



Area Source Methodology Technical Documentation

Section 7.10 **Unpaved Road Dust, Non-Farm Roads**

Yaning Miao
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Area Source Improvement & Community Inventory Development Section
Air Quality Planning and Science Division

Emission Inventory Source Category

Miscellaneous Processes / Road Dust

Emission Inventory Codes (CES Codes) and Description

EIC Codes (CES Codes)	Description
645-633-5400-0000	Road Travel Dust - Non-Farm Roads (Public)
645-638-5400-0000	Road Travel Dust - City & County Roads

Federal Sources Classification Codes and Description

SCC Codes	Description
2296000000	Mobile Sources, Unpaved Roads, All Unpaved Roads, Total: Fugitives

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Source Category Description

This source category provides estimates of the entrained geologic particulate matter (PM) emissions that result from vehicular travel over non-agricultural (public) unpaved roads. PM emissions are estimated using an equation that incorporates vehicle miles travelled (VMT), an emission factor, and a rainfall adjustment.

For this update, emission inventory code (EIC) changed to two EICs codes instead of four EICs in previous methodology due to the data source and methodology change. Emissions are now estimated as two categories: Unpaved Non-Farm Roads (Public) and Unpaved City & County Roads. Unpaved Non-Farm Roads (Public) include all public unpaved roads except for city and county roads. Roads included in unpaved non-farm roads (public) fall into the following three categories: U.S. Forest and park roads, BLM & BIA roads, and other unspecified roads identified as unpaved non-farm roads. Unpaved City & County Roads includes unpaved city and county roads. Unpaved roads were first identified from OpenStreetMap (OSM) [[OpenStreetMap, 2023](#)] and then joined with Replica's Annual Average Daily Traffic (AADT) [[REPLICA, 2023](#)] data to get the corresponding VMT of each identified unpaved road on Replica map layer. Since rainfall and other precipitation reduces unpaved road dust emissions by wetting the surface and preventing particles from becoming airborne, rainfall effects were considered as natural mitigation and adjustment factors when estimating unpaved road dust. Rainfall data were obtained from CARB's Regulatory and Risk Modeling (RRM) section.

In this methodology, "road miles" refers to the total length of identified unpaved non-farm public road segments, expressed in miles. The unpaved road miles, annual VMT for 2023 and associated PM₁₀, PM_{2.5}, and Total Suspended Particulates (TSP) emissions are summarized in Table 1, Table 2 and Table 3. Appendix A presents the average annual days of rainfall by county and air basin. Appendix B presents temporal profiles by county and air basin, based on average days of rainfall per month.

Emission Estimation Inputs

Dust emissions from unpaved roads were calculated using an emissions factor (EF) derived from tests conducted by the University of California, Davis (UCD), and the Desert Research Institute (DRI) [UCD, 1994; DRI, 1996]. This methodology assumes that dust emissions are primarily related to the mechanical disturbance of the roadway and vehicle-generated air turbulence effects. Unpaved VMT were estimated based on unpaved road miles that are identified from Replica data and corresponding link level traffic volume. Link level traffic volume refers to the amount of traffic passing through a specific segment or "link" of a road network. Since Replica data itself doesn't separate paved and unpaved roads, CARB used OpenStreetMap to identify and filter unpaved roads from Replica data. The filtered map for unpaved roads is then used to calculate the corresponding VMT by multiplying traffic volume by road length. Emissions were assumed to be suppressed for each day with rainfall of 0.01 inches or greater.

I. Activity Data

Road miles. Previous methodology collected road miles data from reports and local air district [CARB, 2012]. The use of multiple data sources introduced uncertainty due to inconsistencies among them. Some of the data are outdated, further affecting reliability. Furthermore, some of the unpaved road miles from previous methodology were estimated from paved roads which introduce large uncertainties in unpaved road mile estimation. Also, in previous methodology, due to the fact that most of the unpaved data were from numerical statistic reports, no spatial data available to be used to check the spatial distribution of the unpaved roads. Lack of spatial data also limited the ability to allocate county roads to air basin and air district which will impact the emission estimations at air basin and air district level.

Considering the above-mentioned limitations, for this update, CARB has explored, examined, assessed and compared around 20 different data sets that are currently available and finally decided to use the Replica data to get the link level VMT for each identified unpaved road. CARB's big data team has evaluated Replica data, and it shows good performance on link level VMT estimation.

The county level total unpaved non-farm public road miles were derived from Replica big data. The specific data set of Replica that is used for the purpose of this category is Annual Average Daily Traffic (AADT) data of California which contains annual average daily traffic for almost all major roads within each county. The original data that was provided by Replica did not include road type information to indicate whether a road is unpaved or paved. However, since Replica used OpenStreetMap as basemap, CARB was able to use OpenStreetMap to identify unpaved roads of Replica. OpenStreetMap provides surface type information for existing roads, "unpaved" value under the "surface" tag is a general term for roads that are not paved [[Map features - OpenStreetMap Wiki](#)]. All unpaved roads on OpenStreetMap were identified and extracted by selecting the "unpaved" value from the "surface" tag. Since this source category is focused on non-farm and public roads, further steps were taken to only include public roads and remove farm roads. With the above steps, an unpaved OpenStreetMap map layer of California that is particularly designed for unpaved non-farm public roads was generated. By joining this unpaved OpenStreetMap map layer with Replica AADT data by a sharable variable (unique ID numbers used by OSM to identify roads), unpaved roads on Replica AADT were identified and extracted. Unpaved road miles are summed at the county level to indicate the total unpaved non-farm public road miles for all counties. For counties split among two or more air basins, unpaved road miles was spatially allocated by overlaying the air basin boundary layer to the county map layer.

Road Classification. Since Replica does not provide road type information, CARB utilized the California Protected Area Database (CPAD) [CPAD, 2022] to distinguish city/county roads from other unpaved non-farm public roads. Identified unpaved roads within State and

Federal protected areas were excluded from the city/county road category, and all remaining identified unpaved roads were assumed to be city/county roads.

