

Mechanically-generated Particulate Matter— Causes and Cures

Greg Johnson

Leader, National Air Quality & Atmospheric Change Team

Johnnie Siliznoff

California NRCS Air Quality Specialist



Overview

- Quick overview of PM resource concern and PM basics (types, sizes, sources)
- What is mechanically-generated PM and its characteristics?
- Typical sources and emission characteristics
- Where and why is it an issue (incl. regulations, transport, scale, etc.)
- Mitigation options (NRCS practices, others)
- A NRCS PM₁₀ mitigation success story



Air as a Resource

- We are a conservation agency for natural resources
 - Air is the first “A” in SWAPA + H
- Air Quality was one of the original drivers for the creation of our agency
- We must protect this resource—it can be quickly renewed, but also can quickly deteriorate in quality
- Health effects are a major concern



AQ Resource Concerns

- Emissions of Particulate Matter (PM) and PM Precursors
- Emissions of Ozone (O₃) Precursors
- Objectionable Odors
- Emissions of Greenhouse Gases (GHG)



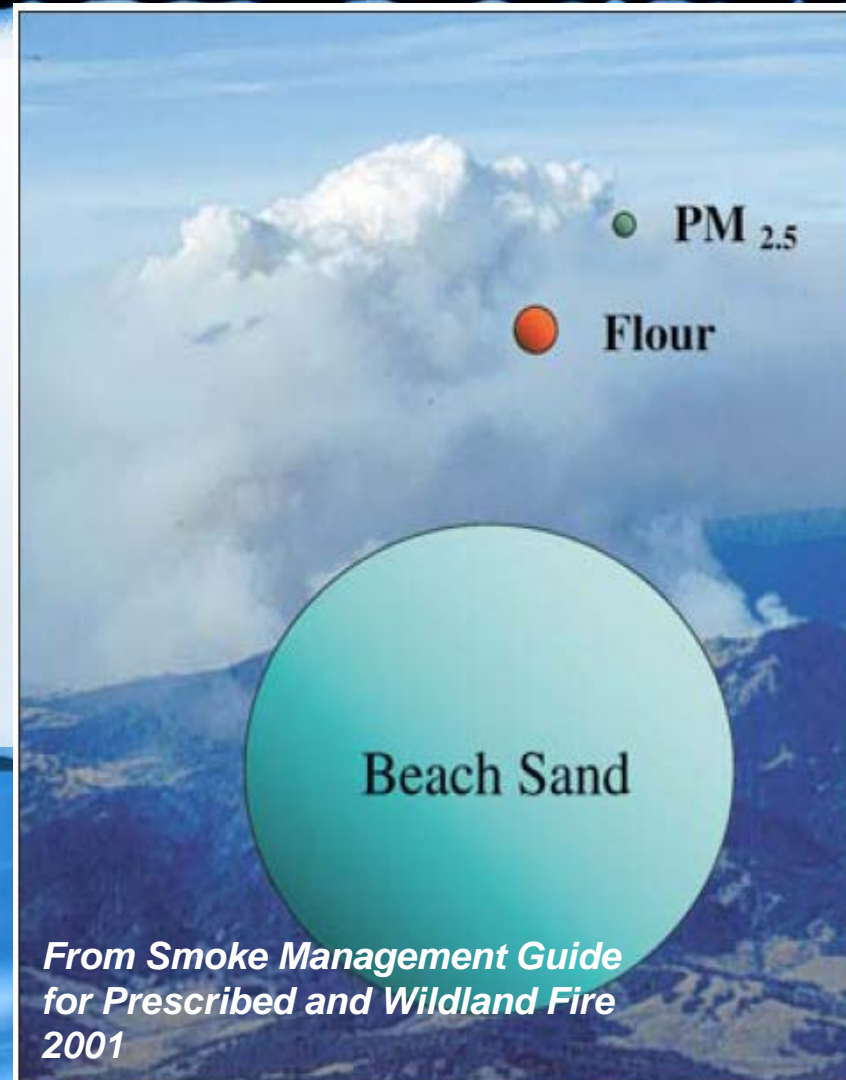
What is Particulate Matter?

