductions calculated on project • Medium emissions reductions calculated on project • High emissions reductions calculated on project
Cost Effectiveness	1 4 10 15	• Unknown or no cost effectiveness evaluation provided • Not Cost Effective $5,000+ per Kg emissions reduced • Marginally Cost Effective $1,000-$4,999 per Kg emissions reduced • Cost effective <$1,000 per Kg emissions reduced
Project s included as a TCM/RACM in Air Quality Plan	No – 0 Yes – 10	Preference towards committed control measures in nonattainment area plans or funding future mitigation measures for transportation conformity.
Project cited in any Transportation Plan (CIP/SLRTP/TIP)	No – 0 Yes – 5	Preference towards projects that have community support and funding as identified in transportation documents.

APPENDIX D

A GUIDE TO FEDERAL-AID PROGRAMS AND PROJECTS

U.S. Department of Transportation
Federal Highway Administration

A Guide To Federal-Aid Programs And Projects



Federal Highway Administration
Office of Program Administration

http://www.fhwa.dot.gov/federalaid/projects.pdf#cmaq

Congestion Mitigation And Air Quality Improvement Program (CMAQ) Updated November 1, 2012

STATUS: ACTIVE

PROGRAM CODES:

- 3200 -- CMAQ
- 32A0 -- CMAQ 100% Safety
- 3AZ0 -- CMAQ-FTA
- 3610 - Congestion Relief Project
- 3BD0 - Congestion Relief Demo.-FTA
- Q400 -- CMAQ TEA-21
- QC10 -- CMAQ FTA
- Q420 -- CMAQ 100% Safety
- H400 -- CMAQ STEA03
- HV20 -- Highways for Life - CMAQ 10% Limit
- L400 -- SAFETEA-LU CMAQ
- LV20 - Highways for Life - CMAQ 10% Limit
- L40E -- CMAQ SAFETEA-LU Ext.
- L40R -- CMAQ SAFETEA-LU Restored (P.L. 111-147 Sec. 413)
- LV2E - Highways for Life -- CMAQ 10% Limit -- SAFETEA-LU Ext.
- M400 -- CMAQ (MAP-21 Section 1101(a)(1))
- M401 -- CMAQ Flexible Funding (MAP-21 Section 1113(b)(3))
- M003 -- CMAQ Projects to Reduce PM 2.5 Emissions (MAP-21 Section 1113(b)(6))

FEDERAL SHARE: The Federal share for CMAQ funds is governed by 23 U.S.C. 120. It is generally 80 percent, subject to the upward sliding scale adjustment for States containing public lands). Certain safety projects that include an air quality or congestion relief component, e.g. carpool/vanpool projects, as provided in 23 USC 120(c) may have a Federal share of 100 percent , but this provision is limited to 10 percent of the total funds apportioned to a State under 23 U.S.C. 104. The 100 percent Federal share provision (from P.L. 110-140) covered only 2008 and 2009 and was not extended by MAP-21.

PERIOD AVAILABLE: They are available for obligation for a period of three years after the last day of the fiscal year for which the funds are authorized.

FUND: Highway account of the Highway Trust Fund

FUND DISTRIBUTION METHOD: Apportionment

AUTHORITY: Contract

SUBJECT TO OBLIGATION LIMITATION: Yes

STATUTORY REFERENCE: 23 U.S.C. 149 (as amended by MAP-21 Sec 1113)

CFR REFERENCE: None

ELIGIBILITY: Generally, projects eligible under the CMAQ program prior to enactment of MAP-21 remain eligible with the new authorization. All CMAQ projects must demonstrate the three primary elements of eligibility: transportation identity, emissions reduction, and location in or benefitting a nonattainment or maintenance area. While project eligibilities are continued, there is some modification with new language placing considerable emphasis on select project types including electric and natural gas vehicle infrastructure and diesel retrofits. As in past authorizations of the program, projects must be included in a Metropolitan Planning Organization (MPO) transportation plan and transportation improvement program (TIP), or the current Statewide TIP in areas that are not part of an MPO. The MPO plans and programs must also have a transportation conformity determination in place, where applicable. In addition, CMAQ

investments must comply with the appropriate Federal cost principles, such as 2 CFR 225, the guidelines for State, local, and tribal governments.

Eligible Activities Include:

1. Acquisition of diesel retrofits, including tailpipe emissions control devices, and the provision of diesel-related outreach activities.
2. Intermodal equipment and facility projects that target diesel freight emissions through direct exhaust control from vehicles or indirect emissions reductions through improvements in freight network logistics.
3. Alternative fuel projects including participation in vehicle acquisitions, engine conversions, and refueling facilities.
4. Establishment or operation of a traffic monitoring, management, and control facility, including the installation of advanced truck stop electrification systems.
5. Projects that improve traffic flow, including efforts to provide signal systemization, construct HOV lanes, streamline intersections, add turning lanes, improve transportation systems management and operations that mitigate congestion and improve air quality, and implement ITS and other CMAQ-eligible projects, including efforts to improve incident and emergency response or improve mobility, such as through real time traffic, transit and multimodal traveler information.
6. Projects or programs that shift travel demand to nonpeak hours or other transportation modes, increase vehicle occupancy rates, or otherwise reduce demand through initiatives, such as teleworking, ridesharing, pricing, and others.
7. Transit investments, including transit vehicle acquisitions and construction of new facilities or improvements to facilities that increase transit capacity. The MAP21 provision on operating assistance (23 USC 149(m)) is being reviewed and guidance interpreting the provision will be issued in the future.
8. Non-recreational bicycle transportation and pedestrian improvements that provide a reduction in single-occupant vehicle travel.
9. Vehicle inspection and maintenance programs.

