

# 1. INTRODUCTION

## BACKGROUND

Maricopa County is the most populous county in Arizona, home to approximately 60 percent of the state's residents. More than three million people currently reside in the cities of Phoenix, Mesa, Glendale, Scottsdale, Tempe, and Chandler, 18 smaller municipalities, two Indian communities, and the unincorporated areas of the county. Maricopa County spans nearly 9,300 square miles, most of which is vacant undisturbed desert.

Over the last two decades, the county has grown at an average annual rate of about 4 percent, and is one of the fastest growing areas of the country. Residents and jobs have more than doubled in 20 years, and daily vehicle travel has nearly tripled over this period. This rapid growth in population has also been accompanied by unprecedented levels of residential construction. Both the increased vehicle mileage and the construction activity have contributed to levels of particulate matter and other air pollutants that have periodically exceeded the National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency (EPA).

### Nonattainment Area

The urbanized portion of Maricopa County was designated a moderate nonattainment area for particulate matter less than 10 microns in diameter (PM<sub>10</sub>) by the 1990 Clean Air Act Amendments. Between 1991 and 1996, several revisions of a PM<sub>10</sub> plan for this area were submitted to the EPA. In May 1997 the Arizona Department of Environmental Quality (ADEQ) submitted a 24-hour PM<sub>10</sub> plan to EPA. After a number of lawsuits, EPA did not approve parts of the ADEQ Plan and promulgated a PM<sub>10</sub> Federal Implementation Plan on July 18, 1998. Due to a failure to attain the NAAQS by the end of 1994, the Maricopa County PM<sub>10</sub> nonattainment area was redesignated to "Serious" in 1996, with a new attainment date of December 31, 2001.<sup>[1]</sup>

In February 2000, the Maricopa Association of Governments (MAG) submitted a "Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area" (Serious Area PM<sub>10</sub> Plan) to EPA. The Serious Area PM<sub>10</sub> Plan shows that attainment of the PM<sub>10</sub> standards by 2001 is infeasible and requests a five-year extension, as allowed in the Clean Air Act. The plan demonstrates attainment of the PM<sub>10</sub> standards by December 31, 2006, based on implementation of 77 control measures. The plan indicates that the largest share (38 percent) of PM<sub>10</sub> emissions in 1995 was caused by construction and earthmoving activities.<sup>[2]</sup>

### Maricopa County Rule 310

Maricopa County Rules 310 and 310.01, the county's comprehensive fugitive dust control rules, are the cornerstone of the Serious Area PM<sub>10</sub> Plan. Eighty percent of the reduction in emissions necessary to attain the standards by 2006 is due to the strengthening and increased enforcement of Rules 310 and 310.01.

Rules 310 and 310.01 were enacted by the Maricopa County Board of Supervisors in 2000 to limit the emission of particulate matter from property, operations or activities that may serve as a source of fugitive dust. These rules mandate the use of measures to mitigate the generation of fugitive dust, specifically PM<sub>10</sub>. Rule 310.01 addresses activities that do not require a permit, such as unpaved roads, unpaved parking lots, and vacant disturbed areas. Rule 310 requires that a permit be obtained prior to undertaking any earthmoving activity that disturbs more than one-tenth of an acre. Rule 310 further requires that persons or entities engaged in earthmoving activities keep accurate records of the measures used to prevent or reduce fugitive dust. Rule 310 is enforced by county inspectors and violations can result in monetary penalties. A detailed discussion of the control measures contained in Rule 310 that address construction sources is included in chapter 6.

### **The Governor's Brown Cloud Summit**

In 2000, Governor Hull appointed community, industrial and public leaders to study the highly visible "brown cloud" in the Phoenix metropolitan area. The Governor's Brown Cloud Summit met from March 15, 2000 until January 16, 2001. A table of the summit's recommended measures for mitigating the brown cloud is presented in chapter 5. A review of ADEQ data showed that visibility in the Valley declined between 1994 and 1998, despite improvements in some of the invisible air pollutants (i.e., Carbon monoxide and ozone) during the same period. The summit devised a visibility measure called "Blue Sky Days." A "Blue Sky Day" is defined as one in which the visibility is at least 25 miles during six hours or more.<sup>[3]</sup>

A key recommendation of the Governor's summit was to:

*...develop and implement a standardized dust control certification program for construction companies and other stakeholders in Maricopa County to enhance compliance with Maricopa County Rule 310. Participation in the training and certification would be required for a construction company to obtain a county permit.*

Prior to the release of the summit's findings, the Arizona Department of Transportation (ADOT) had already committed resources and was working with Maricopa County and Arizona State University to develop dust control educational materials, (Dust Devil Academy Manual) and sponsor a construction dust workshop. The latter was held on September 18, 2000. ADOT also participated actively in summit meetings. A major objective of this research project has been to develop a dust control training and certification program for the construction industry in Maricopa County, as recommended by the Governor's Brown Cloud Summit.

