Appendix A

BMPs for Dust Abatement Practices on Unpaved County Roads in Oregon

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1. Introduction

The Dust Abatement Appendix is part of the County Road Maintenance Submittal Template to NMFS for Coverage under Limit 10 of the 4(d) Rules for Salmon and Steelhead. This template was developed to meet the specific requirements outlined by the National Marine Fisheries Service (NMFS) in Limit 10 of the 4(d) rules for the protection of salmon and steelhead. Dust abatement is included as a section in Limit 10; this appendix is meant to provide Oregon counties with an analysis that can be included with the Road Maintenance submittal for Limit 10 protection.

The Limit 10 template for road maintenance relies on the ODOT road maintenance manual and requires each county to follow the approved BMPs outlined in the manual or practices that are substantially similar. Each county is required to provide baseline environmental information as well as evidence of monitoring and training programs that accompany the maintenance program. The Dust Abatement Appendix provides BMPs for the application of dust suppressants as well as an effects analysis that demonstrates that the application of these materials will not cause significant impacts to water bodies that provide habitat for listed salmonids.

If a county wishes to include dust abatement as part of its routine road maintenance submittal for protection under Limit 10 of the 4(d) rules, the Dust Abatement Appendix must be submitted to NMFS in its entirety along with the template submittal for routine road maintenance. The document has been informally reviewed by NMFS so that each submittal will be uniform, allowing for a facilitated review process.

2. Description

Dust abatement practices help to stabilize gravel roads to reduce damage and maintenance costs. Depending on the type of road treated, application of dust palliatives creates a hard, compact surface that resists potholing, rutting and loss of aggregate.

In addition control of road surface soils reduces the short term, localized air quality hazards associated with unpaved roads. For people living along dirt roads, dust can cause inconveniences from dust settling on their property. While, not all county gravel roads require dust abatement applications, there are situations where dust control is either requested or required.

Dust suppression involves the application of a dust palliative to non-paved road surfaces to temporarily stabilize surface soils, leading to a reduction of dust. Counties provide dust abatement with their own funding in only a few circumstances. In some cases, Counties apply palliatives when excessive truck traffic utilizes a non-paved gravel road such as a quarry or construction site. This practice is for the purpose of the reduction of dust as well as road stabilization. In other instances, private contractors apply dust palliatives to county roads for residents living along county roads to reduce the amount of dust produced by passing vehicles.

Application of dust palliatives often occurs at the beginning of the summer and depending on the road surface and grade, two “light” applications may be made to avoid run off of the palliative from the road surface. In preparation for palliative application, roads are graded and “roughed up” to allow for greater penetration of the palliative. Application normally consists of 0.5 gallons of material per square yard of road and is applied using an applicator truck. Descriptions of the Best Management Practices (BMPs) to be followed for the application of dust palliatives are in Section 4.

3. Palliatives

The following materials are proposed for use in county road dust abatement practices on unpaved roads. They have been selected because of their effectiveness in controlling fugitive dust, as well as minimizing potential environmental impacts.

Lignosulfonates

Lignin is a polymer in the secondary cell wall of woody plant cells that helps to strengthen and stiffen the wall. During the various pulping processes, lignin by-products are produced. Lignosulfonate is a byproduct of the sulfite method for manufacturing paper from wood pulp. Sometimes it is called sulfonated lignin. Lignosulfonate is a complex mixture of small- to moderate-sized polymeric compounds with sulfonate groups attached to the molecule.

Lignosulfonates have a long history of use on roads as a method for dust control and surface stabilization. Lignosulfonates have a natural adhesive property when moist. When applied to gravel roads, the lignosulfonate solution coats individual road particles with a thin adhesive-like film that binds the particles together. The lignosulfonate acts as a dispersant. By attaching to the particle surface, it keeps the particle from being attracted to other particles and reduces the amount of water needed to use the product effectively. This allows the particles to pack closer together for a stronger surface. Consequently, water uptake by the roadbed surface is greatly reduced and the binder is less likely to be washed away by rain.

