

Hazus: Earthquake Global Risk Report

Region Name: DeathValley

Earthquake Scenario: deathvalleynoshaw09m_m7p37_se

Print Date: May 07, 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 10 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 59,736.68 square miles and contains 1,129 census tracts. There are over 1,543 thousand households in the region which has a total population of 4,986,363 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 1,569 thousand buildings in the region with a total building replacement value (excluding contents) of 834,578 (millions of dollars). Approximately 91.00 % of the buildings (and 60.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 90,876 and 113,686 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1,569 thousand buildings in the region which have an aggregate total replacement value of 834,578 (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 90 hospitals in the region with a total bed capacity of 14,628 beds. There are 1,848 schools, 498 fire stations, 153 police stations and 24 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 204,562.00 (millions of dollars). This inventory includes over 6,388.94 miles of highways, 4,350 bridges, 155,652.19 miles of pipes.

Table 1: Transportation System Lifeline Inventory

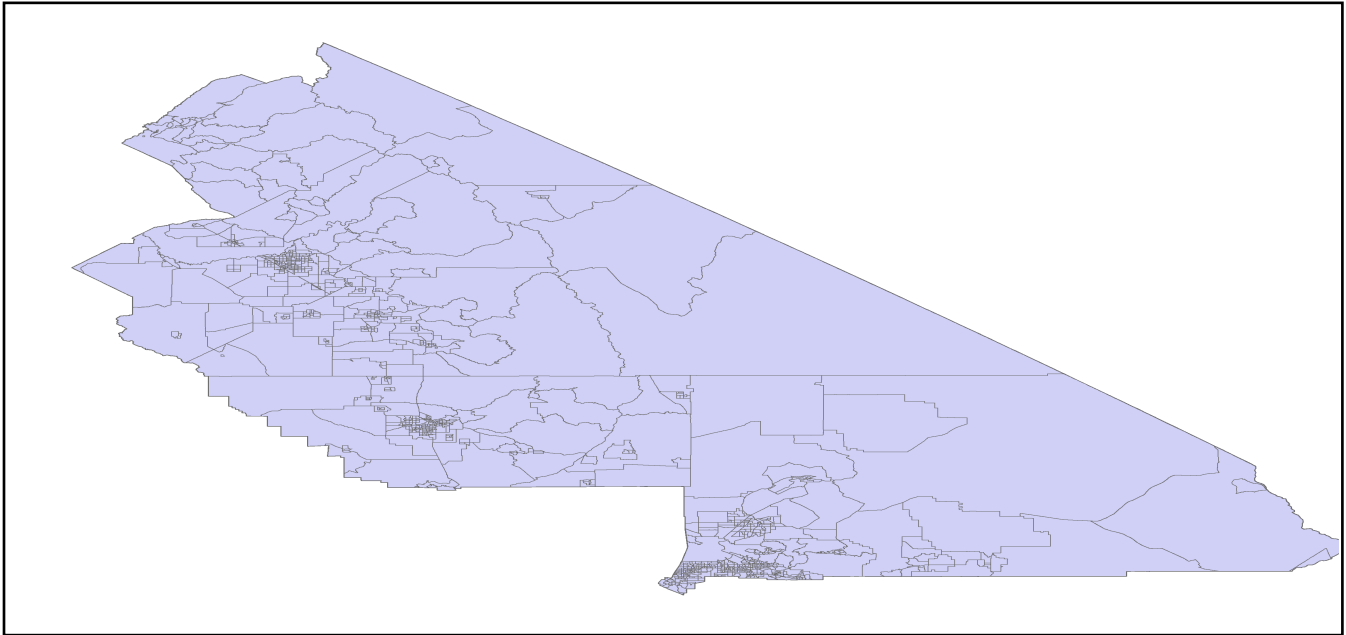
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	4,350	13846.0655
	Segments	2,520	52704.7822
	Tunnels	10	128.3274
	Subtotal		66679.1751
Railways	Bridges	1,051	5980.1900
	Facilities	42	111.8460
	Segments	1,061	16373.5576
	Tunnels	0	0.0000
	Subtotal		22465.5936
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Bus	Facilities	21	45.3681
	Subtotal		45.3681
Ferry	Facilities	0	0.0000
	Subtotal		0.0000
Port	Facilities	0	0.0000
	Subtotal		0.0000
Airport	Facilities	75	732.2691
	Runways	100	954.5758
	Subtotal		1686.8449
		Total	90,877.00

