
Hazus: Earthquake Global Risk Report

Region Name: CarsonRngKingsCyn

Earthquake Scenario: CarsonRngKingsCynFlt_1285_1654_m7p23_se

Print Date: May 06, 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 26 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 52,787.85 square miles and contains 1,712 census tracts. There are over 2,590 thousand households in the region which has a total population of 7,559,630 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 2,464 thousand buildings in the region with a total building replacement value (excluding contents) of 1,389,513 (millions of dollars). Approximately 91.00 % of the buildings (and 66.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 130,364 and 142,223 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 2,464 thousand buildings in the region which have an aggregate total replacement value of 1,389,513 (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 87% 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 131 hospitals in the region with a total bed capacity of 15,780 beds. There are 2,908 schools, 910 fire stations, 262 police stations and 48 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 272,587.00 (millions of dollars). This inventory includes over 7,621.74 miles of highways, 7,106 bridges, 168,880.56 miles of pipes.

Table 1: Transportation System Lifeline Inventory

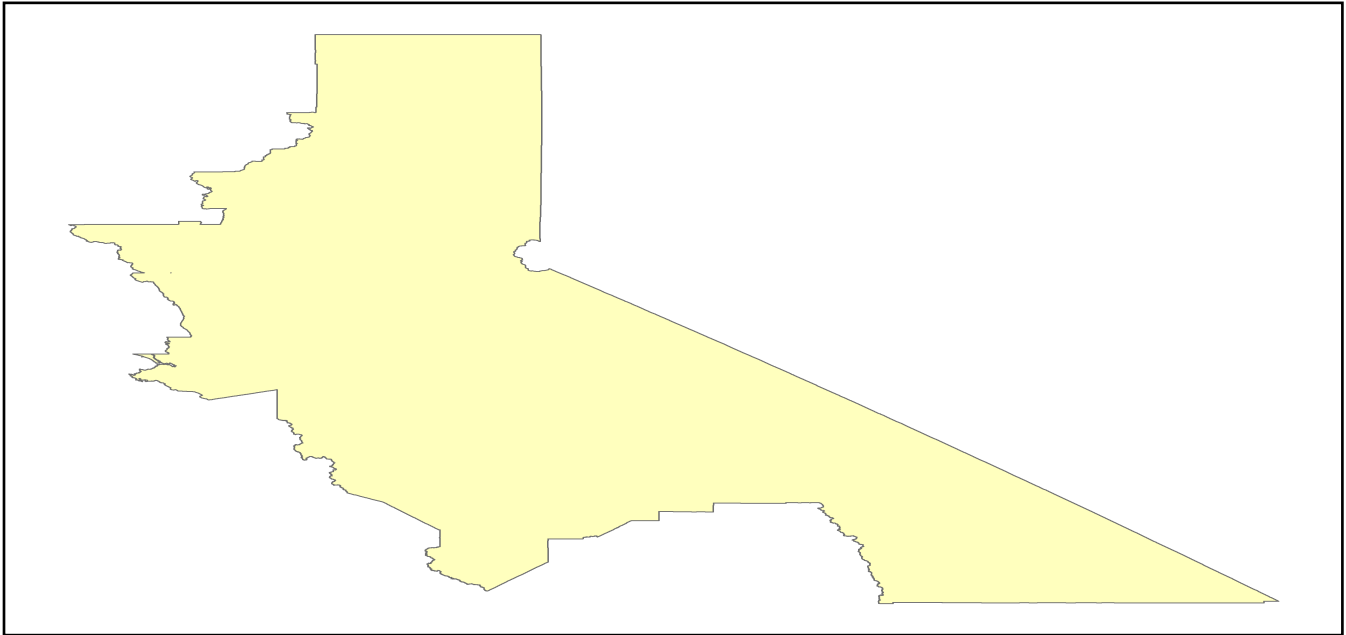
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	7,106	27700.1065
	Segments	3,919	61169.3110
	Tunnels	17	236.8357
	Subtotal		89106.2532
Railways	Bridges	1,172	6668.6800
	Facilities	59	157.1170
	Segments	2,356	29683.3590
	Tunnels	2	1.7557
	Subtotal		36510.9117
Light Rail	Bridges	26	3.3240
	Facilities	58	331.1800
	Segments	4	1771.6066
	Tunnels	0	0.0000
	Subtotal		2106.1106
Bus	Facilities	22	48.6349
	Subtotal		48.6349
Ferry	Facilities	13	17.3030
	Subtotal		17.3030
Port	Facilities	188	716.6268
	Subtotal		716.6268
Airport	Facilities	88	1038.3833
	Runways	113	820.3305
	Subtotal		1858.7138
		Total	130,364.60

