
Hazus: Earthquake Global Risk Report

Region Name: Collayami

Earthquake Scenario: collayami2011cfmellb_m6p7_se

Print Date: May 21, 2024

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 22 county(ies) from the following state(s):

California

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 26,698.62 square miles and contains 2,283 census tracts. There are over 3,539 thousand households in the region which has a total population of 9,777,426 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 3,046 thousand buildings in the region with a total building replacement value (excluding contents) of 1,886,012 (millions of dollars). Approximately 90.00 % of the buildings (and 67.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 161,759 and 102,505 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 3,046 thousand buildings in the region which have an aggregate total replacement value of 1,886,012 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 86% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 171 hospitals in the region with a total bed capacity of 24,832 beds. There are 3,553 schools, 986 fire stations, 328 police stations and 59 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 264,264.00 (millions of dollars). This inventory includes over 5,807.33 miles of highways, 7,468 bridges, 134,525.58 miles of pipes.

Table 1: Transportation System Lifeline Inventory

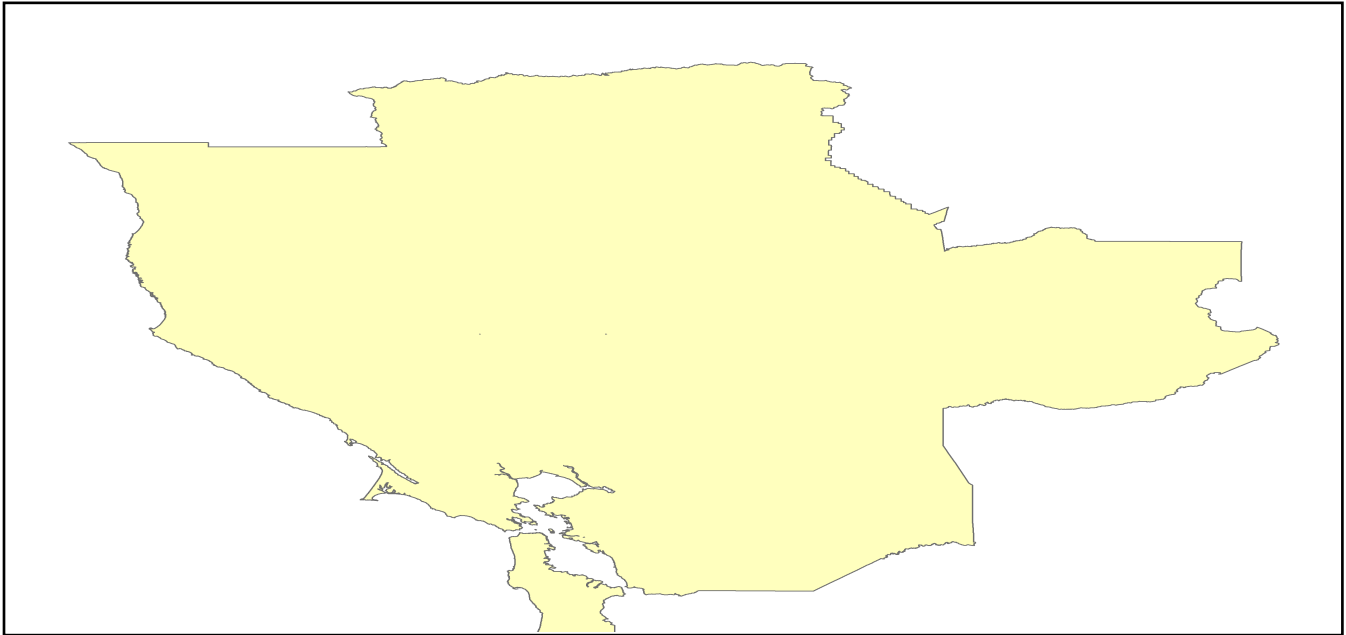
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	7,468	44453.9647
	Segments	4,687	53420.9819
	Tunnels	39	842.4337
	Subtotal		98717.3803
Railways	Bridges	1,184	6736.9600
	Facilities	58	154.4540
	Segments	2,367	44260.2563
	Tunnels	3	1.8495
	Subtotal		51153.5198
Light Rail	Bridges	100	13.0980
	Facilities	194	3589.2500
	Segments	12	3867.6380
	Tunnels	0	0.0000
	Subtotal		7469.9860
Bus	Facilities	23	53.0550
	Subtotal		53.0550
Ferry	Facilities	25	33.2750
	Subtotal		33.2750
Port	Facilities	353	1345.5812
	Subtotal		1345.5812
Airport	Facilities	63	2100.3253
	Runways	98	886.5577
	Subtotal		2986.8830
		Total	161,759.70