Solid or liquid particles suspended in the atmosphere, and especially when considered as an atmospheric pollutant
sometimes the term 'aerosol' also is used



Classes of Particulate Matter (PM)

- How is particulate matter categorized?
 - By its size
- What are the categories of PM?
 - Fine PM (i.e. PM_{2.5})
 - Inhalable Coarse PM (i.e. PM₁₀)
 - Larger PM

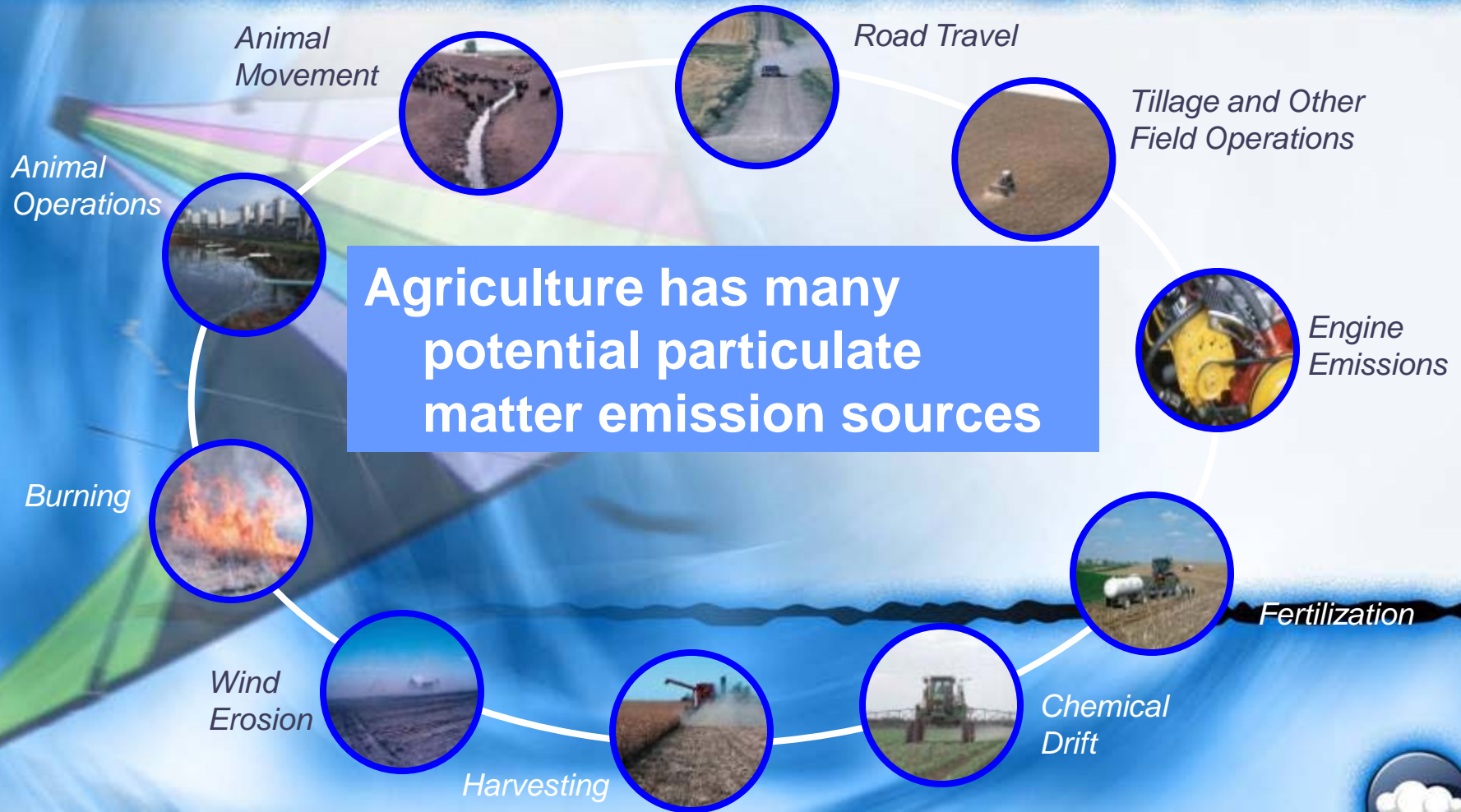


PM Size Characteristics

- **PM_{2.5}**
 - Directly emitted (Primary)
 - mostly through combustion processes, and
 - to a smaller degree by mechanical means (e.g. dust)
 - Also can be formed by chemical reaction (Secondary)
- **PM₁₀**
 - Directly emitted (Primary)
 - Mostly mechanically generated
- **Larger PM**
 - Directly emitted (Primary)
 - Mostly geologic in origin (ex. volcanic, crustal)



