SECTION 7.7

BUILDING CONSTRUCTION DUST

(Revised September 2002)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Construction and Demolition

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
630-622-5400-0000 (47357) Building Construction Dust – Residential

630-624-5400-0000 (47365) Building Construction Dust – Commercial

630-626-5400-0000 (47373) Building Construction Dust – Industrial

630-628-5400-0000 (54551) Building Construction Dust – Institutional

630-630-5400-0000 (60400) Building Construction Dust – Governmental

METHODS AND SOURCES

The building construction dust source category provides estimates of the fugitive dust particulate matter caused by construction activities while building residential, commercial, industrial, institutional, or governmental structures. The emissions result predominantly from site preparation work, which may include scraping, grading, loading, digging, compacting, light-duty vehicle travel, and other operations. Table 1 shows particulate matter emissions less than 10 microns (PM_{10}) estimates by county for construction activities. The process rates (PR) in acre-months/year used to calculate the emissions are also listed.

Dust emissions from construction operations are computed by using a PM_{10} emission factor developed by Midwest Research Institute (MRI) during 1996.[1] The emission factor is based on observations of construction operations in California and Las Vegas. Activity data for construction is expressed in terms of acre-months of construction. Acre-months are based on estimates of the acres disturbed for residential construction, and project valuation for other, non-residential construction. Activity data for 1999 are used to estimate construction operations emissions.

Emission Factor. The emission factor used for our estimates of geologic dust emissions from construction activities is based on work performed by Midwest Research Institute[1] under contract to the PM_{10} Best Available Control Measure (BACM) working group. For most parts of the state, the emission factor used is 0.11 tons PM_{10} /acre-month of activity (or 0.225 tons PM/acre-month). This emission factor is based on MRI's observation of the types, quantity, and duration of operations at eight construction

sites (three in Las Vegas and five in California). The bulk of the operations observed were site preparation-related activities. The observed activity data were then combined with operation-specific emission factors provided in U.S. EPA's AP-42 (5th Edition)[2] document to produce site emissions estimates. These site estimates were then combined to produce the overall average emission factor of 0.11 tons PM_{10}/acre-month. This emission factor is approximately 71% lower than the previous emission factor that was used from the 4th Edition of AP-42.

The construction emission factor is assumed to include the effects of typical control measures such as routine watering. A dust control effectiveness of 50% is assumed from these measures, which is based on the estimated control effectiveness of watering.[3] Therefore, if this emission factor is used for construction activities where watering is not used, it should be doubled to more accurately reflect the actual emissions. The MRI document lists their average emission factor values as uncontrolled. However, our judgement is that the activities observed and the emission estimates do include the residual effects of control. All of the test sites observed were actual operations that used watering controls as part of their standard industry practice in California and Las Vegas. So, even if in some cases watering was not performed during the actual site visits, the residual decreases in emissions from the watering controls and raising the soil moisture are thought to be included in the MRI estimates.

The MRI report also includes an emission factor for worst-case emissions of 0.42 tons PM_{10}/acre-month. This emission factor is appropriate for large-scale construction operations, which involve substantial earthmoving operations. The South Coast Air Quality Management District (SCAQMD) estimated that 25 percent of their construction projects involve these types of operations, and applied the larger emission factor to the activities. For the remainder of the state, such detailed information is not readily available, so the average emission factor of 0.11 tons PM_{10}/acre-month was used.

This methodology directly computes PM_{10} emissions. The PM emissions are PM_{10} x 2.04.[4]

Activity Data. For the purpose of estimating emissions, it is assumed that the fugitive dust emissions are related to the acreage affected by construction. Because region-wide estimates of the acreage under construction are not directly available, other construction activity data are used to derive acreage estimates. Activity data are estimated separately for residential construction, and the other types of construction (commercial, industrial, institutional, and governmental). The activity data for construction are based on 1999 estimates.