Ineligible Activities:

No funds may be used to add capacity except for HOV facilities that are available to SOV only at off-peak times.

BACKGROUND: The CMAQ program was established by the Intermodal Surface Transportation Act of 1991 (1991 ISTEA, Public Law 102-240) and was continued by the Transportation Equity Act for the 21st Century (TEA-21, Public Law 105-178) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) under 23 U.S.C. 149.

Under 23 U.S.C. 104(b)(2)(B)(pre-MAP-21), each State was apportioned funding based on county populations residing within ozone and carbon monoxide (CO) nonattainment and maintenance areas and the severity of the areas' air quality problems. Extra weighting was given to nonattainment or maintenance areas with both ozone and CO problems.

The Energy Independence and Security Act of 2007 (EISA), Public Law 110-140 included a provision in Section 1131, to increase the Federal share for the CMAQ program (23 U.S.C. Section 120(c)(2)(pre-MAP-21)). In enacting the provision, Congress established an 80 percent Federal share subject to new flexibility for a State to increase the Federal share payable on a CMAQ project up to 100 percent of the cost, if funds are obligated in fiscal year 2008 or 2009, and further subject to Section 120(i), which provides that a State may increase the non-Federal share for a project subject to criteria that the Secretary may establish. Consequently, there is no absolute minimum of 80 percent Federal share. As of December 20, 2007, funds obligated under the CMAQ program (23 U.S.C. 149), could be increased up to 100 percent of the total cost, at the discretion of the State, if funds were obligated in fiscal years 2008 and 2009. This provision to increase the Federal Share payable up to 100% was extended by the enactment of the Surface Transportation Extension Acts until October 1, 2012.

Moving Ahead for Progress in the 21st Century (MAP-21) extended the CMAQ program with the eligibilities shown above, and MAP-21 Section 1105, moved the apportionment of CMAQ funds to 23 U.S.C. 104(b)(4). MAP-21's approach to distribution of formula funds is based on the amount of formula funds each State received in FY 2012. Once each State's total Federal-aid apportionment is calculated, an amount is set aside for the State's CMAQ program through a calculation based on the size of the State's FY 2009 CMAQ apportionment relative to the State's total FY 2009 apportionments; the longstanding CMAQ statutory apportionment formula was not retained by MAP-21. Amounts for State Planning and Research and the Transportation Alternatives Program are set aside from each State's CMAQ apportionment. MAP-21 requirements went into effect on October 1, 2012 and apply to all related funding obligated on or after that date, whether carryover or new funds. MAP-21 included several other provisions as outlined below:

Performance Management: The CMAQ program has new performance-based features. The Secretary will establish measures for States to use for assessing traffic congestion and on-road mobile source emissions. Each MPO serving a Transportation Management Area (TMA) with a population of more than one million and also representing a nonattainment or maintenance area is required to develop a performance plan to achieve emission and congestion reduction targets. The MPO plans must be updated biennially and each update must include a retrospective assessment of the progress made toward the air quality and traffic congestion performance targets through the last program of projects.

State Flexibility:

1. A State without a nonattainment or maintenance area may use its CMAQ funds for any CMAQ- or Surface Transportation Program (STP)-eligible project.
2. States with a nonattainment or maintenance area that received a minimum apportionment in FY 2009 may use part of their current CMAQ funds for any STP-eligible project. The amount is based on the proportion of the State's FY 2009 CMAQ apportionment that could be obligated in any area of the State for STP-eligible projects.
3. The amount that may be obligated in any area of the State for STP-eligible projects is to be adjusted if a new nonattainment area is designated, a nonattainment area re-designated as an attainment (including maintenance) area, or a standard is fully revoked in an existing nonattainment or maintenance area.

Priority for PM2.5 Areas: The legislation calls for a State that has PM 2.5 (fine particulate matter) nonattainment and maintenance areas to use a portion of its CMAQ funds, based on population in PM 2.5 nonattainment areas, for projects that reduce PM 2.5 in such areas. Diesel retrofits are highlighted in MAP-21 as eligible to effect such mitigation. Further information on this section will be provided in the future.

Transferability: MAP-21 changed the approach to transfer of CMAQ funds to other elements of the Federal-aid program. Transfers of CMAQ funds no longer are subject to a special statutory formula but follow the maximum 50 percent transfer guideline provided in Transferability of Federal-aid at 23 U.S.C. 126. Exercising this transfer authority could impact traffic congestion and on-road mobile source emissions, the progress of which will be reported once performance measures are established under 23 U.S.C. 150. States continue to have the ability to transfer (or "flex") CMAQ funds to FTA for award as a grant under Chapter 53 of Title 49, as they did under SAFETEA-LU [see 23 U.S.C. 104(f)].

Evaluation of Projects: The Secretary must maintain and disseminate a cumulative database describing the impacts of projects, including project name, location, sponsor, cost, and cost-effectiveness (based on reduction in congestion and emissions) to the extent already measured. The Secretary, in consultation with EPA, shall evaluate cost effectiveness of projects periodically, for use by States and MPOs in project selection.

ADDITIONAL INFORMATION: Contact the Office of Natural and Human Environment (HEPN).

