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Hazus: Earthquake Global Risk Report

Region Name: SC_EQ_QAQC

Earthquake Scenario: EQ_100

Print Date: July 21, 2022

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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 46 county(ies) from the following state(s):

South Carolina

Note:

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

The geographical size of the region is 30,836.68 square miles and contains 1,098 census tracts. There are over 1,801 thousand households in the region which has a total population of 4,625,364 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 1,976 thousand buildings in the region with a total building replacement value (excluding contents) of 515,767 (millions of dollars). Approximately 93.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 102,839 and 109,676 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1,976 thousand buildings in the region which have an aggregate total replacement value of 515,767 (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 68% 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 119 hospitals in the region with a total bed capacity of 14,830 beds. There are 1,805 schools, 1,113 fire stations, 327 police stations and 52 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 18,593 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 212,515.00 (millions of dollars). This inventory includes over 8,151.77 miles of highways, 9,398 bridges, 28,892.51 miles of pipes.

Table 1: Transportation System Lifeline Inventory

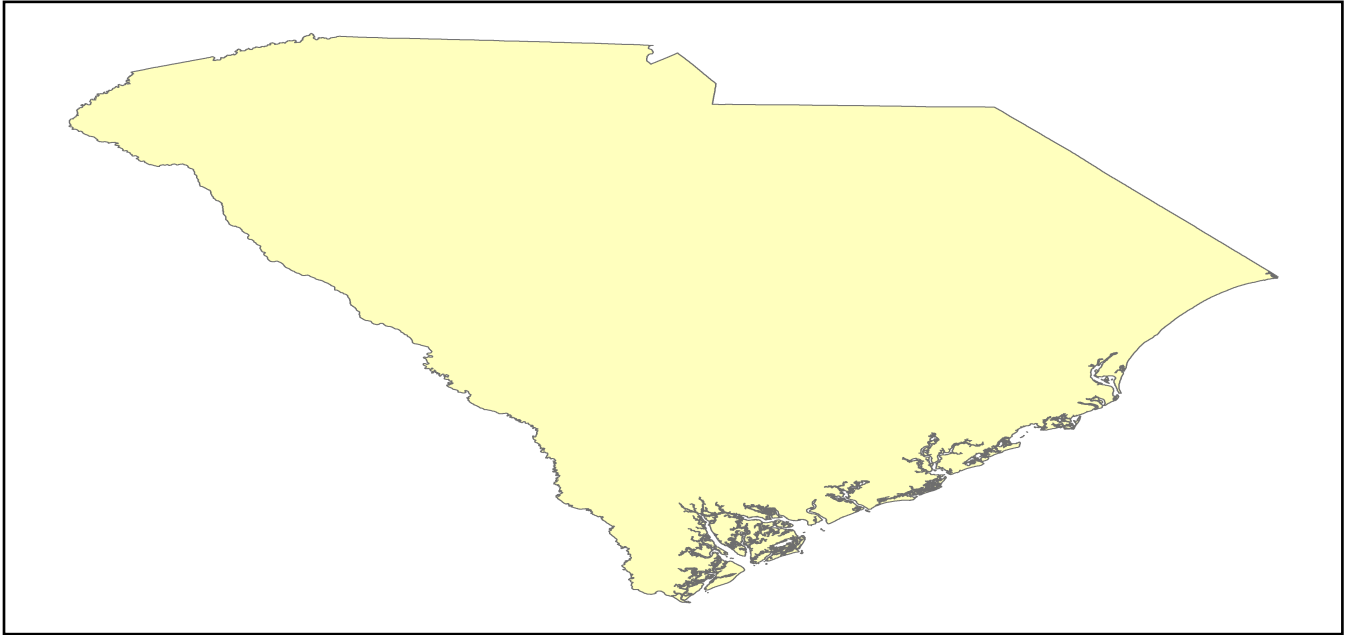
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	9,398	25786.0121
	Segments	3,093	61050.5655
	Tunnels	4	11.6546
	Subtotal		86848.2322
Railways	Bridges	1,086	4602.5152
	Facilities	40	106.5200
	Segments	3,075	6007.3949
	Tunnels	0	0.0000
	Subtotal		10716.4301
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Bus	Facilities	40	54.2469
	Subtotal		54.2469
Ferry	Facilities	14	18.6340
	Subtotal		18.6340
Port	Facilities	175	468.7276
	Subtotal		468.7276
Airport	Facilities	73	764.8066
	Runways	90	3968.0351
	Subtotal		4732.8417
		Total	102,839.10