Lignosulfonates used for road applications are usually shipped in a concentrated solution and diluted with water on the job site to about a 25 percent solid content. Road conditions and climate can affect the application rate. However, as a general rule for dust control, a diluted solution of lignosulfonate is applied at a rate of one-half gallon per square yard.

Magnesium Chloride

Magnesium chloride is a naturally occurring element and is extracted from salt-water solutions such as those found in seawater. To extract the magnesium chloride brine, water is removed from the salt water by solar evaporation, other energy, and a simple refinement process until other chemicals have been extracted resulting in magnesium chloride brine. This brine can then be further dehydrated to produce magnesium chloride solids.

Magnesium chloride can be adapted and designed to provide highest efficiency depending on prevailing dust conditions, anticipated traffic, and type of soil. Dilution can also be varied to obtain the greatest possible economy and minimize environmental impact. Some soil types may be best treated with a one-time heavy application of

product, whereas others may require several light applications. As a general rule, the rate of penetration of magnesium chloride is rapid in sandy soil, moderately fast in silty soil and slow in clay.

4. Effects Analysis

Water Quality

A literature search was conducted to determine the possible effects of lignosulfonates and magnesium chloride on water quality. Though there has been increased interest in this subject recently, there remains little scientific data that fully explores the potential effects of these materials when used as dust palliatives. Both lignosulfonate and magnesium chloride have been tested to determine their potential impacts on water quality, fish and wildlife when introduced directly into surface waters. However, we found no studies that evaluated the effects of these materials when their movement is controlled through application BMPs. Therefore, this appendix will make the assumption that these materials will be applied in a way that reduces their ability to move, thereby limiting the concentrations that reach surface waters, and reducing the likelihood of detrimental effects on receiving water bodies. These BMP recommendations are based on recommendations from County Road Masters who have worked with these materials for many years.

Research does confirm that these materials have limited ability to move (Martin, 1989 and ITT Rayonier, Inc., 1973). They are bonding agents that adhere to material in dry conditions. The BMPs being implemented are meant to further reduce their ability to move and in the unlikely event that these materials were to reach a water body, it would be at very low concentrations that are unlikely to negatively impact the receiving water body.

This analysis was conducted in accordance with the NMFS document "Making Endangered Species Act Determinations of Effect Guidance". The Pathways and Indicators are a Section 7 mechanism that provides a convenient tool for this analysis. The matrix from the report was used to determine the potential for effects to listed salmon and steelhead. The water quality elements that have the potential to be impacted by dust abatement practices were the primary focus. This analysis will provide the scientific background for the BMP recommendations contained in the Oregon County Road Maintenance submittals for coverage under the 4(d) rules for Salmon and Steelhead.

Magnesium Chloride

When magnesium chloride is introduced into the environment as a deicer or as a dust palliative, it is highly soluble in water and has the potential to move through the soil with

water. The movement is dependent on the rate and frequency of rainfall, the drainage characteristics, and soil type. Application of magnesium chloride as a dust palliative is less likely to be carried by water runoff than when it is used as a deicer since it is applied as a palliative during dry periods to reduce dust.

Because of magnesium chloride's ability to dissolve in water, lateral movement can occur. If high volumes of rainfall occur, magnesium chloride can move as either surface runoff or as soil leachate. Under these conditions, it is principally the constituted ions Mg_2^+ and Cl^- that migrate through the environment. These disassociated ions migrate rather than the hydrated magnesium chloride. Because of the widespread occurrence in rocks and soils, and its ready solubility, magnesium is present in nearly all waters. The addition of magnesium from dust palliatives would be insignificant when compared to that already found in the environment (Heffner, 1992).

The usual application of magnesium chloride will be 0.5 gallons per square yard; this is equivalent to 18 tons per mile. The 18 tons per mile includes the weight of the water that is used to dilute the brine solution. This results in an application rate for magnesium chloride of 7.5 to 9 tons per mile.

The typical weight of sodium chloride as a road deicer is 20 tons per mile. With the melted snow and ice and applications on paved roads, the chloride concentrations rise to above 250 ppm. The concentrations of magnesium chloride used for dust abatement are considerably less than those observed for calcium chloride used as a deicer. (Singer et al. 1982) Therefore it is unlikely that receiving waters could have concentrations high enough to cause growth or survival problems for fish.