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	3082.7345
	Facilities	12	471.5280
	Pipelines	0	0.0000
		Subtotal	3554.2625
Waste Water	Distribution Lines	NA	1849.6407
	Facilities	30	5158.5540
	Pipelines	0	0.0000
		Subtotal	7008.1947
Natural Gas	Distribution Lines	NA	1233.0938
	Facilities	21	848.4600
	Pipelines	261	13664.3162
		Subtotal	15745.8700
Oil Systems	Facilities	15	1.7700
	Pipelines	0	0.0000
		Subtotal	1.7700
Electrical Power	Facilities	384	87349.6623
		Subtotal	87349.6623
Communication	Facilities	227	26.7860
		Subtotal	26.7860
	Total		113,686.50

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	deathvalleynoshaw09m_m7p37_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	7.37
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 62 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

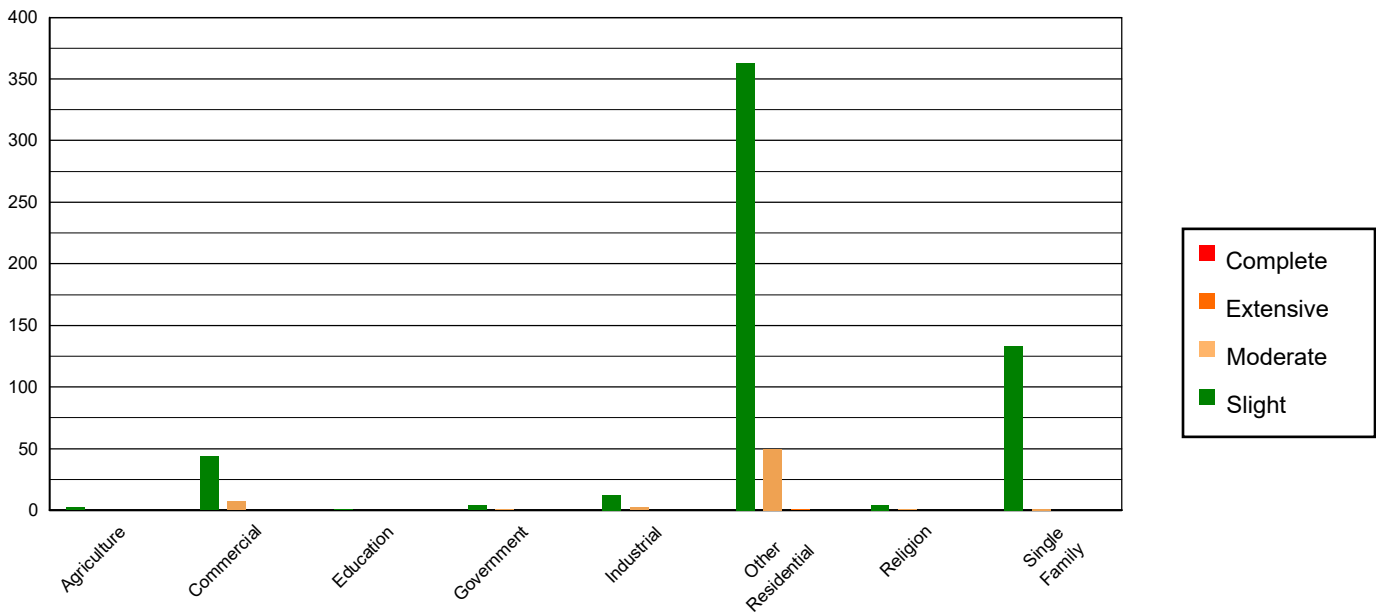


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14661.83	0.93	2.01	0.36	0.16	0.26	0.00	0.09	0.00	0.00
Commercial	94346.44	6.02	43.80	7.78	7.54	12.17	0.22	31.39	0.00	64.68
Education	2681.34	0.17	0.62	0.11	0.04	0.06	0.00	0.00	0.00	0.00
Government	2906.44	0.19	3.89	0.69	0.65	1.06	0.02	2.43	0.00	0.00
Industrial	25302.12	1.61	12.64	2.24	2.17	3.50	0.07	10.11	0.00	0.00
Other Residential	235977.69	15.04	363.09	64.47	49.83	80.42	0.38	54.91	0.00	35.32
Religion	6748.41	0.43	4.04	0.72	0.54	0.87	0.01	1.08	0.00	0.00
Single Family	1185866.83	75.61	133.14	23.64	1.03	1.66	0.00	0.00	0.00	0.00
Total	1,568,491		563		62		1		0	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1370189.88	87.36	190.96	33.90	1.66	2.68	0.00	0.00	0.00	0.00
Steel	29636.42	1.89	30.37	5.39	6.90	11.14	0.21	29.34	0.00	0.00
Concrete	25205.64	1.61	20.99	3.73	3.65	5.89	0.12	17.17	0.00	0.00
Precast	16011.65	1.02	9.35	1.66	1.26	2.03	0.01	1.41	0.00	0.00
RM	52923.69	3.37	7.97	1.41	0.80	1.29	0.00	0.00	0.00	0.00
URM	4225.51	0.27	16.89	3.00	3.90	6.30	0.16	23.20	0.00	100.00
MH	70298.33	4.48	286.69	50.90	43.80	70.69	0.20	28.88	0.00	0.00
Total	1,568,491		563		62		1		0	