## REPORT ORGANIZATION

The report consists of two sections: In section one, chapter 1 establishes the context in which the project has been conducted, and chapters 2 and 3 explain the development of the outreach, training, and certification programs and recommend procedures for implementation. Chapters in section two detail the findings of the early tasks, such as the documentation of pollutants and mitigation practices, as well as the text of the training modules developed near the conclusion of the project.

## RESEARCH OBJECTIVES

ADOT sponsored this research on PM<sub>10</sub> educational tools and outreach in order to assist affected jurisdictions in the nonattainment area in meeting the Federal air quality standards. Construction activity is a significant source of the fugitive dust contributing to PM<sub>10</sub> violations in Maricopa County. Although the county has hired inspectors and attorneys to enforce Rule 310, a need still exists to increase industry awareness of the provisions of the rule and provide tools to assist construction workers in reducing fugitive dust and improving ambient air quality in the region.

At the outset of the project, a Technical Advisory Committee (TAC) composed of key individuals from Federal, State, county and local agencies and the private sector was assembled. The TAC reviewed and commented on the technical memoranda, the training modules and other components of the training and certification program, and other products developed by the project team during the course of the project. The members of the TAC are listed in Table 1.

**TABLE 1. TECHNICAL ADVISORY COMMITTEE**

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Kelly McMullen, Maricopa County Department of Transportation
Estomih Kombe, ADOT Arizona Transportation Research Center
Christine Zielonka, City of Mesa Environmental Programs
Richard Polito, Program Manager Maricopa County Small Business Environmental Assistance Program
Jo Crumbaker, Maricopa County Environmental Services
Ed Stillings, Federal Highways Administration (FHWA)
Pat Cupell, ADOT
Johnnie Mata, Markham Contracting
Jeff Lange, Kitchell Contracting

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The objectives of this project have been:

- To identify, evaluate, and develop a standardized educational and outreach dust mitigation certification program for construction contractors and other stakeholders.
- To build upon work already done by ADOT and Maricopa County, such as the Dust Devil Academy Manual and the Paradise Valley Community College (PVCC) course summarized in chapter 8 of this report.<sup>[4,5]</sup>
- To solicit ideas from real-world practitioners including contractors, employees, and construction experts, concerning the most feasible and effective dust mitigation practices.
- To investigate practices employed in other PM<sub>10</sub> nonattainment areas.
- To explore new forums for communicating the dust mitigation practices and certification program to a larger audience, emulating Occupational Safety and Health Administration (OSHA) courses, and utilizing audiovisual tapes and other electronic media, including compact discs and Web sites.
- To create an effective outreach, training, and certification program targeting the construction industry in the Maricopa County nonattainment Area.
- To develop a plan for implementing the program.

Subsequent to the initiation of the project, an additional objective—that of developing ongoing measures of effectiveness for the program—was added.

## **SUMMARY OF AIRBORNE POLLUTANTS**

This section provides a brief overview of airborne pollutants, and summarizes the processes of monitoring and evaluating the effects of particulate matter. Particulate matter and other airborne pollutants and the findings of the monitoring procedures are described in detail in chapter 5. Carbon monoxide (CO), ozone and particulates are the three criteria pollutants for which Maricopa County is currently designated a nonattainment area. Since the focus of the ADOT research is reducing fugitive dust, this report includes a more detailed discussion of the sources and control measures associated with PM<sub>10</sub>.