VMT. In the previous unpaved road dust methodology, CARB assumed an average of 10 passes per day [Gaffney, 1997] based on surveys of several county traffic engineers and discussions with the U.S. Forest Service (USFS) [Morey, 2002]. However, this approach may overlook variations in traffic activity across different road types and times of a day, potentially introducing significant uncertainty into the VMT estimation. For this update, CARB used Replica AADT data to collect the link level VMT. For each link, Replica AADT provides road length and corresponding annual average daily traffic volume. Annual VMT is calculated by multiplying these two variables and converting the daily VMT to annual values by multiplying by 365.

Rainfall Adjustment. This methodology incorporates the rainfall adjustment based on the most recent version of U.S. EPA's AP-42 for unpaved roads [[USEPA, 2016](#)]. Unpaved road dust emission estimations for each county within air basin were adjusted using the average number of days per year with rainfall equal to or greater than 0.01 inch; data are presented in Appendix A.

The rainfall adjustment is calculated as follows:

$$\text{Rainfall Adjustment} = (365 - P) / 365$$

Where P = days per year with rainfall $\geq$ 0.01 inch

II. Emission Factor

The EF used for estimating PM₁₀ emissions is 2.0 lbs PM₁₀/VMT. It is based on the average of 22 tests conducted by UCD and DRI in the San Joaquin Valley, using light duty trucks on unpaved roads [UCD, 1994; DRI, 1996]. This EF is lower than the previous factor of 2.27 lbs PM₁₀/VMT, which was based on preliminary data from the same studies [Gaffney, 1997]. A step-by-step derivation of CARB's unpaved road EF is presented in the document, "Emission Estimation Methodology Section 7.10-SJV, Unpaved Road Dust (non-farm roads, San Joaquin Valley)" [Gaffney, 2004].

Emission Estimation Methodology

III. PM₁₀

PM₁₀ emissions on unpaved roads are calculated as follows:

$$\text{PM}_{10} \text{ (tons/year)} = \text{VMT} \times \text{EF}_{\text{PM}_{10}} / (2000 \text{ lbs/ton}) \times \text{Rainfall Adjustment}$$

Where:

$$\text{Annual VMT} = \text{Unpaved Road Miles} \times \text{Annual Average Daily Traffic} \times 365$$

$$\text{EF}_{\text{PM}_{10}} = 2 \text{ lbs/VMT}$$

IV. PM_{2.5} and Total PM

PM_{2.5} and PM are calculated from PM₁₀ emissions using ARB's size speciation profile #470 [CARB, Speciation Profiles]. The size profile is based on California road dust sampling conducted for the ARB in 1989 and on evaluations conducted by the Western Regional Air Partnership (WRAP) [Houck, 1989; Countess Environmental, 2006]. The chemical profile is based on sampling conducted in the San Joaquin Valley for the California Regional Particulate Air Quality Study [Chow, 2003]. The size profile assumes that the PM₁₀ fraction of total PM emissions is 0.5943, and the PM_{2.5} fraction is 0.0594 [CARB, Speciation Profiles]. PM_{2.5} and PM emissions can be calculated as follows:

$$\text{PM}_{2.5} \text{ (tons/year)} = [\text{PM}_{10} \text{ (tons/year)} / 0.5943] \times 0.0594$$

$$\text{PM (tons/year)} = \text{PM}_{10} \text{ (tons/year)} / 0.5943$$

Emissions Estimates

Table 1 below shows the unpaved road miles and annual VMT used in this methodology. Tables 2 shows the PM₁₀ emissions for "City and County Roads" and "Other", i.e., Non-Farm Roads (Public). And Table 3 shows the PM_{2.5} and PM emissions for the two categories.

The implementation of this new methodology results in emissions that are significantly higher than previously estimated when compared to CARB's 2012 methodology. For example, the PM₁₀ emissions from Non-Farm Roads (Public) shown in Table 2 below are

approximately 16 percent higher from this methodology, and the PM10 emissions from City and County Roads also shown in Table 2 are approximately 95 percent higher (or about double) from this methodology than previously estimated.

The increase in PM emissions of this update is mainly caused by the increase of VMT. With the application of Replica data, previous statewide assumption of 10 passes per day has been retired and replaced by more accurate link level traffic activity data. While there is significant increase in emissions and VMT, the road miles showed significant decrease compared to CARB's 2012 methodology. The statewide total unpaved non-farm road miles shown in Table 1 are approximately 48 percent lower from this methodology than previously estimated. Decrease in unpaved road miles may be due to the road pavement activities or the change of data source. Although the road miles decreased significantly, the use of the Replica VMT activity far exceeded the prior activity of 10 passes per day thus offsetting the impact of decreased road miles by a large margin leading to the increased emissions noted above.

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Unpaved Road Dust, Non-Farm Roads