For residential construction, the number of new housing units, estimated by the Department of Finance[5] for 1999, are used to estimate acreage disturbed. The DOF data are shown in Table 2. Based on reference sources,[6,7,8] it is estimated that single-family living units (houses) are built on 1/7 of an acre in heavily populated counties, and 1/5 of an acre in less populated counties. Table 3 shows the acreage assumptions by county. It is also estimated that multiple living units, such as apartments, occupy 1/20 of an acre per living unit. For all of these residential construction activities, a project

duration of six months is assumed[6]. Applying these factors to the reported number of new units in each county results in an estimate of acre-months of construction. This, combined with the construction emission factor, is used to estimate residential construction particulate emissions.

For commercial, industrial, and institutional building construction, construction acreage is based on project valuations obtained from the Department of Finance[5] as shown in Table 4. Project valuations for Additions and Alterations were not included. According to the Construction Industry Research Board[9], most additions and alterations would be modifications within the existing structure and normally would not include the use of large earthmoving equipment. Most horizontal additions would usually be issued a new building permit. The valuations are 3.7, 4.0 and 4.4 acres per million dollars of valuation for the respective construction types listed.[8] Valuations are corrected from 1999 to 1977 values using the Annual Average Consumer Price Index (CPI-U-RS) provided by the U.S. Census Bureau[10]. The Census Bureau uses the Bureau of Labor Statistics' experimental Consumer Price Index (CPI-U-RS) for 1977 through 2000[11]. Valuations are corrected from 1999 to 1977 values because the acres per dollar valuation values are based on 1977 valuations. The CPI-U-RS for 1999 is 244.1 and the CPI-U-RS for 1977 is 100.0. The ratio of 1977 to 1999 dollars is 100.0/244.1 or 0.41. Each acre is assumed to be under construction for 11 months for each project type.[6] Sample calculations are provided below.

ASSUMPTIONS

1. The current methodology assumes that all construction operations in all parts of the state emit the same levels of PM_{10} on a per acre basis.
2. It is assumed that watering techniques are used statewide, reducing emissions by 50% and making it valid to apply the MRI emission factor without correction.
3. The methodology assumes that valuation is proportional to acreage disturbed, even for high-rise type building construction.
4. The methodology assumes that construction dust emissions are directly proportional to the number of acres disturbed during construction.
5. The estimates of acreage disturbed are limited in their accuracy. New housing units and project valuations do not provide direct estimates of actual acreage disturbed by construction operations in each county.
6. The methodology assumes that the Consumer Price Index (CPI-U-RS) provides an accurate estimate of 1977 and 1999 values.

TEMPORAL ACTIVITY

The temporal activity is assumed to occur five days a week between the hours of 8:00 a.m. and 4:00 p.m. The table below shows the percentage of construction activity that is estimated to occur during each month. The monthly activity increases during the spring and summer months. Some districts use a slightly different profile that has a larger peak during the summer months. Construction emissions for future years are based on construction activity projections.

Hours	Days	Weeks
8	5	52

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6.4	6.4	8.3	9.2	9.2	9.2	9.2	9.2	9.2	8.3	8.3	7.3

COMMENTS AND RECOMMENDATIONS

To improve the construction dust estimates, both the emission factor and activity data require attention. The emission factor could be improved by gathering more detailed site data to allow use of the more site-specific emission factors listed in the MRI document[1]. The emission factors could be better applied if the percentage of construction projects that involve substantial earthmoving operations could be determined for each county. Possible improvements to the activity data are better estimates of the actual acreage disturbed by projects and the duration of the projects. Dust emissions from governmental structures were not estimated due to lack of activity data.

CHANGES IN METHOD AND EMISSION ESTIMATES

The major change in this methodology from the previous methodology is the use of current activity data.

GROWTH PARAMETERS

For residential and commercial construction, the growth parameters were developed by Pechan (Categories 14 and 15 in their report, “Development of Emission Growth Surrogates and Activity Projections Used in Forecasting Point and Area Source Emissions, Final Report,” February 26, 2001). The growth parameters are based on employment and output data in the construction sector (SIC codes 15 – 17). For the

remaining categories, the growth parameters were developed by Pechan and are based on employment in the construction sector (SIC codes 15 – 17).