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5817.4600
	Facilities	1,798	6503.3306
	Pipelines	69,676	7864.0505
	Subtotal		20184.8411
Waste Water	Distribution Lines	NA	3490.4760
	Facilities	374	45331.8082
	Pipelines	70,839	8009.9171
	Subtotal		56832.2013
Natural Gas	Distribution Lines	NA	2326.9840
	Facilities	6	8.8998
	Pipelines	329	1549.2475
	Subtotal		3885.1313
Oil Systems	Facilities	35	62.5660
	Pipelines	22	231.6181
	Subtotal		294.1841
Electrical Power	Facilities	67	28300.8067
	Subtotal		28300.8067
Communication	Facilities	202	178.8830
	Subtotal		178.8830
		Total	109,676.00

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	EQ_100
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.30
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 3,115 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 2 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

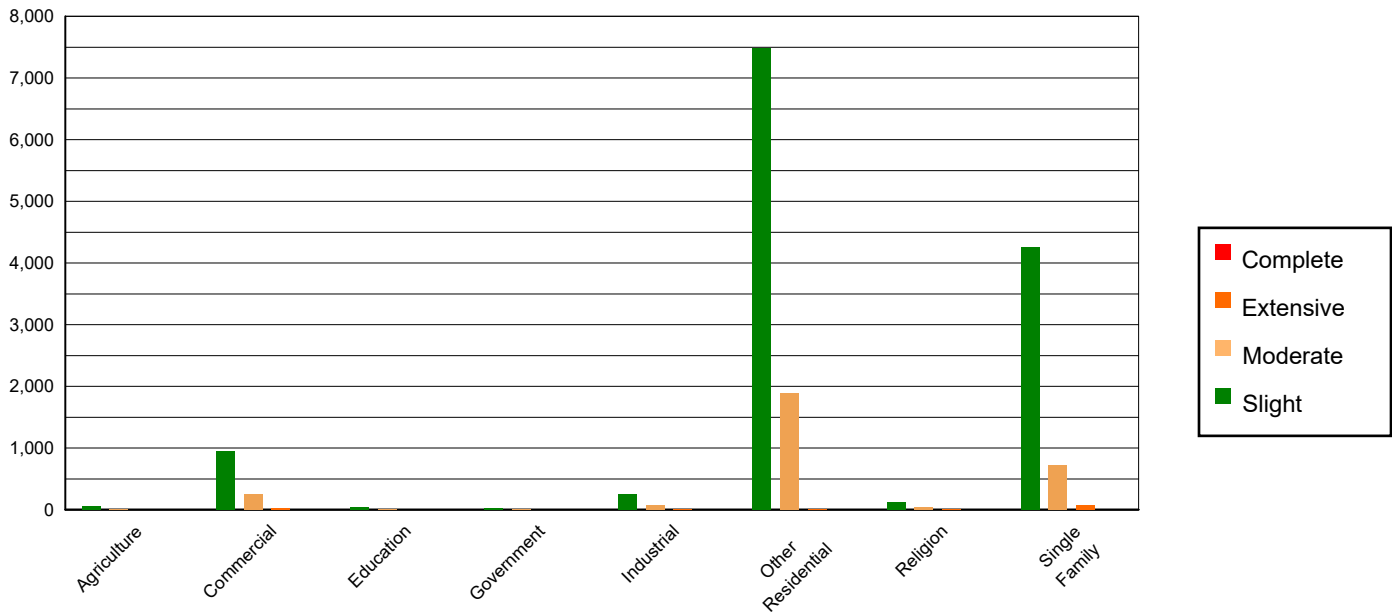


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	5655.19	0.29	51.30	0.39	11.44	0.38	1.07	0.87	0.01	0.42
Commercial	90687.09	4.63	955.31	7.25	254.01	8.49	24.26	19.84	0.32	15.38
Education	3568.66	0.18	35.38	0.27	9.12	0.30	0.83	0.68	0.01	0.67
Government	3310.17	0.17	29.98	0.23	7.25	0.24	0.59	0.48	0.01	0.27
Industrial	26236.82	1.34	258.48	1.96	66.82	2.23	5.82	4.76	0.06	2.96
Other Residential	438216.16	22.35	7479.53	56.73	1886.60	63.07	15.46	12.65	0.25	12.08
Religion	11948.15	0.61	119.70	0.91	36.33	1.21	3.77	3.08	0.06	2.73
Single Family	1380776.46	70.43	4253.86	32.27	719.85	24.06	70.46	57.64	1.37	65.48
Total	1,960,399		13,184		2,991		122		2	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1339646.55	68.34	2512.27	19.06	88.26	2.95	0.00	0.00	0.00	0.00
Steel	64732.59	3.30	515.17	3.91	110.94	3.71	7.00	5.73	0.00	0.00
Concrete	11708.08	0.60	84.05	0.64	15.03	0.50	0.15	0.12	0.00	0.00
Precast	4479.19	0.23	66.34	0.50	31.41	1.05	3.72	3.05	0.00	0.00
RM	17125.28	0.87	133.26	1.01	48.83	1.63	3.72	3.04	0.00	0.00
URM	150848.52	7.69	2817.12	21.37	924.11	30.89	103.32	84.51	2.09	100.00
MH	371858.50	18.97	7055.33	53.52	1772.84	59.26	4.34	3.55	0.00	0.00
Total	1,960,399		13,184		2,991		122		2	

*Note:

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

Essential Facility Damage

Before the earthquake, the region had 14,830 hospital beds available for use. On the day of the earthquake, the model estimates that only 14,547 hospital beds (98.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 99.00% 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	119	0	0	119
Schools	1,805	0	0	1,805
EOCs	52	0	0	52
PoliceStations	327	0	0	327
FireStations	1,113	0	0	1,113