CO is a colorless, odorless, and tasteless gas produced by the incomplete combustion of carbon in fossil fuels. Most carbon monoxide is emitted in the tailpipe exhaust of vehicles traveling on roads, with a smaller contribution from nonroad engines, such as construction equipment, trains, and airplanes. CO emissions are also a byproduct of commercial and residential heating. Ozone in the upper atmosphere occurs naturally and protects life on the earth's surface from harmful ultraviolet radiation. In contrast, ground-level ozone is a poisonous, pungent-smelling gas. Ozone is not emitted by any source, but is formed by the photochemical reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO<sub>x</sub>) in the presence of sunlight. Onroad vehicles and nonroad engines are major sources of the ozone precursors, VOC and NO<sub>x</sub> emissions.

Prolonged exposure to high levels of either CO or ozone can cause or aggravate serious health problems, including cardiovascular and respiratory diseases. As a result of measures such as tighter Federal standards for new car emission controls, an enhanced vehicle-emissions inspection program, and seasonal adjustments in fuel formulas, CO and ozone concentrations have declined since the 1980s.

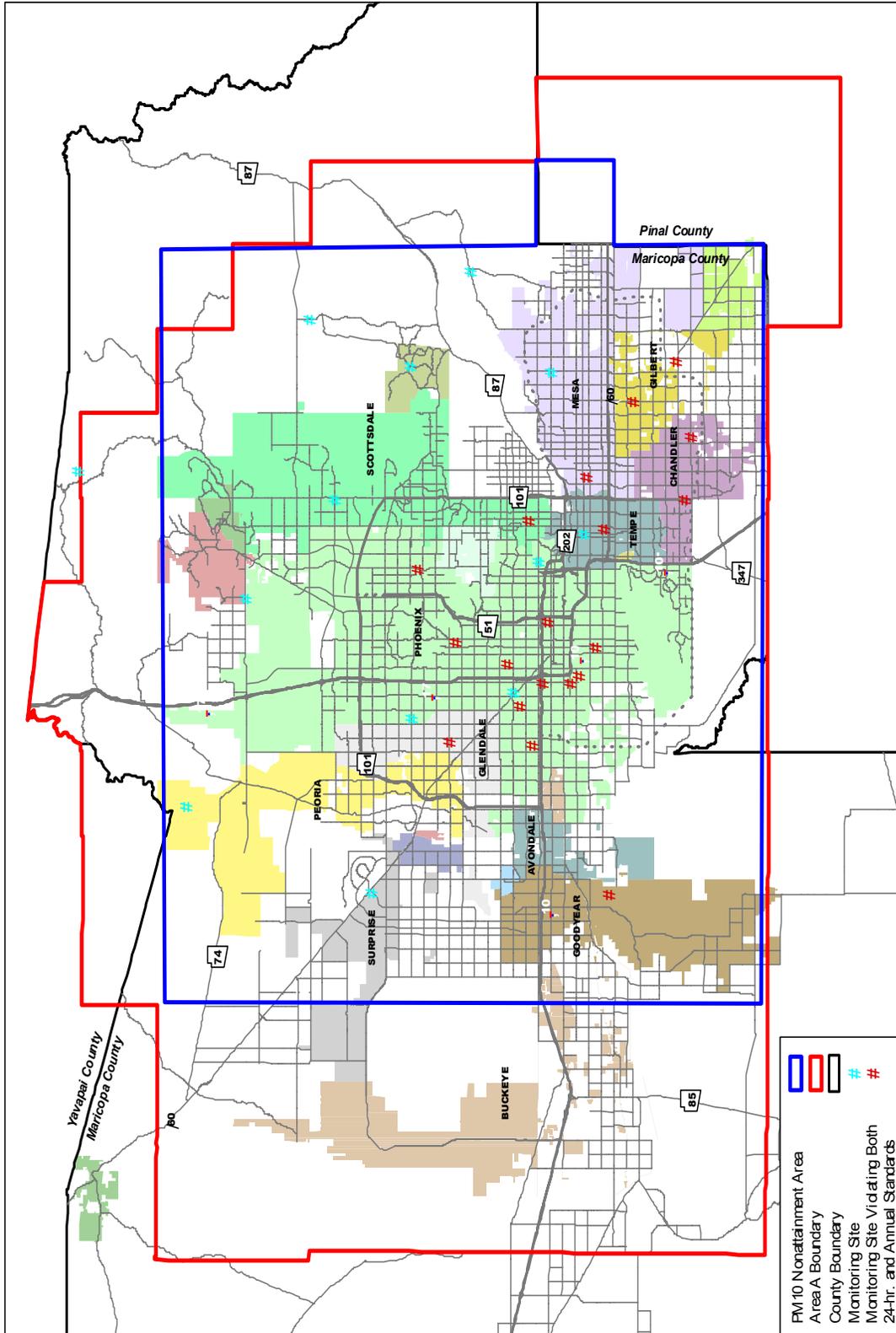
### **Particulate Matter Defined**

Particulates are solid particles and liquid droplets that are small enough to remain airborne, such as dust, soil, and soot. The Federal standards address two sizes of particulates: coarse particulates and fine particulates. The origin of coarse particulates (between 2.5 and 10 microns in diameter) is generally geologic, including reentrained dust from paved and unpaved roads and soil disturbed by earthmoving and construction activities. These are referred to as PM<sub>10</sub>. The finer particulates (less than 2.5 microns in diameter) are usually emitted by combustion sources or formed by gases. These are referred to as PM<sub>2.5</sub>. These particles can be inhaled into the lungs where they decrease breathing efficiency and increase the occurrence of asthma and other lower and upper respiratory ailments. Particulate pollution has been ranked as one of the highest environmental risks in the state by the Arizona Comparative Environmental Risk Project<sup>[6]</sup>, a project initiated by Governor Symington in 1993 to determine the State's most serious environmental problems.