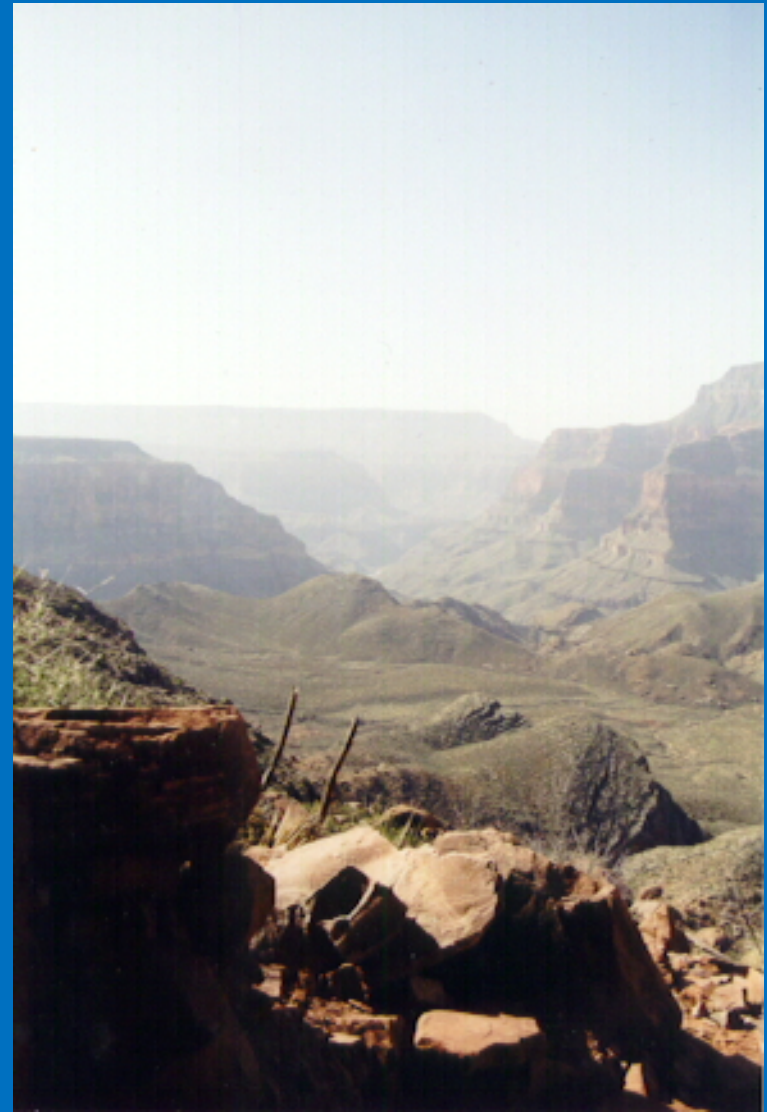
Direct PM Emission Sources



Scales of Particulate Matter Influence

Particulate matter can cause impacts on local, regional, and even global scales



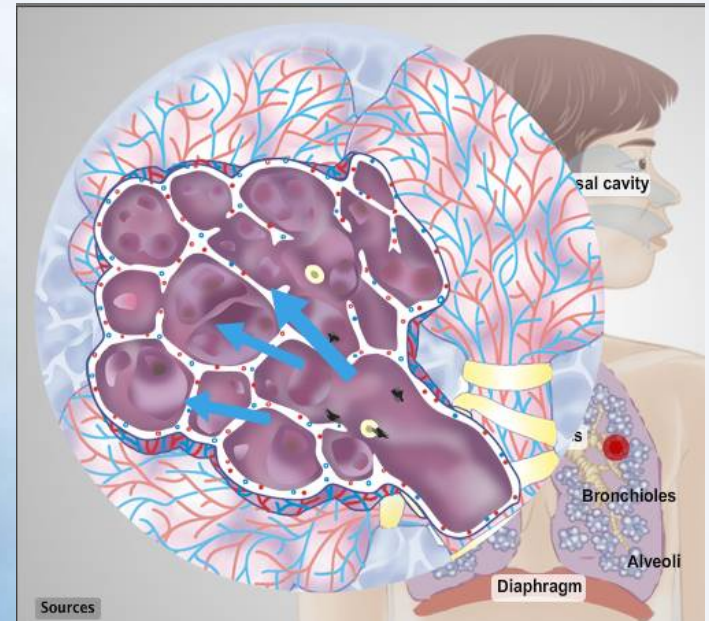


Grand Canyon view with no haze (left) and particulate from Gobi Desert, China dust cloud, April 15, 2001 (right)