SAMPLE CALCULATIONS

The table below provides an example of estimating residential, commercial, industrial and institutional building construction dust emissions for Fresno County.

Follow the steps shown below the table to estimate the construction dust emissions.

Estimating PM_{10} Construction Dust in Fresno County

		Residential Single Family	Residential Multiple Unit	Commercial	Industrial	Institutional
Step 1	Construction Basis	Units Built	Units Built	Valuation (1977 Dollars)	Valuation (1977 Dollars)	Valuation (1977 Dollars)
Step 2	Construction Basis Value	2646	386	$42.05 million	$35.14 million	$32.60 million
Step 3	Acres/Basis	1/5 acres/unit	1/20 acres/unit	3.7 acres/ million	4.0 acres/ million	4.4 acres/ million
Step 4	Project Duration	6 months	6 months	11 months	11 months	11 months
Step 5	Acre-months/year	3175.2	115.8	1711.4	1546.3	1578.0
Step 6	Emission Factor (tons PM10/acre-month)	0.11	0.11	0.11	0.11	0.11
Step 7	PM_{10} Emissions (tons/year)	349.3	12.7	188.3	170.1	173.6

Step 1: Construction Basis. Enter the units. For residential, the activity units are "Units Built". For non-residential, the activity units are "Valuation (1977 dollars)".

Step 2: Construction Basis Value. For residential construction, enter the number of units (either single or multiple) from Table 2. For commercial, industrial and institutional construction, enter the valuation from Table 4 converted to 1977 dollars. To convert the 1999 dollars to 1977 dollars, use the Consumer Price Index (CPI-U-RS)[10]. The CPI-U-RS for 1999 is 244.1 and the CPI-U-RS for 1977 is 100.0. The ratio of 1977 to 1999 dollars is 100.0/244.1 or 0.41. To obtain the valuations in 1977 dollars, multiply the 1999 valuations by 0.41 and divide by 1,000 to convert from thousands to millions of

dollars. In Table 4, valuations listed under “Other” are assumed to be institutional construction.

Step 3: Acres/Basis Unit. Enter the acres per construction units. For residential construction in Fresno County, this is 1/5 acres per home and 1/20 acres per multiple dwelling unit (see Table 3 for acreage assignments for single family living units). For commercial, industrial and institutional construction, the acres per unit are 3.7, 4.0 and 4.4 acres per million dollars valuation, respectively.

Step 4: Project Duration. Residential construction is estimated to take six months, while commercial, industrial and institutional construction are estimated to take 11 months.

Step 5: Compute Acre-Months. Multiply the values from steps 2, 3 and 4 together to get the acre-months.

Process Rate = Construction Basis Value x Acres/Unit x Months = Acre-Months.

Step 6: Emission Factor. Input the emission factor. ARB’s default factor is 0.11 tons PM_{10}/acre-month when watering practices are employed.

Step 7: Compute Emissions. Multiply the values from step 5 and step 6 to compute the annual PM_{10} emissions.

Emissions = Acre-Months x Emission Factor.

REFERENCES

1. Muleski, Greg, Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, Midwest Research Institute (March 29, 1996).

2. U.S. Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, AP-42, Section 13.2.3, Fifth Edition (January 1995).

3. PEDCo Environmental Specialists, Investigation of Fugitive Dust Sources – Emissions and Control, prepared for the Environmental Protection Agency, OAQPS, contract No. 68-02-0044 (May 1973).

4. Houck, James, Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California, Final Report, OMNI Environmental Services, Inc. (June 30, 1989).

5. California Department of Finance, California Statistical Abstract – 2000, Section I, Construction, Economic Research Unit, (916) 322-2263,www.dof.ca.gov.

6. Midwest Research Institute, Inventory of Agricultural Tilling, Unpaved Roads and Airstrips and Construction Sites, prepared for the U.S. Environmental Protection Agency, PB 238-929, Contract 68-02-1437 (November 1974).

7. South Coast Air Quality Management District, Emissions from Construction/Demolition, Emission Programs Unit. December 1977.