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	3361.1156
	Facilities	15	589.4100
	Pipelines	0	0.0000
		Subtotal	3950.5256
Waste Water	Distribution Lines	NA	2016.6694
	Facilities	105	18054.9390
	Pipelines	0	0.0000
		Subtotal	20071.6084
Natural Gas	Distribution Lines	NA	1344.4462
	Facilities	2	59.4451
	Pipelines	783	10207.7765
		Subtotal	11611.6678
Oil Systems	Facilities	17	2.0060
	Pipelines	0	0.0000
		Subtotal	2.0060
Electrical Power	Facilities	309	106561.0542
		Subtotal	106561.0542
Communication	Facilities	228	26.9040
		Subtotal	26.9040
	Total		142,223.80

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	CarsonRngKingsCynFlt_1285_1654_m7p23_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	7.23
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 713 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 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

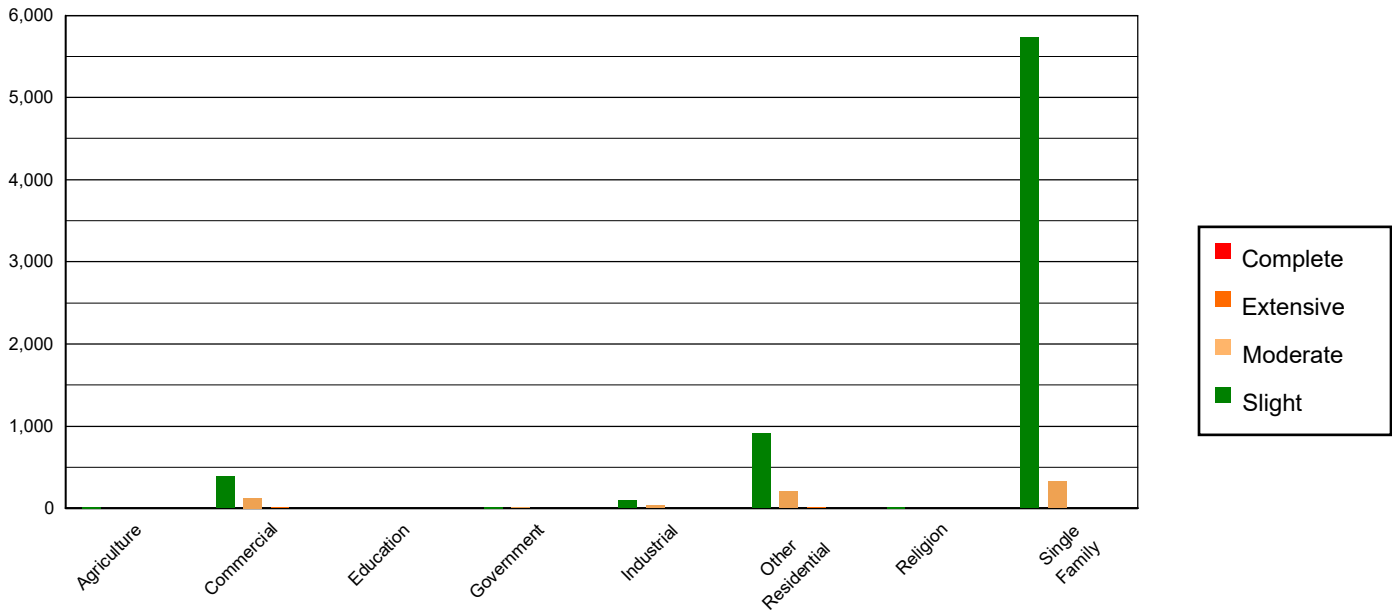


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	20665.81	0.84	14.85	0.21	2.28	0.33	0.05	0.24	0.00	0.00
Commercial	142512.94	5.80	392.16	5.46	121.35	17.48	7.36	37.54	0.19	82.24
Education	4492.44	0.18	3.88	0.05	0.67	0.10	0.01	0.04	0.00	0.00
Government	9322.00	0.38	17.05	0.24	5.63	0.81	0.32	1.63	0.00	0.51
Industrial	39958.87	1.63	94.81	1.32	28.84	4.16	1.47	7.51	0.00	1.63
Other Residential	293172.17	11.94	912.69	12.71	205.00	29.53	10.10	51.50	0.04	15.44
Religion	9035.69	0.37	14.63	0.20	4.48	0.65	0.19	0.95	0.00	0.17
Single Family	1937023.63	78.86	5730.40	79.81	325.86	46.95	0.11	0.57	0.00	0.00
Total	2,456,184		7,180		694		20		0	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2148655.19	87.48	6279.61	87.45	369.42	53.22	0.16	0.80	0.00	0.00
Steel	48731.54	1.98	141.30	1.97	83.64	12.05	7.42	37.86	0.10	44.59
Concrete	51584.18	2.10	157.50	2.19	42.14	6.07	2.58	13.16	0.08	36.25
Precast	32692.08	1.33	81.15	1.13	34.75	5.01	1.44	7.35	0.01	2.67
RM	91227.31	3.71	119.89	1.67	41.15	5.93	1.03	5.23	0.00	0.00
URM	20360.75	0.83	187.22	2.61	12.38	1.78	0.40	2.03	0.03	14.26
MH	62932.49	2.56	213.81	2.98	110.65	15.94	6.58	33.56	0.01	2.22
Total	2,456,184		7,180		694		20		0	

*Note:

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

Essential Facility Damage

Before the earthquake, the region had 15,780 hospital beds available for use. On the day of the earthquake, the model estimates that only 15,644 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	131	1	0	130
Schools	2,908	8	0	2,898
EOCs	48	0	0	47
PoliceStations	262	0	0	260
FireStations	910	0	0	905