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2668.7926
	Facilities	19	746.5860
	Pipelines	0	0.0000
		Subtotal	3415.3786
Waste Water	Distribution Lines	NA	1601.2756
	Facilities	144	24761.0592
	Pipelines	0	0.0000
		Subtotal	26362.3348
Natural Gas	Distribution Lines	NA	1067.5170
	Facilities	2	82.4870
	Pipelines	786	10548.5346
		Subtotal	11698.5386
Oil Systems	Facilities	16	1.8880
	Pipelines	0	0.0000
		Subtotal	1.8880
Electrical Power	Facilities	196	61000.5924
		Subtotal	61000.5924
Communication	Facilities	230	27.1400
		Subtotal	27.1400
	Total		102,505.90

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	collayami2011cfmellb_m6p7_se
Type of Earthquake	User-defined
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	6.70
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 3,715 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 5 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

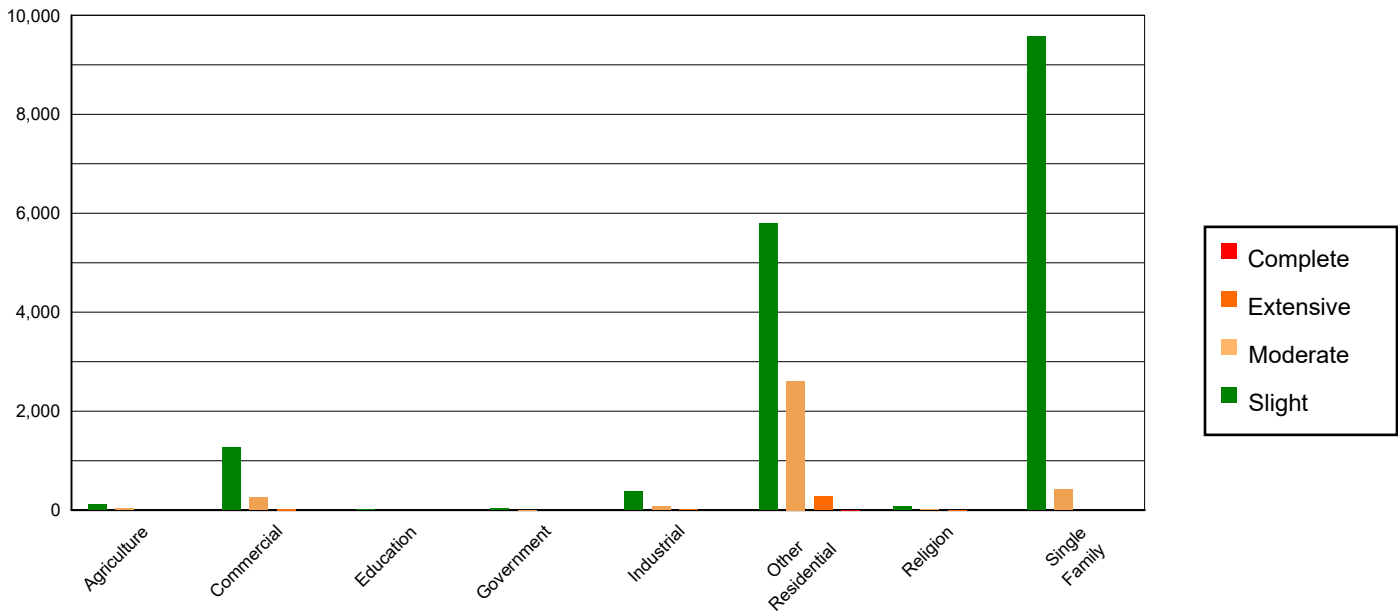


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9893.73	0.33	120.16	0.70	28.41	0.84	1.63	0.53	0.07	1.29
Commercial	193478.47	6.40	1272.19	7.37	248.91	7.32	23.90	7.73	1.53	26.95
Education	6212.75	0.21	18.59	0.11	1.65	0.05	0.01	0.00	0.00	0.00
Government	19543.37	0.65	35.99	0.21	5.40	0.16	0.24	0.08	0.00	0.07
Industrial	54219.85	1.79	378.47	2.19	77.41	2.28	6.04	1.95	0.23	4.04
Other Residential	381156.41	12.60	5792.74	33.55	2609.58	76.75	273.70	88.50	3.57	62.90
Religion	11668.28	0.39	70.68	0.41	15.87	0.47	2.90	0.94	0.27	4.74
Single Family	2348863.35	77.65	9576.85	55.47	412.95	12.15	0.84	0.27	0.00	0.00
Total	3,025,036		17,266		3,400		309		6	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2612341.68	86.36	11177.53	64.74	493.56	14.52	1.27	0.41	0.00	0.08
Steel	68122.92	2.25	561.67	3.25	156.89	4.61	13.89	4.49	0.67	11.79
Concrete	78375.56	2.59	494.11	2.86	110.35	3.25	17.70	5.72	0.88	15.53
Precast	37734.62	1.25	321.05	1.86	73.90	2.17	3.48	1.12	0.16	2.82
RM	126035.91	4.17	311.38	1.80	67.34	1.98	2.03	0.66	0.00	0.03
URM	40502.66	1.34	420.74	2.44	72.04	2.12	13.57	4.39	1.97	34.83
MH	61922.86	2.05	3979.18	23.05	2426.11	71.35	257.34	83.21	1.98	34.93
Total	3,025,036		17,266		3,400		309		6	

*Note:

- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 24,832 hospital beds available for use. On the day of the earthquake, the model estimates that only 24,699 hospital beds (99.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	171	0	0	171
Schools	3,553	8	0	3,535
EOCs	59	0	0	59
PoliceStations	328	0	0	327
FireStations	986	0	0	979