### **Monitoring and Evaluating Particulate Matter**

To comply with the 1990 Clean Air Act Amendments, the Arizona Legislature has enacted a number of air quality measures that apply to the urbanized portion of Maricopa County (referred to as “Area A”). These measures include provisions for the inspection and maintenance of vehicles, the seasonal sale of oxygenated fuels, and the establishment of “no burn” days where use of fireplaces and woodburning stoves is limited based on monitored levels of air pollutants. Over time, and in reflection of the metropolitan Phoenix area’s rapid growth during the decade of the 1990s, Area A has been expanded to include the outlying communities of Buckeye and Surprise on the west, as well as a small portion of adjoining Pinal County on the southeast. An array of monitoring sites was established throughout the urbanized area to measure the levels of PM<sub>10</sub>. Data obtained from these monitors facilitates the evaluation of PM<sub>10</sub> levels that exceed the NAAQS established by the EPA; where and why these high levels occur; and how they relate to the season, the weather, and area construction or industrial activities.

Two national standards exist for PM<sub>10</sub>: a 24-hour standard and an annual standard. An exceedance of the 24-hour standard is defined as a monitored daily value greater than 150 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). An exceedance of the annual PM<sub>10</sub> standard occurs when the annual average concentration at a monitor exceeds  $50 \mu\text{g}/\text{m}^3$ . A detailed discussion of the standards and factors contributing to concentrations of particulates exceeding the standards is presented in chapter 5. The current boundary of Area A and the locations of PM<sub>10</sub> monitors are shown in figure 1.



**FIGURE 1. AREA BOUNDARIES AND PM<sub>10</sub> MONITORING SITE LOCATIONS**

## **PM<sub>10</sub> Designations and Plans**

The boundaries of the PM<sub>10</sub> nonattainment area in Maricopa County are also illustrated in figure 1. MAG submitted to the EPA a “Moderate Area PM<sub>10</sub> Plan”<sup>[2]</sup> for this nearly 3,000 square mile area to EPA in 1991 and revisions to this plan, in 1993 and 1994. The area was reclassified from “Moderate” to “Serious” in June 1996 due to a failure to attain the standards by December 31, 1994. Since then, a series of revisions and legal challenges have occurred. The cumulative effect has been to emphasize the seriousness of the area’s air quality conditions, particularly with respect to particulate matter, and the heightened importance of educating the public and target industries in order to attain the NAAQS standards by December 2006, the current deadline.