Table 1. Base Year 2023 Unpaved Road Miles and Annual VMT

AB	County	DIS	Unpaved Road Miles			Annual VMT		
			City/County	Other	Total	City/County	Other	Total
SF	Alameda	BA	66.92	0.68	67.6	526802.98	6466.02	533269
GBV	Alpine	GBU	2.13	11.95	14.08	9149.67	13577.96	22727.63
MC	Amador	AMA	6.76	2.62	9.39	20848.89	571.75	21420.64
SV	Butte	BUT	38.99	32.4	71.39	529952.59	530594.14	1060546.7
MC	Calaveras	CAL	6.28	8.75	15.03	71609.68	93124.89	164734.57
SV	Colusa	COL	34.24	38.98	73.22	1152074.3	1733853.1	2885927.3
SF	Contra Costa	BA	23.07	5.33	28.4	101527.25	8923.64	110450.89
NC	Del Norte	NCU	5.22	60.13	65.35	104687.73	2996884.1	3101571.8
LT	El Dorado	ED	0.46	3.93	4.38	982.96	8812.73	9795.69
MC	El Dorado	ED	30.78	44.82	75.59	392111.05	1014636.7	1406747.8
SJV	Fresno	SJU	25.31	38.34	63.64	348930.94	363328.27	712259.21
SV	Glenn	GLE	12.24	57.5	69.73	87906.55	3324526.8	3412433.4
NC	Humboldt	NCU	119.38	79.44	198.81	711455.51	282366.93	993822.44
SS	Imperial	IMP	64.01	378.9	442.91	723963.06	3035244.8	3759207.9
GBV	Inyo	GBU	379.29	588.53	967.82	1122805.4	5010873.8	6133679.1
MD	Kern	KER	397.76	235.78	633.54	2886119.7	655848.82	3541968.6
SJV	Kern	SJU	117.36	41.56	158.92	1808713.8	171899.62	1980613.4
SJV	Kings	SJU	1.23	0	1.23	68.42	0	68.42
LC	Lake	LAK	32.98	72.76	105.75	146513.63	58210.45	204724.08
NEP	Lassen	LAS	68.32	150.53	218.85	133447.14	457176.03	590623.17
MD	Los Angeles	AV	586.72	39.31	626.03	6016809.2	375281.63	6392090.8
SC	Los Angeles	SC	145.86	113.69	259.56	1145631	255399.78	1401030.7
SJV	Madera	SJU	52.71	46.34	99.06	1140827.5	328732.73	1469560.2
SF	Marin	BA	14.27	10.48	24.75	128126.77	191654.2	319780.97
MC	Mariposa	MPA	53.97	73.6	127.57	291009.13	371044.13	662053.26
NC	Mendocino	MEN	214.68	86.54	301.22	4190878.4	483105.19	4673983.6
SJV	Merced	SJU	15.69	16.21	31.9	21069.95	26293.18	47363.13
NEP	Modoc	MOD	164.46	115.54	280	1530642.5	195700.17	1726342.7
GBV	Mono	GBU	79.01	340.35	419.36	299438.65	758630.64	1058069.3
NCC	Monterey	MBU	78.63	24.76	103.39	3516221	270823.23	3787044.2
SF	Napa	BA	7.15	15.51	22.66	49457.56	904731.74	954189.3
MC	Nevada	NSI	42.39	72.66	115.06	465343.3	132226.27	597569.58
SC	Orange	SC	36.25	5.11	41.35	768539.43	219576.54	988115.96
LT	Placer	PLA	0.88	1.99	2.87	3279.24	669.64	3948.88
MC	Placer	PLA	19	53.52	72.52	589537	1117570.7	1707107.7
SV	Placer	PLA	10.74	2.6	13.34	48158.93	19063.08	67222.02
MC	Plumas	NSI	18.23	107.35	125.58	107073.59	118480.1	225553.69
MD	Riverside	MOJ	13.28	45.2	58.47	83297.33	166872.32	250169.65

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			Unpaved Road Miles			Annual VMT		
AB	County	DIS	City/County	Other	Total	City/County	Other	Total
MD	Riverside	SC	2.75	75.76	78.51	28394.68	618825.02	647219.7
SC	Riverside	SC	214.98	164.63	379.61	3228576.7	903984.32	4132561
SS	Riverside	SC	116.77	110.4	227.17	2319455.6	1068433.3	3387888.9
SV	Sacramento	SAC	20.65	0.44	21.09	764472.53	876.41	765348.94
NCC	San Benito	MBU	32.23	7.03	39.26	373104.68	135413.14	508517.82
MD	San Bernardino	MOJ	1984.29	1734.37	3718.65	24972823	24721836	49694659
SC	San Bernardino	SC	45.33	277.79	323.12	415575.83	2013274.2	2428850.1
SD	San Diego	SD	319.14	351.75	670.88	3880923.3	4093640.1	7974563.4
SF	San Francisco	BA	1.26	0.52	1.78	7989.53	461.23	8450.76
SJV	San Joaquin	SJU	6.04	1.36	7.41	55718.08	0	55718.08
SCC	San Luis Obispo	SLO	266.97	142.41	409.38	986595.66	557966.5	1544562.2
SF	San Mateo	BA	7.37	1.68	9.05	234384.56	270954.3	505338.87
SCC	Santa Barbara	SB	18.55	15.77	34.32	2101351.8	79546.57	2180898.4
SF	Santa Clara	BA	57.14	0.68	57.82	274190.9	1156.86	275347.76
NCC	Santa Cruz	MBU	18.26	4.68	22.93	298514.54	55498.93	354013.47
SV	Shasta	SHA	117.23	167.26	284.49	736942.06	544662.51	1281604.6
MC	Sierra	NSI	5.25	58.35	63.6	90698.34	363758.75	454457.09
NEP	Siskiyou	SIS	154.76	384.35	539.1	1035254.3	1227674	2262928.3
SF	Solano	BA	14.65	0.03	14.68	106871.21	11.02	106882.23
SV	Solano	YS	5.2	0	5.2	1121385.3	0	1121385.3
NC	Sonoma	NS	35.7	7.4	43.1	317491.9	40896.24	358388.14
SF	Sonoma	BA	3.7	0.53	4.23	14493.23	0	14493.23
SJV	Stanislaus	SJU	38.86	0.18	39.03	416767.62	639.42	417407.04
SV	Sutter	FR	0.51	0	0.51	19178.1	0	19178.1
SV	Tehama	TEH	80.39	121.36	201.75	2291573.8	395230.55	2686804.3
NC	Trinity	NCU	36.52	129.97	166.48	529410.14	320859.55	850269.69
SJV	Tulare	SJU	9.25	52.56	61.81	31593.97	299392.99	330986.96
MC	Tuolumne	TUO	10.96	55.33	66.29	38115.67	278783.07	316898.74
SCC	Ventura	VEN	19.09	24	43.08	57492.15	3345234.8	3402726.9
SV	Yolo	YS	3.61	7.32	10.92	15366.73	75743.71	91110.44
SV	Yuba	FR	13.32	9.72	23.03	129853.28	233249.87	363103.16
	Statewide Totals		6647.34	6931.29	13578.64	78169571	67350779	145520350

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Table 2. Base Year 2023 Unpaved Non-Farm Road Emissions for PM10 (tons/year)