Transportation Lifeline Damage

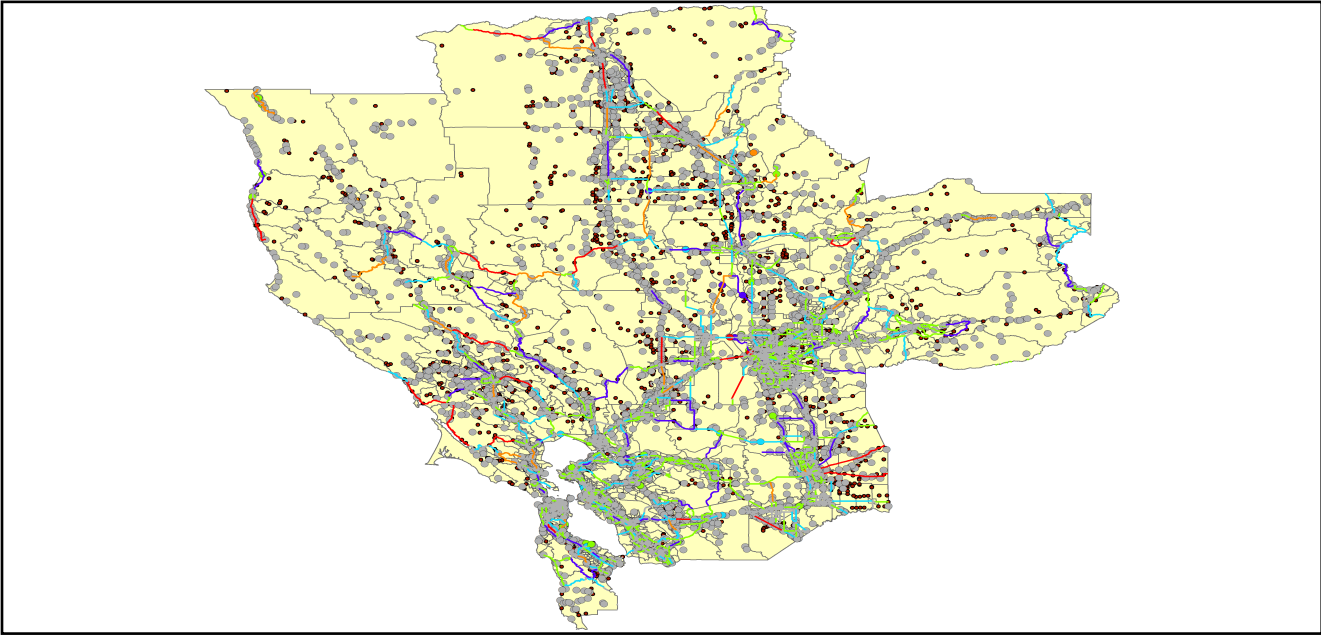


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	4,687	0	0	4,687	4,687
	Bridges	7,468	0	0	7,468	7,468
	Tunnels	39	0	0	39	39
Railways	Segments	2,367	0	0	2,367	2,367
	Bridges	1,184	0	0	1,184	1,184
	Tunnels	3	0	0	3	3
	Facilities	58	0	0	58	58
Light Rail	Segments	12	0	0	12	12
	Bridges	100	0	0	100	100
	Tunnels	0	0	0	0	0
	Facilities	194	0	0	194	194
Bus	Facilities	23	0	0	23	23
Ferry	Facilities	25	0	0	25	25
Port	Facilities	353	0	0	353	353
Airport	Facilities	63	0	0	63	63
	Runways	98	0	0	98	98

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	19	0	0	19	19
Waste Water	144	0	0	144	144