Transportation Lifeline Damage

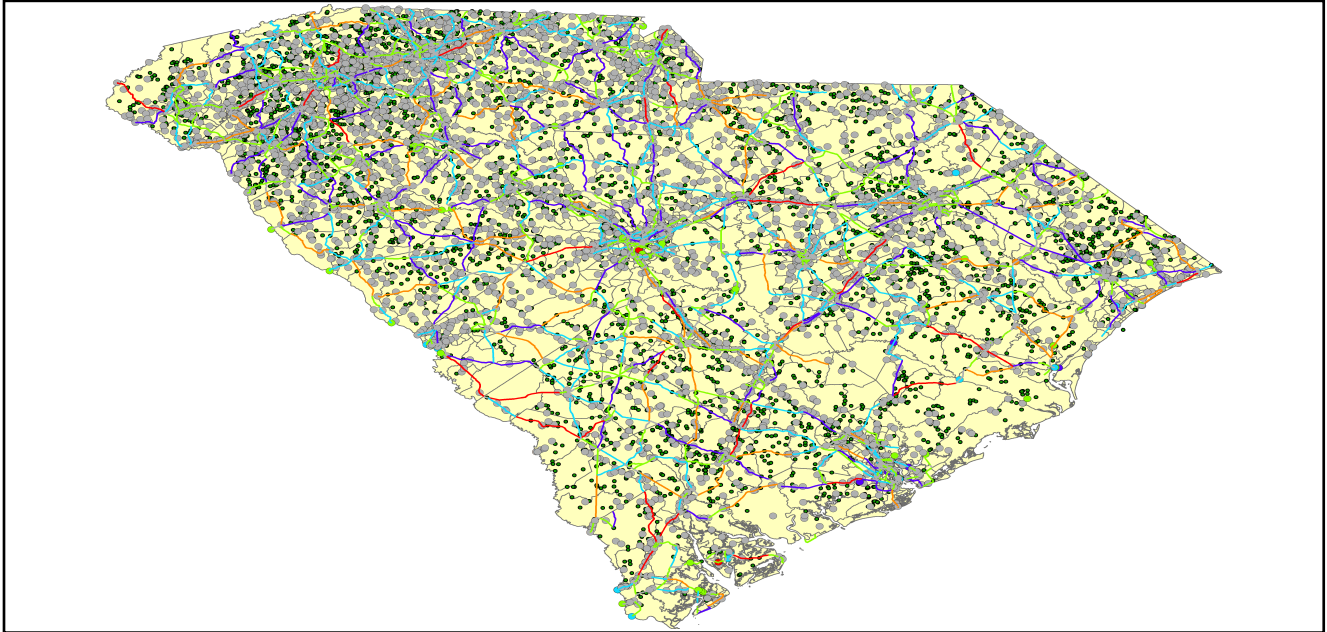


Table 6: Expected Damage to the Transportation Systems

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	3,093	0	0	3,093	3,093
	Bridges	9,398	0	0	9,398	9,398
	Tunnels	4	0	0	4	4
Railways	Segments	3,075	0	0	3,075	3,075
	Bridges	1,086	0	0	1,086	1,086
	Tunnels	0	0	0	0	0
	Facilities	40	0	0	40	40
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	40	0	0	40	40
Ferry	Facilities	14	0	0	14	14
Port	Facilities	175	0	0	175	175
Airport	Facilities	73	0	0	73	73
	Runways	90	0	0	90	90