Air Basin	County	Air District	City/County	Other	Total
SF	Alameda	BA	432.7	5.31	438.01
GBV	Alpine	GBU	6.06	8.99	15.06
MC	Amador	AMA	15.67	0.43	16.1
SV	Butte	BUT	393.33	393.8	787.13
MC	Calaveras	CAL	54.99	71.51	126.51
SV	Colusa	COL	929.55	1398.96	2328.51
SF	Contra Costa	BA	83.73	7.36	91.08
NC	Del Norte	NCU	63.5	1817.84	1881.34
LT	El Dorado	ED	0.68	6.12	6.8
MC	El Dorado	ED	278.99	721.92	1000.91
SJV	Fresno	SJU	281.92	293.55	575.47
SV	Glenn	GLE	68.62	2594.95	2663.57
NC	Humboldt	NCU	460.2	182.65	642.85
SS	Imperial	IMP	674.77	2829.01	3503.79
GBV	Inyo	GBU	941.31	4200.9	5142.21
MD	Kern	KER	2512.11	570.86	3082.97
SJV	Kern	SJU	1550.04	147.32	1697.36
SJV	Kings	SJU	0.06	0	0.06
LC	Lake	LAK	110.15	43.76	153.91
NEP	Lassen	LAS	92.13	315.64	407.77
MD	Los Angeles	AV	5316.22	331.58	5647.81
SC	Los Angeles	SC	997.17	222.3	1219.47
SJV	Madera	SJU	896.72	258.39	1155.11
SF	Marin	BA	102.36	153.11	255.47
MC	Mariposa	MPA	230.34	293.68	524.02
NC	Mendocino	MEN	3042.69	350.75	3393.44
SJV	Merced	SJU	17.9	22.33	40.23
NEP	Modoc	MOD	1020.71	130.5	1151.21
GBV	Mono	GBU	219.7	556.61	776.3
NCC	Monterey	MBU	2906.42	223.86	3130.28
SF	Napa	BA	40.04	732.46	772.5
MC	Nevada	NSI	329.69	93.68	423.37
SC	Orange	SC	675.26	192.93	868.19
LT	Placer	PLA	2.33	0.48	2.81
MC	Placer	PLA	413	782.91	1195.91
SV	Placer	PLA	39.35	15.57	54.92
MC	Plumas	NSI	74.72	82.68	157.39
MD	Riverside	MOJ	77.8	155.85	233.65
MD	Riverside	SC	26.33	573.73	600.05

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Air Basin	County	Air District	City/County	Other	Total
SC	Riverside	SC	2780.11	778.42	3558.53
SS	Riverside	SC	2077.34	956.91	3034.25
SV	Sacramento	SAC	643.83	0.74	644.57
NCC	San Benito	MBU	314.02	113.97	427.99
MD	San Bernardino	MOJ	22003.45	21782.31	43785.76
SC	San Bernardino	SC	349.2	1691.7	2040.9
SD	San Diego	SD	3301.44	3482.4	6783.84
SF	San Francisco	BA	6.54	0.38	6.92
SJV	San Joaquin	SJU	47.37	0	47.37
SCC	San Luis Obispo	SLO	848.2	479.7	1327.9
SF	San Mateo	BA	184.68	213.5	398.18
SCC	Santa Barbara	SB	1819.83	68.89	1888.72
SF	Santa Clara	BA	227.99	0.96	228.95
NCC	Santa Cruz	MBU	241.02	44.81	285.83
SV	Shasta	SHA	525.75	388.58	914.33
MC	Sierra	NSI	63.46	254.53	318
NEP	Siskiyou	SIS	635.62	753.76	1389.38
SF	Solano	BA	87.99	0.01	87.99
SV	Solano	YS	938.28	0	938.28
NC	Sonoma	NS	243.47	31.36	274.83
SF	Sonoma	BA	11.54	0	11.54
SJV	Stanislaus	SJU	352.83	0.54	353.37
SV	Sutter	FR	15.92	0	15.92
SV	Tehama	TEH	1678.19	289.44	1967.62
NC	Trinity	NCU	360.43	218.45	578.88
SJV	Tulare	SJU	25.53	241.89	267.42
MC	Tuolumne	TUO	28.08	205.38	233.46
SCC	Ventura	VEN	51.13	2974.97	3026.1
SV	Yolo	YS	12.76	62.9	75.66
SV	Yuba	FR	97.69	175.48	273.17
	Statewide Totals		65352.93	55996.25	121349.2

Table 3. 2023 Unpaved Non-Farm Road Emissions for PM2.5 and Total PM

			PM2.5 tons/year			Total PM tons/year		
AB	County	DIS	City/County	Other	Total	City/County	Other	Total
SF	Alameda	BA	43.25	0.53	43.78	728.08	8.94	737.02
GBV	Alpine	GBU	0.61	0.9	1.5	10.2	15.14	25.33
MC	Amador	AMA	1.57	0.04	1.61	26.36	0.72	27.09
SV	Butte	BUT	39.31	39.36	78.67	661.83	662.63	1324.46
MC	Calaveras	CAL	5.5	7.15	12.64	92.53	120.33	212.87
SV	Colusa	COL	92.91	139.83	232.73	1564.11	2353.96	3918.07
SF	Contra Costa	BA	8.37	0.74	9.1	140.88	12.38	153.26
NC	Del Norte	NCU	6.35	181.69	188.04	106.85	3058.79	3165.64
LT	El Dorado	ED	0.07	0.61	0.68	1.15	10.29	11.44
MC	El Dorado	ED	27.88	72.16	100.04	469.44	1214.74	1684.18
SJV	Fresno	SJU	28.18	29.34	57.52	474.37	493.94	968.31
SV	Glenn	GLE	6.86	259.36	266.22	115.46	4366.4	4481.86
NC	Humboldt	NCU	46	18.26	64.25	774.36	307.33	1081.7
SS	Imperial	IMP	67.44	282.76	350.2	1135.41	4760.25	5895.65
GBV	Inyo	GBU	94.08	419.88	513.96	1583.9	7068.65	8652.55
MD	Kern	KER	251.08	57.06	308.14	4227.01	960.56	5187.56
SJV	Kern	SJU	154.93	14.72	169.65	2608.18	247.88	2856.06
SJV	Kings	SJU	0.01	0	0.01	0.1	0	0.1
LC	Lake	LAK	11.01	4.37	15.38	185.34	73.64	258.97
NEP	Lassen	LAS	9.21	31.55	40.76	155.03	531.11	686.14
MD	Los Angeles	AV	531.35	33.14	564.5	8945.35	557.94	9503.29
SC	Los Angeles	SC	99.67	22.22	121.89	1677.89	374.06	2051.95
SJV	Madera	SJU	89.63	25.83	115.45	1508.87	434.79	1943.66
SF	Marin	BA	10.23	15.3	25.53	172.24	257.64	429.87
MC	Mariposa	MPA	23.02	29.35	52.38	387.57	494.17	881.74
NC	Mendocino	MEN	304.12	35.06	339.17	5119.79	590.19	5709.98
SJV	Merced	SJU	1.79	2.23	4.02	30.11	37.58	67.69
NEP	Modoc	MOD	102.02	13.04	115.06	1717.5	219.59	1937.09
GBV	Mono	GBU	21.96	55.63	77.59	369.67	936.57	1306.25
NCC	Monterey	MBU	290.5	22.37	312.87	4890.5	376.67	5267.17
SF	Napa	BA	4	73.21	77.21	67.37	1232.48	1299.85
MC	Nevada	NSI	32.95	9.36	42.32	554.76	157.63	712.39
SC	Orange	SC	67.49	19.28	86.78	1136.23	324.63	1460.86
LT	Placer	PLA	0.23	0.05	0.28	3.92	0.8	4.72
MC	Placer	PLA	41.28	78.25	119.53	694.93	1317.37	2012.3
SV	Placer	PLA	3.93	1.56	5.49	66.2	26.21	92.41
MC	Plumas	NSI	7.47	8.26	15.73	125.72	139.12	264.84
MD	Riverside	MOJ	7.78	15.58	23.35	130.91	262.25	393.15