Transportation Lifeline Damage

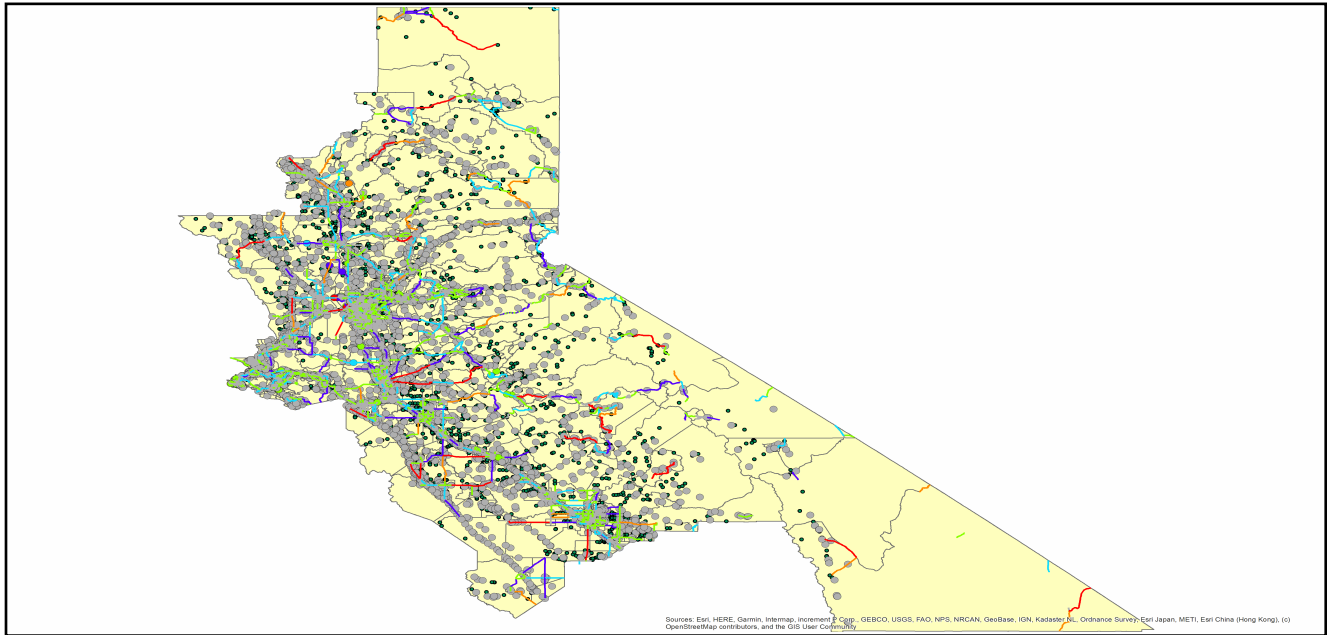


Table 6: Expected Damage to the Transportation Systems

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	3,919	0	0	3,919	3,919
	Bridges	7,106	0	0	7,106	7,106
	Tunnels	17	0	0	17	17
Railways	Segments	2,356	0	0	2,356	2,356
	Bridges	1,172	0	0	1,172	1,172
	Tunnels	2	0	0	2	2
	Facilities	59	0	0	59	59
Light Rail	Segments	4	0	0	4	4
	Bridges	26	0	0	26	26
	Tunnels	0	0	0	0	0
	Facilities	58	0	0	58	58
Bus	Facilities	22	0	0	22	22
Ferry	Facilities	13	0	0	13	13
Port	Facilities	188	0	0	188	188
Airport	Facilities	88	1	0	88	88
	Runways	113	0	0	113	113

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	15	0	0	15	15
Waste Water	105	0	0	105	105
Natural Gas	2	0	0	2	2
Oil Systems	17	0	0	17	17
Electrical Power	309	0	0	309	309
Communication	228	1	0	228	228

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	104,425	417	104
Waste Water	62,655	210	52
Natural Gas	1,801	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	2,590,105	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