Natural Gas	2	0	0	2	2
Oil Systems	16	0	0	16	16
Electrical Power	196	8	0	188	195
Communication	230	3	0	230	230

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	82,915	732	183
Waste Water	49,749	368	92
Natural Gas	1,861	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,539,370	235	9	0	0	0
Electric Power		5,983	3,472	1,242	89	9

Induced Earthquake Damage

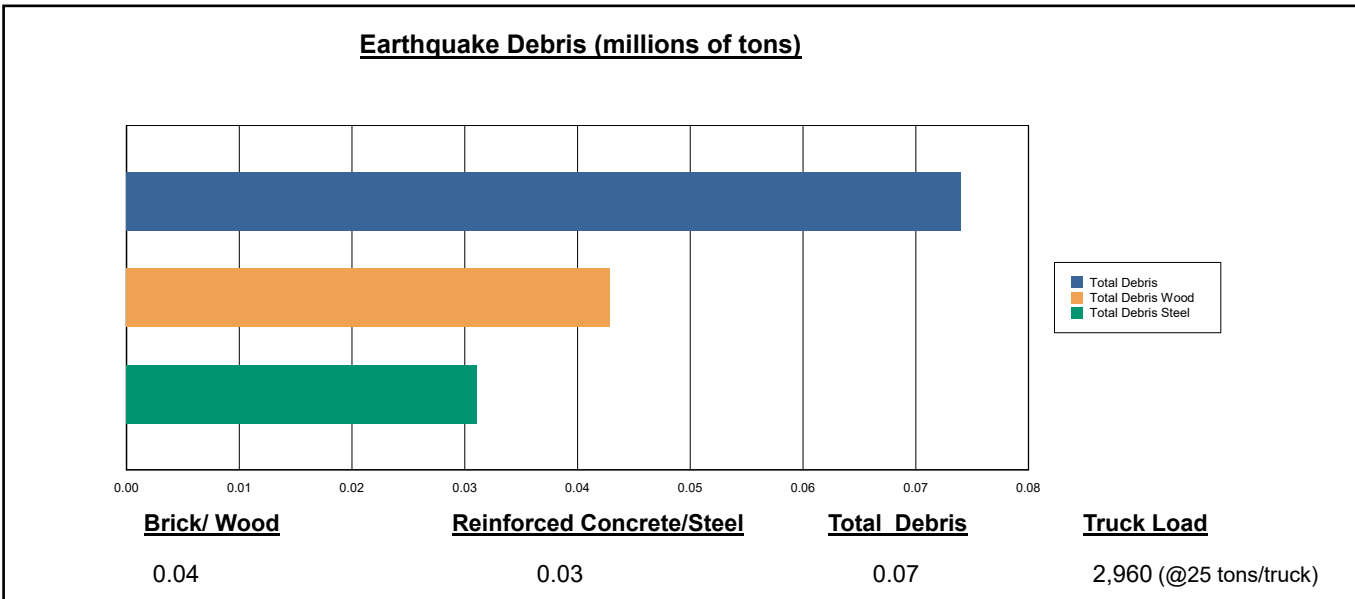
Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.01 sq. mi (0.00 % of the region's total area.) The model also estimates that the fires will displace about 135 people and burn about 13 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

