United States Department of Agriculture **Forest Service** **Eldorado National Forest** **100 Forni Road Placerville, CA 95667 530-622-5061 (Voice) 530-642-5122 (TTY)**

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Route To:

Subject: Process for Recommending Extensions of Travel Management Seasonal Closure

To: Forest Supervisor

INTRODUCTION

This letter describes the process and procedure for preparing a recommendation to the Eldorado National Forest Supervisor regarding whether to issue a Forest Order to close native surface roads and trails beyond the seasonal closure period specified in the Travel Management Record of Decision (ROD). One of the key elements identified in this process is clarifying the soil moisture monitoring procedures that will be followed. Other factors that are to be considered are precipitation, predicted weather patterns, and road and trail conditions. Based on this information, the Soil Scientist and Road Manager will then make recommendations to the Forest Supervisor whether the established closure period is adequate or an extension is desirable to protect Forest resources. The procedures outlined in this letter are essential because the seasonal closure period of January 1 to March 31, as spelled out in the Travel Management ROD, is based on critically dry years[1]. Statistically there is a 13 percent likelihood of a critically dry year occurring within any water year (October 1 through September 30). Conversely, there is an 87 percent chance that the forest will not experience a critically dry year perhaps requiring an administrative order extending the closure period.

DETERMINING WHICH SOILS ARE MOST PRONE TO VEHICULAR DAMAGE

The soils of the Eldorado National Forest have highly variable physical properties primarily due to parent material, climate, and age. There are three primary types of soils within the Eldorado National Forest:

- Granitic Soils: Soils formed from weathered intrusive igneous rocks are coarse textured with very little clay content, and primarily found in the eastern two-thirds of the forest. They are generally higher elevation soils.
- Lahar Soils: These soils that formed from volcanic ash and mud flows tend to be medium-textured loams. They are found throughout the forest generally on ridge tops and tablelands.
- Metasedimentary Soils: These soils formed from metamorphosed marine sediment and tend to be fine-textured soils. These soils are generally found on the western one third of the forest and are characterized by a reddish brown hue when moist.

[1] A critically dry year is defined by the California Department of Water Resources (CDWR) as one in which the annual amount of precipitation is less than 50 percent of the average amount as presented in CDWR Bulletin 120.

The metasedimentary soils are the soil type most prone to damage from vehicular traffic during periods of higher soil moisture. The response of soils to vehicular traffic is primarily governed by the distribution of fine-earth particles in a soil (sand, silt, clay) and the rock content throughout a soil profile. Generally for soils of the Eldorado National Forest, the finer the soil texture, the more prone a soil is to damage from vehicular traffic.

Damage to road tread is manifested by soil rutting. Generally, rutting causes costly physical damage to the road tread and exacerbates sediment delivery to streams by channelizing flow. Rutting occurs when soil strength is diminished by wetting. As soils become progressively wetter, soil particles become surrounded by moisture films. These moisture films act as a lubricant and the soil particles are able to slide relative to each other when a load is applied to the soil surface. The more water held within the soil matrix, the more soil strength is reduced and, subsequently, the ability to support a load is reduced.

To determine which soils are most prone to rutting, the soil property "Plasticity Index" was used as a surrogate soil property. According to the Natural Resources Conservation Services (NRCS), the Plasticity Index … "*is the range of water content in which a soil exhibits the characteristics of a plastic solid*." [ONLINE: http://soils.usda.gov/technical/handbook/contents/part618.html]. When a soil is in a plastic state, "*it is capable of being molded or deformed continuously and permanently, by relatively moderate pressure, into various shapes*" (SSSA 2001). When a road is being rutted, plastic deformation is occurring. A high "Plasticity Index" is the soil characteristic best suited to predict where rutting will be most problematic[2].

LOCATIONS OF SAMPLING LOCATIONS

Sampling sites are based on the following criteria:

- soils with the highest plasticity
- roads with native surface
- the road surface has a low coarse fragment content, so it does not significantly increase the load bearing capacity
- roads with grades between 2 and 5 percent
- areas with high traffic patterns
- reasonable access by district personnel (in order to collect field data)

Because the interaction between available moisture and soil type determines the potential road and trail tread damage, precipitation patterns also need to be considered when identifying sites to sample for soil moisture. There is considerable variation in average annual precipitation throughout the ENF. Precipitation increases from west to east and from south to north. Precipitation primarily falls as rain on those soils that have the highest plasticity index so sampling will be weighted on the western part of the forest where rainfall is more significant and

[2] ArcGIS 9.2 was used to spatially group soils on the Eldorado National Forest with the highest Plasticity Index. The data was acquired using spatial and tabular data from the NRCS Soil Data Mart [ONLINE: http://soildatamart.nrcs.usda.gov/].

soils are more plastic. North-south precipitation patterns are noticeably different on either side of the Highway 50 corridor with average annual precipitation on the north end of the forest having over 10 inches more rain than a similar elevation on the southern edge of the forest. Because of this difference in climate, moisture conditions at two different locations representing a north zone and a south zone will be monitored.

The two selected sites are:

- North Zone: Road 12N47 approximately one mile east of Stumpy Meadow Reservoir. The precipitation is approximately 60 inches/year with some of that precipitation falling as snow.

- South Zone: Road 8N60 near the Gold Note OHV area southeast of Omo Ranch. Precipitation is approximately 50 inches/year and falling primarily as rain with lesser amounts of snow than the North Zone.

The selected sites do not represent the worst case scenario. To choose such a location would likely lead to extended administrative closures every year because of high elevations and extended residence time of snow pack. These sites, however, should not be ignored. They will be visited to determine when soils in these areas do dry enough to resist tread damage. To examine the high elevation, deep snow pack sites where soils with a high Plasticity Index occur, roads near Gerle Meadow will be subjectively examined in late spring.