APPENDIX E

CERTIFIED STREET SWEEPERS UNDER SCAQMD RULE 1186

(As of August 30th, 2012)

South Coast
Air Quality Management District

21865 Copley Drive, Diamond Bar, CA 91765-4182
(909) 396-2000 • www.aqmd.gov

CERTIFIED STREET SWEEPERS UNDER SCAQMD RULE 1186

(AS OF AUGUST 30, 2012*)

SCAQMD Rule 1186 requires local governments within the South Coast Air Quality Management District (see Figure below) to procure certified street sweepers for new equipment purchases or new street sweeping contracts made after January 1, 2000 (there are no retrofit requirements under Rule 1186).

Various SCAQMD regulations also require procurement of certified street sweepers to implement specific rule requirements. This list of equipment is updated periodically based on certifications test results and in response to new information.

The SCAQMD Governing Board adopted Rule 1186 street sweeper testing and certification procedures in September of 1999. Enclosed is a list of equipment that has met the Rule 1186 certification standards. (The equipment may either be new or upgraded to meet certification specifications). Questions on equipment capabilities and options should be directed to your local distributor and/or the manufacturer. Questions regarding the Rule requirements can be directed to Mike Laybourn, Air Quality Specialist, at (909) 396-3066 or mlaybourn@aqmd.gov.

Cleaning the air that we breathe...

* Additional sweepers may be certified based on future tests. You can call 1 (800) CUT-SMOG or visit www.aqmd.gov for the most recent list of Rule 1186 certified equipment.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
RULE 1186 CERTIFIED* STREET SWEEPERS AS OF AUGUST 30, 2012

THE FOLLOWING IS A LIST OF STREET SWEEPING EQUIPMENT THAT HAS CURRENTLY BEEN CERTIFIED FOR SCAQMD RULE 1186. ALL CERTIFIED EQUIPMENT MUST BE OPERATED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. FUTURE TESTING MAY QUALIFY ADDITIONAL EQUIPMENT. CALL 1 (800) CUT-SMOG FOR THE CURRENT LIST.

MAKE*	MODEL*	DUST CONTROL SYSTEMS*
CHALLENGER MANUFACTURING	CHALLENGER	• THREE (3) 0.03 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • FOUR (4) 0.03 INCH DIAMETER ORIFICE NOZZLES CENTRALLY LOCATED BETWEEN THE MAIN BROOM AND THE CONVEYOR • WATER PUMP TO PROVIDE 25 POUNDS PER SQUARE INCH WATER PRESSURE DURING OPERATION; MAXIMUM OF 45 POUNDS PER SQUARE INCH
ELGIN	AIR CUB (LX/DX) CROSSWIND FURY	• DIAMOND GRID DUST SEPARATION SCREEN • LOUVERED CENTRIFUGAL DUST SEPARATOR • ONE (1) 0.06 INCH DIAMETER ORIFICE NOZZLE CENTRALLY LOCATED ABOVE FAN INLET IN THE HOPPER • TWO (2) 0.047 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE THE SUCTION TUBE • FOUR (4) 0.051 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • PUMP TO PROVIDE 40 POUNDS PER SQUARE INCH WATER PRESSURE
ELGIN	CROSSWIND J	• DIAMOND GRID DUST SEPARATION SCREEN • S-TRAP CENTRIFUGAL SEPARATOR • FOUR (4) 0.06 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE HOPPER • THREE (3) 0.059 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE SUCTION TUBE • THREE (3) 0.057 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • WATER PUMP TO PROVIDE 80 POUNDS PER SQUARE INCH WATER PRESSURE

* In order to ensure compliance with Rule 1186 requirements, all certified equipment must be operated and maintained in accordance with the manufacturer's specifications. End users are responsible for ensuring that the dust control systems are in place for each certified sweeper. Note: The make and model of the sweeper must have the dust control system(s) specified above to be in compliance. (Standard or older models may not have all the systems). Please contact the manufacturer if you would like to ensure that your sweeper(s) are Rule 1186 compliant.

1

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
RULE 1186 CERTIFIED* STREET SWEEPERS AS OF AUGUST 30, 2012

THE FOLLOWING IS A LIST OF STREET SWEEPING EQUIPMENT THAT HAS CURRENTLY BEEN CERTIFIED FOR SCAQMD RULE 1186. ALL CERTIFIED EQUIPMENT MUST BE OPERATED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. FUTURE TESTING MAY QUALIFY ADDITIONAL EQUIPMENT. CALL 1 (800) CUT-SMOG FOR THE CURRENT LIST.

MAKE*	MODEL*	DUST CONTROL SYSTEMS*
ELGIN	PELICAN P & S PELICAN SE (WET SUPPRESSION)	• FOUR (4) 0.06 INCH DIAMETER ORIFICE NOZZLES CENTRALLY LOCATED BETWEEN THE MAIN BROOM AND THE CONVEYOR • TWO (2) 0.057 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH GUTTER BROOM • WATER PUMP TO PROVIDE 80 POUNDS PER SQUARE INCH WATER PRESSURE
ELGIN	PELICAN P (WATERLESS SUPPRESSION)	• GUTTER/MAIN BROOM FULLY ENCLOSED SHROUD SYSTEM • TWO CENTRIFUGAL DUST EVACUATION FANS • SYNTHETIC MULTI-POCKET FILTER WITH HYDRAULIC SHAKER FOR DUST REMOVAL
ELGIN	PELICAN P (COMBINATION)	• ALL OF THE FEATURES OF THE WET AND WATERLESS SUPPRESSION PELICAN P STREET SWEEPER WITH THE EQUIPMENT OPERATED IN EITHER THE WET OR WATERLESS MODE
ELGIN	EAGLE E EAGLE F EAGLE (CNG) BROOM BEAR ROAD WIZARD	• FOUR (4) 0.06 INCH DIAMETER ORIFICE NOZZLES CENTRALLY LOCATED BETWEEN THE MAIN BROOM AND THE CONVEYOR • THREE (3) 0.057 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH GUTTER BROOM • WATER PUMP TO PROVIDE 80 POUNDS PER SQUARE INCH WATER PRESSURE
ELGIN	EAGLE F (WATERLESS)	• GUTTER/MAIN BROOM FULLY ENCLOSED SHROUD SYSTEM • CENTRIFUGAL DUST EVACUATION FAN • SYNTHETIC MULTI-POCKET FILTER WITH HYDRAULIC SHAKER FOR DUST CONTROL
ELGIN	EAGLE F (COMBINATION)	• ALL OF THE FEATURES OF THE WET AND WATERLESS EAGLE F STREET SWEEPER WITH THE EQUIPMENT OPERATED IN EITHER THE WET OR WATERLESS MODE

