SECTION 7.10a - SJV

SJV PRIVATE UNPAVED ROAD DUST

(SJV only)

(Updated May 2004)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Road Dust

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION

645-648-5400-0000 (82156) Unpaved Road Travel Dust - Unspecified

DESCRIPTION OF SOURCE

This source category provides estimates of the entrained geologic particulate matter emissions resulting from vehicular travel over *private* unpaved roads in the San Joaquin Valley Unified Air Pollution Control District (SJVU APCD). Private road types could include oil field roads, private unpaved driveways, irrigation canal roads, and non-production oriented travel on agricultural roads and others. The emissions on these roads result from the mechanical disturbance of the unpaved roadway by the tires and the vehicle generated air turbulence effects. This new methodology was developed specifically for the 2003 SJV PM10 SIP. The particulate matter estimates for private unpaved roads in the SJV are summarized in Table 1.

OVERVIEW OF ESTIMATION METHODOLOGY

Dust emissions from unpaved road dust are based on an emission factor that provides an approximation of the amount of PM10 generated per vehicle mile traveled on an unpaved road. The current emission factor used by the ARB is 2.0 lbs PM_{10}/VMT (vehicle mile traveled). This factor is based on measurements of unpaved road dust emissions performed in separate projects by the University of California, Davis (UCD)[1] and the Desert Research Institute (DRI)[2].

After several attempts to collect VMT data for private roads, it was determined to currently be impractical. Therefore, an alternative approach was agreed upon in which it was assumed that private unpaved road travel is equal to one-tenth of all of the other non-agricultural and agricultural unpaved road travel. This magnitude was somewhat confirmed for reasonableness using the limited existing available data.

EMISSIONS ESTIMATION METHODOLOGY

Emission Factor. The emission factor used for the estimates of geologic dust emissions from vehicular travel on unpaved roads is based on work performed by UC Davis[1], and the Desert Research Institute[2]. The emission factor used for all unpaved roads statewide is 2.0 lbs PM_{10}/VMT. The emission factor is based on the average of 22 unpaved road dust emissions tests performed in the San Joaquin Valley for light-duty truck traffic. Because the emission measurements were

performed in California, this emission factor was used to replace the previous generic emission factor provided in U.S. EPA's AP-42 document[3]. The new emission factor is slightly lower than the emission factors derived with the AP-42 methodology when using default inputs.

This methodology directly computes PM_{10} emissions. Using ARB's size speciation profiles, the TSP emissions are PM_{10} x 1.64[4].

Rainfall Correction. The most recent version of EPA's AP-42[5], includes a rainfall correction factor for the unpaved road dust emissions. Because the tests used to calculate the ARB unpaved road dust emission factor do not include rainfall corrections, we adopted the EPA methodology for this purpose. The rainfall correction zeros out the unpaved road dust emissions on days in which there is measurable rainfall. On an annual basis, the rainfall correction factor equation is: EF_{rain} = EF [(365-P)/365], where P equals the number of days in a year with over 0.01 inches of precipitation.

For our estimates, we used monthly precipitation data for each county in the SJV to adjust the default private unpaved road emission estimates. This helped provide localized estimates as well as providing a monthly profile of unpaved road dust emissions. This correction effectively reduces the unpaved road dust emission factor by an amount related to the monthly rainfall.

Activity Data. It was not possible to collect information regarding mileage of private unpaved roads and the amount of vehicle traffic on these roads. Therefore, through discussions with stakeholders, it was decided that as an initial estimate the private unpaved road traffic would be assumed to be 10% of the total traffic on all other unpaved roads. This includes unpaved roads under the jurisdictions of counties and cities, the U.S. Forest Service, the Bureau of Land Management, the Bureau of Indian Affairs, federal and state parks, and agricultural lands. The vehicle miles traveled (VMT) estimates for these unpaved road categories are described and estimated in separate methodologies available on ARB's website[5]. Only the summary data are provided here. Table 1 summarizes the inputs used for the private road emission estimates and the effect of the rainfall correction factor.

TEMPORAL ACTIVITY AND GROWTH

Activity on private unpaved roads is assumed to be the same each day of the week and occur mostly during daylight hours. For the methodology, it is assumed that monthly emissions vary as a function of rainfall. This reflects that during wet months there may be less unpaved road traffic and there are also lower emissions per mile of road when the road soils have a higher moisture content. Table 2 shows the private unpaved road dust temporal profile for each county in the SJV.

The growth for the private roads category in the SJV is set to zero. It is expected that some components of the private VMT may increase, such as unpaved driveways to rural residences, but other elements, such as the agricultural component, are projected to decrease. In the absence of other information, it was

decided to set the growth for the full composite category to zero.