The Colorado Department of Transportation (CDOT, 1998) conducted extensive research on the environmental impacts of magnesium chloride as a deicer on state roads. While this research focuses on a different activity than dust abatement, the results in terms of the chemicals environmental impact are relevant.

Chloride concentration from two separate sources, magnesium chloride and sand with chloride, increased background chloride concentrations by 50 to 100 mg/L during winter application. These concentrations are described as being below levels considered potentially harmful to the most sensitive aquatic organisms. (CDOT, 1998)

Magnesium chloride application as a dust palliative will occur in the summer months. As described above, the ability of magnesium chloride to move to the rivers will be drastically lower than in the Colorado tests because of the minimal rainfall during the summer months when palliatives are commonly applied. The application BMPs include additional measure to limit movement

The conclusions of the CDOT report stated that magnesium chloride is "highly unlikely to cause or contribute to environmental damage at distances greater than 20 yards. Even very close to the roadway, the potential for magnesium chloride to cause environmental damage is probably much smaller than other factors related to road maintenance."

Results

Water Temperature

With the proper and safe application of magnesium chloride according to the Minimization and Avoidance BMPs, the function of existing habitat will be maintained in areas where it is applied. No research was found that would indicate the application of magnesium chloride would have any significant negative impacts to water temperature.

Sediment

Because of its use to reduce fugitive dust, in some cases the use of magnesium chloride may act to restore areas that are limited by sediment deposition in a stream. Magnesium chloride may be effective in reducing the amount of fines that are recruited into a system.

Chemical Contaminants/Nutrients

Proper application of magnesium chloride will reduce the chance that any of the material will reach surface waters or migrate through ground water. For this reason, all research indicates that magnesium chloride will not negatively influence chemical contamination and nutrients in streams with listed salmonids and will likely maintain current conditions.

Ligninsulfonates

Ligninsulfonates encompasses a complex group of high-molecular-weight polymers. As a group lignins are second only to cellulose in abundance as natural polymers. Since very few biological agents can degrade the lignin molecule, it is extremely environmentally stable. In fact the Food and Drug Administration (FDA) currently allows for the use of ammonium-, calcium-, magnesium-, and sodium-lignosulfonates in animal feeds. They are commonly used in pelleted feeds for fish at a level of 2 to 2.5 percent, to increase water stability.

There can be issues associated with increased oxygen demand in a stream when lignosulfonates are introduced directly into a stream from pulping plants. Receiving water near pulping plants experiences an increased oxygen demand and the water takes on a yellowish-brown tint (Schwenderman, 1981). Effluent from pulping plants is often up to 55% lignosulfonates so it is at a much higher concentration than would be achieved from its application as a dust palliative. There has not been any research that shows significant impacts to water quality as a result of lignosulfonates applied as a dust palliative.

Results

Temperature

No research that was found indicated that an application of lignosulfonates anywhere near a fish bearing stream would have any impact on temperature.

Sediment

The application of lignosulfonates may restore the functioning condition of a stream that is impacted by sediments that originate on gravel roads in the watershed. By limiting the fines that reach streams, sediment will be reduced and existing conditions would be improved.

Chemical Contaminants/Nutrients

Chemical contaminant and nutrient addition to a steam will be maintained/avoided with the proper application of dust abatement palliatives.

Toxicity (LC50)

The LC50 test measures the lethal concentration (LC) of a product expressed in parts per million (ppm) that will produce a fifty percent mortality rate in the test group in 96 hours (4 days). When looking at the results of a LC50 test, the larger the concentration the less toxic the material. Typically less than 100ppm is considered toxic, and 1,000ppm is considered practically nontoxic.

Table 1 shows the results from tests on rainbow trout (onchorynchus mykiss) conducted by the British Columbia Ministry of Environment looking at a wide range of materials. The palliatives under consideration for use by Oregon counties were in the range of practically nontoxic (>1000ppmto >10,000ppm).