8. Taback, J.J., et al, Inventory of Emissions from Non-Automotive Vehicular Sources, Final Report, KVB (1980).

9. Personal Communication with Ben Bartolotto, Research Director of the Construction Industry Research Board, (818) 841-8210 (August 2002).

10. U.S. Census Bureau, Income 2000, Supplemental Information: Annual Average Consumer Price Index (CPI-U-RS): 1947 to 2000, www.census.gov/hhes/income/income00.cpiurs.html.

11. U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Indexes, CPI Research Series Using Current Labor Methods (CPI-U-RS), www.bls.gov/cpi/cpirsdc.htm.

UPDATED BY

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Table 1. 1999 Building Construction Dust

				Residential		Commercial		Industrial		Institutional	
				EIC:630-622-5400-0000		EIC:630-624-5400-0000		EIC:630-626-5400-0000		EIC:630-628-5400-0000	
AB	CO	DIS	COUNTY NAME	PR (acre-mo/yr)	PM_{10} (tons/yr)	PR (acre-mo/yr)	PM_{10} (tons/yr)	PR (acre-mo/yr)	PM_{10} (tons/yr)	PR (acre-mo/yr)	PM_{10} (tons/yr)
GBV	2	GBU	ALPINE	33.0	3.6	9.5	1.0	0.0	0.0	13.4	1.5
	14	GBU	INYO	21.6	2.4	105.0	11.6	0.0	0.0	12.6	1.4
	26	GBU	MONO	160.2	17.6	0.0	0.0	64.2	7.1	5.1	0.6
LC	17	LAK	LAKE	194.4	21.4	22.0	2.4	0.0	0.0	63.2	7.0
LT	9	ED	EL DORADO	322.5	35.5	71.2	7.8	4.9	0.5	83.2	9.2
	31	PLA	PLACER	223.0	24.5	87.1	9.6	57.0	6.3	34.9	3.8
MC	3	AMA	AMADOR	292.8	32.2	6.9	0.8	158.8	17.5	95.8	10.5
	5	CAL	CALAVERAS	362.4	39.9	95.2	10.5	0.0	0.0	90.4	9.9
	9	ED	EL DORADO	1198.8	131.9	264.7	29.1	18.3	2.0	309.2	34.0
	22	MPA	MARIPOSA	88.8	9.8	4.2	0.5	0.0	0.0	57.9	6.4
	29	NSI	NEVADA	951.9	104.7	63.2	7.0	17.3	1.9	459.8	50.6
	31	PLA	PLACER	495.6	54.5	193.5	21.3	126.6	13.9	77.5	8.5
	32	NSI	PLUMAS	121.2	13.3	0.0	0.0	5.2	0.6	6.8	0.7
	46	NSI	SIERRA	16.8	1.8	0.0	0.0	0.0	0.0	3.7	0.4
	55	TUO	TUOLUMNE	232.8	25.6	58.0	6.4	0.0	0.0	122.6	13.5
MD	15	KER	KERN	632.8	69.6	125.7	13.8	42.7	4.7	243.4	26.8
	19	AV	LOS ANGELES	278.2	30.6	705.9	77.6	208.5	22.9	275.9	30.4
	33	MOJ	RIVERSIDE	182.8	20.1	68.3	7.5	32.4	3.6	37.2	4.1
	33	SC	RIVERSIDE	22.9	2.5	8.5	0.9	4.0	0.4	4.7	0.5
	36	MOJ	SAN BERNARDINO	1344.4	147.9	790.3	86.9	1385.5	152.4	385.1	42.4
NC	8	NCU	DEL NORTE	40.2	4.4	67.3	7.4	0.0	0.0	38.5	4.2
	12	NCU	HUMBOLDT	440.7	48.5	251.6	27.7	6.0	0.7	97.4	10.7
	23	MEN	MENDOCINO	322.2	35.4	22.1	2.4	54.4	6.0	139.6	15.4
	49	NS	SONOMA	370.9	40.8	138.7	15.3	107.3	11.8	87.4	9.6
	53	NCU	TRINITY	49.8	5.5	13.5	1.5	0.0	0.0	32.2	3.5
NCC	27	MBU	MONTEREY	1979.7	217.8	721.4	79.4	175.3	19.3	579.0	63.7
	35	MBU	SAN BENITO	695.4	76.5	123.7	13.6	75.7	8.3	95.1	10.5
	44	MBU	SANTA CRUZ	486.6	53.5	493.5	54.3	75.5	8.3	173.6	19.1
NEP	18	LAS	LASSEN	137.4	15.1	39.7	4.4	0.0	0.0	39.6	4.4