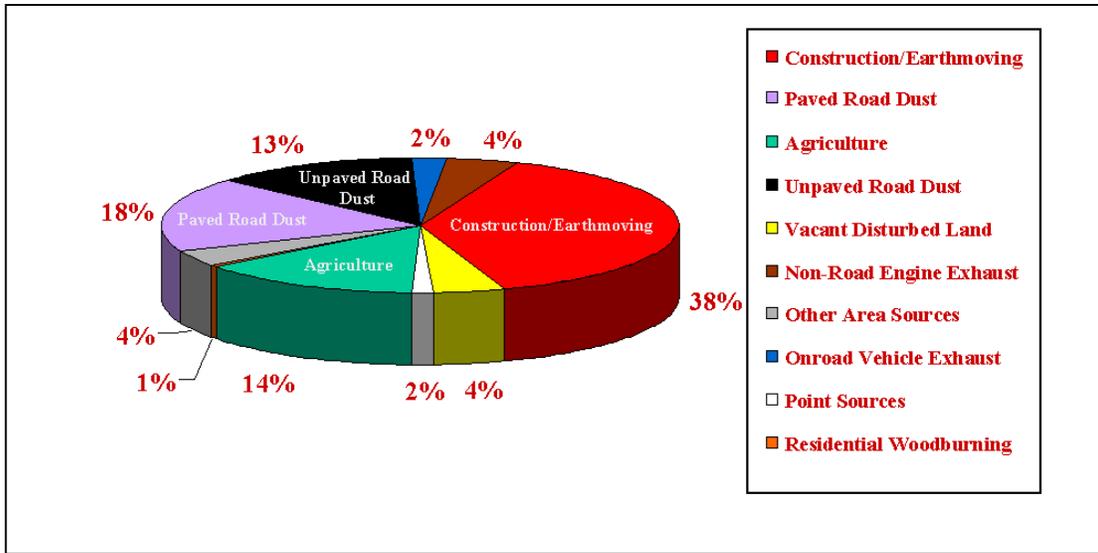
## **PM<sub>10</sub> Sources**

The apportionment of annual PM<sub>10</sub> emissions among sources in the Maricopa County nonattainment area in 1995 is illustrated in figure 2.<sup>[2,6]</sup> On an average annual basis, construction and earthmoving activities contribute the largest share of emissions at 38 percent. The next most significant source, contributing 18 percent, is reentrainment of dust by vehicles traveling on paved roads. Agricultural operations create 14 percent of the PM<sub>10</sub> emissions, and unpaved roads another 13 percent. Other source categories each contribute less than 5 percent of the emissions. Note that onroad vehicle exhaust is responsible for just 2 percent of PM<sub>10</sub> emissions.

## **PM<sub>10</sub> Control Measures**

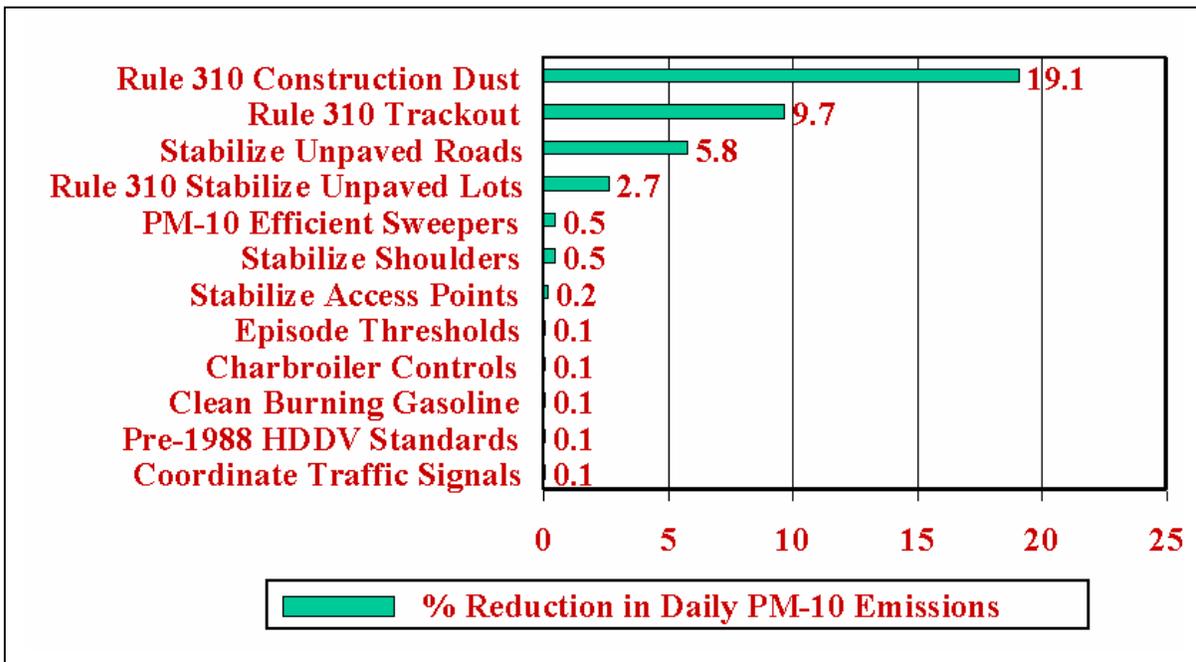
The MAG Serious Area PM<sub>10</sub> Plan contains 77 control measures that reflect legally binding commitments by the State, county, cities, towns, MAG, and ADOT to reduce PM<sub>10</sub>. Emission reduction credit for 12 measures was quantified in the plan; the PM<sub>10</sub> emission reductions attributable to each of these measures are shown in figure 3. In combination, these 12 measures will effect a 39 percent reduction in PM<sub>10</sub> emissions by December 31, 2006. The single most effective control measure in the plan is the strengthening and better enforcement of fugitive dust controls (i.e., Maricopa County Rules 310 and 310.01).