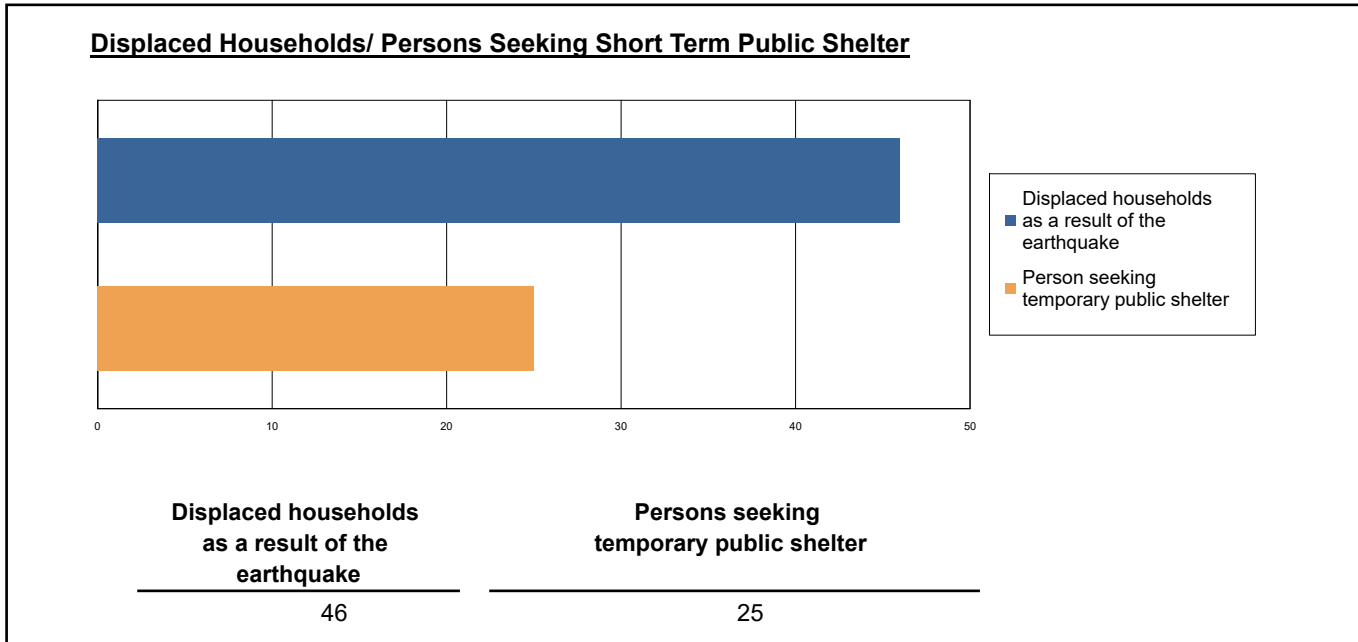
The model estimates that a total of 74,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 58.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 2,960 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 46 households to be displaced due to the earthquake. Of these, 25 people (out of a total population of 9,777,426) will seek temporary shelter in public shelters.



Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.29	0.03	0.00	0.00
	Commuting	0.00	0.00	0.01	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.03	0.00	0.00	0.00
	Industrial	0.36	0.02	0.00	0.00
	Other-Residential	28.14	2.42	0.04	0.07
	Single Family	11.63	0.23	0.00	0.00
	Total	40	3	0	0
2 PM	Commercial	20.05	1.76	0.11	0.22
	Commuting	0.02	0.03	0.05	0.01
	Educational	3.71	0.21	0.01	0.01
	Hotels	0.01	0.00	0.00	0.00
	Industrial	2.62	0.18	0.01	0.01
	Other-Residential	9.49	0.83	0.02	0.03
	Single Family	3.72	0.08	0.00	0.00
	Total	40	3	0	0
5 PM	Commercial	13.24	1.17	0.08	0.14
	Commuting	0.32	0.49	0.76	0.15
	Educational	0.38	0.01	0.00	0.00
	Hotels	0.01	0.00	0.00	0.00
	Industrial	1.64	0.11	0.00	0.01
	Other-Residential	10.06	0.87	0.02	0.03
	Single Family	4.18	0.09	0.00	0.00
	Total	30	3	1	0

Economic Loss

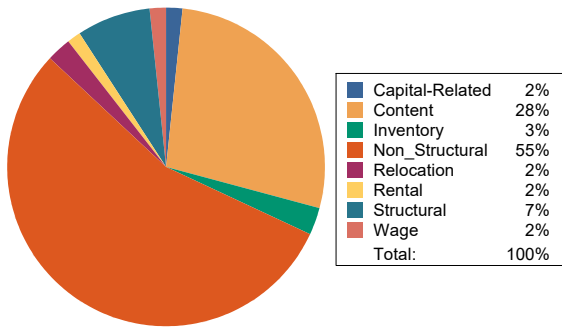
The total economic loss estimated for the earthquake is 4,858.81 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 884.80 (millions of dollars); 7 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 46 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type (\$ millions)



Earthquake Losses by Occupancy Type (\$ millions)

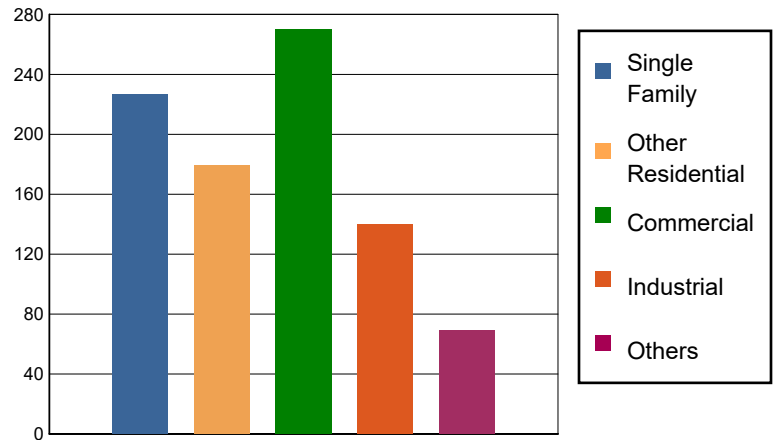


Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	1.2469	12.3797	0.4835	0.8810	14.9911
	Capital-Related	0.0000	0.5294	13.4104	0.3262	0.2114	14.4774
	Rental	1.1808	5.0245	7.3696	0.4239	0.3090	14.3078
	Relocation	2.4976	8.3984	7.2119	1.8358	1.8518	21.7955
	Subtotal	3.6784	15.1992	40.3716	3.0694	3.2532	65.5718
Capital Stock Losses							
	Structural	18.0242	17.4741	16.2992	7.6618	5.6397	65.0990
	Non_Structural	145.2066	114.3867	122.6733	69.4824	33.9944	485.7434
	Content	59.9249	32.1668	78.9521	51.2588	22.2405	244.5431
	Inventory	0.0000	0.0000	11.4752	8.2009	4.1669	23.8430
	Subtotal	223.1557	164.0276	229.3998	136.6039	66.0415	819.2285
	Total	226.83	179.23	269.77	139.67	69.29	884.80