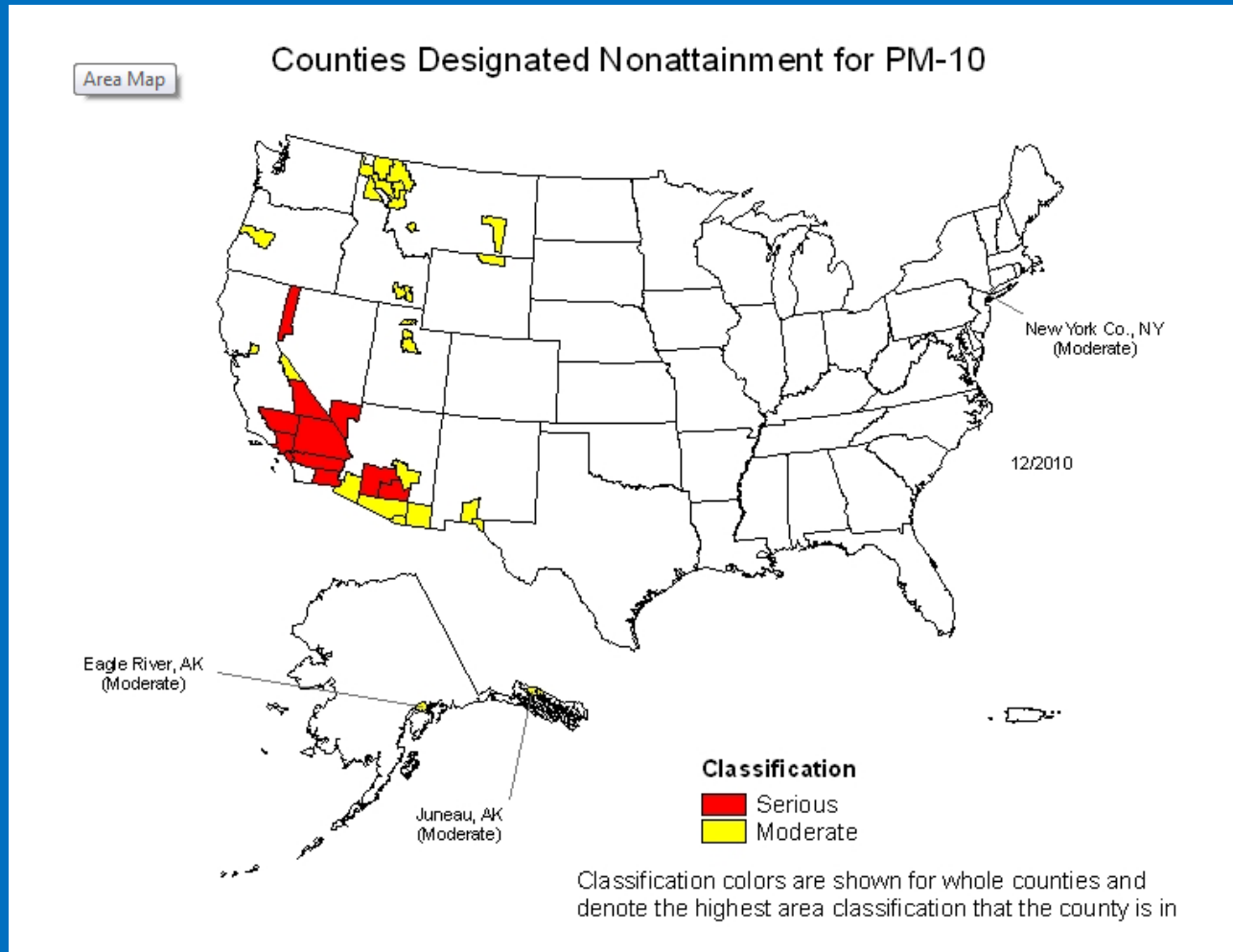
Particulate Matter

Why is PM an issue?

- Health impacts
- Visibility impacts
- Deposition/nuisance
- *Regulatory issues*



PM10 Counties in the U.S.



Does not include maintenance areas



Mechanically- generated Particulate Matter



What is Mechanically-generated PM?

Particulate Matter that occurs when human activity physically causes soil particles to become airborne. In agriculture this includes:

- Tillage / Land Preparation
- Planting
- Harvesting
- Tire action on unpaved roads, surfaces

A significant issue in many areas of the West, but also in the East at times. Generally a local scale issue, but in aggregate can become a regional issue. Resource concern identification: visibility (primarily safety), deposition, health. Citizen/group complaints, landowner objective, regulation.



Emission Characteristics of Mechanically-generated PM

- Soil/surface disaggregation by mechanical operations can result in airborne suspension of particles. The finer the particle the longer the residence time in the atmosphere.
- Factors affecting emissions
 - Soil/surface moisture
 - Soil/surface type
 - Surface cover (vegetation, residue, other)
 - Type of operation
 - Compaction / looseness



Emission Characteristics of Mechanically-generated PM

- For example, with typically dry soils, research reveals significant differences in emissions between types of soil disturbance operations. Values are in lbs PM10 / acre-pass:
 - Chisel, Disc, General Land Preparation: 1.2
 - Subsoiling: 4.6
 - Bed Preparation, Listing, Rolling, Shaping: 4.6
 - Land Planing, Leveling: 12.5



Mechanically-generated PM Mitigation Options

PM Management is possible for all operations where this has been identified as a resource concern. Some examples of PM control measures for **cropland** include:

- Combining tractor operations: 35-50%
- Switching to multi-year vs. single year crop: 65-100%
- Laser directed land planing: 30%
- Plug or punch planter, aerial seeding: 50%
- No-till / direct seeding: 90-99%



Mechanically-generated PM Mitigation Options

Some examples of PM control measures for **orchards and vineyards** include:

- Tilling alternate rows (weed control): 50%
- Maintaining cover between rows vs. tilling: 20-80%
- Flail mowing / low-volume spraying vs. tillage/planing for floor / harvest preparation: 20-80%
- Water application prior to floor harvest: 10-50%



Mechanically-generated PM Mitigation Options

Dust control on Unpaved Roads and Surfaces (373).

Must have >50% PM control at time of application.