* In order to ensure compliance with Rule 1186 requirements, all certified equipment must be operated and maintained in accordance with the manufacturer's specifications. End users are responsible for ensuring that the dust control systems are in place for each certified sweeper. Note: The make and model of the sweeper must have the dust control system(s) specified above to be in compliance. (Standard or older models may not have all the systems). Please contact the manufacturer if you would like to ensure that your sweeper(s) are Rule 1186 compliant.

2

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
RULE 1186 CERTIFIED* STREET SWEEPERS AS OF AUGUST 30, 2012

THE FOLLOWING IS A LIST OF STREET SWEEPING EQUIPMENT THAT HAS CURRENTLY BEEN CERTIFIED FOR SCAQMD RULE 1186. ALL CERTIFIED EQUIPMENT MUST BE OPERATED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. FUTURE TESTING MAY QUALIFY ADDITIONAL EQUIPMENT. CALL 1 (800) CUT-SMOG FOR THE CURRENT LIST.

MAKE*	MODEL*	DUST CONTROL SYSTEMS*
ELGIN	GEOVAC	• DIAMOND GRID DUST SEPARATION SCREEN • FOUR (4) 0.06 INCH DIAMETER ORIFICE NOZZLES CENTRALLY LOCATED IN THE HOPPER • TWO (2) 0.059 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE THE SUCTION TUBE • TWO (2) 0.057 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • FOUR (4) 0.06 INCH DIAMETER ORIFICE NOZZLES LOCATED AT THE EXTENSION BROOM • WATER PUMP TO PROVIDE 80 POUNDS PER SQUARE INCH WATER PRESSURE
ELGIN	WHIRLWIND MV	• DIAMOND GRID DUST SEPARATION SCREEN • FOUR (4) 0.06 INCH DIAMETER ORIFICE NOZZLES CENTRALLY LOCATED IN THE HOPPER • TWO (2) 0.059 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE THE SUCTION TUBE • TWO (2) 0.057 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • FOUR (4) 0.60 INCH DIAMETER ORIFICE NOZZLES LOCATED AT THE EXTENSION BROOM • PUMP TO PROVIDE 80 POUNDS PER SQUARE INCH WATER PRESSURE
JOHNSTON	310	• FOUR (4) 0.072 INCH DIAMETER ORIFICE NOZZLES LOCATED IN FRONT SPRAY BAR • TWO (2) 0.072 INCH DIAMETER ORIFICE NOZZLES PER EACH GUTTER BROOM • ONE (1) 0.026 INCH DIAMETER ORIFICE NOZZLE LOCATED IN THE FAN SUCTION HOOD • WATER PUMP TO PROVIDE 50 POUNDS PER SQUARE INCH WATER PRESSURE

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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
JOHNSTON	3000 MX450 4000 4000 SDS MST 350	• ENCLOSED ELEVATOR SYSTEM • STEEL OR MIXED POLYESTER MAIN PICK UP BROOM • ONE (1) 0.072 INCH DIAMETER ORIFICE NOZZLE PER EACH GUTTER BROOM • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES PER EACH SIDE OF THE MAIN PICK UP BROOM • THREE (3) 0.057 INCH DIAMETER ORIFICE NOZZLES IN SPRAY BAR LOCATED BEHIND THE MAIN PICK UP BROOM • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES IN SPRAY BAR LOCATED UNDERNEATH THE CAB • WATER PUMP TO PROVIDE 40 POUNDS PER SQUARE INCH WATER PRESSURE
JOHNSTON	VT605 VT610 VT605 VT650	• TWO (2) 0.039 INCH DIAMETER ORIFICE NOZZLES PER GUTTER BROOM • THREE (3) 0.042 INCH DIAMETER ORIFICE NOZZLES PER SUCTION BROOM • THREE (3) 0.039 INCH DIAMETER ORIFICE NOZZLES PER SUCTION NOZZLE • MULTI-POSITION SUCTION NOZZLE TWO ARM FACILITY • ONE (1) 0.042 INCH DIAMETER ORIFICE NOZZLE FOR THE IMPELLER FAN • WATER PUMP TO PROVIDE 50 POUNDS PER SQUARE INCH WATER PRESSURE

