For Discussion During
Rule 200 Public Workshop #4
May 26, 2005

After Rule 200 Public Workshop #3, which was conducted on April 28, 2005, Maricopa County Air Quality Department embarked on a search for answers to the following questions:

- How will Maricopa County determine that a dust suppressant proposed to be used/applied by a special event permit applicant will not negatively impact the property and surrounding property, upon which such dust suppressant is applied?

- How many cars can park on one acre?

- How much will it cost to stabilize one acre to be used for a special event and/or to be used for special event parking?

- Do off-road vehicles/all-terrain vehicles create more dust and damage on trails than horses, hiking, and/or bicycling?

There is a considerable amount of information about dust suppressants - types, forms, application, and even certification. However, none of the information that Maricopa County found seems to state/verify/substantially conclude that a dust suppressant - any dust suppressant - will not affect the environment and none of the information seems to specify what the negative environmental effects might be.

Also, there is quite a bit of information about horses and their effect on trails. Again, though, there does not seem to be a consensus about horses making/creating more or less dust on trails than off-road vehicles/all-terrain vehicles, hiking, and/or bicycling.

In regards to parking on one acre, according to the San Joaquin Unified Air Pollution Control District, the minimum area needed to park 1,000 vehicles is estimated to be 400,000 square feet or 9.2 acres. Using this estimate, then, the minimum area needed to park about 100 cars is one acre. This estimate jives with the Maricopa County Zoning Ordinance, which requires for 90° parking, a parking space to measure nine feet by 18 feet with a 24 foot wide maneuvering lane. Using the Maricopa County Zoning Ordinance dimensions, then, a one acre lot or 40,000 square feet could accommodate about 100 vehicles. Neither of these estimates, however, includes space for trailers or semi-trucks.

Detailed information (but unfortunately not necessarily direct answers) that the Maricopa County Air Quality Department found is summarized in the literature review on the pages that follow.

Literature Review

Controlling Fugitive Dust Emissions From Unpaved Roads

A wide variety of options exist to control emissions from unpaved roads. Options fall into the following three categories:

- Vehicle restrictions that limit the speed, weight, or number of vehicles on the road
- Surface improvements, such as paving or adding gravel or slag
- Surface treatments, such as watering or applying chemical dust suppressants

Available control options span broad ranges in terms of cost, efficiency, and applicability. For example, traffic controls provide moderate emission reductions (often at little cost) but are difficult to enforce. Although paving is highly effective, its high initial cost is often prohibitive. Furthermore, paving is not feasible for industrial roads subject to very heavy vehicles and/or spillage of material in transport. Watering and chemical suppressants, on the other hand, are potentially applicable to most industrial roads at moderate to low costs. However, these require frequent reapplication to maintain an acceptable level of control. Chemical suppressants are generally more cost-effective than water but not in cases of temporary roads (which are common at mines, landfills, and construction sites). In summary, then, one needs to consider not only the type and volume of traffic on the road but also how long the road will be in service when developing control plans.

Vehicle Restrictions

These measures seek to limit the amount and type of traffic present on the road or to lower the mean vehicle speed. For example, many industrial plants have restricted employees from driving on plant property and have instead instituted bussing programs. This measure eliminates emissions due to employees traveling to/from their worksites. Although the heavier average vehicle weight of the busses increases the base emission factor, the decrease in vehicle-miles-traveled results in a lower overall emission rate.

Surface Improvements

Control options in this category alter the road surface. As opposed to “surface treatments” discussed below, 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. Unless curbing is to be installed, the effects of vehicle excursion onto unpaved shoulders (berms) also must be taken into account in estimating the control efficiency of paving. 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. Control plans should address regular maintenance practices, such as grading, to retain larger aggregate on the traveled portion of the road.

Surface Treatments

Surface treatments fall into two main categories: wet suppression (i.e., watering) and chemical stabilization (i.e., applying dust suppressants other than water). The necessary reapplication frequency varies from minutes or hours for watering under summertime conditions to several weeks or months for applying dust suppressants other than water. A

rule-of-thumb is that one inch of precipitation is equivalent to an application of 5.6 gallons of water per square yard of road.

Whatever treatment used for on road surfaces, it is necessary to have the roadbed in good condition before application. The road should be graded and crowned, and potholes should be eliminated. Grading after a surface treatment will partially destroy the effect of the dust suppressants.

Wet Suppression

Watering increases the moisture content, which in turn causes particles to conglomerate and reduces the likelihood of the particles from becoming suspended when vehicles pass over the surface. The control efficiency depends on how fast the road dries after water is added. This in turn depends on: (1) the amount (per unit road surface area) of water added during each application, (2) the period of time between applications, (3) the weight, speed and number of vehicles traveling over the watered road during the period between applications, and (4) meteorological conditions that affect evaporation during the period (i.e., temperature, wind speed, cloud cover).

Given the complicated nature of how a road dries, characterization of emissions from watered roadways is best done by collecting road surface material samples at various times between water truck passes. The moisture content measured can then be associated with a control efficiency. Samples that reflect average conditions during the watering cycle can take the form of either a series of samples between water applications or a single sample at the midpoint. It is essential that samples be collected during periods with active traffic on the road. Finally, because of different evaporation rates, it is recommended that samples be collected at various times during the year. If only one set of samples is to be collected, these must be collected during hot, summertime conditions.

Chemical Stabilization

As opposed to wet suppression (i.e., watering), chemical stabilization has much less frequent reapplication requirements. Chemical stabilization (i.e., applying dust suppressants other than water) suppresses emissions by changing the physical characteristics of the existing road surface material. Many dust suppressants applied to unpaved roads form a hardened surface that binds particles together. After several applications, a treated unpaved road often resembles a paved road except that the surface is not uniformly flat.

The control effectiveness of dust suppressants appears to depend on: (1) the dilution rate used in the mixture, (2) the application rate (volume of solution per unit road surface area), (3) the time between applications, (4) the size, speed and amount of traffic during the period between applications, and (5) meteorological conditions (rainfall, freeze/thaw cycles) during the period. Other factors that affect the performance of dust suppressants include other traffic characteristics (e.g., cornering and trackout from unpaved areas) and road characteristics (e.g., bearing strength and grade). The variability in these factors and differences between individual dust suppressants make the control efficiencies of dust suppressants difficult to estimate. Past field testing of emissions from controlled unpaved roads has shown that dust suppressants provide a PM_{10} control efficiency of about 80% when applied at regular intervals of two weeks to one month.

For the purpose of estimating emissions, it is assumed that the unpaved road dust emissions are primarily related to the vehicle miles traveled (VMT) on the roads. State highway data are used to estimate unpaved road miles for each roadway category in each county. It is assumed that 10 daily VMT (DVMT) are traveled on unpaved city and county roads

as well as U.S. forest and parks roads and BLM and BIA roads. Road mileage, if needed, can be simply computed by dividing the annual VMT values by 3650 (which is 10 DVMT x 365 days).

Daily activity on unpaved roads occurs primarily during daylight hours. Activity is assumed to be the same each day of the week. Monthly activity varies by county and is based on estimates of monthly rainfall in each county, because during wet months there is less unpaved road traffic and there are also lower emissions per mile of road when the road soils have a higher moisture content. Unpaved road growth is tied to on-road VMT growth for many counties. For other counties, growth is set to zero and VMT is not used.

Several products are available for controlling dust from unpaved roads. These products work by attracting moisture, binding dust particles together, sealing the surface, or some combination of these effects. Dust suppressants include, but are not limited to, chloride salts, organic or synthetic compounds, and polyvinyl acrylic polymer emulsions.

Chloride Salts

Chloride salts are moisture attractants, which work by drawing moisture out of the air during periods of high humidity, particularly at night. Also, chloride salts reduce the evaporation rate of water during hot dry periods, which tends to hold the dust on the road surface although there is no physical bonding. Chloride salts include, but are not limited to, calcium chloride, magnesium chloride, and sodium chloride.

Calcium chloride or magnesium chloride are the most effective chloride salts. Calcium chloride is the same material commonly used for fluid ballast in farm tractor tires and is readily available in a flake or pellet form. Calcium chloride should be mixed into a solution and sprayed on the surface at a rate of 1 pound - 1.5 pounds of salt per square yard. At this rate, it would require about 75 pounds of dry flake to treat 100 linear feet of road - 20 feet wide. A follow-up treatment at one-half–two-thirds of the initial rate is usually needed. Sodium chloride, or common salt, is cheaper but not very effective alone. Sodium chloride can be mixed with calcium chloride in equal parts to reduce the cost, however.

Magnesium chloride is a by-product of potash production and is available as a liquid solution. Being in liquid solution complicates transport and storage and generally requires ordering a tanker truckload. Magnesium chloride should be applied at a rate of ½ gallon of 30% solution per square yard. Thirty-seven gallons of this product would treat 100 linear feet of road - 20 feet wide. A follow-up treatment at one-half the initial rate is often needed.

The applied cost of calcium chloride or magnesium chloride is typically between 30¢ - 50¢ per running foot of road. Calcium chloride, magnesium chloride, and sodium chloride are corrosive to metals, toxic to plants, irritating to human skin and should be used with care. Also, calcium chloride, magnesium chloride, and sodium chloride may result in a slippery coating on the road surface. A slippery coating on the road surface is not usually a problem on a gravel surface, but care should be taken to avoid spreading the solution on bridge floors. There is potential for some off-site plant damage during periods of heavy rainfall.

Organic Or Synthetic Compounds

Organic or synthetic compounds physically bind dust particles together. Some compounds produce a surface that resembles pavement but at a lower cost. One class of organic or synthetic compounds is formulated from a by-product of soybean oil extraction. Several soy-based commercial products are available and are referred to collectively as soybean

feedstock (SBF). These products are non-corrosive and are not toxic to plants or animals. Since SBF products are organic-oil based, they are not as likely to wash or leach away as chloride salts. One application of SBF is reported to be effective in controlling dust for three to four months. Applied SBF products typically cost 40¢ - 50¢ per linear foot of road.

Lignin is similar to SBF in performance and may cost less in some areas. Lignin is a by-product of the pulp and paper industry and has been used as a binder in feeds and fertilizers for many years. Several commercial road stabilization products use lignin as a base.

Problems with odor and stickiness sometimes occur on roadways treated with SBF products, particularly in the first few days after application. These products will also track onto paved driveways under certain conditions. Although SBF products are non-toxic, they will suppress weeds and grass in the roadbed. There is no residual effect, however, and little chance of movement during rainfall. SBF products are sold by the tanker load. One truck load of SBF will treat approximately two miles of road.

Polyvinyl Acrylic Polymer Emulsions

Polyvinyl acrylic polymer emulsions, or PVA, are long-chained synthetic polymers that generally cost less than organic or synthetic compounds. Polyvinyl acrylic polymer emulsions perform best when blended with the top two to four inches of roadway material and followed by compaction.

Dust Palliatives

Dust palliatives are products that are applied to soil surfaces in order to limit the creation of fugitive dust emissions. For many projects, dust palliatives can be an effective and economical alternative to watering. A variety of products are available, and finding one that fits your project's activities can reduce the need for regular, frequent watering, resulting in significant cost savings over the long term. In some instances, the soil stabilization from dust palliative application can last from 1 to 12 months. Some dust palliatives are not designed for areas subject to daily disturbances, high volume traffic, or heavy equipment traffic—check with the product vendor if these conditions exist at your site.

Be sure to ask the product vendor for the recommended dilution, application rate, and application frequency of the product you choose because these vary significantly by product. Before a weekend, holiday, or other inactive period of less than five days, a dust palliative that is diluted to not less than 1/20 of the concentration required to stabilize a surface for six months is recommended. Maricopa County recommends the use of non-toxic, non-corrosive products. A contractor is responsible for assuring that its use of dust palliatives is in compliance with all applicable environmental laws.

Sources Of Information

- Fugitive Dust: Nonpoint Sources. John H. Ferguson, H.Willard Downs, and Donald L. Pfost. Department Of Agricultural Engineering. University Of Missouri. 1999.
- Fugitive Dust Handbook. Western Regional Air Partnership's (WRAP's) Dust Emissions Joint Forum. Countess Environmental and Midwest Research Institute. 2004.

Literature Review Of Dust Suppressant Verification / Certification Information

Environmental Protection Agency (EPA), Air Pollution Control Technologies (APCT), Environmental Technology Verification (ETV) Program

Sources:

- http://etv.rti.org/apct/index.html
- http://www.epa.gov/etv
- "Air Pollution Control Technologies Performance Verification-A Permit Tool", Jack R. Farmer, Andrew Trenholm, Buddy Newman, and Theodore G. Brna
- "Promoting Improved Air Quality Through Environmental Technology Verifications", Theodore G. Brna and Jack R. Farmer

EnvironKleen®35 Environmental Technology Verification Report

Source:

- Environmental Technology Verification Report-Dust Suppression And Soil Stabilization Products-Midwest Industrial Supply, Inc.-EK®35, Midwest Research Institute, RTI, September 2002

Test/QA Plan For Testing Of Dust Suppressant Products At Maricopa County, Arizona

Source:

- Test/QA Plan For Testing Of Dust Suppressant Products At Maricopa County, Arizona, RTI and MRI, October 2, 2002

California Air Resources Board (CARB), Evaluation Of The Air Quality Performance Claims, Equipment And Process Precertification Program

Sources:

- http://www.arb.ca.gov/eqpr/eqpr.htm
- http://www.arb.ca.gov/eqpr/mainlist.htm

Soil-Sement® California Air Resources Board Certification Evaluation Report

Source:

- http://www.arb.ca.gov/eqpr/midwest.htm

PennzSuppress®D California Air Resources Board Certification Evaluation Report

Source:

- http://www.arb.ca.gov/eqpr/pennzoil/pennzoil.htm

City Of Phoenix Dust Palliative/Stabilizer Requirements Contract

Source:

- City Of Phoenix Dust Palliative/Stabilizer Requirements Contract, #IFB 04-032 (TH), September 15, 2003

Environmental Protection Agency (EPA)
Air Pollution Control Technologies (APCT)
Environmental Technology Verification (ETV) Program

EPA began the ETV program **to verify the environmental performance characteristics** of commercial-ready air pollution control technologies using objective and quality-assured data. The process results in the publication of test reports and verification statements for the technologies. The statements give state and local permitters, vendors, and potential purchasers an independent and credible verification of the performance of innovative or improved control technologies. The Research Triangle Institute (RTI) is the verification partner for the APCT ETV program, which includes other organizations for support in various aspects of the work (i.e., Midwest Research Institute (MRI).