Section 7.10
Unpaved Road Dust, Non-Farm Roads

			PM2.5 tons/year			Total PM tons/year		
AB	County	DIS	City/County	Other	Total	City/County	Other	Total
MD	Riverside	SC	2.63	57.34	59.97	44.3	965.38	1009.68
SC	Riverside	SC	277.87	77.8	355.67	4677.96	1309.81	5987.77
SS	Riverside	SC	207.63	95.64	303.27	3495.44	1610.14	5105.58
SV	Sacramento	SAC	64.35	0.07	64.42	1083.35	1.24	1084.59
NCC	San Benito	MBU	31.39	11.39	42.78	528.39	191.77	720.16
MD	San Bernardino	MOJ	2199.23	2177.13	4376.37	37024.15	36652.04	73676.19
SC	San Bernardino	SC	34.9	169.08	203.99	587.58	2846.55	3434.12
SD	San Diego	SD	329.98	348.06	678.04	5555.18	5859.66	11414.84
SF	San Francisco	BA	0.65	0.04	0.69	11.01	0.64	11.65
SJV	San Joaquin	SJU	4.73	0	4.73	79.7	0	79.7
SCC	San Luis Obispo	SLO	84.78	47.95	132.72	1427.23	807.17	2234.39
SF	San Mateo	BA	18.46	21.34	39.8	310.76	359.24	670
SCC	Santa Barbara	SB	181.89	6.89	188.78	3062.14	115.92	3178.05
SF	Santa Clara	BA	22.79	0.1	22.88	383.63	1.62	385.25
NCC	Santa Cruz	MBU	24.09	4.48	28.57	405.55	75.4	480.95
SV	Shasta	SHA	52.55	38.84	91.39	884.66	653.84	1538.5
MC	Sierra	NSI	6.34	25.44	31.78	106.79	428.29	535.08
NEP	Siskiyou	SIS	63.53	75.34	138.87	1069.52	1268.31	2337.84
SF	Solano	BA	8.79	0	8.8	148.05	0.02	148.06
SV	Solano	YS	93.78	0	93.78	1578.79	0	1578.79
NC	Sonoma	NS	24.33	3.13	27.47	409.67	52.77	462.44
SF	Sonoma	BA	1.15	0	1.15	19.41	0	19.41
SJV	Stanislaus	SJU	35.26	0.05	35.32	593.68	0.91	594.59
SV	Sutter	FR	1.59	0	1.59	26.78	0	26.78
SV	Tehama	TEH	167.73	28.93	196.66	2823.8	487.02	3310.83
NC	Trinity	NCU	36.03	21.83	57.86	606.48	367.57	974.06
SJV	Tulare	SJU	2.55	24.18	26.73	42.95	407.02	449.97
MC	Tuolumne	TUO	2.81	20.53	23.33	47.25	345.59	392.84
SCC	Ventura	VEN	5.11	297.35	302.46	86.03	5005.83	5091.87
SV	Yolo	YS	1.28	6.29	7.56	21.47	105.84	127.31
SV	Yuba	FR	9.76	17.54	27.3	164.38	295.27	459.65
Statewide Totals			6531.99	5596.8	12128.79	109966.2	94222.19	204188.4

Temporal Activity

Activity on unpaved roads is assumed to occur primarily during daylight hours and to be uniform each day of the week. It is also assumed more unpaved road travel takes place

during the dry months than the rainy months. Temporal profiles are used to allocate total annual unpaved road dust emissions to each month to account for this seasonal variation in activity. Appendix B presents county- and air basin- specific temporal profiles, based on monthly days of rainfall.

Growth Forecasting

Historically, CARB has assumed “NO-GROWTH i.e. FLAT” for Non-Farm Roads (Public) and City & County Roads. Typically, over time, unpaved roads are frequently paved over so this would result in a declining growth profile. However, we do not currently have a record of these paving projects, so ‘NO-GROWTH” is considered to be conservative.

Controls

The emission estimates in this methodology represent statewide emissions controlled only by rainfall. Some local air districts have adopted regulations that control emissions from unpaved non-farm roads. These local controls are not incorporated into the statewide methodology or the emissions estimates presented in Table 2 and Table 3. Applicable district-specific controls were applied separately when the emissions were incorporated into the California Emission Inventory Development and Reporting System (CEIDARS) and the California Emissions Projection Analysis Model (CEPAM). Therefore, the controlled emissions in CEIDARS and CEPAM may differ from the uncontrolled estimates presented in this document.

Speciation

V. Organic Gas Speciation Profiles

Not applicable

VI. Particulate Matter Speciation Profiles

See above section: PM_{2.5} and Total PM

Sample Calculations

This section provides an example of estimating unpaved non-farm road dust emissions of Alameda County in base year 2023.