Magnesium Chloride

Impacts of chloride have been documented mostly in the Northeast. In these cases large amounts of chloride are applied to roads and highways for de-icing purposes. There are environmental impacts associated with chloride but most have been seen at the higher application rates. Worst case scenarios for runoff from magnesium chloride applications as a deicer are less than 70 ppm within 5-30 ft of the application (Martin, 1989). 70 ppm is the concentration of chloride for irrigation water and is considered safe for most plants.

Kunkle studied the impacts of road salt on a fresh water stream in Vermont, USA. Here the application of pure salt to paved roads adjacent to the stream resulted in salt concentrations that did not exceed 100ppm, with the mean levels below 50. (1972) Although the addition of magnesium and chloride in streams can cause hardness in water, no regulation exists which limits the concentrations found in drinking water. (Schwendeman, 1981)

Lignosulfonates

Lignosulfonates have been studied at high-level concentrations when discharged from pulping plants directly to a water body. These discharges have been shown to increase biological oxygen demand and produce a yellowish-brown tint to the water (Schwendeman, 1981). No research was found that evaluates the rate at which lignosulfonates move in the soil or how concentrated it would be reaching surface water The LC50 concentration for lignosulfonates was calculated to be between 5,200ppm and 6,400ppm, classifying them as practically non-toxic.

Table 1: Rainbow trout 96-hour LC50 Dust Suppressant Results

Substance	**ppm**
35% Calcium Chloride	45,000
35% Magnesium Chloride	9,000
Sodium Lignosulfonate	6,400
Calcium Lignosulfonate	5,200
Emulsion Oil	200
Laundry Detergent	10

(Ministry of Environment, 1990)

5. Minimization and Avoidance:

Road maintenance employees and anyone applying dust palliatives on county roads will use the following BMPs to prevent palliatives from reaching water bodies thereby mitigating any possible water quality impacts:

- During preparation for application of dust palliatives, gravel roads will be tight bladed or processed (cut 2" and watered, then laid gravel back to grade and roll) to bring fines to the surface.

- Dust palliatives, when applied, will remain on the road surface and will not go over the road edge. The use of berms at the road shoulder or applying palliatives at a low rate are two methods to achieve ensure material remains on the road surface.

- All private contractors that apply palliatives to county right of ways must first obtain a dust control permit for each section of road that will receive an application. (See attached example of dust control permit.)

- Application shall follow the conditions of a dust abatement permit outlining the Minimization and Avoidance methods described here and assure materials are applied in a manner that is not detrimental to either water or vegetation.

- A 1-foot buffer zone on the edge of gravel will be used if the road width allows.

- The machinery used to apply palliatives will carry adequate spill protection equipment during application.

- Dust palliatives will not be applied while raining. (Where practicable, a 3-day forecast of clear weather should follow any application of dust palliatives).

- Environmentally-sensitive cleaning agents will be used on trucks and equipment used for palliative application at the designated areas with the county for truck maintenance and cleaning.

(Counties must include a map or addresses of designated cleaning and maintenance areas for application equipment.)

- Excess materials will be disposed of at designated and approved locations for receiving such materials.

(Counties must include a map or addresses of designated disposal sires for excess material.)

6. Example Dust Control Permit

This permit allows the applicant or his contractor to treat sectors of Secondary Roads with chemicals to control dust. It is granted subject to the following:

- Two materials are approved for use: Magnesium Chloride and Lignin Sulfonate.
- All contractors receiving a Dust Control Permit are bound to follow BMPs for Dust Abatement approved by the National Marine Fisheries Service to prevent or minimize harm to water quality and the take of salmonids listed under the Endangered Species Act.
- Each applicant will fill out and turn in a Dust Control Permit to the County Public Works Department.
- The applicant or contractor must coordinate application of material with the County Public Works Department at (xxx) xxx-xxxx at least two (2) working days prior to application of the material.
- The applicator will provide adequate notification in the area prior to application of the dust palliatives.
- This permit is valid until October 1 of the year issued, after which the County reserves the right, regardless of actual conditions, to re-blade treated areas in order to prepare the road for winter.
- The permit applicant understands that by signing this permit they assume full responsibility for any and all liability resulting from this treatment of a public highway.