The APCT ETV program approach includes selecting technologies, developing generic verification protocols, testing the performance of technologies, and reporting results. Testing is conducted following procedures established under the protocols, and technology verification reports and statements are issued for the control technologies.

After a technology is selected for verification testing, a generic verification protocol is drafted and a technical panel is formed to review and reach consensus on the protocol. Each protocol defines the types and characteristics of data that must be present in verification statements and reports in order for technology-specific verification tests to be accepted as credible by EPA and other stakeholders. Protocols are applicable to any test laboratory that wishes to perform verification tests for the APCT ETV program. They are not laboratory-specific documents. The protocols are developed to ensure that there is no technology bias during the verification tests. They are based upon detailed examination by all stakeholders of issues associated with the acceptance of air pollution control technologies.

Protocols address a subset of the following verification factors:

(1) Emission control efficiency
(2) Emission rates
(3) Wastewater and solid waste
(4) Effluents
(5) By-products
(6) Reliability
(7) Operating limitations
(8) Operation and maintenance (O&M) requirements

Parameters to be tested and the reporting format are specified in each generic verification protocol. The APCT ETV program verifies performance of control technologies in terms most beneficial to developers, vendors, users, and permitters. The developer's/vendor's performance claims (e.g., percent reduction, outlet emission rate, or production-based limit) are considered as the protocols are being prepared.

The objective of the APCT ETV program is to verify, with high data quality, the performance of air pollution control technologies. A subset of air pollution control technologies is products used to control dust emissions from unpaved roads. Dust suppressant products are designed to alter the roadway by lightly cementing the particles together, either by increasing the particles' weight so that they are less likely to move under traffic or wind or by forming a surface that attracts and retains moisture.

"Dust suppressants" and "dust palliatives" generally mean the same thing. Dust suppressants include water, fiber mulches, water-absorbing materials (e.g., calcium chloride, magnesium chloride), petroleum based organics (e.g., asphalt emulsion), non-petroleum based organics (e.g., vegetable oil, molasses), synthetic polymer emulsions, and lignin products. Non-toxic chemical stabilizers are used as dust suppressants or dust palliatives. In order to use non-toxic chemical stabilizers, non-toxic chemical stabilizers must be of sufficient concentration, must be of sufficient application frequency, and must be allowed for use by regional/local water quality boards and EPA.

A field test program was designed by RTI and MRI to evaluate the performance of dust suppressant products. Seven dust suppressants, manufactured/distributed by 3 firms, were subject to this test.

EnviroKleen®35
Environmental Technology Verification Report

A field test program was designed by RTI and MRI to evaluate the performance of dust suppressant products. Seven dust suppressants, manufactured/distributed by 3 firms, were subject to this test. One of those dust suppressants was EnviroKleen® developed Midwest Industrial Supply, Inc. The host facility for the field test program was Fort Leonard Wood (FLW), Missouri, a U.S. Army base. The test site at FLW was the drivers' course used to train recruits to drive heavy vehicles.

A test/quality assurance (QA) plan for the field testing was developed and approved by EPA on October 3, 2001. The goal of the test was to measure the performance of the products relative to uncontrolled sections of road. A comparison was also made between alternative dust emission measurement methods (exposure profiling and mobile dust sampling). Field testing was conducted over a 3-month period from October 20, 2001 to January 27, 2002. This was a preliminary test in the program to verify the performance of dust suppressant and soil stabilization products. It was to be followed by a more thorough 1-year test of product performance.

Description And Identification Of Product
EnviroKleen®35 is an intense use continuous life dust control agent and is a synthetic fluid with a proprietary ingredient formulation. It is supplied as a ready-to-use liquid that can be sprayed directly over surfaces such as dirt roads. The MSDS for it "is not known to pose any ecological problems".

Test Design
The test program was designed to determine the control efficiency (CE) of dust suppressants applied to unpaved roads. The test approach was to measure the source emission strength of both the treated and untreated unpaved road surfaces. The uncontrolled testing was performed on a separate (but similar) section of the test road from the controlled test. Road conditions and any potential effects from ambient conditions and human intervention were monitored.

The test on the uncontrolled surface was conducted once (triplicate measurements). Testing of the dust suppressant CE was conducted 3 times (once per month) over the 3-month test campaign. Duplicate measurements were made for each of the 3 CE tests and the results were presented in relative time.

Sampling Methods
The following factors were verified:

(1) Dust suppressant control efficiency relative to uncontrolled emissions
(2) Dust suppressant application intensity
(3) Product application resources
(4) Method of application of product
(5) Climatic conditions during dust emission measurement
(6) Road surface samples
(7) Traffic
(8) Size of uncontrolled and controlled test sections
(9) Area climatic conditions

Sampling collection and handling was conducted using the following methods:

(1) Mobile dust sampling
(2) Visible emissions
(3) Surface sampling
(4) Ambient and service environment records
(5) Dust suppressant application intensities
(6) Sample handling

Test Site Conditions
All sections of the test site were exposed to 2 sets of traffic during the field test - long-term repeated travel by heavy Army vehicles and incidental traffic related to distinct testing events.

The climatic and atmospheric conditions and especially soil moisture may affect the performance of dust suppressant products. Ambient meteorological data were supplied for the Bailey site, which is located approximately 4 km (2.5 miles) west of the test site, for the 3-month test period. Precipitation data were supplied for the Forney Airport, which is located within FLW, approximately 6 km (3.7 miles) north-northeast of the test site.

Background Particulate Concentration
During all tests series the measured TP, PM_{10}, and $PM_{2.5}$ background concentrations were below 30 ug/m^3. Based on a typical sampling time of 30 minutes for a mobile sampling test and the nominal sampling rates, which were 1133 Lpm (40 cfm) for the high-vol cyclone and 16.7 Lpm for the unit from URG Company, the background particulate level would account for no more than 1.0 mg (0.015 grains) of PM_{10} or TP sample mass or 0.015 mg (0.00023 grains) for the $PM_{2.5}$ sample mass.

Application Of Dust Suppressant
MRI observed and documented all steps in the application of EnviroKleen®35 to the road test section. The product was applied only once at the start of the 3-month test period. As EnviroKleen®35 is available in ready-to-use liquid form, no water was mixed with it for application. The density of the product as applied was 0.85 g/ml (7.1 lb/gal). The product was applied to the test section surface by an Etnyre-brand spray truck in 4 application passes, with each pass consisting of separate 3.7 m (12 ft) wide sprays in each direction. The test section was allowed to cure for approximately 45 hours (i.e., from Saturday until Monday morning) without vehicle traffic.

Conditions During Dust Suppressant Testing
Two road surface samples were collected on the days when air sampling was conducted. The surface samples were analyzed for moisture and silt (i.e., fraction passing 200 mesh upon dry sieving).

Verification Results
For test series #1, PM_{10} control efficiency (CE) was 97%. For test series #2, PM_{10} CE was 99%.

Test / QA Plan For Testing Of Dust Suppressant Products In Maricopa County, Arizona

The Air Pollution Control Technology Verification Center (APCTVC) selected Maricopa County, Arizona as the site for this test of the following dust suppressant products:

(1) **EnviroKleen®35:** A patent-pending dust control and soil stabilization agent formulated with continuous acting, long life, synthetic fluids and naturally occurring rosons. It is uniquely developed with optimum environmental sensitivity especially for air, water, and storm water criteria.
(2) **EnviroKleen®C:** A patent-pending dust control and soil stabilization agent formulated with continuous acting, long life, synthetic fluids and dust control modifiers. It is uniquely developed with optimum environmental sensitivity especially for air, water, and storm water criteria.

Management and testing of dust suppressants within the APCTVC were performed in accordance with procedures and protocols defined by a series of quality management documents.

The goal of this test was to measure the performance of the products relative to uncontrolled sections of road.

Project Description
Testing was performed on 2 dust suppressant products on a rural, unpaved road in Maricopa County, Arizona. Test campaigns were conducted at quarterly intervals over a 1-year period. Each test campaign consisted of 5 replicate dust emission measurements of controlled and uncontrolled road sections. Performance of the products was determined in terms of dust control efficiency (CE) relative to uncontrolled roads. The CE was determined relative to its decay over time and with traffic. The mobile dust sampler was used to obtain dust CE data for the products.

The tests gathered information and data for evaluating the performance of the products as applied by the manufacturers/distributors. The critical measurement was the dust suppression CE.

The test was conducted on rural, unpaved roads in Maricopa County, approximately 50 miles west of Phoenix, near the towns of Buckeye and Wintersburg. All test sections are located on Lower Buckeye Road (a country road) near the towns of Buckeye and Wintersburg. The sections used for dust suppressant testing were on portions of the road constructed of shale. The road experienced approximately 150 vehicle passes per day, with the majority of passes by light-duty cars and trucks. Much of the traffic appears to be associated with local residents commuting to their workplaces and thus occurring during the early morning and late afternoon hours. Traffic between 9 am and 4 pm was infrequent.

The project was conducted in June 2002.

Performance Of The Products (Date Quality Objective (DQO) For Dust Suppression)
Product performance is the major determinant of the absolute magnitude of CE. However, CE is also influenced by climate and road characteristics. Climate varied throughout the year-long test and both climate and road characteristics varied with the location of the test site. Neither of these factors could be controlled to provide standardization of their effects on the measured product performance.

Test Design
The test approach for dust suppressants was to measure the source emission strength of both the treated and untreated unpaved road surface. There were several features inherent to open dust sources (as opposed to more traditional stack sources) that had to address in the test design:

(1) Unlike stack sources with "end of pipe" controls, you cannot test simultaneously at the front and back ends to determine controlled and uncontrolled emission levels. In contrast, you must either (a) perform uncontrolled testing followed by a separate set of controlled tests after the suppressant is applied to the same section of road or (b) perform uncontrolled and controlled tests on separate sections of the test road. You must always separate the controlled and uncontrolled tests either spatially or temporally.

(2) All unpaved road dust suppression is time-dependent, decaying from roughly complete control at the time of application to essentially no control after some period of time (ranging from hours in the case of watering to months for chemical dust suppressants). No set of measurements during a single time period can characterize the long-term, average control performance. The extended period of time necessary to complete the test program as well as the method used to present the emissions control as a meaningful long-term average must be considered.

(3) The extended period of time in #2 above is further complicated by the open nature of the emission source. Unlike stacks, roads are exposed for a long period to the ambient conditions of precipitation and water erosion from neighboring areas. Furthermore, the test program may be affected because of human intervention (i.e., damage to the treated surface from very heavy or tracked vehicles or vandalism).

The test program was designed to address the issues described above. Controlled and uncontrolled tests were conducted on physically separated road sections. To guard against variability between different road sections, the test sections were located at different points along the same road. Ambient and visible effects of human intervention were monitored and any potential effect on the results was assessed.

California Air Resources Board (CARB)
Evaluation Of The Air Quality Performance Claims
Equipment And Process Precertification Program

California State Statute
Health And Safety Code, Division 26, Air Resources, Section 39620 (Adoption And Implementation Of Program):

(a) The state board shall implement a program to assist districts to improve efficiencies in the issuance of permits pursuant to this division. The program shall be consistent with the requirements of Title V.

(b)(1) The program shall include a process, developed in coordination with the districts, for the state board **to precertify simple, commonly used equipment and processes as being in compliance with applicable air quality rules and regulations, under conditions specified by the state board.** The state board shall develop criteria and guidelines for precertification in coordination with the districts.

(2) The state board shall charge a reasonable fee for precertification, not to exceed the state board's estimated costs. Payment of the fee shall be a condition of precertification.

(3) Precertification shall not affect any existing authority of a district regarding permitting and compliance requirements. Precertification shall constitute a preliminary evaluation of the equipment or process, and a recommendation by the state board for permit conditions to be adopted by a district having jurisdiction over particular equipment or a particular process, that would allow district permitting staff to more quickly process permit applications for air pollution sources.

(4) The California Environmental Protection Agency, within existing resources, and in consultation with appropriate state and local regulatory agencies, shall evaluate the feasibility and benefits of expanding the precertification program to involve other state and local regulatory agencies with jurisdiction over other environmental media, including land and water.

Equipment And Process Precertification Program
The Equipment And Process Precertification (Equipment Precertification) Program is a voluntary fee-based program administered by the California Air Resources Board (CARB) for manufacturers of commonly-used equipment or processes that are operated as stationary sources. Manufacturers request CARB **to conduct a third-party verification of performance claims**, which focus on the air quality benefits of their equipment or processes.

Most equipment or processes must possess the following (related to air quality) to be accepted into precertification:

- Commonly used
- Not pose a significant hazard to public health, safety and the environment
- Operated as a stationary source

Most manufacturers participate in the Equipment And Process Precertification (Equipment Precertification) Program to familiarize government agencies with their equipment and to enhance marketing activities. If CARB successfully verifies a product's claim, the product manufacturer/developer receives a technical evaluation report, an executive order, a precertification certificate, and inclusion in CARB's list of precertified equipment on the CARB website with links to the product's webpage. CARB also notifies all air pollution control districts in California that the product's claims have been verified.

Precertification verification testing is conducted by qualified testing companies. A precertification is valid for 3 years. If the equipment, process, or claims have not changed significantly, the cost of precertification renewal is minimal.