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
JOHNSTON	770 CYCLONE	• THREE (3) 0.067 INCH DIAMETER ORIFICE NOZZLES FOR GUTTER BROOMS • TWO (2) 0.07 INCH DIAMETER ORIFICE NOZZLES FOR CENTER CURTAIN • FOUR (4) 0.055 INCH DIAMETER ORIFICE NOZZLES FOR FRONT BUMPER • TWO (2) 0.067 INCH DIAMETER ORIFICE NOZZLES FOR FRONT CURB SPRAY • TWO (2) 0.07 INCH DIAMETER ORIFICE NOZZLES ON LEFT AND RIGHT SIDE OF PICK UP HEAD • THREE (3) 0.082 INCH DIAMETER ORIFICE NOZZLES FOR PICK UP HEAD FRONT SIDE • SEVEN (7) 0.079 INCH DIAMETER ORIFICE NOZZLES FOR PICK UP HEAD REAR SIDE • THREE (3) 0.079 INCH DIAMETER ORIFICE NOZZLES FOR WINDROW PATH • TWO (2) 0.045 INCH DIAMETER ORIFICE NOZZLES FOR PICK UP HEAD SUCTION • ONE (1) 0.079 INCH DIAMETER ORIFICE NOZZLE FOR BLOWER FAN OUTLET • PUMP TO PROVIDE 50 POUNDS PER SQUARE INCH WATER PRESSURE
NESCON	X-BROOM	• THREE (3) 0.079 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • FIVE (5) 0.079 INCH DIAMETER ORIFICE NOZZLES ACROSS FRONT BUMPER • FIVE (5) 0.050 INCH DIAMETER ORIFICE NOZZLES IN MAIN BROOM HOUSING • WATER PUMP TO PROVIDE 50 POUNDS PER SQUARE INCH WATER PRESSURE

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
SCHWARZE	EV-1	• TWELVE (12) POLYESTER DRY FILTER CARTRIDGES (MAINTAINED TO ENSURE PROPER INTEGRITY) • FILTRATION CLEANED THREE TIMES PER MINUTE • FILTRATION SYSTEM ACTIVE AT ALL TIMES
SCHWARZE	EV-2	• EIGHT (8) POLYESTER DRY FILTER CARTRIDGES (MAINTAINED TO ENSURE PROPER INTEGRITY) • FILTRATION SYSTEM OPERATED AT ALL TIMES • EACH FILTER CLEANED THREE TIMES PER MINUTE
SCHWARZE	DXR	• POLYESTER DRY FILTER CARTRIDGES (MAINTAINED TO ENSURE PROPER INTEGRITY) • FILTRATION SYSTEM ACTIVE AT ALL TIMES • FILTRATION CLEANED FOUR TIMES PER MINUTE AND A HALF
SCHWARZE	A4000	• FOUR (4) 0.036 INCH DIAMETER ORIFICE NOZZLES LOCATED ON THE SWEEPING HEAD • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES INSIDE HOPPER • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • FOUR (4) 0.036 INCH DIAMETER ORIFICE NOZZLES INSIDE HOPPER ON SPRAY BAR • WATER PUMP TO PROVIDE 70 POUNDS PER SQUARE INCH WATER PRESSURE
SCHWARZE	M5000/M6000	• FIVE (5) 0.036 INCH DIAMETER ORIFICE NOZZLES ON MAIN BROOM • THREE (3) 0.036 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • WATER PUMP TO PROVIDE 70 POUNDS PER SQUARE INCH WATER PRESSURE

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
SCHWARZE	A 7000/ A 8000/ A 9000	• SAWTOOTH DUST SEPARATION SCREEN, SELF DUMPING DUST SEPARATOR, FAN CENTRIFUGE • FIVE (5) 0.036 INCH DIAMETER ORIFICE NOZZLES LOCATED ON THE SWEEPING HEAD • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES LOCATED ON HEAD INTAKE TUBE • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES IN RIGHT HAND GUTTER BROOM • FOUR (4) 0.036 INCH DIAMETER ORIFICE NOZZLES LOCATED ON HOPPER SPRAY BAR • WATER PUMP TO PROVIDE 70 POUNDS PER SQUARE INCH WATER PRESSURE • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES IN LEFT HAND GUTTER BROOM (REQUIRED IF BOTH GUTTER BROOMS ARE USED)
SCHWARZE	S348-I/ S348-LE	• FOUR (4) 0.036 INCH DIAMETER ORIFICE NOZZLES ON HOPPER SPRAY BAR • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES IN HOPPER • TWO (2) 0.036 INCH DIAMETER ORIFICE NOZZLES ON RIGHT HAND GUTTER BROOM • WATER PUMP TO PROVIDE 70 POUNDS PER SQUARE INCH WATER PRESSURE
STEWART-AMOS	STARFIRE S-4, S-5, AND S-6	• FOUR (4) 0.05 INCH DIAMETER ORIFICE NOZZLES CENTRALLY LOCATED BETWEEN THE MAIN BROOM AND THE ELEVATOR • FOUR (4) 0.05 INCH DIAMETER ORIFICE NOZZLES LOCATED BENEATH THE FRONT BUMPER OF THE CHASSIS • TWO (2) 0.05 INCH DIAMETER ORIFICE NOZZLES LOCATED IN FRONT OF EACH GUTTER BROOM • WATER PUMP TO PROVIDE 40 POUNDS PER SQUARE INCH WATER PRESSURE