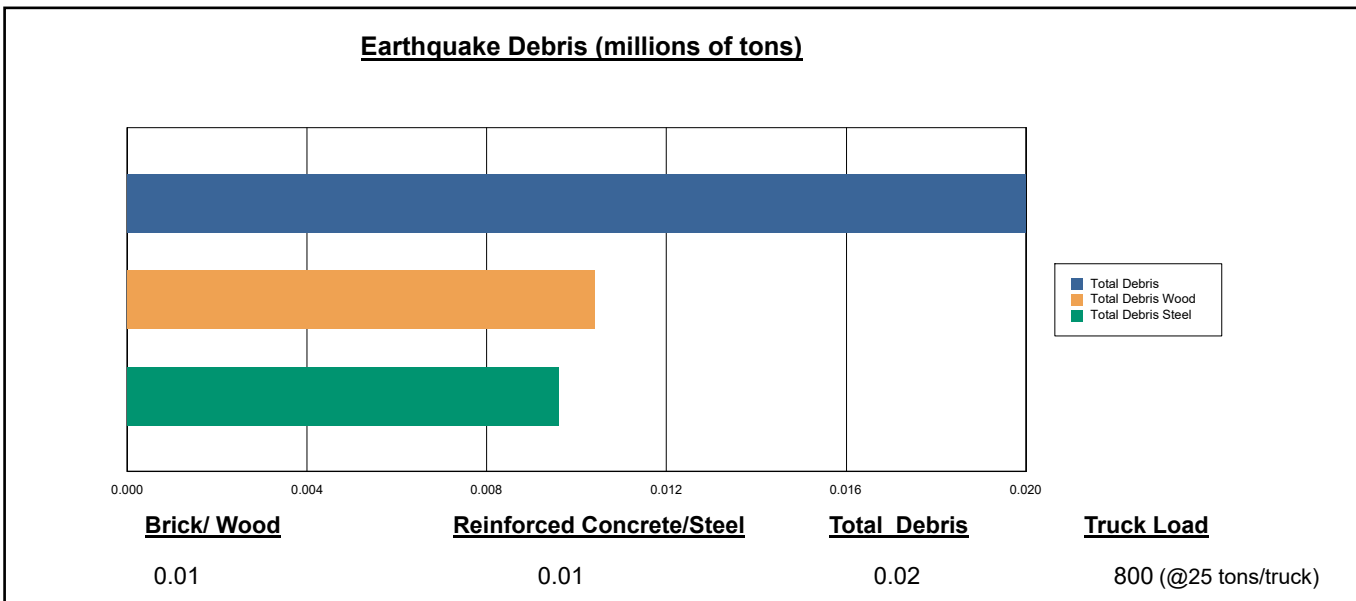
Fire Following Earthquake

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 0 ignitions that will burn about 0.00 sq. mi (0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (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.

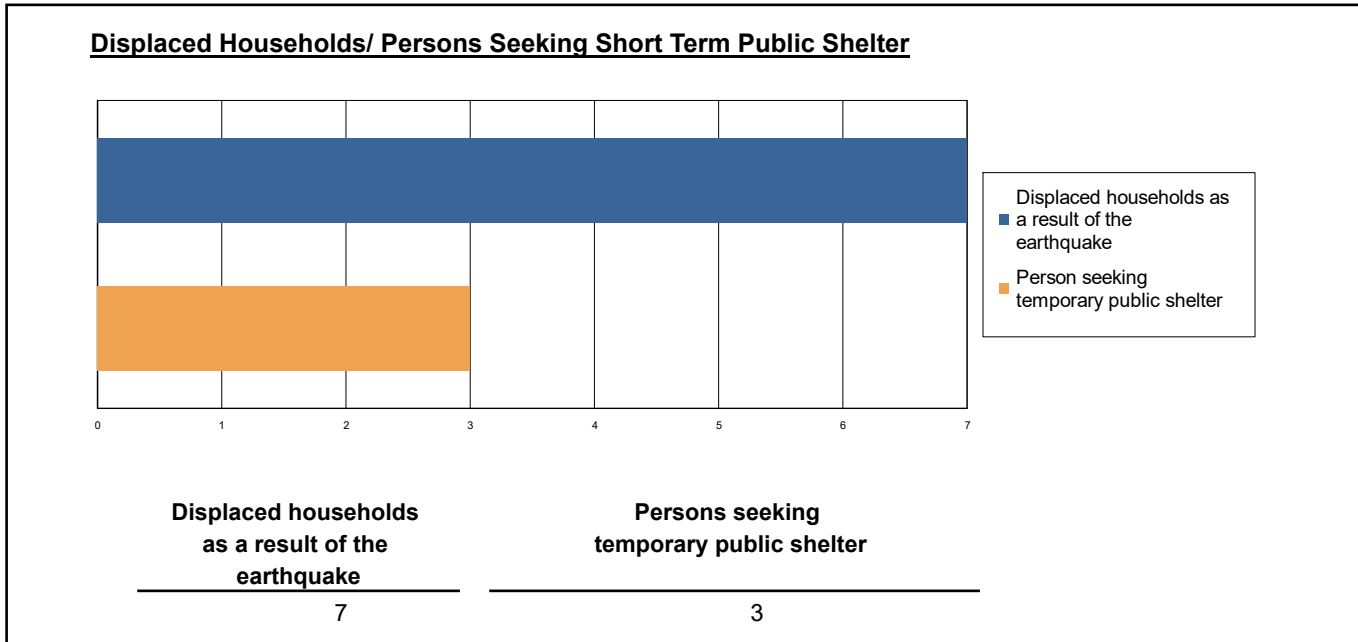
The model estimates that a total of 20,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 52.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 800 truckloads (@25 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 7 households to be displaced due to the earthquake. Of these, 3 people (out of a total population of 7,559,630) 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	0.11	0.01	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.05	0.00	0.00	0.00
	Industrial	0.10	0.01	0.00	0.00
	Other-Residential	3.65	0.21	0.00	0.00
	Single Family	5.18	0.14	0.00	0.00
	Total	9	0	0	0
2 PM	Commercial	7.29	0.59	0.01	0.02
	Commuting	0.01	0.01	0.02	0.00
	Educational	2.18	0.18	0.01	0.01
	Hotels	0.01	0.00	0.00	0.00
	Industrial	0.70	0.05	0.00	0.00
	Other-Residential	1.11	0.06	0.00	0.00
	Single Family	1.57	0.04	0.00	0.00
	Total	13	1	0	0
5 PM	Commercial	4.82	0.40	0.01	0.02
	Commuting	0.20	0.25	0.44	0.08
	Educational	0.63	0.06	0.00	0.00
	Hotels	0.02	0.00	0.00	0.00
	Industrial	0.44	0.03	0.00	0.00
	Other-Residential	1.32	0.08	0.00	0.00
	Single Family	1.87	0.05	0.00	0.00
	Total	9	1	0	0