The following equipment and processes have been precertified by CARB through the Equipment And Process Precertification Program:

- Flameless Catalytic Combustion System. Effective until June 24, 2005
- Lokring Fittings. Effective until November 13, 2006
- **Soil-Sement® dust suppressant. Effective until April 11, 2005**
- **PennzSuppress® dust suppressant. Effective until November 13, 2006**
- Cam Shaft Cylinder Re-Engineering Kits. Version I effective until December 18, 2004. Version II effective until September 2, 2002
- Flow Control Valves. Effective until June 7, 2004
- Assistive Device. Effective until February 14, 2005
- Natural Gas-Fired Direct-Contact Water Heater. Effective until November 28, 2004

Evaluation Report
A typical Evaluation Report includes the following categories:

General Information
Background information on CARB's Equipment And Process Precertification Program

Summary Of Scope, Statement Of Claims, Description Of Technology
Breadth or CARB's evaluation, product performance claim, and a detailed description of the product

Technical Evaluation and Evaluation Of Claims
Detailed information on CARB's technical review and assessment of product

Quality Management and Environmental And Economic Benefits
Supporting information on product's procedures to produce a dust suppressant that meets the product's claim and a brief assessment of potential environmental and economic impacts of the product

Recommendations and Precertification Conditions
CARB's determination of the product's performance relative to the product's claim and guidance with respect to the specific conditions that must be met for the certificate to remain valid for 3 years

Appendices
Supporting information/data

Soil-Sement®

California Air Resources Board Certification Evaluation Report

Soil-Sement® is used as a dust suppressant, as a soil-stabilization agent, and to control erosion and silt runoff. Soil-Sement® relies upon its high carbon-index polymers to bind a road's soil to increase the cohesion among the aggregate particles.

CARB regional water quality control boards require a report of waste discharge, if the application of the dust suppressants threaten water quality.

Soil-Sement® was subjected to EPA's toxicity characteristics leaching procedures (TCLP) which is one of the tests used to assess whether a substance should be handled as a hazardous waste.

California Water Resources Control Board indicated that it did not oppose CARB's performance precertification.

California Department Of Toxic Substance Control (DTSC) did not have any concerns with CARB's precertification of Soil-Sement® for air-related claims.

Soil-Sement® Undiluted Product Composition

- Primarily composed of: acrylic, acrylate, acetate liquid polymer
- Specific gravity: 1.0 - 1.2
- Density: 8.4 - 9.5 pounds per gallon
- pH: 4.0 - 9.5
- Soluable in water
- Minimum solids content: 40% based on oven-dry solids
- 5% - 50% by weight of polymer
- 50% - 95% by weight of water
- Optimal dust control: Concentration rate of 0.28 gallons of concentrate per square yard of unpaved road surface consisting of silty, sandy loam.
- Application: Liquid application truck with a pressurized spray bar (typically operated at 20-25 pounds per square inch) designed to apply the product evenly over the roadbed surface.

Health And Environmental Impacts

Based on CARB's review of Material Safety Data Sheet (MSDS) for Soil-Sement®, CARB determined that Soil-Sement® would not likely present health impacts significantly different from those associated with road paving materials.

Technical Evaluation-Description Of Testing-Field Testing

Eight days prior to initial testing, 4 passes of Soil-Sement® were applied to the controlled road section in a single day. Each pass was applied at a rate of 0.07 gallons per square yard of road, using a dilution rate of 6.8 parts water to 1 part of concentrate. The total ground inventory of Soil-Sement® after these treatments was 0.28 gallons of concentrate per square yard of unpaved road.

The testing equipment setup was used by Desert Research Institute (DRI) to quantify particulate emissions from the segregated untreated (uncontrolled) and treated (controlled) portions of the test road. The testing setup provided simultaneous measurement of particulate concentrations at various points over the effective height of the plume generated by passing vehicles. The sampling equipment was placed downwind of the test area at heights of 1.3, 2.0, 2.5, 5.0, and 10.0 meters. The duration of the sampling periods was 6 hours per day.

The testing equipment setup also included meteorological instrumentation that monitored wind direction. EPA's AP-42 emissions factor equations for paved and unpaved roads were followed. Vehicle passes, vehicle speed, and vehicle weights were monitored.

Several parameters (monitored at the test site) were not used directly in conducting the evaluation: precipitation, wind speed, temperature, barometric pressure, and soil silt content.

There were limitations in the test design, particularly in the limited number of treated and untreated runs. CARB calculated the control efficiencies using Mass Concentration Approach to verify the control efficiencies.

Control Efficiency Methodology
CARB calculated the instantaneous control efficiency for each run using the ratio of treated or untreated PM_{10} mass concentrations reported in micrograms per cubic meter (ug/m^3). CARB calculated the control efficiency as follows:

Control Efficiency=[Untreated(downwind-upwind)Conc.-Treated(downwind-upwind)Conc.]÷Untreated(downwind-upwind)Conc.

Tri-State Lab Test Results
Analyzed samples using 2 gas chromatograph/mass spectrometer (GC/MS) systems and specific ion probes. One GC/MS was used to detect volatile compounds (liquids and gases with a boiling point of less than 200°C) while the other GC/MS was used to detect semivolatiles. The volatiles included chlorinated hydrocarbons and aromatics. Semivolatiles included phthalates and PAHs.

Fluoride and bromide analysis was done in TSLs inorganic lab using specific ion probes.

CARB reviewed and verified the TSL test results; No detectable levels of volatiles, semivolatiles, fluoride, or bromide.

Other Certification/Approvals
Environmental and transportation agencies for the states of Arizona, Nevada...and California have granted approval for the use of Soil-Sement® as a dust suppressant. Product safety and performance information was reviewed to varying degrees by each state. None of the states included the evaluation of a performance claim as part of their review.

PennzSuppress®D
California Air Resources Board Certification Evaluation Report

PennzSuppress®D is used as a dust suppressant on engineered unpaved roads (a purpose built road) consisting of well-graded aggregate (road material with a wide range in grain sizes). It is applied primarily to soils on roads, parking lots, parks, fields, off-highway motor vehicle parks, and other similar high dust areas.

CARB's precertification only evaluates the effectiveness of suppressing fugitive dust emissions from engineered unpaved roads consisting of well-graded aggregate.

California Water Resources Control Board indicated that it did not oppose CARB's performance precertification.

California Department Of Toxic Substance Control (DTSC) did not have any concerns with CARB's precertification of Soil-Sement® for air-related claims.

PennzSuppress®D contains hydrocarbons that are primarily C-25 and higher; No detectable levels of VOCs. PennzSuppress®D will not significantly contribute to existing levels of VOCs.

PennzSuppress®D is not recommended on aggregates that have low abrasion resistance (i.e., those that will crush and form new dust under the weight of vehicles). Also, it is not recommended that the product be applied when the ambient temperature is below 45°F.

Health, Environmental Impacts, And Economic Benefits
Based on CARB's review of Material Safety Data Sheet (MSDS) for PennzSuppress®D, CARB determined that PennzSuppress®D would not likely present health impacts significantly different from those associated with asphalt or concrete road paving materials.

Because C-20 and higher compounds are not soluble in water, PennzSuppress®D does not dissolve and wash away when exposed to rain. Because of its low solubility in water, PennzSuppress®D is not influenced by moisture in the atmosphere and can be used in both arid and humid environments.

Environmental and transportation agencies in Nevada…and California have granted approval for use of PennzSuppress®D as a dust suppressant.

The use of PennzSuppress®D as a dust suppressant in accordance with manufacturer's instructions will likely result in a significant reduction of PM_{10} emissions from unpaved roads without contributing to existing levels of VOC.

PennzSuppress®D Undiluted Product Composition

- Primarily composed of: C-25 and higher hydrocarbons (Petroleum resin is produced from the vacuum tower bottoms of the refining process for highly parafinnic Pennsylvania grade (Penn Grade) crude oil.
  30%-60% petroleum resins
  20%-40% water
  15%-35% emulsifiers
  1%-5% surfactants
  5%-15% vacuum residuum
- Optimal dust control: Concentration rate of 0.15 gallons of concentrate per square yard of unpaved road surface
- Application: Liquid application truck with a pressurized spray bar (typically operated at 20-30 pounds per square inch) designed to apply the product evenly over the roadbed surface.

Technical Evaluation-Description Of Testing-Field Testing

Prior to testing, 3 passes of PennzSuppress®D were applied to the unpaved road. Each pass was applied at a rate of 0.025 gallon per square yard of unpaved road, using a dilution rate of 9 parts water to 1 part of concentrate. Seven days later, the same application rate of PennzSuppress®D was applied to the same portion of the unpaved road that had been treated a week earlier. The total ground inventory of PennzSuppress®D after these 2 treatments was 0.15 gallons of concentrate per square yard of road. Vehicle traffic was not allowed on the road until after the second application.

Although CARB confirmed the control efficiencies calculated by Midwest Research Institute (MRI), the CARB evaluation concluded that the average PM_{10} control efficiency of PennzSuppress®D cannot be estimated with statistical confidence due to the limitations in the test design, particularly in the small number of both treated and untreated runs.

A cumulative number of vehicle passes appears to heavily influence the control efficiency of PennzSuppress®D.

CARB contacted current users of PennzSuppress®D. Users indicated that they have been pleased with the performance of PennzSuppress®D as a dust suppressant on unpaved roads. One customer included the California Department Of Transportation in southern California where PennzSuppress®D was used to reduce PM10 emissions from unpaved road surfaces associated with the construction of a freeway. CARB also visited a winery and vineyard in central California where PennzSuppress®D was applied to reduce PM_{10} emissions and the associated dust mites that affect grape quantity and quality.

City Of Phoenix Dust Palliative / Stabilizer Requirements Contract

The City Of Phoenix invited sealed bids for Dust Palliative/Stabilizer Requirements Contract for a 2-year period commencing on or about December 1, 2003.

The proposed work was located at Phoenix Sky Harbor International, Goodyear, and Deer Valley Airports. The work consisted of soil stabilization and dust control, in accordance with EPA PM_{10} requirements. The area to be treated was estimated at 1.2 million square yards. The City Of Phoenix estimated that 25% of the soil to be treated was to be scarification and compacted, with the balance being topical application.

The work was to be separated into 3 distinct dust palliative/stabilizer application methods:

#1. Scarification And Compaction: Work was to be done as directed by the Aviation Department Representative (ADP) and was to consist of scarification, placement of a palliative/stabilizer into the soil, and compaction.

#2. Standard Topical Application: Work was to be done as directed by the ADP and was to consist of topical application of a palliative/stabilizer.

#3. Heavy Topical Application: Work was to be done as directed by the ADP and was to consist of heavy topical application of a palliative/stabilizer.

The contractor was responsible for obtaining the necessary environmental permits and for filing the necessary environmental notices. Also, the contractor was to comply with all requirements in the City Of Phoenix (Aviation), Maricopa County Air Quality Block Permit Dust Control Plan and associated "Best Management Practices".

All costs associated with testing the soil, prior to the application of product for soil stabilization, were to be paid by the contractor.

All material that was to be reincorporated into the soil was to be pre-approved by the ADR. The moisture content was to be brought to that required for compaction by the addition of water, by the addition and blending of dry, suitable material, or by the drying of existing material. The dust palliative/stabilizer was to be applied and incorporated into the soil thoroughly until the homogeneous mixture is obtained. This uniformity was to be consistent throughout the scarification depth of 6 inches. Scarified and compacted soils were to be constructed to achieve a uniform soil structure having a 90% density, when tested in accordance with ASHTO T-99, Method A, and T-191, or ASTM D-2922 and D-3017 with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination, standard detail, to compensate for the rock content larger than that which will pass a No.4 sieve.

Types Of Materials
Acrylic, acrylate, and acetate liquid polymers characterized by the following:
- Specific gravity: 1.0 - 1.15 at 258°C
- Active solids content minimum 40%
- Odor intensity slight
- pH: 4.0 - 9.5
- Soluble in water dilutable
- Brookfield viscosity at 258°C, cps. Maximum 1500

The emulsion was to be stable (i.e., should not break when stored in clean, closed containers at ordinary temperatures, excluding freezing or boiling, for a minimum of 3 months). It was to be miscible with water in all proportions. The sequestering agents were to make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion was to be non-corrosive to metal containers. The materials were to penetrate to a minimum of 1/8 inch into the soil surface and not form a skin at the surface.

Products were not to contain or emit chlorinated fluorocarbons (CFCs, Freons) or chlorinated VOCs. Also, products were not to contain detectable levels of polycyclic organic matter which included aromatic hydrocarbons nor contain detectable levels of fluorinated or brominated compounds that could be expected to contribute to ozone depletion or global warming.

The contractor was to provide adequate proof that storm water runoff from the treated areas (as a result of application of the chemical dust palliative/stabilizer product) would not contain concentrations that exceed the benchmarks in the National Pollutant Discharge Elimination System Storm Multi-Sector General Permit For Industrial Activities or the Arizona Surface Water Quality Numeric Standards as defined in Arizona Administrative Code, Title 18, Chapter 11, for stretches of the Salt River.

To demonstrate adequate proof, the contractor was to provide one of the following:
- Complete aquatic toxicity test for lethal concentration at 50% (LC50).
- Complete list of all individual chemical constituents (including proprietary chemical information) and percentage of each in a given volume of pure chemical product.
- Surface water runoff test. This test involves running distilled water over a treated soil area, collecting the test water, and submitting to a certified lab for analysis.

The manufacturer was to provide independent verification and certification of performance and environmental claims by a recognized agency of the United States or Canadian Environmental Technology Verification programs for chemical dust suppressants. The certifications must state as a minimum that the product complies with the specifications submitted with the bid. Hazardous Material Identification System (HMIS) and/or National Fire Protection Association (NFPA) ratings labels must be exhibited on all containers.