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	53420.9819	0.0000	0.00
	Bridges	44453.9647	3.7246	0.01
	Tunnels	842.4337	0.0000	0.00
	Subtotal	98717.3803	3.7246	
Railways	Segments	44260.2563	0.0000	0.00
	Bridges	6736.9600	0.0414	0.00
	Tunnels	1.8495	0.0000	0.00
	Facilities	154.4540	1.2528	0.81
	Subtotal	51153.5198	1.2942	
Light Rail	Segments	3867.6380	0.0000	0.00
	Bridges	13.0980	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	3589.2500	34.5156	0.96
	Subtotal	7469.9860	34.5156	
Bus	Facilities	53.0550	0.7802	1.47
	Subtotal	53.0550	0.7802	
Ferry	Facilities	33.2750	0.3204	0.96
	Subtotal	33.2750	0.3204	
Port	Facilities	1345.5812	12.4794	0.93
	Subtotal	1345.5812	12.4794	
Airport	Facilities	2100.3253	24.5958	1.17
	Runways	886.5577	0.0000	0.00
	Subtotal	2986.8830	24.5958	
Total		161,759.68	77.71	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	746.5860	5.4031	0.72
	Distribution Lines	2668.7926	3.2960	0.12
	Subtotal	3415.3786	8.6991	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	24761.0592	61.7118	0.25
	Distribution Lines	1601.2756	1.6557	0.10
	Subtotal	26362.3348	63.3675	
Natural Gas	Pipelines	10548.5346	0.0000	0.00
	Facilities	82.4870	0.0749	0.09
	Distribution Lines	1067.5170	0.5672	0.05
	Subtotal	11698.5386	0.6421	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	1.8880	0.0013	0.07
	Subtotal	1.8880	0.0013	
Electrical Power	Facilities	61000.5924	3823.1766	6.27
	Subtotal	61000.5924	3823.1766	
Communication	Facilities	27.1400	0.4153	1.53
	Subtotal	27.1400	0.4153	
	Total	102,505.87	3,896.30	

Appendix A: County Listing for the Region

Alameda,CA

Butte,CA

Colusa,CA

Contra Costa,CA

El Dorado,CA

Glenn,CA

Lake,CA

Marin,CA

Mendocino,CA

Napa,CA

Nevada,CA

Placer,CA

Sacramento,CA

San Francisco,CA

San Joaquin,CA

San Mateo,CA

Solano,CA

Sonoma,CA

Sutter,CA

Tehama,CA

Yolo,CA

Yuba,CA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
California	Alameda	1,682,353	209,951	122,639	332,590
	Butte	211,632	25,875	16,639	42,514
	Colusa	21,839	2,244	2,024	4,268
	Contra Costa	1,165,927	158,118	60,339	218,458
	El Dorado	191,185	34,907	9,704	44,611
	Glenn	28,917	2,791	3,717	6,508
	Lake	68,163	9,699	4,530	14,229
	Marin	262,321	47,738	15,030	62,769
	Mendocino	91,601	14,237	8,510	22,748
	Napa	138,019	20,517	13,045	33,563
	Nevada	102,241	17,908	6,108	24,016
	Placer	404,739	69,985	24,193	94,179
	Sacramento	1,585,055	179,811	83,911	263,723
	San Francisco	873,965	108,848	46,020	154,869
	San Joaquin	779,233	82,706	56,882	139,589
	San Mateo	764,442	110,372	44,995	155,368
	Solano	453,491	55,802	26,393	82,195
	Sonoma	488,863	68,827	35,781	104,609
	Sutter	99,633	10,618	6,448	17,066
	Tehama	65,829	7,705	5,113	12,818
Yolo	216,403	24,130	18,343	42,473	
Yuba	81,575	8,161	4,677	12,839	
Total Region		9,777,426	1,270,950	615,041	1,886,002