SOIL MOISTURE SAMPLING METHODS

Soil sampling and testing will be conducted to better calibrate the correlation between soil moisture and rutting susceptibility and to more precisely determine the maximum soil moisture to support the load of a moving vehicle. Three methods will be considered to determine soil moisture ranging from objective to subjective. Those methods are:

- drying soil samples in an oven to determine moisture percentage
- using a soil moisture tensiometer to indirectly measure the amount of free water within the soil matrix that influences soil strength
- using field indicators of soil moisture suitable for compaction in Table 1 (Poff, 2001) to subjectively determine soil moisture thresholds. Using the field indicators in Table 1, rutting is most likely to occur on finer textures in the “Moist”, “Very Moist” and “Wet” categories. These moisture levels tend to be on the high side or higher for moisture levels ideal for compaction.

During winter rains, soils wet from the surface. Soils become wetter with depth only until the upper parts of a soil become saturated. This zone between wet and dry soil is called the wetting front. The drying front also works vertically through a soil. The lower portions of a soil cannot dry until evaporation has dried the upper-most portions of a soil. To account for these wetting and drying fronts, the soil will not be considered too wet in the fall/winter until the wetting front has exceeded three inches and the soil will not be considered dry enough in the spring until the drying front has exceeded three inches. All sampling will occur at three inches.

In the first year of implementation of the seasonal closure under the recent Travel Management Record of Decision (2008), the steps described below will be followed to provide guidance to the Forest Supervisor on when soil moisture conditions are conducive to vehicular traffic.

- Soil moisture will be determined once a week using the three methods outlined above while gathering baseline data at the locations detailed above. Sampling depth will be three inches within the road tread. Springtime sampling will begin by mid-March and will continue until the soils are determined to have a moisture content below optimal levels for compaction, as shown in Table 1. Fall sampling will begin after the Forest has received an appreciable amount of precipitation and additional precipitation is forecasted.

- Using the field indicators of soil moisture contents listed in Table 1, the Soil Scientist in consultation with the Roads Manager will determine if soil is too moist for vehicle traffic and will lead to resource damage.

- In conjunction with soil sampling, long range weather patterns will be monitored to determine if weather trends will alter the drying trajectory of the soils or cause enough precipitation to significantly wet the soil. Road and trail conditions will also be considered. If extensive road or trail damage has occurred due to winter storms or use, it may be appropriate to delay opening roads and trails until there is a lower likelihood of rutting, based on soil moisture conditions.

- Administrative closures will be reassessed in two week increments. This requires the Soil Scientist to begin the process of determining soil moistures three weeks prior to an administrative decision.

Once the sampling sites and methodology are sufficiently developed, and a reliable field method is identified, District personnel will collect samples, conduct field tests, and report to the Soil Scientist and Road Manager when threshold moistures have been crossed. Until the sampling methodology is more fully developed, recommendations will be based on the professional judgment of the Soil Scientist and Road Manager, using data collected during site visits.

/s/ John M. Sherman
JOHN M. SHERMAN
Forest Engineer

I concur:

/s/ Jeffrey Vail 3/30/09
JEFFREY VAIL DATE
Acting Forest Supervisor

Table 1 Qualitative field indicators of soil moisture content by soil texture group. This table predicts soil types and moisture contents most susceptible to rutting, and is modified from Poff, 2001 Appendix 8.

Soil Moisture Content	**Coarse Soils***	**Light Soils**	**Medium Soils <35% clay**	**Heavy Soils >35% clay**
	Sands, Loamy Sands, and Very Coarse Sandy Loams	*Coarse, Medium, and Fine Sandy Loams*	*VF Sandy loam, Loam, Silt Loam, Sandy Clay Loam, Light Clay Loam*	*Heavy Clay Loam, Silty Clay Loam, Sandy Clay, Clay*
Dry	loose, single grained; flows through fingers	loose; flows through fingers	powdery; sometimes slightly crusted but breaks down into powder	hard, baked, cracked; sometimes has loose crumbs on surface
Slightly Moist	still appears dry; will not form a ball with pressure	still appears dry; will not form a ball with pressure	somewhat crumbly, but ball holds together after release	somewhat pliable; forms a ball under pressure
Moist	still appears dry, will not form a ball with pressure	tends to form ball with pressure, but ball seldom holds together	forms a ball and is very pliable; slicks readily if high in clay	easily ribbons out between fingers; has a slick feeling
Very Moist	tends to stick together slightly; sometimes forms a very weak ball	forms a weak ball with pressure; ball breaks easily; will not slick	forms a ball and is very pliable; slicks readily if high in clay	easily ribbons out between fingers; has a slick feeling
Wet	free water may appear on squeezing; wet outline is left on hand	free water may appear on squeezing; wet outline is left on hand	can squeeze out free water; wet outline is left on hand	puddles and free water forms on surface; wet outline is left on hand

	moisture level suitable for compaction, may be prone to rutting
	moisture level marginally suitable for compaction, too dry for rutting
	soil too dry or too wet for compaction
	moisture level predicted to be ideal for rutting

REFERENCES

Natural Resource Conservation Service, 2009, National Soil Survey Handbook, Part 618, Definitions (618.45). **http://soils.usda.gov/technical/handbook/contents/part618.html** Website accessed March 16, 2009

Poff, R., T. Ryan. 2001A Field Evaluation of the Use of Small Trail Tractors to Maintain and Construct OHV Trails on National Forests in California. Natural Resources Professional Services Contract 53-91S8-NRM-08 Natural Resources Management Corporation, Prime Contractor

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