Dust palliatives/stabilizers and their degradation products must <u>not</u>:
- Be constituents that are identified or listed as a hazardous waste under the Arizona Administrative Code R18-8-261
- Emit or off-gas during placement, use, or degradation of any hazardous air pollutant listed under Rule 370, Section 203 of the Maricopa County Air Pollution Control Regulations
- Be a hazardous chemical substance or mixture pursuant to Section 7 of the Federal Toxic Substances Control Act (15 U.S.C. 2606)
- Be designated by rule an extremely hazardous chemical substance pursuant to the Arizona Environmental Quality Act
- Be prohibited for use by the Arizona Department Of Environmental Quality, the Environmental Protection Agency, or any applicable law, rule, or regulation

- Be substances or composed of substances known to be, or reasonably anticipated to be, carcinogenic by the U.S. Department Of Health And Human Services

The contractor must provide a copy of the current Material Safety Data Sheet (MSDS) for the product(s) bid. The MSDS was to include all chemical compounds present in concentrations greater than 0.1% for each product bid.

The City Of Phoenix was to provide the contractor with a standard fire hydrant meter, for all on-site water needs for ground preparation or application dilution.

The application methods must include:
- Applicators qualifications and experience conducting the work.
- Manufacturer's standard literature for dust palliative/stabilizer.
- Curing time for each application method.
- Application and dilution rates proposed for a soil defined by the following: medium grained, 0%-50% passing Tyler Sieve No. 4, 12%-50% passing Tyler Sieve No. 200. (These limits are for "typical" soil found on aviation property; however, other types/ranges of soil may be encountered.

- Equipment to be used during all phases of application.
- Description of any construction activities not specifically referenced in the bid.

The contractor was to provide all labor, material, and equipment to dust palliative/stabilizer:

Acrylic Polymer				
		Placement Procedure #1 Scarify & Compact	Placement Procedure #2 Topical Application	Placement Procedure #3 Topical Application
Soil Category	**Pricing Unit**	**Unit Price**	**Unit Price**	**Unit Price**
Medium Grained	Square Yard			

Description	Unit Price Per Cubic Yard
Fill Material	

Clearing America's Dusty Trails

Erosion Control Magazine - March-April 2003

Idaho's Ada County Highway District was searching for a compromise with local Boise hikers, bikers, and foothills enthusiasts over how to control the fugitive-dust problem on the unpaved, washed-out North 8th Street extension. The controversy over the rural road had begun when the highway district decided to pave it for easier maintenance and to prevent the erosion that occurs every spring from snowmelt runoff. Boise residents who use the road for outdoor sports and hiking were adamant that they wanted to retain the rustic feel of the area and to discourage motor vehicle traffic on the road.

A task force, made up of the City of Boise, the Bureau of Land Management, the United States Forest Service, and other agencies, searched for some common ground with the residents. It was more than happy, says Craig Quintana of the Ada County Highway District, when one local resident suggested Soil-Sement as a paving alternative.

Soil-Sement provided a workable solution for both sides of the 8th Street debate. For the highway district, **the polymer emulsion will act to prevent washboards from forming by creating a hardened surface and will control dust on the road.** Environmentally concerned citizens like the **soil additive's nontoxic, nonflammable, and nonpolluting characteristics**. "It looks like we might come up with a win-win situation, and it's not paving," says Boise City Councilwoman Paula Forney. "It solves the drainage issues and saves everybody money too."

In October, work crews began to apply the dust suppressant, manufactured by Midwest Industrial Supply Inc. in Canton, OH, to approximately 1.1 mi. of the Boise foothills road. If it passes the freeze-thaw cycles of Idaho's

harsh winter climate, the highway district will apply more of the dust-control material on unpaved roads around the Treasure Valley area.

The first application cost around $13,000, and each year the highway district will need to apply a $4,000 maintenance coating. The highway district says the savings are huge compared to the $30,000 it has been spending to maintain the pastoral atmosphere of the foothills road each year. **Soil-Sement has been tested, evaluated, and certified by some leading advocates of environmental technologies, including San Diego State University, the California Environmental Technology Certification, the Engineer Research and Development Institute, the Desert Research Institute, and the Arizona Department of Emergency and Military Affairs.**

Used for dust control, erosion control, and soil stabilization on unpaved roads, building pads, parking lots, fields, and other off-road motor vehicle parks, the product has a molecular structure that allows bonding and cohesion with small soil particles, resulting in a strong surface sealant.

After dealing with dust problems for several years at Lower Valley Turf Farm, Tom and Sandy Vanaken decided enough was enough. **The sod farm, located in Terrebonne, OR, had a stretch of unpaved road approximately 1.75 mi. long of heavy volcanic pumice soil.** Sandy says that with her allergies, the dust clouds made her miserable, and in March the Vanakens **worked with Round Butte Seed to get EnviRoad's Earthbind applied to the road**. "As far as farm traffic on the road, it's definitely helped us a lot," Sandy says. "It was absolutely worth the money, and we will be doing it again."

Earthbind is tank-mixed and diluted with water to be sprayed on the unpaved surface, where it provides a cohesive material to bind the dust particles. The parent company got its start in the 1970s when the family-owned and -operated business began applying lignin and magnesium chloride products for the US Forest Service in the Pacific Northwest. As concern for the environment grew, so did research that eventually launched Earthbind at the EnviRoad facility in Portland, OR. There the challenge was to develop a product that would meet the need for environmentally safe dust-control and soil stabilization.

At the King County Airport (Boeing Field) in Seattle, WA, Christine Thedens became concerned about the wind-blown dust coming off a previously designed art park at the airport. Originally, Ruby Chow Park had used ivy as its main ground cover. But when ivy became listed on the state's noxious-weed list, the entire area was sprayed out. "When it was taken out it left huge areas of bare ground and weeds," says Thedens, the perimeter lead for landscaping at Boeing Field. Thedens had a twofold mission. **She needed to suppress the dust blowing off the bare ground, but she also wanted to quickly establish more permanent turf and ground cover in the form of flowers and trees.** To solve her problem she turned to **Michael Alms, president of Growing Solutions Inc. in Eugene, OR. Growing Solutions manufactures "compost tea" systems designed for areas as small as five acres and as large as 100-acre farms. Municipalities, golf courses, and organic farms have used the system, which is also popular among greenhouses and nurseries in the Northwest.**

"In our system, we **extract microorganisms and nutrients from high-quality compost. When these extracts - or compost tea - are applied to the soil, the aggregate structure is improved, allowing for an increase in water retention and improved drainage**," explains Alms. "These conditions in turn provide an optimum environment for root growth, soil stability, and plant health."

For the King County Airport, Thedens says it has had a dramatic impact. She spent her first year mixing the compost tea, worm castings, and a proprietary catalyst agent in large garbage cans and applying it to the soil with buckets. But that

was the old way, she says. The compost tea proved itself, and the airport purchased a **Growing Solutions 12-gallon machine and a small spraying unit. The machine produces 120 gallons at a time of mixed solution** for the park and flower strips around the airport.

"We've been able to get great dust suppression because of the depth of the roots on our plants and the better-quality soil," Thedens says emphatically. "And dust suppression is very important at the airport because of the problems it can cause for the planes."

Watering programs and chemical stabilizers are common dust-control measures. **Although water is usually readily available and often considered to be the least expensive measure, it usually provides very temporary control, depending on the soil and climate at the site. Other problems associated with water use can actually make it more costly than other methods.** For example, for equipment such as rock quarry crushers, water can create problems when it's used in amounts needed to control the dust problem. Dust coming off the crushers can be so thick that to try to suppress it with water alone would cause clogged screens and downtime at the plant. Additionally, the grit caused by water is abrasive to equipment and increases maintenance costs.

Maryland-based Martin Marietta Magnesia Specialties produces a foam-based product that avoids some of the problems caused by using water alone. Dust-Buster is sprayed on the large rocks going into the crushers so that the resulting end product is already treated; hence, less dust coming off at the end of the line.

"Relatively speaking, **this is a short-term control on the end product**," explains Martin Marietta's Lin Midyett. "**It will dissipate after a period of time. In a few days it will be gone**." **Dust-Buster works by increasing the surface area of a small amount of water used and depolarizing that water. By creating literally millions of tiny bubbles of foam, the quarry uses possibly one-fifth to one-tenth of what it would otherwise use in a water-spray program.**

When developing dust-control options for unpaved roads, things to consider include how long the road will be operational and the volume and type of traffic it is expected to bear. There are basically three groups of control options, including restricting vehicle traffic, improving the road surface, and applying surface treatments, such as dust suppressants. Restrictions might include setting speed limits or limiting the weight or number of vehicles that may pass on the road. These measures have shown to provide moderate emission reductions when they are strictly enforced. Paving is a surface improvement that works well but is so costly that it often becomes unaffordable, and in some cases, such as the Boise 8th Street example, it's undesirable for other reasons. Paved roads also generally create more stormwater runoff. **Chemical dust suppressants offer the least expensive and most efficient option. Reapplication rates vary and are a major item to address in the development of a dust-control plan.**

Chemical stabilization treatments suppress dust by changing the physical characteristics of the soil surface. The effectiveness of these treatments is highly dependent on applicators strictly following the manufacturer's label directions. Each dust suppressant has its own restrictions on dilution rates, application rates, amount of time between applications, climatic conditions during application, and size, speed, and amount of vehicular traffic between applications. EPA field tests have demonstrated that when applied correctly, chemical dust suppressants provide, on average, about 80% control efficiency of PM_{10}.

Anthony Mariniello of the North Andover, MA, Rohm and Haas office notes that education about the correct application of the company's polymer products has become a major focus over the last few years. "We want to make certain that the product is used properly so customers will get the effectiveness. We would rather they not use our product than use it incorrectly."

PaveCryl Suppress Emulsion is one of the Rohm and Haas products used for dust suppression. **The vinyl/acrylic emulsion provides penetration and bonding when it is applied to fine or granular materials. "Basically it goes down wet, and then the water evaporates and the product hardens**," Mariniello explains. "**If they scarify the ground and mix and roll [the PaveCryl] in native soil, it can last as much as several years, with one-year topical touch-ups**." When PaveCryl is used for road stabilization, if potholes do begin to emerge, the holes can simply be filled in with a mixture of native soil and the emulsion; it adheres to the surrounding surface and becomes part of the treated road. **The lower viscosity of PaveCryl Suppress Emulsion compared to other vinyl/acrylic copolymers allows for easier transfer from tank trucks to bulk storage equipment. Less handling results in less foam generation and less of the polymer drying in the transfer lines.**

"PaveCryl Suppress Emulsion will actually cure, depending on the weather conditions, in a few hours, and it doesn't change the color of the soil," Mariniello notes. "Twenty minutes after application, you can't tell it's down."

Using various techniques, Maricopa County Department of Transportation conducted tests on dust palliative products with soil-stabilizing qualities. These tests were all done on low-volume roads, and it should be noted that under different traffic conditions the results might vary significantly. The use of product names does not constitute endorsement of any particular product, and they only are used in the context of the test results.

Dust Palliatives

Product	Application	Results
Soil-Sement	Surface application	Reduced dust 95% at 6 months
Road Master	Surface application	Reduced dust 50% for 2 weeks. Not effective at 6 weeks
Dusdown 28*	Surface application	Reduced dust for 3 months
Cohrex*	Shoulder application	Reduced dust for 2 months
Enduraseal 200*	Soil mixed	Reduced dust for 3 months
Dustac*	Soil mixed	Reduced dust for 11 months

* Tested with visual observation only

Soil Stabilizers

Cohrex	Bonded milled asphalt pavement well when mixed or surface-applied to the millings. Might extend life of millings.
Reclamite	Bonded milled asphalt pavement when mixed into millings.
B.C. Stabilizer	Bonded native soil together when capped with a chip seal. Performed well as a base stabilizer. Without capping breakdown occurred after 7 months.
Dustac	Bonded milled asphalt pavement together on the steep inclined road. Capped with a petroleum resin for waterproofing. Performed well in stabilizing a slope grade.
ERA-25/75/Cyclogen	Bonded milled asphalt pavement together successfully when capped with a chip seal.
Lime Slurry	Changed properties of native soil for improved strength.
EB001	Bonded native soils together. Capped with milled asphalt pavement. Shows promise.
Road Oyl	Bonded milled asphalt pavement together. Surface application shows promise.

Chemical Soil Stabilization

Erosion Control Magazine - January-February 2003

Despite all the work done by earthmoving equipment, each year wind and rain move much more soil than man could ever hope to shovel. And because soil is a finite commodity, one has to hold on to as much of it as possible. Plantings aid in this quest; the roots of trees and forbs help bind the soil, keeping it in one spot. **Some spaces, such as dirt roads and trails, however, can't or shouldn't be seeded, so what are the options for holding the soil?**

Water has traditionally been used on dirt roads for temporary dust suppression, but the oft-resultant mud not only impedes the area's use, it can also cause more eventual erosion - the mud can be carried away on shoes,

tires, or treads, and the gullies caused by heavy equipment can collect rainwater and cause washouts. If, as in the case of new home construction, the high-trafficked soil will eventually be planted, the cycle of water-mud-traffic can compact the soil so much that the homeowner will have a tough time getting anything to grow.

Many such problem areas are now being resolved by chemical intervention, with environmentally safe polymers that bind the soil, making it resistant to wind and water erosion. These **surface-applied chemicals usually create cationic actions that bind dust particles together, forming a semihard surface that resists wind, rain, and the ravages of traffic.** Midwest Industrial Supply in Canton, OH, offers a number of soil-binding products for a variety of applications. **Arena Rx**, for example, eliminates airborne dust in equine arenas, allowing humans and horses alike to breathe more easily. **Diamond Dr** is a dust control agent specifically designed for ball fields. **Dust Fyghter**, a chloride dust suppressant, absorbs moisture from the air and locks it into the soil. **Dustac** breaks down water's surface tension, increasing the attraction and encapsulation of dust particles. **Hydro-Plus**, which includes a wetting additive, helps eliminate heat or soil conditions that cause water to drain from seed, fertilizer, or mulch mix. **EK35** uses environmentally friendly synthetic fluids and rosins to provide a dust-suppressing weighting mechanism while acting as a durable, reworkable binder. Designed for intense-use traffic sites (even for tracked and chained vehicles) with heavy powder or surface dust, EK35 does not dry or cure but acts as a continuously active suppressant. The product, which is applied without water, works well with all aggregate materials and soil types. **Soil-Sement**, one of Midwest Industrial Supply's most popular products, prevents fugitive dust while providing erosion control. It can be applied to many surfaces and substrates, including unpaved roadways, well-graded aggregates, and clay, silty, or sandy loam soils. The product can also be used on storage piles of coal, minerals, ore, and limestone; on mine tailings, ash ponds and landfills; and on radioactive-containing and asbestos-containing soils. Soil-Sement can be used in compliance with PM_{10} air-quality and National Pollutant Discharge Elimination System stormwater requirements.