	25	MOD	MODOC	16.8	1.8	7.2	0.8	0.0	0.0	15.7	1.7
	47	SIS	SISKIYOU	165.9	18.2	90.7	10.0	0.0	0.0	79.5	8.7
SC	19	SC	LOS ANGELES	8414.8	1577.8	21352.2	4003.5	6306.0	1182.4	8347.0	1565.1
	30	SC	ORANGE	7986.6	1497.5	13285.4	2491.0	2217.7	415.8	2409.7	451.8
	33	SC	RIVERSIDE	9004.1	1688.3	3361.6	630.3	1595.5	299.2	1832.6	343.6
	36	SC	SAN BERNARDINO	4450.4	834.5	2616.2	490.5	4586.5	860.0	1274.7	239.0
SCC	40	SLO	SAN LUIS OBISPO	1919.4	211.1	497.3	54.7	222.6	24.5	455.8	50.1
	42	SB	SANTA BARBARA	609.3	67.0	771.8	84.9	339.7	37.4	626.9	69.0
	56	VEN	VENTURA	3372.9	371.0	2072.0	227.9	1052.8	115.8	1621.3	178.3
SD	37	SD	SAN DIEGO	10495.6	1154.5	7943.1	873.7	3491.7	384.1	3203.1	352.3
SF	1	BA	ALAMEDA	3033.6	333.7	5369.1	590.6	2480.5	272.9	971.5	106.9
	7	BA	CONTRA COSTA	3650.4	401.5	2134.9	234.8	328.2	36.1	1129.9	124.3
	21	BA	MARIN	610.2	67.1	226.2	24.9	0.0	0.0	644.0	70.8
	28	BA	NAPA	753.3	82.9	678.5	74.6	312.1	34.3	418.7	46.1
	38	BA	SAN FRANCISCO	1206.8	132.7	2461.4	270.8	0.0	0.0	203.3	22.4
	41	BA	SAN MATEO	698.2	76.8	5123.1	563.5	602.3	66.3	1123.7	123.6
	43	BA	SANTA CLARA	3960.0	435.6	7193.7	791.3	5087.5	559.6	2251.3	247.6
	48	BA	SOLANO	1292.3	142.2	414.6	45.6	206.7	22.7	256.4	28.2
	49	BA	SONOMA	2669.6	293.7	998.0	109.8	772.0	84.9	628.7	69.2
SJV	10	SJU	FRESNO	3291.0	362.0	1711.4	188.3	1546.3	170.1	1578.0	173.6
	15	SJU	KERN	2863.1	314.9	568.6	62.6	193.4	21.3	1101.4	121.2
	16	SJU	KINGS	591.6	65.1	137.5	15.1	291.7	32.1	104.0	11.4
	20	SJU	MADERA	618.6	68.0	146.2	16.1	128.0	14.1	63.9	7.0
	24	SJU	MERCED	1203.6	132.4	109.7	12.1	327.8	36.1	651.0	71.6
	39	SJU	SAN JOAQUIN	4844.4	532.9	1713.9	188.5	1514.8	166.6	1105.4	121.6
	50	SJU	STANISLAUS	2714.4	298.6	872.3	96.0	492.3	54.2	710.8	78.2
	54	SJU	TULARE	1859.4	204.5	570.5	62.8	62.0	6.8	1041.0	114.5
SS	13	IMP	IMPERIAL	394.2	43.4	81.1	8.9	322.7	35.5	4255.5	468.1
	33	SC	RIVERSIDE	2216.8	410.1	827.6	153.1	392.8	72.7	451.2	83.5
SV	4	BUT	BUTTE	1140.3	125.4	368.4	40.5	85.3	9.4	179.1	19.7
	6	COL	COLUSA	57.6	6.3	21.8	2.4	0.0	0.0	40.9	4.5
	11	GLE	GLENN	64.8	7.1	26.8	2.9	0.0	0.0	46.9	5.2
	31	PLA	PLACER	4237.6	466.1	1654.2	182.0	1082.6	119.1	662.5	72.9
	34	SAC	SACRAMENTO	7436.7	818.0	4183.7	460.2	1123.2	123.5	1331.2	146.4
	45	SHA	SHASTA	913.2	100.5	226.8	25.0	159.8	17.6	388.0	42.7
	48	YS	SOLANO	580.6	63.9	186.3	20.5	92.9	10.2	115.2	12.7
	51	FR	SUTTER	219.6	24.2	17.1	1.9	30.6	3.4	1151.5	126.7
	52	TEH	TEHAMA	184.2	20.3	51.7	5.7	8.9	1.0	105.8	11.6
	57	YS	YOLO	1065.9	117.2	588.5	64.7	625.0	68.8	182.9	20.1
	58	FR	YUBA	137.4	15.1	16.4	1.8	0.0	0.0	212.4	23.4
Total Statewide				112,645.1	14,871.1	95,228.1	13,684.9	40,701.3	5,646.3	46,637.4	6,238.4