*Note:

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

Essential Facility Damage

Before the earthquake, the region had 14,628 hospital beds available for use. On the day of the earthquake, the model estimates that only 14,618 hospital beds (100.00%) 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	90	0	0	90
Schools	1,848	0	0	1,848
EOCs	24	0	0	24
PoliceStations	153	0	0	153
FireStations	498	0	0	496

Transportation Lifeline Damage

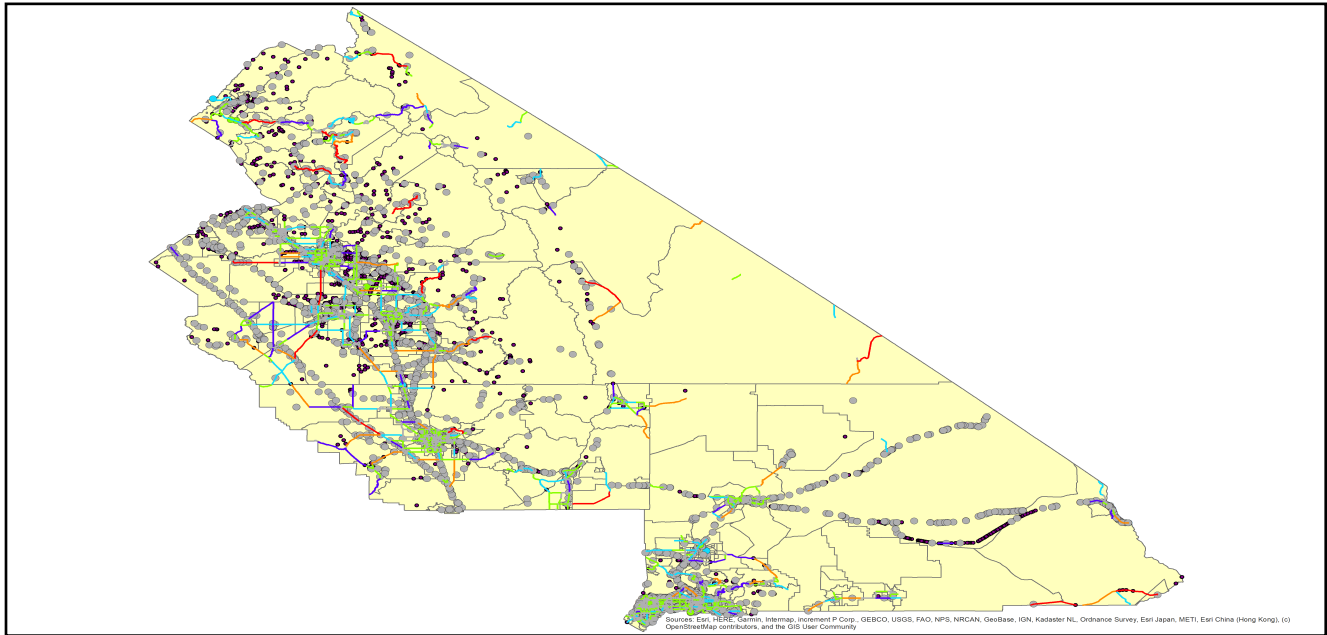


Table 6: Expected Damage to the Transportation Systems

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	2,520	0	0	2,520	2,520
	Bridges	4,350	0	0	4,350	4,350
	Tunnels	10	0	0	10	10
Railways	Segments	1,061	0	0	1,061	1,061
	Bridges	1,051	0	0	1,051	1,051
	Tunnels	0	0	0	0	0
	Facilities	42	0	0	42	42
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	21	0	0	21	21
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	75	0	0	75	75
	Runways	100	0	0	100	100

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	12	0	0	12	12
Waste Water	30	0	0	30	30
Natural Gas	21	0	0	21	21
Oil Systems	15	0	0	15	15
Electrical Power	384	0	0	384	384
Communication	227	0	0	227	227