In signing and accepting this permit for dust control, I agree to abide by all of the conditions of the permit as listed above.

Permit # _____

PERMIT FOR SURFACE APPLICATION OF DUST PALLIATIVES

Applicant: _____
Address: _____
Mailing Address City State Zip
Phone Number: _____**Date:** _____
Location and/or description of road section proposed for surface dust control application:

Starting Point: Road Name _____ *Milepost* _____

Ending Point: Road Name _____ *Milepost* _____

Application Distance: _____

Person or Company selected to apply the chemicals or road oils:

_____
(Name)
_____

(Address)

Palliative to be used *(check one)*
[ ] magnesium chloride [ ] lignin sulfonate

When Application will occur: Date: _____ Time Period _____

I have read the entire permit and have provided all data called for herein truthfully and correctly and I agree to abide by all general provisions set forth herein and attached conditions pertaining to Minimization and Avoidance and Dust Control Permit.
I will provide notification in the area where palliatives will be applied by the following method:

_____

The following signing plan will be used:

_____

_____
(Applicant's Signature)

Approved on behalf of _____ County

By _____

Date

Permit Number _____

Dust Suppressant	Attributes	Limitations	Application	Origin	Environmental Impact
Lignin Sulfonate	Binds surface particles because of adhesive properties. Greatly increases dry strength of material under dry conditions. Retains effectiveness during long dry periods with low humidity. With high amounts of clay, it tends to remain slightly plastic permitting reshaping and additional traffic compaction.	Corrosive to aluminum alloys due to acidity (CaC0 3 added ingredient, can neutralize acidity). Proper aggregate mix (4 - 8% fines) important to performance. Becomes slippery when wet, brittle when dry.	Generally ½ gallon per square yard of road surface. Can vary based on soil condition and application method. Spread by spreader trucks.	By-product of softwood pulping and the sulfite pulping process.	Lignin products have a high BOD (biological oxygen demand) in aquatic systems. Spills or runoff into surface or groundwater may create low dissolved oxygen conditions resulting in fish kills or increases in groundwater concentrations of iron, sulfur compounds, and other pollutants.
Magnesium Chloride	Increases compacted density of road material and the effectiveness is retained after blading. Lower freezing level of water to –27 degrees F, minimizing frost heaves and reducing freeze-thaw cycles.	Solubility results in leaching during heavy rain.	Generally ½ gallon per square yard of road surface. Can vary based on soil condition and application method. Spread by spreader trucks.	Produced from natural salt brine and a by-product of potash production. Results from a reaction between hydroxide and hydrochloric acid.	From *Studies of Environmental Effects of Magnesium Chloride Deicer in Colorado. (CDOT, 1999)* Unlikely to cause environmental damage if safely applied at distances greater than 20 feet from water body. Study was done evaluating it as a deicer. Dilution of magnesium chloride by melting snow and ice was a factor

Pathways: Indicators	Environmental Baseline			Effects of the Actions		
	Properly Functioning	At Risk	Not Prop. Functioning	Restore	Maintain	Degrade
Water Quality						
Temperature					X	
Sediment				X		
Chem. Contam./Nut					X	
Habitat Access:						
Physical Barriers						
Habitat Elements:						
Substrate					X	
LWD					X	
Pool Frequency					X	
Pool Quality					X	
Off-Channel Habitat					X	
Refugia					X	
Channel Conditions & Dyn:						
Width/Depth Ratio					X	
Streambank Condition					X	
Floodplain Connectivity					X	

Flow/Hydrograph:						
Peak/Base Flows					X	
Drainage Network					X	
Increase					X	
Watershed Conditions:						
Road Den. and Location					X	
Disturbance History					X	
Riparian Reserves					X	

Effects of proposed Actions on Water Quality Indicators/Pathways:
If the minimization and avoidance procedures outlined in this document are followed, the application of dust abatement materials to county roads will maintain the water quality of streams in the area. In addition application of dust palliatives will help to improve sediment issues by reducing the amount of loose sand and gravel on the road.

7. Bibliography

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