Table 2
NUMBER AND VALUATION OF NEW HOUSING UNITS AUTHORIZED BY BUILDING PERMITS, CALIFORNIA, 1999

	Number of units			Valuation ($1,000)			
County	Single	Multiple	Total	Single	Multiple	Additions & Alterations	Total
Total	**101,711**	**38,426**	**140,137**	**$19,262,653**	**$3,187,535**	**$3,333,078**	**$25,783,265**
Alameda	3,016	1,495	4,511	828,966	146,334	$183,031	$1,158,331
Alpine	20	30	50	7,503	8,969	151	$16,623
Amador	240	16	256	29,471	1,190	3,360	$34,021
Butte	947	13	960	114,103	806	11,496	$126,405
Calaveras	302	0	302	54,363	0	5,910	$60,273
Colusa	48	0	48	6,148	0	1,466	$7,615
Contra Costa	4,081	508	4,589	853,526	44,769	165,019	$1,063,314
Del Norte	33	2	35	3,644	128	917	$4,689
El Dorado	1,212	223	1,435	263,487	17,013	25,356	$305,856
Fresno	2,646	386	3,032	340,238	16,082	22,479	$378,800
Glenn	54	0	54	5,264	0	1,577	$6,842
Humboldt	355	49	404	32,813	1,641	10,047	$44,501
Imperial	327	6	333	37,644	338	3,742	$41,724
Inyo	18	0	18	3,729	0	994	$4,724
Kern	2,832	325	3,157	320,812	17,954	22,375	$361,140
Kings	493	0	493	55,558	0	3,326	$58,884
Lake	161	4	165	23,044	326	3,791	$27,161
Lassen	114	2	116	11,780	158	1,450	$13,389
Los Angeles	7,858	6,525	14,383	1,852,937	586,734	865,352	$3,305,023
Madera	481	138	619	41,096	7,274	4,322	$52,692
Marin	699	37	736	176,687	6,883	113,851	$297,420
Mariposa	74	0	74	10,716	0	853	$11,569
Mendocino	268	2	270	21,126	59	8,682	$29,868
Merced	1,003	0	1,003	121,496	0	8,497	$129,993
Modoc	14	0	14	1,487	0	805	$2,292
Mono	107	106	213	23,347	13,278	1,532	$38,157
Monterey	1,506	575	2,081	298,338	39,311	63,401	$401,050
Napa	597	123	720	145,345	8,169	21,201	$174,714
Nevada	786	29	815	117,370	2,581	12,106	$132,057
Orange	7,686	4,662	12,348	1,655,568	372,559	234,364	$2,262,491
Placer	3,875	1,021	4,896	714,476	70,047	30,402	$814,925
Plumas	101	0	101	10,243	0	113	$10,357
Riverside	12,659	1,920	14,579	2,275,766	130,796	65,796	$2,472,358
Sacramento	5,682	2,061	7,743	982,841	139,106	115,550	$1,237,497
San Benito	579	2	581	80,403	120	2,244	$82,767
San Bernardino	6,593	479	7,072	1,154,664	19,633	75,898	$1,250,195
San Diego	9,993	6,434	16,427	2,247,394	527,131	211,434	$2,985,960
San Francisco	114	3,697	3,811	29,117	456,151	212,346	$697,614
San Joaquin	4,034	12	4,046	582,934	1,125	16,255	$600,314
San Luis Obispo	1,578	86	1,664	242,940	5,011	22,130	$270,080
San Mateo	768	133	901	213,773	15,135	205,843	$434,751
Santa Barbara	601	314	915	141,335	21,338	62,667	$225,340
Santa Clara	3,333	3,677	7,010	739,017	291,309	275,701	$1,306,027
Santa Cruz	372	134	506	84,618	13,542	34,183	$132,342
Shasta	745	64	809	100,393	3,785	10,739	$114,917
Sierra	14	0	14	1,763	0	705	$2,468
Siskiyou	133	21	154	21,063	1,565	3,748	$26,375
Solano	1,430	523	1,953	261,516	30,728	18,368	$310,612
Sonoma	2,361	691	3,052	409,934	40,112	54,615	$504,661
Stanislaus	2,246	64	2,310	284,175	3,208	19,212	$306,594
Sutter	183	0	183	27,599	0	4,340	$31,939
Tehama	153	2	155	18,751	144	2,128	$21,023
Trinity	40	6	46	4,438	350	948	$5,736
Tulare	1,515	138	1,653	181,946	9,164	9,053	$200,163
Tuolumne	194	0	194	22,727	0	8,522	$31,249
Ventura	3,662	780	4,442	829,693	54,009	56,786	$940,488
Yolo	696	769	1,465	131,577	53,604	8,971	$194,152
Yuba	79	142	221	9,950	7,869	2,929	$20,748