Some suppressants and their PM control:

- Water Application [12 hours]
- Hygroscopic Suppressants (Road Salts)—not in arid/semi-arid climates [1-2/season]
- Petroleum Emulsions [Once a year]
- Clay Adhesives (Bentonite, etc.) [Once / 5 years]
- Polymer Emulsions [Once / 3 years]
- Bituminous Materials (Petroleum Road Oils) [up to 5 years]
- Organic non-Petroleum Products (Lignosulfonate, etc.) [1-2/season]



Mechanically-generated PM Mitigation Options

NRCS Practices for Managing Mechanically-generated PM:

- Residue and Tillage Management (329, 345)
- New “Field Operations Emissions Reduction” (756)
- Dust Control on Roads and Unpaved Surfaces (373)
- Dust Control from Animal Activity on Open Lot Surfaces (375)
- Conservation Cover (327), Cover Crop (340) and Conservation Crop Rotation (328)
- Windbreak/Shelterbelt Establishment (380), and other interception practices
 - *Even practices like Integrated Pest Management (595) and Nutrient Management (590) can reduce PM*



Mechanically-generated PM Mitigation Options

Use Residue and Tillage Management when applicable and criteria can be met

- 329: STIR < 20; soil loss objective
- 345: STIR < 80; no primary inversion tillage

Use new 756 (Field Operations Emissions Reduction) when these criteria can't be met, but PM from field operations is resource concern

- Combined Tillage Operations
- Precision Guidance Systems
- Alternative Equipment Technology
- Timing of Field Operations
- Modifying Crop Cultural and Harvest Methodologies



PM10 & Conservation Management Plans (CMPs): A San Joaquin Valley Success Story

**AGRICULTURAL
AIR QUALITY**

**Conservation Management Practices for
San Joaquin Valley Farms**

Minimizing agricultural PM10 emissions from on-farm practices:

Land preparation / cultivation
Harvest activities
Unpaved roads
Unpaved equipment yards
Other cultural practices

Produced by AIR in partnership with the SJVUAPCD and the
USDA Natural Resources Conservation Service.

Reason for Conservation Management Plans (CMPs)

- SJV was in nonattainment status for PM10
- Agriculture was identified as a source category
- Agricultural operations were no longer exempt from air regulations
- SJVUAPCD, CARB and EPA gave approval to NRCS and other partners to develop and execute voluntary approach to reduce agricultural PM10 emissions
- Included lots of mechanically-generated PM activities/sources



CMP Program Concept

- Mandatory participation for farm sites 100+ contiguous acres
- Select 1 measure from each of 5 categories
 - Land preparation/cultural activities
 - Harvest
 - Unpaved roads
 - Unpaved parking and staging areas
 - Other – wind erosion prevention, waste burning
- Relatively simple plans submitted to NRCS/RCD for review and to District for approval



Who is required to have a CMP?

A farm with 100+ contiguous acres.

A dairy with 500 or more mature cows.

A cattle feedlot with 190 or more cows.

A turkey ranch with 55,000 or more turkeys.

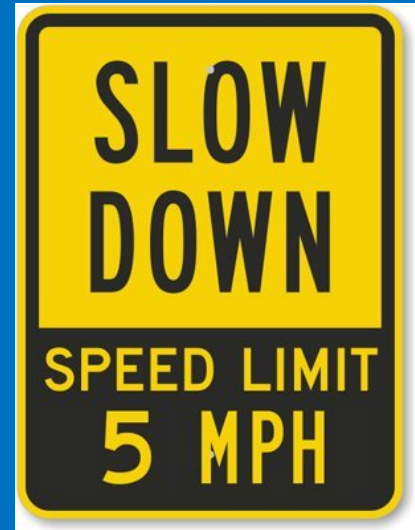
A chicken ranch with 125,000 or more chickens.

A chicken egg ranch with 82,000 or more laying hens.

Public Involvement

- Public Workshops
 - Outreach to affected sources
 - Solicit public/stakeholder suggestions on implementation strategies
 - Solicit input and comments on proposed regulations
- Public Hearings
- Business assistance to affected facilities

Conservation Practices being Applied in CA to Reduce Mechanically-generated PM



**These and other farming practices helped
the San Joaquin Valley reduce 35 tons per
day of PM10 AND the valley is now in
attainment!**

Demonstrating new technologies



Questions?

Greg Johnson

AQAC National Team Leader

greg.johnson@por.usda.gov

503.273.2424

Johnnie Siliznoff

CA State AQ Specialist

johnnie.siliznoff@ca.usda.gov

559.252.2191 X 112