Step	Calculation Description	Road Type		Total
		Non-Farm Roads (Public)	City/County Roads	
1	Annual VMT (Table 1)	6466.02	526802.98	533269.00
2	EF, lbs PM10/VMT	2.00	2.00	2.00
3	Average Annual Rainfall Days (P) (Appendix A)	65.20	65.20	65.20
4	Rainfall Adjustment Factor	0.8214	0.8214	0.8214
5	PM10, tons/year	5.31	432.70	438.01
6	PM2.5, tons/year (PM2.5 and Total PM Section)	0.53	43.25	43.78
7	Total PM, tons/year (PM2.5 and Total PM Section)	8.94	728.08	737.02

Changes in This Update

There are several methodology changes for this update. The changes are:

- For the first time, unpaved road miles are based on an estimation from a large sampling of real-world data - Replica. Previous methodology collects unpaved road miles either from local air districts, public reports or oversimplified such as assumptions: scaling unpaved road miles from paved roads and assuming vehicle activity of 10 passes per day on all roads. This introduced large uncertainties of the estimations for both road miles and VMT. The updated methodology of using Replica AADT data combined with OSM map layer to identify unpaved roads from the map significantly improved the accuracy of estimations on road miles and VMT
- Unpaved road miles and VMT were updated to reflect the latest available calendar year 2023 estimates
- VMT was calculated using Replica AADT data by multiplying road length and annual average daily traffic instead of multiplying road length by 10 passes per day
- Changed previous four EICs to two EICs
- Counties split among air basins and districts are spatially allocated based on geographic locations of unpaved roads. Previous methodology split counties based on land surface area which assumes that both unpaved road miles and VMT share the same split ratio. For this method, Replica GIS data with ARB's COABDIS shapefile were used to split unpaved roads based on their geographic locations and then calculate corresponding VMT for each part.

Assumptions and Limitations

1. This methodology assumes that all public and industrial unpaved roads in California emit the same levels of PM₁₀ per VMT for all vehicles.
2. It is assumed that the emissions factors derived in the San Joaquin Valley are applicable to the rest of the state.
3. It is assumed that the particle size speciation profile derived in the San Joaquin Valley are applicable to the rest of the state.
4. It is assumed that rainfall of at least 0.01 inch on any day mitigates unpaved road dust emissions for 24 hours
5. This inventory does not include private unpaved roads. Agricultural unpaved road emissions estimates are computed in a separate methodology
6. This methodology does not account for emission reductions from control measures for unpaved roads.
7. It is assumed that all unpaved roads remaining after removing unpaved roads that fall into State and Federal protected areas are city and county roads

Comments and Recommendations

Although transitioning from report-based data to Replica represents a substantial improvement in estimating unpaved non-farm road dust emissions, the Replica dataset still has notable limitations regarding unpaved roads. Because unpaved roads typically have very low traffic volumes compared to paved roads, Replica may underestimate unpaved road miles and vehicle miles traveled (VMT). Future updates should consider integrating additional large-scale datasets or other advanced data sources to improve the accuracy of unpaved road VMT estimation.

In addition, the emission factors (EFs) used in this methodology are outdated—nearly three decades old. It is strongly recommended that future updates include a comprehensive review and revision of these emission factors, where possible, to ensure that the methodology reflects current conditions and the best available science.

References

1. OpenStreetMap, 2023. <https://www.openstreetmap.org/#map=5/38.01/-95.84>
2. REPLICA, 2023. <https://www.replicahq.com/traffic-datasets>
3. Flocchini, R.G., Cahill, T.A., Matsumura, R.T., Carvacho, O., Lu, Z. Evaluation of the Emission of PM10 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. http://gate1.baaqmd.gov/pdf/0055_Evaluation_Emission_PM10_Participulates_from_Unpaved_Roads_San_Joaquin_Valley_1994.pdf
4. Watson J.G., Rogers, C.F. Chow, J.C., DuBois, D., Gillies, J.A., Derby, J., Moosmuller, H. 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. https://www.arb.ca.gov/airways/Documents/reports/dri_dustcontrol.pdf
5. CARB, 2012. MISCELLANEOUS PROCESS METHODOLOGY 7.10 Unpaved Road Dust, Non-Farm Roads. https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full7-10_2012.pdf
6. OpenStreetMap, Wiki. https://wiki.openstreetmap.org/wiki/Main_Page
7. Gaffney, P. Section 7.10, Unpaved Road Dust Methodology (Non-Farm Roads). California Air Resources Board. August 1997.
8. Morey, J.E., Niemeier, D.A. Estimating Statewide Vehicle Activity and Roadway Mileage for Unpaved Roads in California. UC Davis Contract Number 99-715. California Air Resources Board. October 31, 2002. <http://www.arb.ca.gov/research/apr/reports/99-715.pdf>
9. USEPA, AP-42 13.2.2 Unpaved Roads, 2006. https://www.epa.gov/sites/default/files/2020-10/documents/13.2.2_unpaved_roads.pdf
10. California Protected Area Database, 2022. <https://hub.scag.ca.gov/datasets/2c85a1c0109746f48834007432594c8e/explore>
11. California Air Resources Board, Speciation Profiles Used in ARB Modeling. PMSIZE Spreadsheet, Speciation Profile #470. <http://www.arb.ca.gov/ei/speciate/dnldoptvv10001.php#specprof>
12. 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.

<http://www.arb.ca.gov/ei/speciate/r01t20/rf20doc/refnum20.htm>

13. Countess Environmental. Western Regional Air Partnership (WRAP) Fugitive Dust Handbook. Prepared for the Western Governors' Association, contract number 30204-111. September 7, 2006.