Economic Loss

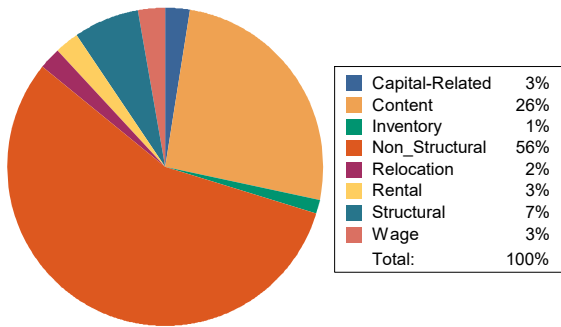
The total economic loss estimated for the earthquake is 648.45 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 351.62 (millions of dollars); 10 % 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 63 % 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)

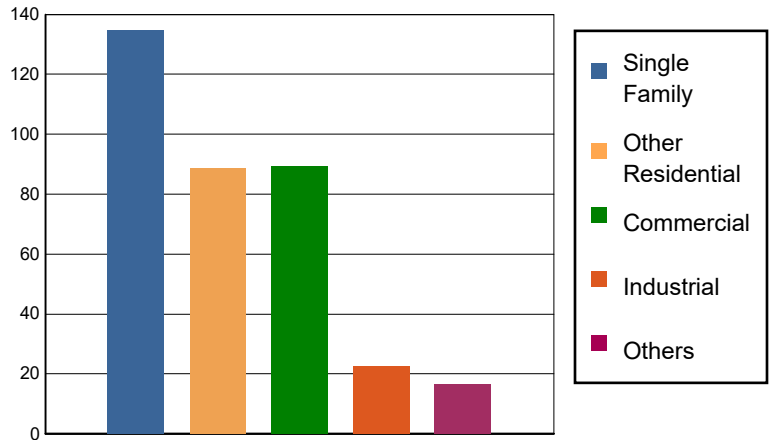


Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	2.1499	7.3430	0.0870	0.4442	10.0241
	Capital-Related	0.0000	0.9125	8.1980	0.0517	0.0646	9.2268
	Rental	0.8514	5.2387	2.7032	0.0691	0.2157	9.0781
	Relocation	2.0438	1.4036	3.0320	0.3452	0.8761	7.7007
	Subtotal	2.8952	9.7047	21.2762	0.5530	1.6006	36.0297
Capital Stock Losses							
	Structural	11.1815	4.9161	5.1926	1.0095	1.0228	23.3225
	Non_Structural	83.6362	56.4723	36.7729	11.4072	8.4922	196.7808
	Content	36.8156	17.5294	22.8514	8.1303	5.3218	90.6485
	Inventory	0.0000	0.0000	3.2876	1.2306	0.3201	4.8383
	Subtotal	131.6333	78.9178	68.1045	21.7776	15.1569	315.5901
	Total	134.53	88.62	89.38	22.33	16.76	351.62