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	95,776	455	114
Waste Water	57,466	228	57
Natural Gas	2,411	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	1,543,927	1	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

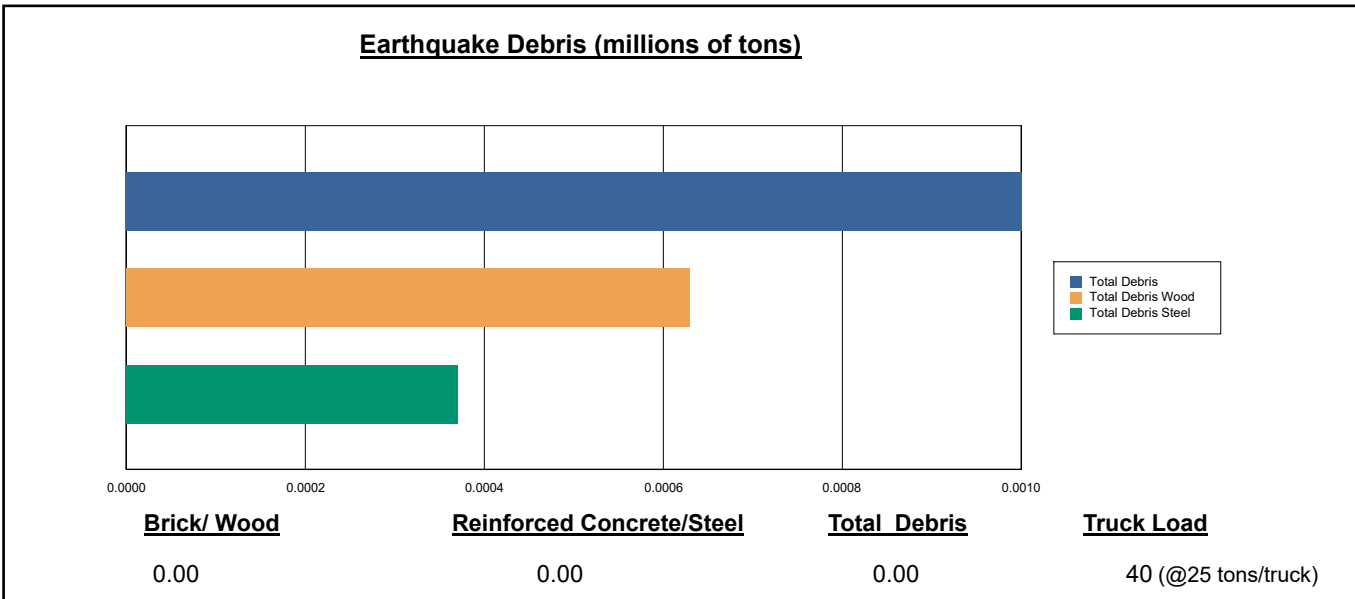
Fire Following Earthquake

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 1,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 63.00% 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 40 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 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 4,986,363) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households
as a result of the
earthquake

0

Persons seeking
temporary public shelter

0

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	0.01	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.01	0.00	0.00	0.00
	Other-Residential	0.64	0.03	0.00	0.00
	Single Family	0.12	0.00	0.00	0.00
	Total	1	0	0	0
2 PM	Commercial	0.54	0.03	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.06	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.05	0.00	0.00	0.00
	Other-Residential	0.22	0.01	0.00	0.00
	Single Family	0.04	0.00	0.00	0.00
	Total	1	0	0	0
5 PM	Commercial	0.33	0.02	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.03	0.00	0.00	0.00
	Other-Residential	0.23	0.01	0.00	0.00
	Single Family	0.04	0.00	0.00	0.00
	Total	1	0	0	0

Economic Loss

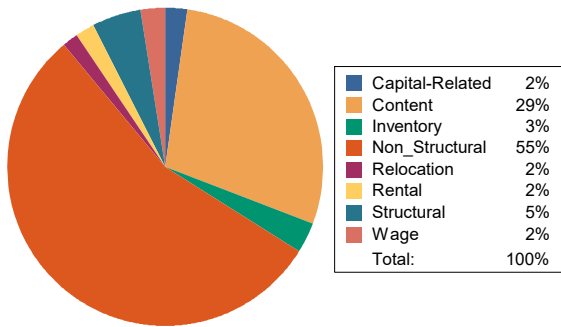
The total economic loss estimated for the earthquake is 188.31 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 25.23 (millions of dollars); 8 % 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 41 % 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)