ASSUMPTIONS AND LIMITATIONS

1. This methodology assumes that all private unpaved roads in California emit the same levels of PM_{10} per VMT for all vehicles, locations, and conditions. However, some adjustments were made to the emission estimates to reflect rainfall conditions.
2. It is assumed that the travel on private unpaved roads is equal to 10% of the travel on agricultural and non-agricultural unpaved roads.
3. This methodology does not attempt to directly measure the actual miles of private unpaved roads or the number of vehicle passes on those roads.
4. This methodology assumes that no controls are used on the roads included in this inventory.

CHANGES IN THE METHODOLOGY

This is a new methodology.

COMMENTS AND RECOMMENDATIONS

If it is determined that controlling emissions from private unpaved roads could meaningfully help to improve air quality, it will be important to develop estimates of the miles of private unpaved roads and the amount of vehicle traffic on those roads. If additional refinement is needed, it may be worthwhile to more completely evaluate the emission factors for private unpaved roads.

SAMPLE CALCULATIONS

The instructions and table below provide an example of computing baseline private unpaved road dust emissions. For the SJV, the emissions are then corrected for the effects of rainfall. Unfortunately, the full rainfall correction method is too complex to display here, so please contact the ARB for the detailed calculation spreadsheet if needed[6].

Step 1: Refer to the methodologies for the agricultural and non-agricultural unpaved road dust estimates to get the VMT for each road category[5].

Step 2: Calculate 10% of the total VMT for each road category.

Step 3: Input the unpaved road dust emission factor.

Step 4: Multiply the VMT by the unpaved road dust emission factor to get the uncorrected emissions estimate.

Step 5: Using county specific rainfall data and EPA's AP-42 methodology, develop a rainfall correction factor. The factor shown is the annual composite for Fresno county.

Step 6: Compute rainfall corrected emissions by multiplying the uncorrected emissions by the rainfall correction factor.

Step 7: Calculate the total emissions for all private unpaved roads by summing all of the individual columns for each road type.

Estimating Private Unpaved Road Dust
PM_{10} Emissions for Fresno County

		City & County	U.S. Forest & Parks	BLM & BIA	Agricultural Lands	Total
Step 1	Vehicle Miles Traveled (1000/year)	367	621	2062	949	3049
Step 2	10% of Vehicle Miles Traveled (1000/year)	*36.7*	*62.1*	*206.2*	*94.9*	*304.9*
Step 3	Emission Factor *(lbs PM_{10}/mile)*	2.0	2.0	2.0	2.0	
Step 4	Uncorrected Emissions *(tons PM_{10}/year)*	36.7	62.1	206.2	94.9	399.8
Step 5	Rainfall Correction*	0.891	0.891	0.891	0.891	2.0
Step 6	Emissions *(tons PM_{10}/year)*	32.7	55.3	183.7	84.5	356

*Contact ARB for detailed calculations

References

1. Flocchini, Robert; et al. Evaluation of the Emission of PM_{10} Particulates from Unpaved Roads in the San Joaquin Valley, Final Report. University of California, Davis. Air Quality Group, Crocker Nuclear Laboratory. San Joaquin Valley Grant File #20960. April, 1994.

2. Gillies, John; et al. Effectiveness Demonstration of Fugitive Dust Control Methods for Public Unpaved Roads and Unpaved Shoulders on Paved Roads, Final Report. Desert Research Institute. DRI Document No. 68505200.1F1, for the California Regional Particulate Air Quality Study. December 1996.

3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Section 13.2.2, Fifth Edition. December 2003. http://www.epa.gov/ttn/chief/ap42/ch13/

4. Houck, J.E., Chow, J.C., Watson, J.G., et al. Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California, Final Report. Desert Research Institute & OMNI Environmental. Prepared for California Air Resources Board. Agreement No. A6-175-32. June 30, 1989.

5. California Air Resources Board, Areas Source Methods Web Page. http://www.arb.ca.gov/emisinv/areasrc/areameth.htm, Sections 7.10 and 7.11.

6. Gaffney, Patrick. California Air Resources Board. Spreadsheet used for San Joaquin Valley Unified Air Pollution Control District PM10 SIP, 2003. Spreadsheet, "Unpaved1999Mar_13_2003Final.xls"

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Table 1. 1999 SJV Unpaved Road Dust Emissions.