Note: Detail may not add to total because of rounding
Source: Construction Industry Research Board, http://www.cirbdata.com
Department of Finance, Economic Research Unit, (916) 322-2263, http://www.dof.ca.gov

Table 3
Estimated Acres Disturbed for Single Living Unit Construction in California, 1999

Alameda	1/7
Alpine	1/5
Amador	1/5
Butte	1/5
Calaveras	1/5
Colusa	1/5
Contra Costa	1/7
Del Norte	1/5
El Dorado	1/5
Fresno	1/5
Glenn	1/5
Humboldt	1/5
Imperial	1/5
Inyo	1/5
Kern	1/5
Kings	1/5
Lake	1/5
Lassen	1/5
Los Angeles	1/7
Madera	1/5
Marin	1/7
Mariposa	1/5
Mendocino	1/5
Merced	1/5
Modoc	1/5
Mono	1/5
Monterey	1/5
Napa	1/5
Nevada	1/5

Orange	1/7
Placer	1/5
Plumas	1/5
Riverside	1/7
Sacramento	1/5
San Benito	1/5
San Bernardino	1/7
San Diego	1/7
San Francisco	1/7
San Joaquin	1/5
San Luis Obispo	1/5
San Mateo	1/7
Santa Barbara	1/7
Santa Clara	1/7
Santa Cruz	1/5
Shasta	1/5
Sierra	1/5
Siskiyou	1/5
Solano	1/5
Sonoma	1/5
Stanislaus	1/5
Sutter	1/5
Tehama	1/5
Trinity	1/5
Tulare	1/5
Tuolumne	1/5
Ventura	1/7
Yolo	1/5
Yuba	1/5

Table 4
NONRESIDENTIAL CONSTRUCTION VALUATION
AUTHORIZED BY PERMITS, CALIFORNIA, 1999
(Thousands of dollars)