<http://www.wrapair.org/forums/dejf/fdh/index.htm>

14. Chow, J.C., Watson, J.G., Ashbaugh, L.L., Magliano, K.L. 2003. Similarities and differences in PM10 chemical source profiles for geological dust from the San Joaquin Valley, California. Atmospheric Environment 37:1317-1340. 2003. <http://www.arb.ca.gov/ei/speciate/r01t20/rf13doc/Ref%2013%20-%20Chowetal2003AESJVFugDustProfiles.pdf>

Appendix A: Annual rainfall days: Average days per year that California counties received 0.01 inches or greater precipitation over 2013-2023

County	Annual Rainfall Days
Alameda	65.2
Alpine	123.2
Amador	90.7
Butte	94.1
Calaveras	84.7
Colusa	70.5
Contra Costa	64.0
Del Norte	141.9
El Dorado	108.5
Fresno	70.1
Glenn	80.1
Humboldt	117.3
Imperial	24.8
Inyo	59.0
Kern	49.8
Kings	44.0
Lake	90.6
Lassen	113.0
Los Angeles	42.2
Madera	78.1
Marin	73.5
Mariposa	76.1
Mendocino	100.0
Merced	55.0
Modoc	121.6
Mono	97.2
Monterey	62.3
Napa	69.5
Nevada	106.4
Orange	41.9
Placer	93.9
Plumas	110.3
Riverside	34.9
Sacramento	57.6
San Benito	57.8
San Bernardino	50.9

Section 7.10
Unpaved Road Dust, Non-Farm Roads

County	Annual Rainfall Days
San Diego	49.1
San Francisco	66.0
San Joaquin	54.7
San Luis Obispo	48.6
San Mateo	80.6
Santa Barbara	45.3
Santa Clara	61.5
Santa Cruz	66.5
Shasta	104.6
Sierra	109.6
Siskiyou	140.9
Solano	62.1
Sonoma	79.8
Stanislaus	56.0
Sutter	62.1
Tehama	97.7
Trinity	116.5
Tulare	70.1
Tuolumne	96.1
Ventura	37.9
Yolo	61.9
Yuba	90.4

Appendix B: Temporal profiles for unpaved non-farm road dust emissions based on monthly days of rain

AB	County	DIS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MC	Amador	AMA	0.079	0.081	0.076	0.082	0.082	0.088	0.090	0.090	0.087	0.086	0.081	0.078
MD	Los Angeles	AV	0.077	0.079	0.075	0.085	0.085	0.089	0.090	0.087	0.086	0.086	0.084	0.075
SF	Alameda	BA	0.076	0.080	0.074	0.083	0.087	0.090	0.091	0.090	0.089	0.087	0.080	0.073
SF	Contra Costa	BA	0.075	0.080	0.075	0.083	0.087	0.090	0.091	0.090	0.089	0.086	0.081	0.073
SF	Marin	BA	0.075	0.081	0.077	0.083	0.087	0.090	0.090	0.090	0.088	0.085	0.081	0.074
SF	Napa	BA	0.075	0.081	0.076	0.083	0.087	0.090	0.091	0.090	0.089	0.086	0.080	0.073
SF	San Francisco	BA	0.076	0.080	0.075	0.083	0.087	0.090	0.090	0.090	0.089	0.086	0.080	0.073
SF	San Mateo	BA	0.077	0.081	0.075	0.084	0.086	0.090	0.089	0.089	0.088	0.087	0.081	0.075
SF	Santa Clara	BA	0.076	0.079	0.074	0.083	0.087	0.090	0.091	0.091	0.089	0.087	0.080	0.073
SF	Solano	BA	0.075	0.080	0.075	0.083	0.087	0.090	0.091	0.091	0.089	0.086	0.081	0.073
SF	Sonoma	BA	0.075	0.081	0.076	0.083	0.086	0.090	0.091	0.090	0.088	0.085	0.081	0.074
SV	Butte	BUT	0.077	0.081	0.075	0.082	0.084	0.088	0.091	0.090	0.088	0.086	0.081	0.076
MC	Calaveras	CAL	0.079	0.081	0.075	0.082	0.083	0.088	0.090	0.090	0.087	0.086	0.081	0.078
SV	Colusa	COL	0.075	0.081	0.076	0.084	0.084	0.089	0.091	0.090	0.088	0.085	0.081	0.075
LT	El Dorado	ED	0.080	0.081	0.077	0.083	0.083	0.088	0.088	0.087	0.086	0.085	0.082	0.078
MC	El Dorado	ED	0.080	0.081	0.076	0.083	0.082	0.088	0.089	0.089	0.087	0.085	0.082	0.078
SV	Sutter	FR	0.076	0.080	0.075	0.083	0.086	0.089	0.091	0.090	0.089	0.086	0.080	0.074
SV	Yuba	FR	0.076	0.082	0.075	0.083	0.084	0.089	0.091	0.090	0.088	0.085	0.081	0.076
GBV	Alpine	GBU	0.081	0.082	0.078	0.083	0.083	0.087	0.087	0.086	0.086	0.085	0.082	0.079
GBV	Inyo	GBU	0.080	0.082	0.079	0.084	0.083	0.087	0.084	0.084	0.087	0.087	0.084	0.079
GBV	Mono	GBU	0.081	0.082	0.079	0.084	0.082	0.087	0.084	0.085	0.087	0.086	0.083	0.080
SV	Glenn	GLE	0.076	0.081	0.077	0.083	0.084	0.089	0.090	0.090	0.088	0.085	0.081	0.075
SS	Imperial	IMP	0.077	0.083	0.083	0.087	0.088	0.090	0.085	0.078	0.082	0.084	0.086	0.077
MD	Kern	KER	0.076	0.080	0.075	0.085	0.085	0.089	0.090	0.088	0.088	0.087	0.082	0.076
LC	Lake	LAK	0.076	0.082	0.076	0.083	0.085	0.089	0.091	0.090	0.088	0.085	0.081	0.075
NEP	Lassen	LAS	0.080	0.082	0.079	0.083	0.082	0.086	0.088	0.088	0.087	0.086	0.083	0.077
NCC	Monterey	MBU	0.076	0.079	0.074	0.084	0.086	0.090	0.090	0.090	0.089	0.087	0.080	0.073
NCC	San Benito	MBU	0.075	0.080	0.073	0.084	0.086	0.090	0.090	0.090	0.090	0.087	0.080	0.073