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	1,798	0	0	1,798	1,798
Waste Water	374	0	0	0	0
Natural Gas	6	0	0	0	0
Oil Systems	35	0	0	0	0
Electrical Power	67	0	0	0	0
Communication	202	0	0	0	0

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	16,176	0	0
Waste Water	10,851	0	0
Natural Gas	1,663	0	0
Oil	203	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						
Electric Power						

Induced Earthquake Damage

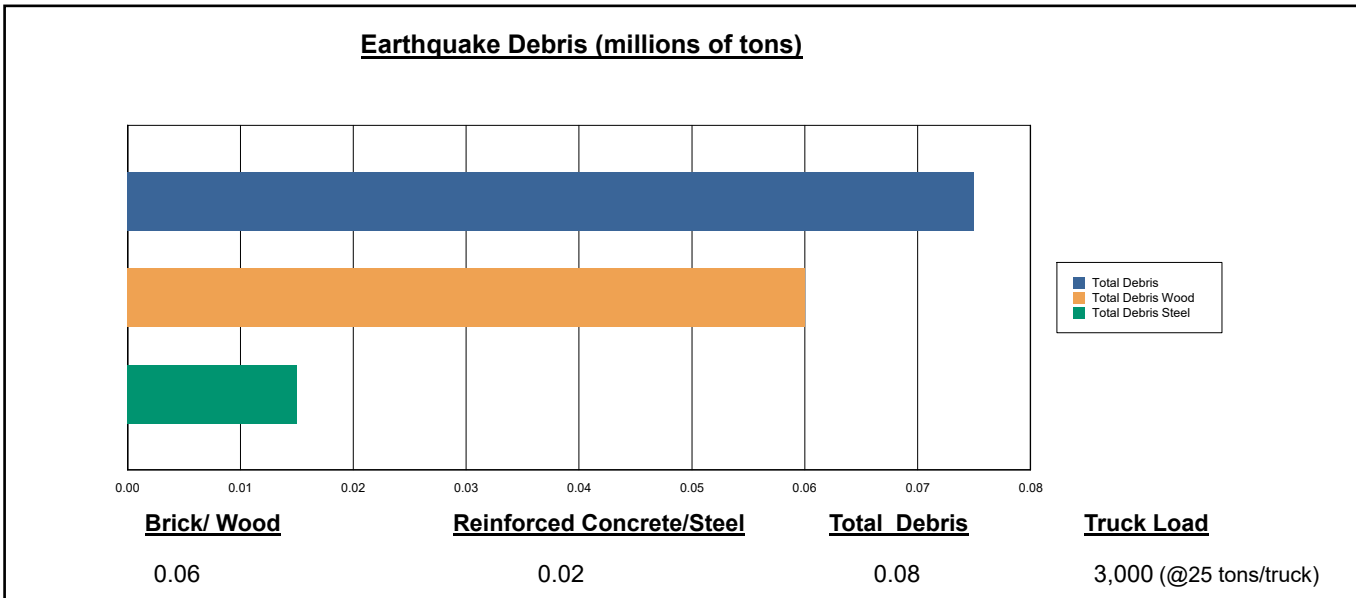
Fire Following Earthquake

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.