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	61169.3110	0.0000	0.00
	Bridges	27700.1065	1.1140	0.00
	Tunnels	236.8357	0.0001	0.00
	Subtotal	89106.2532	1.1141	
Railways	Segments	29683.3590	0.0000	0.00
	Bridges	6668.6800	0.0012	0.00
	Tunnels	1.7557	0.0000	0.00
	Facilities	157.1170	0.9242	0.59
	Subtotal	36510.9117	0.9254	
Light Rail	Segments	1771.6066	0.0000	0.00
	Bridges	3.3240	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	331.1800	3.0426	0.92
	Subtotal	2106.1106	3.0426	
Bus	Facilities	48.6349	1.2163	2.50
	Subtotal	48.6349	1.2163	
Ferry	Facilities	17.3030	0.1182	0.68
	Subtotal	17.3030	0.1182	
Port	Facilities	716.6268	3.1528	0.44
	Subtotal	716.6268	3.1528	
Airport	Facilities	1038.3833	11.0463	1.06
	Runways	820.3305	0.0000	0.00
	Subtotal	1858.7138	11.0463	
Total		130,364.55	20.62	

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	589.4100	0.2254	0.04
	Distribution Lines	3361.1156	1.8769	0.06
	Subtotal	3950.5256	2.1023	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	18054.9390	14.2952	0.08
	Distribution Lines	2016.6694	0.9428	0.05
	Subtotal	20071.6084	15.2380	
Natural Gas	Pipelines	10207.7765	0.0000	0.00
	Facilities	59.4451	0.0000	0.00
	Distribution Lines	1344.4462	0.3230	0.02
	Subtotal	11611.6678	0.3230	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	2.0060	0.0000	0.00
	Subtotal	2.0060	0.0000	
Electrical Power	Facilities	106561.0542	258.4622	0.24
	Subtotal	106561.0542	258.4622	
Communication	Facilities	26.9040	0.0875	0.33
	Subtotal	26.9040	0.0875	
	Total	142,223.77	276.21	

Appendix A: County Listing for the Region

Alpine,CA
Amador,CA
Butte,CA
Calaveras,CA
Colusa,CA
Contra Costa,CA
El Dorado,CA
Fresno,CA
Inyo,CA
Lassen,CA
Madera,CA
Mariposa,CA
Merced,CA
Mono,CA
Nevada,CA
Placer,CA
Plumas,CA
Sacramento,CA
San Joaquin,CA
Sierra,CA
Solano,CA
Stanislaus,CA
Sutter,CA
Tuolumne,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	Alpine	1,204	721	139	861
	Amador	40,474	5,608	2,517	8,125
	Butte	211,632	25,875	16,639	42,514
	Calaveras	45,292	8,305	4,893	13,199
	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
	Fresno	1,008,654	98,532	61,772	160,304
	Inyo	19,016	2,951	1,970	4,921
	Lassen	32,730	4,033	2,008	6,042
	Madera	156,255	18,025	9,641	27,667
	Mariposa	17,131	3,299	1,141	4,441
	Merced	281,202	25,194	26,098	51,292
	Mono	13,195	3,293	1,083	4,377
	Nevada	102,241	17,908	6,108	24,016
	Placer	404,739	69,985	24,193	94,179
	Plumas	19,790	6,128	2,276	8,405
	Sacramento	1,585,055	179,811	83,911	263,723
	San Joaquin	779,233	82,706	56,882	139,589
	Sierra	3,236	596	419	1,015
Solano	453,491	55,802	26,393	82,195	
Stanislaus	552,878	62,937	37,511	100,449	
Sutter	99,633	10,618	6,448	17,066	
Tuolumne	55,620	8,964	3,507	12,471	
Yolo	216,403	24,130	18,343	42,473	
Yuba	81,575	8,161	4,677	12,839	
Total Region		7,559,630	918,851	470,636	1,389,500