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
PYTHON	S2000	• FOUR (4) 0.008 INCH DIAMETER ORIFICE NOZZLES MOUNTED ABOVE AND AHEAD OF A 36 INCH FILL DIAMETER REAR BROOM • WATER LINE WITH 0.02 INCH DIAMETER ORIFICE AND THREE (3) 0.06 DIAMETER OUTLETS ABOVE EACH 42 INCH DIAMETER GUTTER BROOM • PUMP TO PROVIDE 24 POUNDS PER SQUARE INCH WATER PRESSURE DURING OPERATION *PLEASE NOTE THAT THE GUTTER AND REAR BROOM SIZES ARE DIFFERENT THAN THE STANDARD MODEL*
PYTHON	S3000	• FOUR (4) 0.008 INCH DIAMETER ORIFICE NOZZLES MOUNTED ABOVE AND AHEAD OF REAR BROOM • WATER LINE WITH 0.02 INCH DIAMETER ORIFICE AND THREE (3) 0.06 DIAMETER OUTLETS ABOVE EACH GUTTER BROOM • PUMP TO PROVIDE 24 POUNDS PER SQUARE INCH WATER PRESSURE DURING OPERATION
WAYNE SWEEPERS LLC	CENTURION	• SEVEN (7) 0.0925 INCH DIAMETER ORIFICE NOZZLES ON SPRAY BAR UNDERNEATH THE CAB • TWO (2) 0.0925 INCH DIAMETER ORIFICE NOZZLES PER GUTTER BROOM • (GUTTER BROOMS CAN BE OPERATED WITHOUT WATER SPRAYS IF FULLY ENCLOSED SHROUD SYSTEM IS UTILIZED AND MAINTAINED PER THE MANUFACTURERS SPECIFICATIONS) • THREE (3) 0.0925 INCH DIAMETER ORIFICE NOZZLES ON SPRAY BAR ABOVE CONVEYOR • 300 GALLON WATER TANK • WATER PUMP TO PROVIDE MINIMUM OF SEVEN GALLONS PER MINUTE • SINGLE FAN VACUUM SYSTEM • GLAZED, POLYESTER FILTER SYSTEM (MAINTAINED TO ENSURE PROPOER INTEGRITY)

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
TENNANT	SENTINEL	• GUTTER/MAIN BROOM FULLY ENCLOSED SHROUD SYSTEM • DUAL FAN VACUUM SYSTEM (OPERATED AT ALL TIMES) • SYNTHETIC-SINGED POLYESTER FILTER (MAINTAINED TO ENSURE PROPER INTEGRITY)
TENNANT	830 I / 830 II	• GUTTER/MAIN BROOM FULLY ENCLOSED SHROUD SYSTEM • DUAL FAN VACUUM SYSTEM (OPERATED AT ALL TIMES) • SYNTHETIC-SINGED POLYESTER FILTER (MAINTAINED TO ENSURE PROPER INTEGRITY)
TYMCO	210 300 350 435	• CYCLONIC, MULTIPASS, CENTRIFUGAL SEPARATION • CENTER DEBRIS DEFLECTOR ASSEMBLY PERPENDICULAR TO THE PICK UP HEAD • TWO (2) 0.043 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • ONE (1) 0.063 INCH DIAMETER ORIFICE NOZZLE FOR EACH GUTTER BROOM • ONE (1) 0.063 INCH DIAMETER ORIFICE NOZZLE LOCATED IN THE HOPPER • ONE (1) 0.063 INCH DIAMETER ORIFICE NOZZLE LOCATED IN BLOWER HOUSING • WATER PUMP WITH A MINIMUM SYSTEM RELIEF VALVE SET AT 25 POUNDS PER SQUARE INCH.

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
TYMCO	600 600 BAH FHD 500X	• CYCLONIC, MULTIPASS, CENTRIFUGAL SEPARATION • CENTER DEBRIS DEFLECTOR ASSEMBLY PERPENDICULAR TO THE PICK UP HEAD • FRONT DEBRIS DEFLECTOR CURTAIN ASSEMBLY PARALLEL TO THE PICK UP HEAD • LOW EMISSION DUST GUARDS (ONLY APPLICABLE TO CABOVER TRUCKS) • THREE (3) 0.063 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • TWO (2) 0.043 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • ONE (1) 0.093 INCH DIAMETER ORIFICE NOZZLE LOCATED IN THE HOPPER • ONE (1) 0.093 INCH DIAMETER ORIFICE NOZZLE LOCATED IN BLOWER HOUSING • TWO (2) [MINIMUM] HOPPER BAFFLE CURTAINS • WATER PUMP WITH A MINIMUM SYSTEM RELIEF VALVE SET AT 25 POUNDS PER SQUARE INCH.
TYMCO	DST - 4	• CYCLONIC, MULTIPASS, CENTRIFUGAL SEPARATION • SELF CONTAINED MULTIPLE FILTRATION SYSTEM UTILIZING PTFE MEMBRANE FILTERS • TWO (2) 0.043 INCH DIAMETER ORIFICE NOZZLES FOR EACH 32 INCH DIAMETER GUTTER BROOM • ONE (1) 0.063 INCH DIAMETER ORIFICE NOZZLES FOR EACH 32 INCH DIAMETER GUTTER BROOM • ONE (1) 0.063 INCH DIAMETER ORIFICE NOZZLE LOCATED IN THE HOPPER • WATER PUMP WITH A MINIMUM SYSTEM RELIEF VALVE SET AT 25 POUNDS PER SQUARE INCH.