Section 7.10
Unpaved Road Dust, Non-Farm Roads

AB	County	DIS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NCC	Santa Cruz	MBU	0.076	0.080	0.075	0.083	0.086	0.089	0.090	0.090	0.089	0.086	0.081	0.075
NC	Mendocino	MEN	0.077	0.081	0.076	0.083	0.085	0.089	0.090	0.090	0.088	0.085	0.080	0.076
NEP	Modoc	MOD	0.080	0.082	0.079	0.082	0.082	0.087	0.089	0.088	0.087	0.086	0.082	0.078
MD	Riverside	MOJ	0.077	0.083	0.082	0.087	0.089	0.089	0.083	0.077	0.084	0.085	0.086	0.078
MD	San Bernardino	MOJ	0.079	0.082	0.081	0.086	0.086	0.089	0.082	0.079	0.084	0.085	0.086	0.080
MC	Mariposa	MPA	0.079	0.080	0.075	0.082	0.083	0.088	0.089	0.089	0.087	0.086	0.082	0.078
NC	Del Norte	NCU	0.079	0.081	0.079	0.082	0.085	0.087	0.090	0.089	0.087	0.083	0.080	0.078
NC	Humboldt	NCU	0.079	0.081	0.078	0.082	0.084	0.088	0.090	0.090	0.087	0.084	0.081	0.077
NC	Trinity	NCU	0.078	0.081	0.077	0.083	0.084	0.088	0.089	0.089	0.088	0.085	0.081	0.078
NC	Sonoma	NS	0.076	0.081	0.076	0.082	0.086	0.090	0.090	0.090	0.088	0.085	0.081	0.075
MC	Nevada	NSI	0.079	0.082	0.077	0.082	0.082	0.087	0.089	0.088	0.087	0.086	0.082	0.078
MC	Plumas	NSI	0.079	0.082	0.077	0.082	0.082	0.087	0.089	0.088	0.087	0.086	0.082	0.079
MC	Sierra	NSI	0.079	0.082	0.078	0.082	0.082	0.087	0.089	0.088	0.087	0.086	0.082	0.078
LT	Placer	PLA	0.080	0.082	0.077	0.083	0.083	0.088	0.089	0.088	0.087	0.085	0.081	0.078
MC	Placer	PLA	0.079	0.081	0.077	0.082	0.083	0.087	0.089	0.089	0.087	0.086	0.082	0.078
SV	Placer	PLA	0.076	0.081	0.076	0.084	0.085	0.090	0.091	0.090	0.088	0.086	0.080	0.074
SV	Sacramento	SAC	0.076	0.081	0.075	0.083	0.086	0.090	0.091	0.091	0.089	0.086	0.081	0.073
SCC	Santa Barbara	SB	0.075	0.078	0.073	0.085	0.085	0.089	0.090	0.090	0.088	0.087	0.083	0.075
MD	Riverside	SC	0.076	0.083	0.083	0.086	0.088	0.090	0.081	0.077	0.083	0.087	0.087	0.080
SC	Los Angeles	SC	0.077	0.078	0.075	0.085	0.084	0.089	0.090	0.089	0.087	0.085	0.084	0.077
SC	Orange	SC	0.079	0.080	0.075	0.084	0.083	0.088	0.090	0.089	0.087	0.086	0.082	0.077
SC	Riverside	SC	0.079	0.081	0.076	0.084	0.083	0.089	0.088	0.086	0.086	0.085	0.084	0.079
SC	San Bernardino	SC	0.079	0.081	0.077	0.084	0.083	0.089	0.087	0.085	0.086	0.086	0.084	0.080
SS	Riverside	SC	0.078	0.080	0.078	0.086	0.086	0.090	0.084	0.084	0.084	0.086	0.085	0.078
SD	San Diego	SD	0.078	0.080	0.077	0.084	0.084	0.090	0.087	0.087	0.086	0.085	0.083	0.078
SV	Shasta	SHA	0.078	0.082	0.077	0.082	0.083	0.087	0.090	0.090	0.087	0.085	0.081	0.078
NEP	Siskiyou	SIS	0.080	0.081	0.079	0.083	0.083	0.087	0.088	0.089	0.087	0.085	0.081	0.078
SJV	Fresno	SJU	0.079	0.081	0.074	0.083	0.083	0.088	0.089	0.089	0.088	0.087	0.082	0.078
SJV	Kern	SJU	0.075	0.080	0.073	0.084	0.085	0.089	0.090	0.090	0.088	0.087	0.083	0.075
SJV	Kings	SJU	0.075	0.080	0.073	0.084	0.086	0.090	0.089	0.090	0.090	0.087	0.083	0.073
SJV	Madera	SJU	0.078	0.080	0.074	0.083	0.083	0.088	0.088	0.090	0.088	0.086	0.082	0.078

Section 7.10
Unpaved Road Dust, Non-Farm Roads

AB	County	DIS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SJV	Merced	SJU	0.076	0.080	0.073	0.083	0.086	0.091	0.091	0.090	0.090	0.086	0.081	0.073
SJV	San Joaquin	SJU	0.076	0.080	0.075	0.082	0.087	0.090	0.091	0.091	0.090	0.086	0.080	0.072
SJV	Stanislaus	SJU	0.076	0.079	0.074	0.083	0.086	0.091	0.091	0.091	0.089	0.087	0.080	0.073
SJV	Tulare	SJU	0.078	0.080	0.075	0.083	0.083	0.088	0.088	0.087	0.089	0.087	0.084	0.079
SCC	San Luis Obispo	SLO	0.076	0.080	0.073	0.084	0.086	0.090	0.091	0.090	0.089	0.088	0.081	0.073
SV	Tehama	TEH	0.077	0.082	0.076	0.082	0.083	0.088	0.090	0.090	0.088	0.085	0.081	0.077
MC	Tuolumne	TUO	0.080	0.081	0.077	0.083	0.082	0.087	0.087	0.088	0.087	0.086	0.083	0.079
SCC	Ventura	VEN	0.076	0.079	0.073	0.086	0.084	0.089	0.090	0.089	0.088	0.087	0.084	0.075
SV	Solano	YS	0.075	0.080	0.074	0.084	0.087	0.090	0.091	0.091	0.089	0.086	0.081	0.072
SV	Yolo	YS	0.075	0.081	0.075	0.084	0.085	0.090	0.091	0.091	0.089	0.086	0.081	0.073