County	Commercial	Industrial	Other	Additions and Alterations	Total
Total	**$5,706,720**	**$2,256,165**	**$2,350,196**	**$6,269,200**	**$16,582,282**
Alameda	321,753	137,499	48,956	408,531	$916,738
Alpine	572	0	677	0	$1,249
Amador	413	8,801	4,826	715	$14,755
Butte	22,076	4,727	9,027	15,160	$50,990
Calaveras	5,705	0	4,558	2,029	$12,292
Colusa	1,304	0	2,061	5,205	$8,570
Contra Costa	127,939	18,192	56,940	128,974	$332,044
Del Norte	4,035	0	1,938	1,641	$7,614
El Dorado	20,133	1,287	19,774	10,182	$51,377
Fresno	102,559	85,716	79,521	73,635	$341,431
Glenn	1,604	0	2,364	735	$4,703
Humboldt	15,079	333	4,909	10,075	$30,396
Imperial	4,860	17,889	214,449	6,090	$243,288
Inyo	6,293	0	633	929	$7,855
Kern	41,608	13,087	67,769	41,928	$164,391
Kings	8,240	16,172	5,239	7,705	$37,355
Lake	1,316	0	3,184	1,970	$6,470
Lassen	2,377	0	1,994	8,672	$13,043
Los Angeles	1,321,869	361,114	434,538	1,558,733	$3,676,254
Madera	8,759	7,094	3,219	5,380	$24,452
Marin	13,557	0	32,453	48,992	$95,002
Mariposa	251	0	2,919	213	$3,384
Mendocino	1,324	3,016	7,036	7,941	$19,317
Merced	6,572	18,168	32,804	14,929	$72,473
Modoc	429	0	791	424	$1,644
Mono	0	3,556	255	174	$3,985
Monterey	43,234	9,719	29,179	30,906	$113,037
Napa	40,660	17,302	21,101	54,408	$133,470
Nevada	3,788	957	23,173	1,556	$29,475
Orange	796,154	122,935	121,433	573,906	$1,614,428
Placer	115,943	70,186	39,050	53,656	$278,834
Plumas	0	291	341	103	$734
Riverside	255,646	112,239	117,198	126,079	$611,162
Sacramento	250,714	62,260	67,082	188,818	$568,874
San Benito	7,414	4,198	4,791	2,128	$18,531
San Bernardino	204,143	331,039	83,643	139,794	$758,619
San Diego	476,008	193,553	161,412	505,656	$1,336,629
San Francisco	147,503	0	10,247	496,970	$654,719
San Joaquin	102,711	83,970	55,706	63,128	$305,515
San Luis Obispo	29,799	12,337	22,971	27,940	$93,047
San Mateo	307,010	33,386	56,629	217,028	$614,054
Santa Barbara	46,249	18,830	31,590	45,661	$142,329
Santa Clara	431,098	282,014	113,449	1,029,389	$1,855,950
Santa Cruz	29,574	4,184	8,749	19,380	$61,886
Shasta	13,593	8,856	19,555	10,557	$52,560
Sierra	0	0	186	33	$219
Siskiyou	5,437	0	4,008	3,487	$12,931
Solano	36,011	16,605	18,729	36,208	$107,553
Sonoma	68,119	48,739	36,085	73,286	$226,230
Stanislaus	52,273	27,288	35,819	33,165	$148,545
Sutter	1,026	1,695	58,028	5,835	$66,583
Tehama	3,101	495	5,334	1,202	$10,132
Trinity	812	0	1,622	941	$3,375
Tulare	34,189	3,435	52,457	32,130	$122,212
Tuolumne	3,477	0	6,177	1,686	$11,340
Ventura	124,166	58,359	81,700	102,461	$366,685
Yolo	35,264	34,646	9,218	29,173	$108,301
Yuba	980	0	10,704	1,569	$13,253

Source: Construction Industry Research Board, http://www.cirbdata.com
Department of Finance, Economic Research Unit, (916) 322-2263, http://www.dof.ca.gov