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
TYMCO	DST - 6	• CYCLONIC, MULTIPASS, CENTRIFUGAL SEPARATION • SELF CONTAINED MULTIPLE FILTRATION SYSTEM UTILIZING PTFE MEMBRANE FILTERS • THREE (3) 0.063 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • TWO (2) 0.043 INCH DIAMETER ORIFICE NOZZLES FOR EACH GUTTER BROOM • ONE (1) 0.094 INCH DIAMETER ORIFICE NOZZLE LOCATED IN THE HOPPER • TWO (2) [MINIMUM] HOPPER BAFFLE CURTAINS • WATER PUMP WITH A MINIMUM SYSTEM RELIEF VALVE SET AT 25 POUNDS PER SQUARE INCH
VACALL	VS10/10D, VF10 VS13/13D, VF13 VS14/14D, VF14 VS16/16D, VF16 VS20/20D, VF20	• FOUR (4) 0.062 INCH DIAMETER ORIFICE NOZZLES LOCATED IN FRONT OF EACH 36 INCH GUTTER BROOM • FOUR (4) 0.062 INCH DIAMETER ORIFICE NOZZLES LOCATED IN FRONT OF THE TRANSFER BROOM • TEN (10) 0.125 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE THE PICK UP HEAD • SIX (6) 0.181 INCH DIAMETER ORIFICE NOZZLES LOCATED INSIDE THE SCRUBBER COLLAR OF THE PICK UP HEAD • 48 INCH POWER VACUUM NOZZLE • MINIMUM 300 GALLON GRAVITY FEED WATER SUPPLY SYSTEM WITH WATER CONTINOUSLY SUPPLIED TO ALL NOZZLES • LOW VELOCITY DUST COLLECTION AIR CHAMBER • MINIMUM OF SIX (6) EXPANDED METAL SCREENS

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MAKE*	MODEL*	DUST CONTROL SYSTEMS*
WAYNE SWEEPERS	GLADIATOR	• THREE (3) 0.0925 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • SIX (6) 0.0925 INCH DIAMETER ORIFICE NOZZLES ACROSS FRONT BUMPER • FOUR (4) 0.0925 INCH DIAMETER ORIFICE NOZZLES AT THE REAR BROOM • WATER PUMP TO PROVIDE 60 POUNDS PER SQUARE INCH WATER PRESSURE
WAYNE SWEEPERS	WARRIOR	• THREE (3) 0.0925 INCH DIAMETER ORIFICE NOZZLES LOCATED AT EACH SIDE BROOM • SIX (6) 0.0925 INCH DIAMETER ORIFICE NOZZLES ACROSS FRONT BUMPER • WATER PUMP TO PROVIDE 60 POUNDS PER SQUARE INCH WATER PRESSURE

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APPENDIX F

BLANK EMISSIONS CALCULATION SHEETS

Unpaved Road Dust Suppression

	PM10 Emissions Factor (kg/mile)
Urban Unpaved	0.36
Rural Unpaved	0.7073

	Control Efficiency	Number of Days Effective
Water	50%	
Chemical Stabilizers	70%	

Daily Emissions Reductions

Road Name	Emissions Factor (kg/Mile)	X	Control Efficiency	X	Average Daily Traffic	X	Length of segment (miles)	=	Daily PM10 Emissions Reductions (kg/day)
		X		X		X		=	

Number of Days with Emissions Reductions

Number of Days Effective per Application	X	Number of Applications per Year	=	Number of Days with Emissions Reductions (days/year)
	X		=	

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days with Emissions Reductions (days/year)	=	Annual PM10 Emissions Reductions (Kg/Year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (Kg/Year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
	÷		÷		=	

Construction Dust Suppression

	PM10 Emissions Factor (kg/mile)
Topsoil Removal	9
Earthmoving	1.95
Truck Haulage	4.54

	Control Efficiency	Number of Days Effective
Water	50%	
Chemical Stabilizers	70%	

Daily Emissions Reductions

Road Name	Emissions Factor (kg/Mile)	X	Control Efficiency	X	Average Daily Traffic	X	Length of segment (miles)	=	Daily PM10 Emissions Reductions (kg/day)
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	

Number of Days with Emissions Reductions

Number of Days Effective per Application	X	Number of Applications per Year	=	Number of Days with Emissions Reductions (days/year)
	X		=	

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days with Emissions Reductions (days/year)	=	Annual PM10 Emissions Reductions (Kg/Year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (Kg/Year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
	÷		÷		=	

Paving Unpaved Roads or Alleys

Difference in Emissions Factors

	Emissions Factor Unpaved (g/mile)	-	Emissions Factor Paved (g/mile)	=	Difference in Emissions Factors (g/mile)
Road	660.16	-	1.47	=	658.69
Alley	417.45	-	1.47	=	415.98

Daily PM10 Emissions Reductions

Road Name	Difference in Emissions Factors (g/Mile)	X	Length of segment (miles)	X	Average Daily Traffic	X	Factor to convert from weekday to AADT on arterials	=	Emissions Reductions (kg/day)
		X		X		X	0.93	=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
							Total Daily Emissions Reductions		

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year (days/year)	=	Annual PM10 Emissions Reductions (kg/year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
	÷		÷		=	

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

Reduction Factor (RF) (g/vmt)

	Low volume arterials (<10,000 ADT)		High volume arterials (>=10,000 ADT)
If paving shoulders and providing C&G on both sides of the road	0.76		0.53
If paving shoulders on both sides of the road without C&G	0.57		0.4
If paving shoulders and providing C&G on one side of the road	0.38		0.27
If paving shoulders on one side of the road without C&G	0.29		0.2
If providing C&G on both sides of a road with paved shoulders	0.19		0.14
If providing C&G on one side of a road with paved shoulders	0.1		0.07

PM10 Daily Emissions Reductions

Project Name	RF	X	Average Daily Traffic	X	Length of segment (miles)	X	Factor to convert from weekday to AADT on arterials	=	Emissions Reductions (kg/day)
		X		X		X	0.93	=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
							Total Daily Emissions Reductions		

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year (days/year)	=	Annual PM10 Emissions Reductions (Kg/Year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
	÷		÷		=	

Paved Road Baseline Emissions

Emissions Factor: Eext = [k (sL)0.91 x (W)1.02] (1 – P/4N)