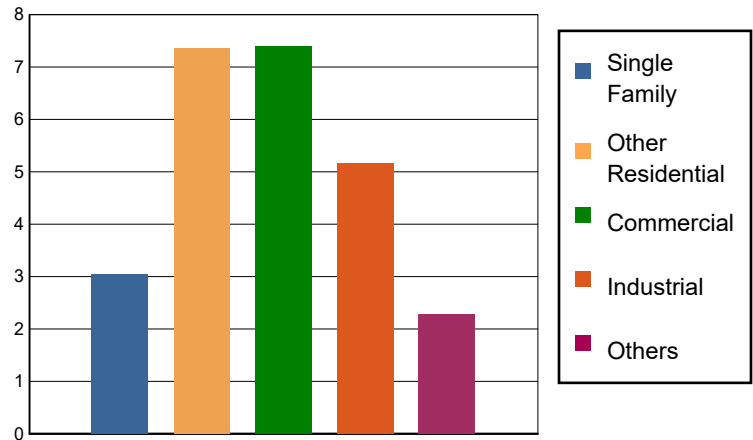


Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0730	0.4276	0.0178	0.0948	0.6132
	Capital-Related	0.0000	0.0309	0.5216	0.0148	0.0040	0.5713
	Rental	0.0096	0.2629	0.1981	0.0126	0.0113	0.4945
	Relocation	0.0062	0.1258	0.1637	0.0423	0.0487	0.3867
	Subtotal	0.0158	0.4926	1.3110	0.0875	0.1588	2.0657
Capital Stock Losses							
	Structural	0.1782	0.4280	0.3587	0.2156	0.0971	1.2776
	Non_Structural	1.9559	4.8945	3.2140	2.6053	1.2061	13.8758
	Content	0.8906	1.5468	2.1153	1.9398	0.7466	7.2391
	Inventory	0.0000	0.0000	0.3868	0.3068	0.0748	0.7684
	Subtotal	3.0247	6.8693	6.0748	5.0675	2.1246	23.1609
	Total	3.04	7.36	7.39	5.16	2.28	25.23

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	52704.7822	0.0000	0.00
	Bridges	13846.0655	0.0198	0.00
	Tunnels	128.3274	0.0000	0.00
	Subtotal	66679.1751	0.0198	
Railways	Segments	16373.5576	0.0000	0.00
	Bridges	5980.1900	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	111.8460	0.1368	0.12
	Subtotal	22465.5936	0.1368	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Bus	Facilities	45.3681	0.1707	0.38
	Subtotal	45.3681	0.1707	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	0.0000	0.0000	
Airport	Facilities	732.2691	6.0931	0.83
	Runways	954.5758	0.0000	0.00
	Subtotal	1686.8449	6.0931	
Total		90,876.98	6.42	

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	471.5280	0.0305	0.01
	Distribution Lines	3082.7345	2.0464	0.07
	Subtotal	3554.2625	2.0769	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	5158.5540	0.6431	0.01
	Distribution Lines	1849.6407	1.0280	0.06
	Subtotal	7008.1947	1.6711	
Natural Gas	Pipelines	13664.3162	0.0000	0.00
	Facilities	848.4600	0.0420	0.00
	Distribution Lines	1233.0938	0.3522	0.03
	Subtotal	15745.8700	0.3942	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	1.7700	0.0001	0.01
	Subtotal	1.7700	0.0001	
Electrical Power	Facilities	87349.6623	152.4956	0.17
	Subtotal	87349.6623	152.4956	
Communication	Facilities	26.7860	0.0199	0.07
	Subtotal	26.7860	0.0199	
	Total	113,686.55	156.66	

Appendix A: County Listing for the Region

Fresno,CA

Inyo,CA

Kern,CA

Kings,CA

Madera,CA

Mariposa,CA

Mono,CA

San Bernardino,CA

Tulare,CA

Tuolumne,CA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
California	Fresno	1,008,654	98,532	61,772	160,304
	Inyo	19,016	2,951	1,970	4,921
	Kern	909,235	87,567	59,168	146,736
	Kings	152,486	13,719	7,861	21,581
	Madera	156,255	18,025	9,641	27,667
	Mariposa	17,131	3,299	1,141	4,441
	Mono	13,195	3,293	1,083	4,377
	San Bernardino	2,181,654	225,045	152,557	377,602
	Tulare	473,117	43,262	31,210	74,472
	Tuolumne	55,620	8,964	3,507	12,471
Total Region		4,986,363	504,657	329,910	834,572