Sante Tulli, superintendent of Stavola Construction in Tinton Falls, NJ, uses **Soil-Sement** for dust control in housing development projects. "We **spray it onto the soil out of a water truck. It looks like Elmer's Glue when it comes out**," he says. "You get a little film atop the soil, which keeps dust to a minimum. **You can walk on that film without cracking it.** "We started using it three or four years ago," Tulli continues. "We spray it on housing development pads. If no one drives big equipment on it, it will last eight months to a year. We're very happy with it, and it keeps the area soil erosion people happy."

Environmental Products and Applications in Palm Desert, CA, has offered **Envirotac II** since 1986, producing more than a million pounds a month for a variety of applications: **dust control on landfill slopes, mining operations, freeway shoulders; in power plants on dissipation ponds; and in residential neighborhoods for erosion control**. "It's like liquid plastic. **It makes the soil water-resistant; although, when used in smaller quantities, it can be used as a tackifier**," describes John Vermillion, the company's president. "It's easy to **apply with a [hydroseeding machine] or a water truck**." Envirotac II can be added to a hydroseeding mix. "It will enhance the growth of seeds because it bonds with the seed and holds onto the dew to keep the seed moist, to aid in germination. But it won't hold too much moisture, which could make the seed moldy. It holds a certain amount of water but blocks water out if it gets too much."

The product poses no environmental concerns, Vermillion says. "**Envirotac II is like a water-based paint - it won't leach and is cured within 12 to 2 hours. Eventually UV [ultraviolet] light breaks it down, and it dissipates into the soil, but by then the vegetation will have grown up.** In the case of mining applications, **Envirotac II will be reapplied. It holds up one to three seasons, depending on the amount of rain.** Other customers spray Envirotac II on coal to keep it from igniting. **It's also used for erosion and dust control, like on unpaved roads**." The product was put to an unusual use recently during United States military operations in Afghanistan.

From its offices in North Andover, MA, chemical giant Rohm and Haas Company supplies the industry with **PaveCryl Suppress**, a product that offers dust suppression and road stabilization. According to the company, **the vinyl/acrylic emulsion provides optimum penetration and bonding when applied to fine or granular materials such as soil or dust-producing gravel.** Treating an area with PaveCryl Suppress **results in a durable water-resistant surface**. "Although it's water-resistant, the surface is still permeable," says Anthony Mariniello of Rohm and Haas's Road Construction Chemical Group. "And it is, of course, a water-based product. When applied to a surface at dust-suppression strength, it's like a 'liquid crust.'" **At higher dilution levels, PaveCryl Suppress can be used in a hydroseeding mix.** "Sunlight eventually breaks it down, unlike MC-70 oil, which never dries and is always in the environment."

Chris Rider, owner of **DirtGlue Enterprises** in Mendon, MA, offers an anecdote about his product's genesis: "Rohm and Haas originally made the formulation for the paint industry, so paint could be water-based. They found problems with production; the formula wouldn't work with paint, so they used to throw it away. Environmental Products & Applications put it on the ground to suppress dust, and the formula turned out to be better than the alternatives."

"I learned of this product about 16 months ago and started my own firm," Rider continues. "I'm not exclusively doing slopes and roads; I have even been experimenting with the product for unrelated uses. For example, I recently built an addition to my house and, instead of using tar to seal the concrete before backfilling, I sprayed the foundation with DirtGlue. It went on smoothly, not leaving any air bubbles, as tar can. It dried in 15 minutes, instead of tar's two to three days, and I effectively sealed the foundation, giving it a plastic-type coating. Since I backfilled, it will never be exposed to UV, so it shouldn't break down. I believe DirtGlue's eventual uses will be limited only by one's imagination."

Rider has also used DirtGlue for its original intent. "**Many roads in rural Pennsylvania are dirt roads, which get washed out by snowmelt. The state also has 18,000 miles of gravel roads. Pennsylvania offers a Dirt and Gravel Road Program, in which towns get 100% reimbursement for road repair as long as they have state-approved training. One goal of the project is to keep silt and pollutants out of the streams; Pennsylvania wants no more oil going down on gravel roads**," he points out.

"Penn State presents agricultural demos, which include new technology, during which about 100,000 people show up for each of the three-day events," he continues. "We did a demonstration, an application at Penn State, **putting DirtGlue on farm lanes. To show farmers this indeed could be done easily, we used old tractors from the 1950s, with a manure spreader, to spread the DirtGlue, to 'blow' it onto the road. There were no negative comments with our results. Roads are likely the best application for high-concentration DirtGlue because it contains two different polymers plus a UV stabilizer, so you wouldn't use it at this strength on a slope because it doesn't break down."**

For dirt or gravel roads, Rider explains proper application: "First, you scarify the surface. If the use is light parking, you'd scarify maybe to three inches, up to 8 inches - 10 inches if it's a road at a quarry, for example. Apply this to the entire depth to saturate the soil. Next, grade it when it's wet - very little sticks to the blade. The last step is very important: Compact it, probably with a vibratory compactor, when it's wet. The less air, the stronger the bond."

When he receives his basic mix from Rohm and Haas, it's "50% solid and 50% water," Rider says. "Depending on the application, we dilute it between four-to-one to 12-to-one. It's about the same texture as latex paint and smells slightly like Elmer's Glue before it dries. DirtGlue can be an excellent additive to hydroseeding; wind or water can't erode it, and it acts slightly as a nutrient when it breaks down. We've noticed that birds don't bother it either."

Rider confirms that DirtGlue is safe for the environment. "It's not actually water-soluble but waterborne. It has a high LC50 [lethal concentration in water having 50% chance of causing death to aquatic life] - 50,000 ppm for 96 hours was a lethal dose for trout."

Materials to which the product has been applied can be recycled. "Unlike asphalt, you can reuse the stuff, such as gravel, that's been sprayed with DirtGlue," Rider points out. "In fact, you could probably spray this on concrete abutments, to keep them from spalling from salt. Of course, you'd first have to remove anything loose or moldy. You'd have to give it a maintenance coat once a year, to fill in any nicks or scratches, but the repairs would be virtually invisible and stronger than the original. DirtGlue bonds to itself very well."

According to an abstract published by the Cognis Corporation of Cincinnati, OH, and Duesseldorf, Germany, the company's Terra-Control Soil Stabilizer, a polyvinyl acetate-based formulation, forms a three-dimensional membrane structure that holds seeds and soil in place while allowing water and oxygen penetration (see the article "Environmentally Favorable Erosion Control With a Polyvinyl Acetate-Based Formulation" at www.kiwipower.com/QEI_Atlas_article.html). Various tests and field trials in the US, Europe, Australia, Malaysia, and Africa revealed that Terra-Control improved soil structure by increasing water and air permeability, the stability of soil aggregates, and infiltration/drainage. The product was also shown to reduce water demand; test plots of lettuce seedlings that received applications of Terra-Control yielded identical plant biomasses to the control groups while reducing water demand between 5% and 50%. Even in Algeria's sandy soil, with temperatures of 35°C - 0°C (95°F - 10°F), soil saturation was improved 30% - 0%.

Other trials with the product revealed that seeds germinated two to five days earlier and that grasses had a higher germination rate (more than 20%). The product also helped retain soil during strong precipitation and despite wind erosion.

The abstract also states that no toxic effects against plants, soil bacteria, and fungi are known and that acute toxicity of the primary degradation products of the ingredients is accordingly very low. Toxicity to fish (golden orfe) and Daphina magna (acute, 8 hours) rated an LC50 >100 mg/l; toxicity to bacteria (*Pseudomonas putida*) for the same period rated LC0 >10,000 mg/l.

Nashville, TN's Cypher USA, a subsidiary of Cypher International, produces a similar product, **EarthZyme**. The **multienzyme product was developed as an aid for the workability, mixability, binding, and compaction of soil, improving stability in road, dam, and landing-strip construction**. **The biodegradable product is suspended in water, and its cationic action binds soil particles together.**

When used on unsealed roads, EarthZyme creates a strong, dense pavement. Trials show that when EarthZyme is used, unsealed-road maintenance can be reduced significantly; less dusting occurs, and gravel might last up to two years longer before re-sheeting is required. **If used on subgrade materials, EarthZyme shows its greatest effect on clay, a soil type that can bond itself into a concrete-like material. (Because of the properties of the three main soil types, most chemical intervention products work much better on clay than on sandy or loam soils.)** When applied to natural subgrades, EarthZyme has produced California Bearing Ratio increases of 30% - 0%; -5% increases in density can also be achieved, and reductions in both optimum moisture content and plasticity index can occur. Such improvements in soil strength can reduce the need for the purchase and transport of base gravels. EarthZyme can increase the physical characteristics of lower-quality base-course material with too high a clay content, bringing it to a suitable seal standard.

Potential Environmental Impacts Of Dust Suppressants

An Expert Panel Summary - May 30 - 31, 2002

In the past decade, there has been an increased use of chemical dust suppressants, such as water, salts, asphalt emulsion, vegetable oils, molasses, synthetic polymers, mulches, and lignin products. Dust suppressants abate dust by

changing the physical properties of the soil surface and are typically used on construction sites, unpaved roads, and mining activities. The use of chemical dust suppressants has increased dramatically due to rapid population growth and increased emphasis on the need to control particulates in the interest of air quality. In the United States, there are over 2,500,000 km of public unpaved roads, of which 25% (625,000 km) are treated with chemical dust suppressants. A critical problem in the arid southwestern U.S. is dust suppression on land disturbed for residential construction.

The purpose of this report is to summarize the current state of knowledge on the potential environmental impacts of chemical dust suppressants. Furthermore, the report summarizes the views of an expert panel that was convened on May 30-31, 2002 at the University Of Nevada, Las Vegas to probe into the potential environmental issues associated with the use of dust suppressants.

The majority of research on dust suppressants has been by industry and has focused on the effectiveness (or performance) of dust suppressants to abate dust, however, little information is available on the potential environmental and health impacts of these compounds. Impacts will depend upon their composition, application rates, and interactions with other environmental components. Potential environmental impacts include: surface and groundwater quality deterioration; soil contamination; toxicity to soil and water biota; toxicity to humans during and after application; air pollution; accumulation in soils; changes in hydrologic characteristics of the soils; and impacts on native flora and fauna populations.

Potential environmental impacts include:

- Surface and groundwater quality deterioration
- Soil contamination
- Toxicity to soil and water biota
- Toxicity to humans during and after application
- Air pollution from volatile dust suppressant components
- Accumulation in soils
- Changes in hydrologic characteristics of the soils
- Impacts on native flora and fauna populations

Water quality impacts include:

- Possible elevated chloride concentrations in streams downstream of application areas
- Shallow groundwater contamination
- Negative impacts on plant growth, in the area near the application of salts
- Reduced biological activity and retarded fish growth, for organic non-petroleum based dust suppressants, (e.g., ligninsulfonate)
- Toxic to avian eggs, for organic petroleum-based dust suppressants
- Heavy metals and PCBs, for recycled oil waste

The expert panel was not able to identify specific concerns on the use of dust suppressants due to the high amount of variability associated with site conditions, dust suppressant composition, and application techniques. The experts did agree more attention should be paid to dust suppressant composition and management. The determination of whether a problem might exist in any given case, however, must be based on the assessment of site-specific condition.

There are no federal regulations controlling the application of dust suppressants; however, some states have developed guidelines for the use of dust suppressants. These include:

- **U.S. Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) Program:** Voluntary and available to any developer/vendor of environmental technology, including dust suppressants; created by

partnerships between regulatory environmental agencies and either the private sector or non-profit organizations, with an emphasis on the performance claims and some environmental tests of the products. Responsibility of the technology vendor/developer to provide sufficient performance data and documentation to support the claims of the technology under consideration. Note specific tests that have to be performed to evaluate the environmental impacts of the products under consideration. Scientists and engineers form regulatory agencies, universities, research laboratories, and the private sector examine the supporting documentation for product verification. Issues a report or certificate as proof of verification. Requires acute and chronic toxicity tests and analyses of biological oxygen demand, chemical oxygen demand, volatile organic compounds, toxicity characteristic leaching procedure, inorganics/metals, semi-volatile organics, volatile organics, pesticides/herbicides, and PAHs.

- **California Environmental Technology Certification Program (CalCert):** Voluntary and available to any developer/vendor of environmental technology, including dust suppressants; created by partnerships between regulatory environmental agencies and either the private sector or non-profit organizations, with an emphasis on the performance claims and some environmental tests of the products. Responsibility of the technology vendor/developer to provide sufficient performance data and documentation to support the claims of the technology under consideration. Scientists and engineers form regulatory agencies, universities, research laboratories, and the private sector examine the supporting documentation for product verification. Issues a report or certificate as proof of verification. Issues a report or certificate as proof of verification. Required renewal of the verification after three years.

- **Application Of Oil Field Brine Regulations - Michigan:** Created specific regulations for the application of oil field brine as a dust suppressant. Does not specify any specific test methods. Establishes acceptable application rates, methods, and types of areas where it can and cannot be applied. Requires the property owner or contractor to maintain detailed recordkeeping of the specific locations, amounts, and source or brine applied.