Particle Size	Particle Size Multiplier (k) (g/VMT)	Road Surface Silt Loading (sL) (g/m^3)	Average Weight of Vehicles (W) (ton)	Number of Wet Days (P) (>=0.254 mm)	Number of Days in Averaging Period (N)	Emission Factor (E_{ext})
PM10	1	0.105	3	45	365	

Annual PM10 Emissions Reduction

Road Name	Roadway VMT_{Annual}	X	Emission Factor (E_{ext})	=	Annual Emissions Reduction (kg/year)
		X		=	
		X		=	
		X		=	
		X		=	
		X		=	
		X		=	
			Total Daily Emissions Reductions		

Paved Road Sweeping

Particle Size	Emission Factor (E_{ext})
PM10	

Control Measure	
Sweeping Alone	16 - 50%
Flusher Truck	30 - 70%
Combined	35 - 90%

PM10 Emissions Reductions Over Entire Network

Road Name	Emissions Factor (kg/mile)	X	Control Efficiency	X	Average Daily Traffic	X	Lane Miles to be Cleaned (miles)	=	Emissions Reductions (kg/day)
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
							Emissions Reductions Over Entire Network		
							Total Lane Miles to be Cleaned		

Percent of Total Lane Miles to Be Cleaned per Day

Lane Miles Cleaned per Day	÷	Total Lane Miles to Be Cleaned	=	Percent of Total Lane Miles to Be Cleaned per Day
	÷		=	

Daily Emissions Reductions

PM10 Emissions Reductions Over Entire Network (kg)	X	Percent of Total Lane Miles to Be Cleaned per Day	=	Daily PM10 Emissions Reductions (kg/day)
	X		=	

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year that Roads are Cleaned (days/year)	=	Annual PM10 Emissions Reductions (kg/year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (Kg/Year)	=	Cost Effectiveness ($/Kg)
	÷		÷		=	

Water Trucks

	PM10 Emissions Factor (kg/mile)
Urban Unpaved	0.36
Rural Unpaved	0.7073

	Control Efficiency
Flusher Truck	35%

Daily Emissions Reductions

Road Name	Emissions Factor (kg/Mile)	X	Control Efficiency	X	Average Daily Traffic	X	Total Miles to be Cleaned	=	Daily PM10 Emissions Reductions (kg/day)
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
							Total Daily Emissions Reductions		
							Total Lane Miles to be Cleaned		

Percent of Total Lane Miles to Be Cleaned per Day

Lane Miles Cleaned per Day	÷	Total Lane Miles to Be Cleaned	=	Percent of Total Lane Miles to Be Cleaned per Day
	÷		=	

Daily Emissions Reductions

PM10 Reductions Over Entire Network (kg)	X	Percent of Total Lane Miles to Be Cleaned per Day	=	Daily PM10 Emissions Reductions (Kg/Day)
	X		=	

Annual Emissions Reductions

Daily PM10 Emissions Reductions (Kg/Day)	X	Number of Days Roads are Cleaned (days/year)	=	Annual PM10 Emissions Reductions (Kg/Year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost	÷	Life of Project (suggest 8 yrs)	÷	Annual PM10 Emissions Reductions (Kg/Year)	=	Cost Effectiveness ($/Kg)
	÷		÷		=	

Bicycle and Pedestrian

Particle Size	Emission Factor (E_{ext})
PM10	

Single Occupancy Vehicle (SOV) Miles Replaced ** NOTE: For Average Trip Length use local data, or 1.8 as default

Expected Average Daily Bike Traffic	÷	Average Auto Occupancy	X	Average Trip Length (miles/trip)	=	Daily SOV Miles Replaced (miles/day)
	÷		X		=	

Daily Emissions Reductions (SOV Vehicle Emissions Saved)

Daily SOV Miles Replaced (miles/day)	X	PM10 Emissions Factor (kg/mile)	=	Daily PM10 Emissions Reductions (kg/day)
	X		=	

Annual Emissions Reductions

Daily PM10 Emissions Reductions (kg/day)	X	Number of Days per Year (days/year)	=	Annual PM10 Emissions Reductions (kg/year)	X	Emission Factor Used for PM2.5 Contribution	=	Annual PM2.5 Emissions Reductions (kg/year)
	X		=		X		=	

Cost/Benefit Analysis

Total Project Cost ($)	÷	Life of Project (year)	÷	Annual Emissions Reductions (kg/year)	=	Cost Effectiveness ($/kg)
	÷		÷		=	

Diesel Retrofits

Must be on verified list from the EPA website http://epa.gov/cleandiesel/verification/verif-list.htm

Manufacturer	Technology	Is it Made in the USA	EPA Estimated Emissions Reductions (%) Enter as .xx				Total Cost	Year of Equiptment Being Replaced	Year of New Equiptment Being Purchased	Quantity	VMT per Year	Fuel Type	Fuel Use (gallon/year)
			PM	NOx	HC	CO							

The EPA Diesel Emission Quantifier Tool will be used to estimate emissions reductions http://epa.gov/cleandiesel/quantifier/deq-checklist.htm

	Quantifier Results
Capital Cost Effectiveness ($/short ton), Retrofitted Vehicles (PM2.5)	
Amount Reduced per Year(PM2.5, short tons)	

Other pollutants optional

Project Summary Sheet for Project Selection Team

Project Name	Cost Effectiveness ($/kg)	Annual PM2.5 Emissions Reductions (Kg/Year)	Annual PM10 Emissions Reductions (Kg/Year)	CMAQ Funds Requested	Local Match Funds	Total Project Evaluation Score