As shown in figure 3, strengthening and increased enforcement of Rules 310 and 310.01 will reduce dust from construction, vehicle “trackout,” and unpaved lots. (Vehicle trackout is mud and dirt that escapes a construction site on construction vehicles) Together, these reductions represent 80 percent of the total reductions in the plan. While construction and earthmoving activities are the largest source of PM<sub>10</sub> emissions, they are also the source of the largest reductions in the plan. As a result of the strengthening and better enforcement of Rule 310 on construction sites, PM<sub>10</sub> emissions are expected to decline by 19 percent, almost half of the total reduction required to show attainment of the annual PM<sub>10</sub> standard by December 31, 2006. Making dust suppression a standard practice on and around construction sites is essential to attain and maintain the PM<sub>10</sub> standards in Maricopa County’s urbanized desert environment.



**FIGURE 2. SOURCES OF PM<sub>10</sub> IN MARICOPA COUNTY**

Source: Maricopa Association of Governments, *Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area, 2000.*<sup>[2]</sup>



**FIGURE 3. ANTICIPATED 2006 PM<sub>10</sub> EMISSION REDUCTIONS FROM COMMITTED CONTROL MEASURES**

Source: Maricopa Association of Governments, *Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area, 2000.*<sup>[2]</sup>

## **MITIGATION PRACTICES AND DUST PALLIATIVES**

The scope of the project included researching the mitigation practices—including dust palliative use—of peer jurisdictions, as these practices relate to outreach efforts conducted by the jurisdictions. This section introduces mitigation practices that peer jurisdictions are employing to control fugitive dust. The practices themselves are summarized in further detail in chapter 6. The second section summarizes the application of dust palliatives, a topic described in detail in chapter 7.

### **Mitigation Practices**

Maricopa County enacted the latest revisions to Rule 310 in February 2000 to address EPA comments made during their review of the MAG Serious Area PM<sub>10</sub> Plan for the Maricopa County nonattainment area. Rule 310 requires that dust control plans be submitted by contractors and approved by the county prior to the initiation of earthmoving activities that will disturb more than one-tenth of an acre. This rule also requires that such dust control plans, once approved, be closely followed during the conduct of the dust-generating activity and provides penalties for failure to comply.

#### ***Mitigation Practices Mandated by Maricopa County Rule 310***

Maricopa County Rule 310 contains control measures and requires that a dust control plan be submitted for earthmoving operations that disturb one-tenth of an acre or more. Table 2 summarizes the provisions of Rule 310 and 310.01. Chapter 6 details the dust control requirements of the rule, emphasizing those sections pertaining to construction-related activities. A table contained in chapter 6 lists dust generating activities and accompanying control measures required by the rule.

#### ***Control Measures of Other Entities***

Chapter 6 also summarizes control measures of the following entities:

- Maricopa County Flood Control District (MCFCD)
- MAG
- Clark County, Nevada
- Coachella Valley, California

## **PERSONS INTERVIEWED DURING PROJECT RESEARCH**

During the conduct of the project, the consultant team benefited from the input and assistance of a number of individuals, including the advice and oversight of Estomih Kombe of the ATRC, and Patrick Cupell from ADOT.