- **Interim Guidelines For Dust Palliative Use In Clark County, Nevada:** Issued detailed interim guidelines for the use of dust suppressants on disturbed lands. The guidelines were drafted by a working group composed of air and water quality professionals from state and local agencies, as directed by the Clark County Commissioners. Guidelines specify types of areas where the application of specific dust suppressants are discouraged. Contains recommendations on the types of suppressants, dilution, and application rates to be used in different types of dust control areas (e.g., roads, construction sites). Discourages the application of products known to potentially contain specific pollutants near lakes, streams, channels, and flood control channels.

- **Dirt & Gravel Roads Maintenance (DGRM) Program - Pennsylvania:** Developed by joint efforts of conservation interests, academia, and industry; is used for all materials, including dust suppressants, for projects funded by the Dirt And Gravel Roads Maintenance Program under the State Of Pennsylvania Conservation Commission. The stringent specifications require product testing by a certified lab and manufacturer guaranteed product uniformity, delivery, application, and cure. Results in the program have been positive and reception by industry strong. It has been used voluntarily by other. Responsibility of the technology vendor/developer to provide sufficient performance data and documentation to support the claims of the technology under consideration. Note specific tests that have to be performed to evaluate the environmental impacts of the products under consideration. The data supporting the claim, issued by the EPA certified labs, are evaluated by the State Conservation Commission for authenticity. Issues a report or certificate as proof of verification. Requires bulk analysis of products using EPA SW-846 tests (originally designed for testing RCRA wastes), leach analysis by EPA Method 1312 (includes metals, volatiles, and semi-volatiles), 7-day survival and growth test for rainbow trout, BOD, and COD.

● **Environmental Technology Verification Program - ETV Canada, Inc:** Voluntary and available to any developer/vendor of environmental technology, including dust suppressants; created by partnerships between regulatory environmental agencies and either the private sector or non-profit organizations, with an emphasis on the performance claims and some environmental tests of the products. Responsibility of the technology vendor/developer to provide sufficient performance data and documentation to support the claims of the technology under consideration. Scientists and engineers form regulatory agencies, universities, research laboratories, and the private sector examine the supporting documentation for product verification. Maintains a list of approved expert entities (e.g., universities, private consultants) to be used to conduct tests to support the verification. An agreement is reached with the vendor/developer regarding the expert entity to be used in the technology verification process. Issues a report or certificate as proof of verification. Required renewal of the verification after three years.

Although there are no specific regulations in place to control dust suppressant application, the following regulations restrict the introduction of harmful substances into the environment:

- Resource Conservation Recovery Act (RCRA)
- Comprehensive Environmental Response Compensation And Liability Act (CERCLA)
- Superfund Amendments And Re-Authorization Act (SARA)
- Clean Water Act (CWA)
- TOSCA (Transformation Of The Secondary School System And Academic Careers)

There is significant regional variation in the use of dust suppressants. In Pennsylvania, the major use is on unpaved roads. In other parts of the eastern United States, dust suppressants are used on landfills, coal fields, steel mills, and mines. They are also used as temporary covers on lands that are disturbed for short periods, such as slopes exposed during road construction that are eventually re-vegetated. In Texas, dust suppressants are used largely on construction sites with disturbed lands and haul roads. In Clark County, Nevada, and other parts of the southwest, 90% of the use is on disturbed vacant land - land that has been cleared for residential or commercial development but on which construction has not yet begun. In some cases, disturbed land can remain vacant for several years. In eastern Oregon and Washington, dust suppressants are used on fallow agriculture fields. The United States Department Of Agriculture (USDA) Forest Service also uses dust suppressants on unpaved roads.

The following items would cause the expert panel to limit the use of dust suppressants:

- Data indicating a potential ecological impact (e.g., plant stress, isolation of animal communities, habitat disruption)
- Data indicating carcinogens, toxins in levels that would cause negative impacts in human health
- Industrial waste by-product containing potential toxic contaminants
- Suppressants containing significant amounts of products regulated under FIFRA (Federal Insecticide, Fungicide, And Rodenticide Act), TSCA (Toxic Substance Control Act), and RCRA (Resources Conservation And Recovery Act)
- Potential or observed negative impacts to adjacent landowners

Other considerations that should be made before using/allowing the use of dust suppressants:

- Primarily, materials that fail existing regulatory thresholds for toxicity and those containing FIFRA, TSCA, and RCRA regulated compounds should not be used as dust suppressants.

- Chlorinated compounds and materials containing any paints should be carefully evaluated, if used in a dust suppressant.
- Food products (e.g., soy oil, molasses) could be used, when possible, because food products are likely to contain less toxic compounds than the industrial materials and waste products currently used as dust suppressants.
- Natural products are likely to biodegrade in the environment and toxic effects are expected to be minimal. But the makeup of these products needs to be considered, since some biodegradable products can be toxic before degradation occurs.
- A guideline should be drafted to indicate where specific dust suppressants should be applied. Application of chemical dust suppressants should be avoided near sensitive environments, near water bodies and fractured rock, and other areas where water could quickly reach the saturated zone. Site-specific characteristics should be considered, when approving the use of dust suppressants. Dust suppressants should be screened via certification program and a proper monitoring program of product makeup over time. Also, the number of dust suppressants to be applied could be limited to specific types, which would facilitate regulation and monitoring of the environmental impacts.
- The smell and the visual impact of dust suppressants should be considered.
- Information on environmental impacts and effectiveness of dust suppressants should be used together, when determining the type of dust suppressant to be used.

There are a significant number of “data gaps” that need to be filled to more adequately address environmental and regulatory issues. The following issues/questions need to be addressed/answered before a decision can be made about whether or not more federal regulation is need:

- Better definition of what is meant by “effective” dust suppressant
- Better understanding of dust characteristics as an air pollutant
- Better understanding of how dust suppressants change after application
- Better definition of current and potential problems/uses
- Source of dust suppressants and dilution water
- Clearinghouse for dust suppressant information
- Risk assessment and how to decide what to test for

Preventive Maintenance For Unpaved Roads And Shoulders

Conference Presentation - Fugitive Dust Control In The Western United States: Past, Present, And Future
May 10 - 11, 2005
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Preventive chemical stabilization programs not only produce dust control, they also produce: cost reductions, higher service levels - including safety, reduced backlogs, and high constituency approval. Preventive maintenance is a planned strategy utilizing cost effective chemical treatments on existing unpaved roadway system (including shoulders) that preserves the system, retards future deterioration, and improves the functional condition of the system, without increasing costs. Unpaved road traffic volumes are not proportional to the lane mile that must be maintained, therefore increasingly important to follow good design, good maintenance, and good rehabilitation.

On average a mile of road looses 1-inch of surface or 500 tons/year.

California (Kern County and Fresno County) shoulder preventative maintenance is cost effective - almost three-times the miles for 15% of the cost of paving.

Paved And Unpaved Surfaces: Emission Control Methods And Their Cost Effectiveness

Conference Presentation - Fugitive Dust Control In The Western United States: Past, Present, And Future
May 10 - 11, 2005
Richard J. Countess
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Published Measures For Paved Surfaces Show Large Variability

Water flushing:	50% – 70%
Sweeping:	4% - 26%
Covering haul trucks:	>90%
Prevention of trackout:	42% – 80%
Cleanup of spills as soon as possible:	>90%

Published Measures For Unpaved Surfaces Also Show Large Variability

Paving:	>90%
Watering:	10% – 74%
Chemical stabilization:	60% – 90%
Surface improvement:	60% – 90% (for gravel)
Vehicle speed reduction:	44% (limit speed <25 mph)

Estimated Costs Of Paving Access Roads In PM_{10} Non-Attainment Areas

Typical Section RTC Standard DWG No. 209
3" asphalt, 32' wide
10" Type II aggregate base with 2' aggregate shoulders
Estimated Costs ($/linear foot)

Type II aggregate at $10/ton:	$19.84
Excavation at $4/cubic yard:	$5.78
Scarify at $0.50/square yard:	$2.00
Asphalt at $30/ton:	$18.60
Total paving cost:	$46.22
Engineering cost:	$8.78
TOTAL COST	**$55.00 ($290,000/mile)**

Cost - Measures From The San Joaquin Valley's PM_{10} SIP ($/ton PM_{10} reduction)

Replace a non-PM_{10}-efficient sweeper with a PM_{10}-efficient unit every three years:	$792
Sweep streets with PM_{10}-efficient sweepers at least once per month:	$1,070
Clean up deposits/spills within 24 hours of discovery:	$2,850
Pave shoulders to a width of 4 feet:	$13,800

Cost - Unpaved Surfaces From The San Joaquin Valley's PM_{10} SIP ($/ton PM10 reduction)

Limit speed on unpaved roads to 25 mph:	$1,080
Pave unpaved roads in urban areas:	$2,160
Pave unpaved parking lots:	$22,800
Water unpaved parking lots daily:	~$2 x 10^6

Emission Control Methods For Construction And Their Cost Effectiveness

Conference Presentation - Fugitive Dust Control In The Western United States: Past, Present, And Future
May 10 - 11, 2005
Frank Elswick
Midwest Industrial Supply, Inc.

Dust Control For Construction

There are a wide variety of products and methods to deal with dust control issues at a construction site, each with its own attributes and limitations. Dust suppressant methods fall into six categories:

- Watering
- Chemical Stabilizers
  - Water absorbing products
  - Organic petroleum products
  - Non-organic petroleum products
  - Polymer products
  - Synthetic products
- Sand fences
- Perimeter sprinklers
- Tire cleaning systems at site exit
- Rumble strips or other trackout preventers
- On-site speed control

Chemical Stabilizers

Water Absorbing Products

Costs associated with traffic areas - not suitable for non-traffic areas

Material cost: ~ 3¢ - 5¢ per square foot
Frequent re-application in dry climates
Must be watered to activate during dry months
Potential costly environmental impacts to fresh water aquatic life, plants and water quality
Corrosive to metal and steel

Organic Petroleum Products

Costs associated with traffic areas - not suitable for non-traffic areas

Material cost: ~ 5¢ - 75¢ per square foot
Potentially costly environmental impacts due to presence of polycyclic aromatic hydrocarbons (PAH's)
Can fragment under traffic conditions

Non-Organic Petroleum Products

Costs associated with traffic areas - not suitable for non-traffic areas

Material cost: ~ 4¢ - 7¢ per square foot
Ligninsulfonates can impact freshwater aquatic life due to high B.O.D. and C.O.D
Performance affected by rainfall
Limited availability

Polymer Products

Costs associated with traffic and non-traffic areas

Material cost: Non-traffic areas: ~ $300 - $800 per acre
Traffic areas: ~ 5¢ - 8¢ per square foot
Polymers dry virtually clear to create an aesthetically pleasing result
Polymers create a tough yet flexible crust to prevent wind and water erosion

Synthetic Products

Costs associated with traffic areas

Material cost: 5¢ - 10¢ per square foot
Non-hazardous per OSHA, EPA, and US DOT
Contains no asphalt, oil, or PAH's
Easy application
No water required

Preferred Control Measures By Dust Source

Dust Source	Preferred Control Measure	Cost Effectiveness
Site Preparation Bull-dozers Scrapers Grading operations	Pre-watering and as-needed watering	Costs range geographically but generally are $55 - $80 per hour
Disturbed Non-Traffic Areas Building pads Fairways prior to landscaping Inactive borrow pits	Polymer products Generally preferred for their binding properties, pleasing aesthetics, superior performance, and cost effectiveness	$300 - $800 per acre depending on longevity desired
Inactive Stockpiles	Polymer products	$500 - $1,000 per acre
Slopes	Polymer products	$500 - $1,000 per acre
Traffic Areas Haul roads Unpaved parking Equipment yards Laydown yards	Chemical stabilizers Soil type, road stability, climate, and traffic demographics dictate which chemical stabilizer	Costs vary with products used, type of traffic, stability of road base, level of dust control desired but are generally 4¢ - 8¢ per square foot applied
Site Exit Roads	Tire cleaning system	
Active Construction Areas	Synthetic products	5¢ - 10¢ per square foot applied

Performance, ease of application, and environmental data factor into cost-effectiveness. Developers should require complete aquatic toxicity and environmental data on any product before allowing its use on-site for greatest reliability and protection of use. Products should be independently tested and certified by the California Environmental Technology Certification Program (CalCert), California Air Resource Board (CARB), and the U.S. Environmental Protection Agency Environmental Technology Verification Program (EPA-ETV).

Parking Possibilities On One Acre

According to the Final BACM Technological And Economic Feasibility Analysis prepared by Sierra Research, Inc. for San Joaquin Valley Unified Air Pollution Control District dated March 21, 2003, the minimum area needed to park 1,000 vehicles is estimated to be 400,000 square feet or 9.2 acres. This estimate is derived from parking requirements contained in the Transportation And Traffic Engineering Handbook-Institute Of Traffic Engineers-1976 and is adjusted to account for the lack of striped lines on an unpaved parking lot and to account for 400 square feet being needed per parking space. Watering 400,000 square feet or 9.2 acres of unpaved parking lot is estimated to cost $264 per day.

Baseline emissions have been computed on the basis of the California Air Resources Board emission factor for unpaved road travel adjusted for a vehicle speed of 10 miles per hour. This adjustment resulted in an emission factor of 0.77 pounds of PM_{10} per vehicle-mile traveled and daily emissions of 185 pounds of PM_{10} per event day of parking 1,000 vehicles.

Watering of special event unpaved parking areas could be one of several alternatives (i.e., paving, applying gravel, apply dust suppressants other than water). If a polymer emulsion were applied to 400,000 square feet or 9.2 acres of unpaved parking lot, then the estimated cost would be $5,340 per acre or $49,100 per year. The cost effectiveness of

annual polymer emulsion application to a special event parking lot handling 1,000 vehicles per day for 10-100 days per year was estimated to range from $2.99 per pound-$29.90 per pound or $5,980 per ton-$59,800 per ton of PM_{10} reduced.

According to the Particulate Control Measure Feasibility Final Report prepared for Maricopa Association Of Governments dated January 24, 1997, the cost of mitigating a one-acre parking lot with four inches of aggregate base and two inches of asphalt paving would cost $31,400. The annual maintenance costs are estimated to be $300 per acre.