					Private Unpaved Roads		
		Miles	Vehicle Passes per Day	VMT (1000/year)	10% VMT (1000/year)	Rain Adjusted Emissions (PM10 tpy)	Rain Adjusted Emissions (TSP tpy)
Fresno	**City/County**	100.5	10	366.6	36.7	32.7	55.0
10	**BLM/BIA**	153.4	10	620.9	62.1	55.3	93.1
	USFS/Parks	509.5	10	2061.7	206.2	183.7	309.1
	Agriculture	NA	NA	948.75	94.9	84.5	142.2
	Totals (1999)	**763.4**		**3,049**	**400**	**356**	**599**
Kern	**City/County**	74.0	10	270.1	27.0	24.3	40.9
15	**BLM/BIA**	429.4	10	1749.2	174.9	157.3	264.7
	USFS/Parks	54.9	10	223.6	22.4	20.1	33.8
	Agriculture	NA	NA	423.3	42.3	38.1	64.0
	Totals (1999)	**558.3**		**2,243**	**267**	**240**	**403**
Kings	**City/County**	70.1	10	255.9	25.6	22.9	38.6
16	**BLM/BIA**	0.3	10	1.2	0.1	0.1	0.2
	USFS/Parks	0.0	10	0.0	0.0	0.0	0.0
	Agriculture	NA	NA	368.9	36.9	33.1	55.6
	Totals (1999)	**70.4**			**63**	**56**	**94**
Madera	**City/County**	87.0	10	317.6	31.8	28.0	47.1
20	**BLM/BIA**	0.0	10	0.0	0.0	0.0	0.0
	USFS/Parks	91.5	10	403.8	40.4	35.6	59.9
	Agriculture	NA	NA	186.3	18.6	16.4	27.7
	Totals (1999)	**178.5**		**721**	**91**	**80**	**135**
Merced	**City/County**	222.0	10	810.3	81.0	69.7	117.3
24	**BLM/BIA**	0.0	10	0.0	0.0	0.0	0.0
	USFS/Parks	35.8	10	139.5	14.0	12.0	20.2
	Agriculture	NA	NA	428.7	42.9	36.9	62.1
	Totals (1999)	**257.8**		**950**	**138**	**119**	**200**
San Joaquin	**City/County**	20.0	10	73.0	7.3	6.2	10.4
39	**BLM/BIA**	0.0	10	0.0	0.0	0.0	0.0
	USFS/Parks	14.2	10	57.7	5.8	4.9	8.2
	Agriculture	NA	NA	504.3	50.4	42.9	72.1
	Totals (1999)	**34.2**		**131**	**63**	**54**	**91**
Stanislaus	**City/County**	47.0	10	171.6	17.2	14.9	25.0
50	**BLM/BIA**	0.0	10	0.0	0.0	0.0	0.0
	USFS/Parks	0.5	10	2.0	0.2	0.2	0.3
	Agriculture	NA	NA	390.0	39.0	33.8	56.9
	Totals (1999)	**47.5**		**174**	**56**	**49**	**82**
Tulare	**City/County**	128.6	10	469.4	46.9	41.4	69.7
54	**BLM/BIA**	45.0	10	180.8	18.1	16.0	26.9
	USFS/Parks	74.3	10	298.3	29.8	26.3	44.3
	Agriculture	NA	NA	750.5	75.0	66.3	111.5
	Totals (1999)	**247.9**		**948**	**170**	**150**	**252**

SJV Emissions Summary

Total 1999	**2157.9**		**8216**	**1247**	**1103**	**1857**

PM Fraction: PM_{10} = TSP x 0.5943 (TSP Emissions = PM_{10}/0.5943)

Table 2
Seasonal Profile for SJV Unpaved Road Dust Emissions

Basin	Co #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SJV	10	FRESNO	7.26	6.58	7.50	8.12	8.98	9.10	9.53	9.53	8.92	8.92	7.81	7.75
	15	KERN	7.25	6.52	7.62	7.92	8.90	9.14	9.45	9.45	8.84	9.02	7.98	7.92
	16	KINGS	7.34	6.57	7.65	7.95	8.87	9.17	9.48	9.48	8.87	8.87	7.95	7.80
	20	MADERA	7.14	6.52	7.45	8.07	9.01	9.01	9.63	9.63	9.01	9.01	7.76	7.76
	24	MERCED	6.61	6.37	7.48	8.20	9.24	9.32	9.87	9.87	9.24	9.08	7.64	7.09
	39	SAN JOAQUIN	6.61	5.96	7.41	7.98	9.11	9.35	9.99	9.99	9.35	9.11	7.66	7.49
	50	STANISLAUS	6.95	6.32	7.38	8.01	9.17	9.17	9.80	9.80	9.17	9.06	7.69	7.48
	54	TULARE	7.14	6.44	7.53	8.07	9.00	9.23	9.62	9.62	9.00	9.00	7.84	7.53