**TABLE 2. SUMMARY OF RULE 310 AND 310.01 CONTROL MEASURES**

Source Type	Summary of Control Measures
Vehicle Use In Open Areas And Vacant Lots:	Restrict trespass by installing signs, or install physical barriers such as curbs, fences, gates, posts, signs, shrubs, and/or trees to prevent access to the area.
Unpaved Parking Lots:	Pave, apply and maintain gravel or other suitable material, or apply a suitable dust suppressant.
Unpaved Haul/Access Roads:	Limit vehicle speed to 15 miles per hour or less and limit vehicular trips to no more than 20 per day, apply water, so that the surface is visibly moist, pave, apply and maintain gravel or other suitable material, or apply a suitable dust suppressant.
Disturbed Surface Areas - Preactivity:	Prewater site to the depth of cuts, or phase work to reduce the amount of disturbed surface areas at any one time.
Disturbed Surface Areas - During Dust Generating Operations:	Apply water or dust suppressant, as necessary to maintain a soil moisture content at a minimum of 12 percent. Construct fences or 3-foot to 5-foot high wind barriers with 50 percent or less porosity adjacent to roadways or urban areas that reduce the amount of wind blown material leaving a site.
Temporary Stabilization During Weekends, After Work Hours, And On Holidays:	Apply a suitable dust suppressant, establish vegetative ground cover, and/or restrict vehicular access to the area.
Onsite Hauling/Transporting Within The Boundaries Of The Worksite	Load all haul trucks such that the freeboard is not less than 3 inches when crossing a public roadway. Prevent spillage or loss of bulk material from the truck. Install a suitable trackout control device that controls and prevents trackout and/or removes particulate matter from tires and the exterior surfaces of haul trucks and/or motor vehicles that traverse such work site. Limit vehicular speeds to 15 miles per hour or less. Apply water to the top of the load, or cover haul trucks with a tarp or other suitable closure.
Off-Site Hauling/Transporting Onto Paved Public Roadways:	Cover haul trucks with a tarp or other suitable closure, and load all haul trucks such that the freeboard is not less than 3 inches. Prevent spillage or loss of bulk material from the truck, and clean all emptied trucks before they leave the site.
Cleanup Of Spillage, Carry Out, Erosion, And/Or Trackout:	Clean up with a street sweeper, wet broom, or by hand. Spillage or trackout areas more than 50 feet long must be cleaned up immediately
Trackout:	Pave the first 100 feet of a site access road to a width of at least 20 feet. For disturbed surfaces of 5 acres or more, install a grizzly, wheel wash system, or gravel pad at all access points.

Source: Maricopa County Rule 310

The project team maintained a continuous dialogue with TAC members and other key stakeholders throughout the course of the study. Team members also interviewed contractors, employees, and construction experts to solicit ideas on dust mitigation practices and training approaches. Tables 3 and 4 are partial lists of the many other persons who were interviewed and who contributed information and input.

**TABLE 3. PERSONS INTERVIEWED ABOUT MITIGATION PRACTICES**

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Marty Koether, Managing Partner  
EarthCare Consultants, LLC.

Mike Laybourn, Planning, Transportation, and Information Management  
South Coast Air Quality Management District

Eric R. Mayer, Civil Engineering Technician  
Maricopa County Department of Transportation

Jo Crumbaker, Environmental Services  
Maricopa County

Robert Vitale, President  
Midwest Industrial Supply, Inc.

Rick Polito, Program Manager  
Maricopa County Small Business Environmental Assistance Program

Robert R. Treloar, MT, REP, CET  
Director of Training, Environmental Health and Safety Technology Program  
Paradise Valley Community College

Gaye Knight, Environmental Programs Specialist  
City of Phoenix

Karene Gottfried, Administrative Assistant  
Airmetrics

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**TABLE 4. PERSONS CONTACTED ABOUT OUTREACH ISSUES**

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Mark Minter, Executive Director  
Arizona Builders Alliance

Connie Wilhelm, Executive Director  
Home Builders Association of Central Arizona

Kurt Maurer, Communications Director  
Arizona Department of Environmental Quality

Bob Evans  
Maricopa County Environmental Services Department (MCESD)

Brent Jones  
Arizona Contractors Association

David M. Martin, President, Arizona Chapter  
Associated General Contractors

Lewis Wallenmeyer, Enforcement Supervisor  
Clark County Department of Air Quality Management

Robert Farrell, Environmental Engineer  
Pinal County Air Quality Department

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