In a study conducted by San Joaquin Valley Unified Air Pollution Control District, the cost of watering an unpaved parking lot one acre in size or larger once per day, immediately prior to the commencement of parking activity, is estimated to be $68 per day.

According to Controlling Particulate Matter Under The Clean Air Act: A Menu Of Options prepared by State And Territorial Air Pollution Program Administrators (STAPPA) and Association Of Local Air Pollution Control Officials (ALAPCO) dated July 1996, some fugitive dust sources may be considered insignificant. The Environmental Protection Agency (EPA) has suggested that the following sources have little effect on PM_{10} emissions:

- Disturbed ground of less than 1 acre
- Construction or demolition projects with a floorplan of less than 10,000 ft^2 or movement of less than 250 yd^3 of dirt or rock
- Paved and unpaved driveways, public easements, and shared public access roads serving a maximum of 20 single-family dwellings
- Paved and unpaved roads with road length or less than ½-mile or less than 20 vehicle trips per day
- Storage and handling of material of a volume less than 250 yd^3 or total annual throughput less than 2,000 tons

Trail Traffic Conflicts Among Hikers, Bikers, And Horse Riders Cause Dust-Ups On The Ground

Los Angeles Times - Doug Duhigg
March 24, 2005

"You see those!" said Jim Frapton, a day hiker from Los Angeles, pointing to deep grooves from bike tires. "The mountain bikers are killing this forest! They come around corners at 30 mph! They'll kill me someday, or I'll kill them first."

Such discord echoes across California as well as Moab, Utah, the Denver area and most anywhere cities lap against mountains. As **competing users crowd onto trails, they blame one another for ruining their outdoor experience yet often overlook how their own activity affects trails and other users**. Hard feelings sometimes result in fistfights, sabotage and lawsuits.

Experts say trails were not designed for so many different users, which exacerbates the problem.

"Almost since mountain bikes were invented, there have been conflicts over trail use," said Pam Gluck, executive director of American Trails, a multiuse advocacy group. **"Everyone blames someone else for trail damage, and each group has different expectations." Hikers point fingers at mountain bikes, and cyclists blame horses, but all users contribute to erosion. Studies show that hiking boots and bike tires cause similar erosion, but horse hoofs do the most damage.**

In one key study, two Montana State University scientists installed pipes to simulate rain across 108 portions of trails in and around Gallatin National Forest. They hiked and rode bicycles and horses 100 times and measured how boots, hoofs and tires displaced soil.

They found that hikers and horses "have more surface contact than ... the mountain bike, so statistically, boots and hoofs cause more change," said coauthor and geography professor John Wilson, who now teaches at USC.

The study, published in 1994 in the journal Mountain Research and Development, also concluded that wet soil erodes more than dry ground, though the study examined only a few soil types.

In a separate but similar study, a pair of Canadian researchers at the University of Guelph in Ontario hiked and biked 500 times across four plots, each a meter long, in Boyne Valley Provincial Park, then counted the plant stems and plant species and measured the soil displacement in the affected ground. They found that both activities eliminated plants on the path and increased the amount of upturned soil by 54%. (The study only examined bikes and hikers moving downhill on dry trails in deciduous forest.) The findings, published in 2001 in the journal Environmental Management, show "that at a similar intensity of activity, the short-term impacts of mountain biking and hiking may not differ greatly."

But hiking advocates say those studies don't consider the extended range of bikes. **"If a mountain bike travels 50 miles in a day, and hikers travel only five miles, the destruction caused by bikes is 10 times greater,"** said Michael Vandeman, a San Francisco hiker who lobbies to close trails to cyclists.

Real forest damage, say hiking and biking enthusiasts as well as experts, is caused by poorly designed trails.

National Park Service officials say they can build lots of trails, but they all erode in time. "Once rainwater begins following a rut created by a trail, the soil will eventually become damaged," said Steve Griswold, a trail builder at the Golden Gate National Recreation Area. "If a trail is designed properly, no one group will do more damage."

Off-path destruction is another concern. It occurs when hikers and riders strike out to form new routes or find sites not connected by trail. Said Gluck of American Trails: "A good trail must anticipate what people want. If there aren't any trails leading to a fantastic overlook, hikers will create their own. If signs don't clearly communicate where trails lead, people will cross back and forth."

Outdoors users often hit the trail with strikingly different expectations of what fun is all about. Social scientists say those hopes lie at the root of conflicts.

U.S. Forest Service studies show that whereas hikers frequently seek tranquility, mountain bikers want adrenaline. Hikers polled in the Los Padres National Forest in 1989 said they objected to mountain bikers because they ride too fast, have difficulty stopping on blind corners and startle equestrians and hikers.

"Bikes are silent and fast," said Jim Absher, a social scientist with the Forest Service. "If you've ever experienced someone roaring around a corner at 30 mph, it's terrifying. That feeling is the opposite of what hikers want from a forest trail."

Back at the Mulholland trail in the Santa Monica Mountains, Frapton dittoed that. "I come here to relax, but it's impossible with all the bikes constantly zipping past," he said. "These paths were built for hiking."

But a mountain biker prepping his bike nearby disagreed. He said cyclists are not unmindful of hikers.

"I always make it a point to be courteous to hikers," said Jerry Flattery, 48, of Los Angeles, sitting atop his silver mountain bike. "There's more bikers out here than hikers. If we use it more, why shouldn't it be ours?"

Despite safety concerns, accidents seem rare. A 1993 study of 40 Forest Service managers found that only one hiker had been injured by a mountain bike in the previous year.

Another federal survey of 1,400 users in California's Los Padres National Forest in 1989 found that only 15 bike and hiker encounters were potentially harmful, and the only accident involved bikes colliding with each other - when riders tried to avoid a hiker.

To prevent conflict, officials and trail users call for more paths to separate bikes, horses and hikers.

"If I want to encourage bikers to go one direction and hikers another, signs are ineffective," said Joey Klein, a trail building specialist with the International Mountain Bike Assn. "Instead, I'll have the trail go through sand. Bikers hate sand, but hikers love it."

Klein designed a Black Canyon trail in Prescott National Forest in Arizona with water crossings that attract equestrians and dog walkers but deter bikers.

The goal, Klein said, is to create trails that encourage users to move at the same speed - like the rocky paths around Fruita, Colo., that force bikers and hikers to slow down.

"Hikers want to get to the summit as fast as possible, but bikers don't care about vistas," Klein said. "Instead, they want hills that feel like a roller coaster."

Physiographic Components Of Trail Erosion

Ian Chandler Paterson Godwin - Montana State University
August 2000

The purposes of this project are to estimate the relative effects of compaction and erosion on trail cross sectional area along the New World Gulch Trail, Montana, and to better understand the relationship between erosion, compaction, local topography, vegetation, soil bulk density, and soil texture. **While compaction has been measured and observed to be an important component contributing to trail erosion, it has not been evaluated as a possible cause for the "missing" trail cross-sectional area commonly used to quantify the amount of erosion from a given point.** Similarly, aside from the "Leave No Trace" principal of traveling cross country on durable surfaces to minimize erosion, the bulk density of pre-trampled soils has been overlooked as a significant control on erosion. The results should assist forest and park managers in evaluating the appropriate location for planned and future trails.

The type and amount of use have been identified as important controls on the amount of trail erosion (McQuaid-Cook, 1978; Summer, 1980; Cole, 1983; Vogler and Butler, 1996; Seney, 1991), although studies have been hampered by the scarcity of data on users in back country areas (Krumpe and Lucas; Daigle, et al., 1994). More people tracking over the same land reduce the vegetative cover and increase disturbance to the soil surface. **Different user types, such as hikers, bikers and horses, all may eliminate vegetation and disturb soil particles, but each produces different amounts and rates of soil erosion on trails.** Wilson and Seney (1994) found that different user types caused differing amounts of soil displacement depending on whether they were ascending or descending a trail. **Generally, horses caused the most soil displacement when descending trails, followed in quantity by hikers and mountain bikers. Mountain bikers produced the most soil displacement when ascending trails, followed by hikers and horses.** Soil compaction and bulk density soil compaction may result when pressure is applied to soils. Compaction increases the soil's bulk density and decreases its porosity, which in turn reduces the infiltration rate, influences plant root propagation, and increases the potential for overland flow (McQuaid-Cook, 1978; Quinn et al., 1980; Vogler and Butler, 1996). Compaction often occurs in soils under intensive agriculture, grazing, and forestry. Animals, machinery and the dragging of fallen logs can exert pressures up to 100 kPa (Marshall et al., 1996).

According to Vogler and Butler (1996), paths on level ground at their university campus were more susceptible to compaction than they were to water erosion. Their assertion is based on previous research by others (Liddle, 1975; Bratton et al., 1979; Coleman, 1981; Morgan and Kuss, 1986; Garland, 1990; Ferris et al., 1993; Wilson and Seney, 1994) showing the effects of trampling on trail soil, and they suggest that soil bulk density data on paths and in adjacent un-trampled areas be collected to evaluate differences in compaction. They observed a weak correlation between depth of

path incision and slope, though they ascribed the relationship more to the user types than specific terrain attributes. They found that the steeper paths were located next to stairways and used almost exclusively by bicyclists.

In their laboratory based experiments, Quinn et al. (1980) found that the maximum compressive load occurs as a hiker's heel places pressure on a small contact area of the ground. In keeping with their findings regarding the compressive effects of the heel, Quinn et al. viewed the shearing action associated with toe action at the end of each step, and loss of vegetation, as the major controls on soil detachment.

Horses In Ecological Reserves

Buzz Williams - Executive Director - Chattooga River Watershed Coalition
Georgia Conway and Linda Conway - Durver-Conway Conservation, Inc.
November 1998

Contemporary use of horses in the ecological reserves in the moist forests of the eastern U.S. may be a different proposition than the use of horses in the more arid West, for both historical and environmental reasons. Regardless of the ecosystems or the historical significance of the horse to human activity in that system, our main focus in ecological reserves must be to protect and restore natural biodiversity. Horse impacts on natural ecosystem components and processes must be minimal, and mitigated wherever they do occur.

The problems that we perceive with horse trails in ecological reserves regarding biodiversity protection are:

- Erosion and sedimentation
- Carrying capacity as related to desired experience
- Resource damage
- Exotic species

We make the following suggestions to document, research, and mitigate impacts in ecological reserves:

- Increase appropriations for Federal and State agencies that manage ecological reserves
- Increase appropriations for Federal and State research programs to address trail maintenance and construction
- Develop positive monetary incentives for horse trail construction and maintenance within ecological reserves on private lands, and base construction and maintenance on sound science
- Encourage academic participation
- Educate the public with economic and ecological facts about horse trails in ecological reserves

We suggest the following guidelines for regulating horse impacts in ecological reserves:

- Establish carrying capacities for ecological reserves
- Explore the feasibility of user fees

The current management direction for horse trails in ecological reserves is in an embryonic state of development. Research on the impacts of horse trails in ecological reserves is almost nonexistent. Future management direction will depend on a cooperative effort between public and private land managers, academia, political leaders and informed citizens. **Years of experience with both groups indicates that land managers and ecologists do not understand horses and riders and vice versa.**

The current "knowledge" about horse trail impacts can be conceptualized as a kernel of truth in a pile of manure. Lots of concerns have been expressed, but there are few documented facts to back them up. There has been very little meaningful research on the subject and most of what has been done applies to mountain landscapes in the west and is of minimal applicability in other regions.

The following summary statements synthesize the scanty information currently available in the literature. They focus on situations in which the more or less accepted "common knowledge" differs from the documented evidence:

Common Belief: Horses cause erosion
Evaluation: Horses may loosen hillside soils and initiate erosion on poorly designed or mismanaged trails. Continued erosion is not directly related to level of horse use.

Common Belief: Horses destroy trail surfaces
Evaluation: Hooves loosen soil; feet compact it. Horses tend to destabilize hilly/sandy/mucky trails, but may maintain permeability of level or hard surfaces. Horse traffic may cause a washboard effect on some rocky trails. Management can mitigate damage.

Common Belief: Horses are more damaging than hikers
Evaluation: As a general rule, horses wear trails three times more than hikers (and less than bikes or ORVs). But factors other than user type are more closely linked to trail degradation.

Common Belief: Horse trails fragment habitats
Evaluation: All trails fragment habitats and eventually develop the "ribbon of foreigners" characteristic of trailside vegetation, but horse trails don't have to be wider or worse than hiking trails

Common Belief: Horses spread exotic species in their manure
Evaluation: Exotic invasion has been observed along some trails. Horses can carry viable seeds, but the dispersal process is complex and the facts are largely unknown. Special feeding programs offer a solution when real problems exist.

Concern: Horses might degrade water quality
What We Know: Erosion may lead to siltation. Bacteriological and nutrient effects are seldom detectable except next to stables.

Concern: Horses might disturb wildlife
What We Know: All sporadic human use disturbs wildlife. Many animals are less afraid of horseback riders than hikers. Riders seldom dismount to touch flora or fauna.

Given the above concerns, why should we allow horseback riding on natural areas at all? Riders can be a dedicated and energetic volunteer and advocacy group. The horse rider relationship promotes a non-anthropocentric worldview that facilitates ecological understanding. Horses are useful for patrols and surveys. Horse traffic can be used to maintain firebreaks and seldom-used trails.

How Many Is Too Many?
Light Use Concerns: Lightly used trails may grow over and require more maintenance, whereas moderate horse activity may help to maintain a multiple-use trail.
Moderate Use Concerns: Traffic on soft or wet stretches must be managed carefully. Erosion will demand maintenance on steep slopes. Management will be necessary to keep riders on the trail and out of trouble.
Heavy Use Concerns: Multiple-use is impractical on heavily used horse trails; hikers and bikes will need separate trails. The trails will require routine monitoring and maintenance. Additional research is urgently needed. Relevant questions include:

- Which problem exotics really use horses as vectors for invasion of natural areas?
- How might trail edge vegetation be stabilized with desirable species?
- What feeding regimes are practical for eliminating seed in the manure of horses in sensitive areas?

The bottom line is that horse trails can be maintained on most natural areas without unacceptably impacting ecological values, but new management approaches, better user education, and increased user-manager cooperation will be necessary.

Erroneous Task Group #1 Recommendation To Reclassify Equestrian Use To "Consumptive" Or High Impact Re: Western Mojave Management Plan

EnviroHorse
May 2, 2001

We believe that the Task Group #1 has made **a serious error in suggesting that horseback riding (equestrian access) be reclassified from LOW IMPACT recreation to "Consumptive" or HIGH IMPACT use.** This suggestion appears to be arbitrary and ignores **a vast body of literature that defines the horse as a lightweight low impact user**. We ask to be provided with the scientific data that has led to this unwarranted decision. We further ask the Task Group to reconsider its prior decision and retain the horse as a low impact user.

The Horse: High vs Low Impact User

In virtually every mixed use trail reference within the State of California and nationally, the horse has been defined as a low impact user or lightweight impact user, even in the most sensitive environments - the Natural Preserves.

Edgewood Park And Natural Preserve Master Plan adopted May 1997 (Parks and Recreation Division San Mateo County) Definitions 6. Definition Of Low-Intensity Recreation Uses: "Define low-intensity recreation uses as passive recreation uses that will not create a direct or cumulative adverse environmental impact. Such uses include, but are not limited to, on-trail hiking, walking, jogging, horseback riding, nature observation, education, docent-led group tours, and picnicking and camping…" This is a natural preserve of rare serpentine grassland that supports numerous threatened and endangered species. Horses share the same trails as hikers. Bikes are not permitted.

The Mid-Peninsula Open Space District (MROSD) defines Trail Use Suitability to include: hiking, running, equestrian, and bicycling throughout most of their 43,000 acres of natural preserves.

Santa Clara County Countywide Trails Master Plan, 1995, "identifies hiking, horseback riding, and bicycling trails" as lightweight use.

The USDA Region Five Shasta-Trinity Nation Forest Trail Procedure Guide builds trails to include the horse as a lightweight user.

The US Forest Service/USDA Rocky Mountain Region Guide For Mountain Trail Development builds trails for hikers, joggers, and equestrians - all considered lightweight, low-impact users.

The California Trails Foundation uses the California Department Of Parks And Recreation Klamath District/North Coast Redwoods District Trail Manual. Section 1.4 Trail Standards for Class I Trails that states, "These trails include handicapped accessible, equestrian, interpretive and hiking trails assigned a Class I point criteria value."

The State of Washington Department of Natural Resources' Recreation Trail Maintenance produced in cooperation with the USDA and NPS designs trails for low-impact users, including equestrians.

The Bay Area Ridge Trail creates a multi-use trail system around the San Francisco Bay for hikers, bikers, joggers, and equestrians - all considered lightweight users.

Since 1915, the Rocky Mountain National Park has included equestrians as low-impact users.

Equine Trail Interactions

Every trail user group causes some impact to the environment by their use. For lightweight low impact users, the effects are usually minimal. The attempt to describe the horse as "consumptive" use is really a stretch. On what basis is any lightweight trail user "consumptive"? There are scientific studies which clearly indicate that the horse is much more benign to wildlife than hikers, nature studiers and photographers. There are no studies that implicate the horse with spreading weeds. And, natural erosive forces are by far the major alteration factors in trail erosion.

In a five-year study, Summer (1990-1996) concluded that horse traffic was not the single, dominant process active on trails. Trail degradation was a function of landform, climatic and catastrophic events, and geomorphic processes. Seasonal use was important in keeping the soil exposed and vegetative cover absent on trails. Such processes as sheetwash, rilling, gullying and soil creep actively modified and eroded the trails and resulted in a measurable fluctuating rate of change over time. **Limited data suggested that foot traffic produced effects similar to horse traffic in exposing the trail to the effects of geomorphic process or climatic events.** Intensive runoff resulting form natural events can cause significant geomorphic change in a trail from such processes as **gullying and earth slumps. Erosion from these events may overshadow effects of horse use on trails.** Williams et al 1998 concur that factors other than user type are more closely linked to trail degradation. **Lightly used trails may grow over and require more maintenance, whereas moderate horse activity may help to maintain a multiple-use trail.** The bottom line is that horse trails can be maintained on most natural preserves without unacceptably impacting ecological values.

Petition To Enhance And Expand The Regulations Governing The Administration Of Off-Road Vehicle Use On Lands Managed By The U.S. Forest Service

The 192 million-acre National Forest System includes almost every type of ecosystem in the nation and off road vehicles (ORVs) are found in nearly all of them. These public forest and grass lands, managed by the U.S. Forest Service, encompass alpine tundra, forests and woodlands, meadows, swamps and bogs, grasslands and prairies, and arid desert and canyon country. Consequently, **many kinds of ORVs, such as all-terrain vehicles, motorcycles, snowmobiles, and four-wheel drive vehicles used off-road, can be found operating somewhere on Forest Service lands.**

ORVs represent one of the fastest growing threats to the natural integrity of our national forest lands. As a result, the qualities for which most Americans value these lands, like clean air and water, protection of wildlife and wildlife habitat, and the beauty and tranquility of un-trammeled wild places, are being diminished or destroyed at an alarming rate. The increased popularity of ORVs has coincided with technological advances that have enabled these machines to penetrate deeper into the backcountry and pristine areas of our national forests. While the use grows and the range of ORVs increases, the Forest Service has largely ignored resulting resource damage and user conflicts.

This petition calls on the U.S. Forest Service to develop an affirmative, uniform policy that gives specific direction on how ORVs should be managed to protect resources and eliminate user conflicts. **Today, ORV management by the Forest Service is inconsistent between different districts on the same forest, different forests in the same region, and different regions within the National Forest System.** For example, 30% of National Forests follow a policy that areas are closed to off-road travel unless specifically signed open. Similarly, another 30% of National Forests follow the exact opposite policy. Almost all the remaining Forests do not have a clear policy. Two Forests, Monongahela (WV) and Hoosier (IN), do not allow ORV use at all. Consequently, Wildlands Center For Preventing Roads, The Wilderness Society, and dozens of other organizations and individuals hereby request the adoption by the U.S. Forest Service of enhanced and expanded regulations governing the administration of off-road vehicle use on those lands managed by the Forest Service.

The Environmental Impacts Of Off-Road Vehicle Use On Forest Service Lands

Scientists have recognized the severe environmental impacts caused by ORVs for decades. For instance, as early as 1979 the Council On Environmental Quality (CEQ) published a report noting that: ORVs have damaged every kind of ecosystem found in the United States: sand dunes covered with American beach grass on Cape Cod; pine and cypress woodlands in Florida; hardwood forests in Indiana; prairie grasslands in Montana; chaparral and sagebrush hills in Arizona; alpine meadows in Colorado; conifer forests in Washington; arctic tundra in Alaska. (Sheridan, 1979). While ORVs exert a significant impact on the environment, they are particularly devastating to soil, the thin layer of disintegrated rock and organic matter to which all life is connected. **According to the U.S. Geological Survey, based on an 18-month study of ORV impacts to more than 500 soils from more than 200 sites in various climatic zones, virtually all soil types examined are vulnerable to ORV damage.**

Soils are among the natural resources most severely impacted by ORV use. On steep slopes, for instance, ORVs cause severe destabilization and erosion. Many soils are susceptible to compaction and rutting. Eroded soil entering streams and rivers can dramatically reduce the quality of native fish habitat. Impacts to soil quality and quantity then produce impacts to vegetation, wildlife, and entire ecosystems.

Vegetation, too, suffers from ORV use. ORVs crush, trample, bruise, shred, tear, and otherwise destroy trees, shrubs, and other plant life. In other cases, the impacts are more subtle but not less insidious or significant. By disturbing the soil, ORVs make it easy for exotic plants, such as knapweed, to become established. ORVs suppress existing native vegetation, making it easier for the exotic invaders to out compete the native plants, and they carry the foreign seeds to the very places where they most readily establish a foothold.

Wildlife and wildlife habitat are jeopardized by ORV activity as a result of habitat alteration, disturbance, or direct mortality. ORVs sometimes strike animals, intentionally or unintentionally, causing their death. The use of ORVs can severely disturb and harass wildlife, most significantly in the winter, when wildlife are already severely stressed by weather conditions and the lack of food. ORV routes often fragment and degrade wildlife habitat as well.

The noise of ORVs can directly impede the ability of wildlife to find prey, avoid predators, and successfully reproduce. ORV noise can also dangerously disorient wildlife.

ORVs, especially those powered by two-stroke engines are highly polluting. The carbon monoxide, polycyclic aromatic hydrocarbons, MTBE, particulate matter, and other pollutants emitted by ORVs can have devastating effects on the quality of the air, soil, snow, and water, and on human health.

Finally, ORVs also cause adverse impacts on the recreational experiences of every other user of the National Forest System. There are safety concerns regarding ORV use, as well as conflicts with other forest users seeking a non-motorized experience. ORV conflicts with hunters, hikers, and other non-motorized recreationists are well documented. It is important to recognize that many of the environmental impacts of ORVs are synergistic, combining to produce impacts that are vastly greater than the sum of their parts.

ORV Impacts On National Forests

The adverse impacts of ORVs are not limited to soils, vegetation, and wildlife. ORV management problems include illegal trespass into areas in which ORV use is not authorized, widening of trails, fragmentation of wildlife habitats through unauthorized proliferation of trails, increased access to sensitive habitat and resources, and increased vandalism associated with increased visitor use. ORVs have also been implicated in damaging archaeological and geologic sites. In addition, ORVs are costly to the American taxpayer. For example, **according to Forest Service records, the average maintenance cost of ORV trails ($5,000/mile) is more than six times greater than hiking trails ($750/mile).** Far from

being simply theoretical, the substantial adverse impacts of ORVs on soils, vegetation, wildlife, other forest resources, and forest users are real and have been documented on a large number of National Forests.

The Wildlands Center For Preventing Roads collected evidence through a freedom of information request submitted to 134 National Forests in October 1998. The case studies listed below are primarily Forest Service reports gathered in the study.

Wayne National Forest (OH)

In an October 29, 1998 letter, Marsha Lee Winkle of the Forest Service writes, "I am disheartened by our inability to control ORV users. On every visit to the trail system, I find new trespass and resource damage. We cannot meet our mission to protect watersheds and allow this type of use to continue." A monitoring report from April 1998 concludes: "we have no control over off-road vehicle use. Whether it is Wayne or any other forest, the concept of “off-road vehicle” is contrary to the mission of national forests. We cannot, regardless of dollars, maintain trails that will not erode into our streams. And we cannot control users equipped with vehicles designed to go on all types of terrain."

Helena National Forest (MT)

Numerous complaints, primarily from non-motorized users, have been received about illegal trail building and use. In response to such complaints, one Forest Service employee stated, "This illegal trail building is really getting out of hand." In a separate memorandum, forester David Payne said, "To prevent continued resource damage (loss of vegetation, erosion, and impacts to wildlife) I firmly believe that the Helena Forest should be closed to all motorized travel except on designated routes. This certainly would not be popular with many of our publics and initially may be difficult to enforce. However, as public land managers, I believe this action is necessary [to] protect forest resources." The Forest Service has not adopted such a policy on the Helena National Forest.

Kaibab National Forest (AZ)

The Kaibab’s response to Wildlands CPR’s information request said, “In summary, the monitoring we are doing indicates that far from getting a handle on this problem, the situation is worse than the planners anticipated and at current budget levels, we do not have the resources available to begin to deal with it.”

Lewis & Clark National Forest (MT)

A wide range of ORV impacts have been documented on the Lewis & Clark National Forest, such as the following:

- Along Oti Park Creek Trail 732: Wet areas are heavily rutted and motorbikes are widening the trails trying to get around the wet areas.
- In the Big Snowies Wilderness Study Area: "Motorized vehicles are simply driving across any terrain which will support their vehicles."
- In the Badger Two Medicine Area: "Snowmobilers have been viewed violating the closure in the Box/Hyde/Mettler Coulee areas during winter.
- In the Lubec Ridge Area: Elk try to winter here, but the area has no restrictions on snowmobiling, despite the fact that the area is a designated winter range.

National Forests In Texas

Monitoring of ORV impacts has found widespread soil and water damage, unsafe practices, and user conflicts. ORV use on the Sam Houston National Forest has been difficult to control with over 746 ORV incidents documented between October 1988 and June 1990, including trespass into wilderness, resulting in 227 violations. According to the Forest Service: “The management problem caused by “open cross-country” use is the basic lack of control. This lack of control causes conflicts in uses, soil and water degradation, wildlife conflicts, safety and protection, and law enforcement. Concern for seasonal use to reduce these conflicts with other users and resources have been under consideration, but

have not been officially implemented. Unfortunately, resources necessary to manage the ORV trails have been limited, and impacts to the resources have been continuing to show conditions that suggest past management practices were not adequate to ensure that off-highway vehicles were controlled to protect the resources, manage safety, and minimize conflicts among uses as required by Executive Order No. 11644."

Medicine Bow National Forest (WY)

A 1999 Forest Service assessment reported escalating problems with ORV use over the last several years: "User-created trails have been developed and trees are being cut illegally. Erosion is occurring in areas where existing trails are being shortcut, hill climbs are being developed, and user-created trails/roads are being developed in inappropriate locations. Resource damage is especially prevalent in riparian areas and stream locations as accessibility to these areas increases. Further, people are now able to access areas that were once remote, which has the potential to impact wildlife and reduce solitude for non-motorized Forest users." The Forest Service also reported "a significant increase in documented [travel management] violations from 1994 through 1997 (92 vs. 384). This increase in documented violations has been directly linked to the increase in the number of all terrain (ATV) and off-highway (OHV) vehicles observed on the Forest over the last several years."