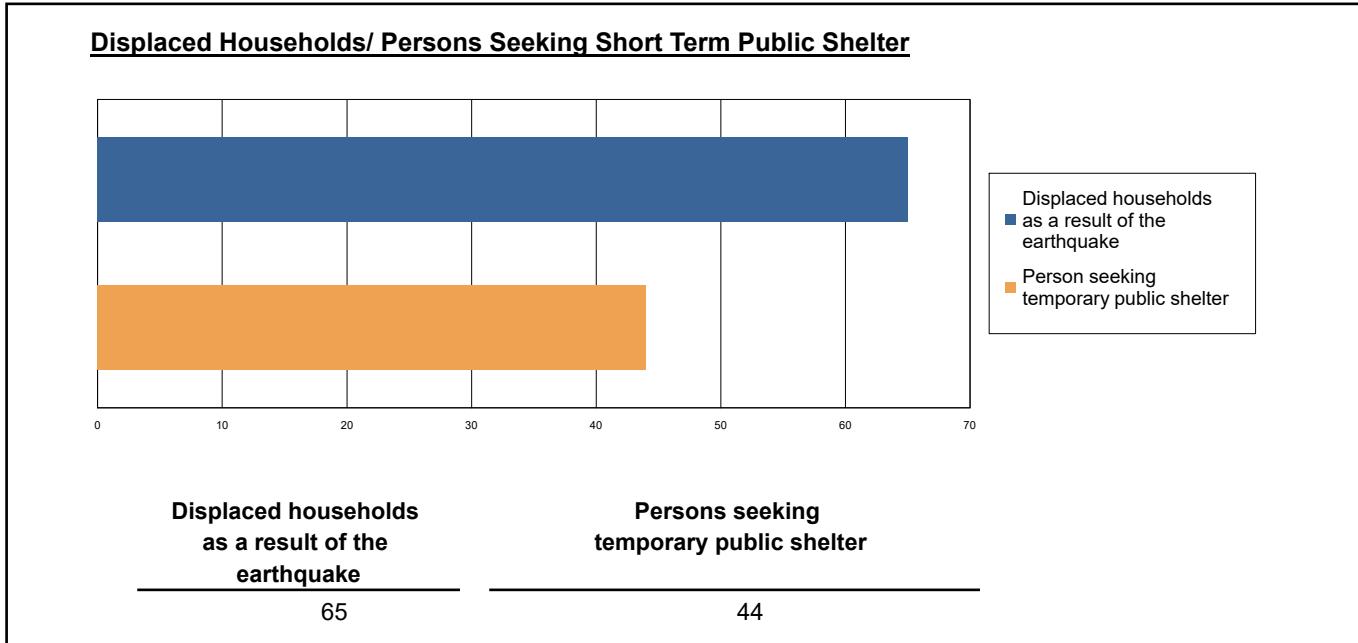
The model estimates that a total of 75,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 80.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 3,000 truckloads (@25 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 65 households to be displaced due to the earthquake. Of these, 44 people (out of a total population of 4,625,364) 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	0.56	0.05	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	0.67	0.05	0.00	0.00
	Other-Residential	22.02	1.68	0.03	0.05
	Single Family	15.35	1.23	0.05	0.08
	Total	39	3	0	0
2 PM	Commercial	33.27	2.82	0.09	0.13
	Commuting	0.00	0.00	0.00	0.00
	Educational	10.52	0.90	0.03	0.05
	Hotels	0.00	0.00	0.00	0.00
	Industrial	4.91	0.40	0.01	0.01
	Other-Residential	4.67	0.36	0.01	0.01
	Single Family	3.36	0.28	0.01	0.02
	Total	57	5	0	0
5 PM	Commercial	23.98	2.05	0.06	0.10
	Commuting	0.00	0.00	0.00	0.00
	Educational	1.29	0.11	0.00	0.01
	Hotels	0.00	0.00	0.00	0.00
	Industrial	3.07	0.25	0.01	0.01
	Other-Residential	8.11	0.63	0.01	0.02
	Single Family	6.00	0.50	0.02	0.03
	Total	42	4	0	0



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Economic Loss

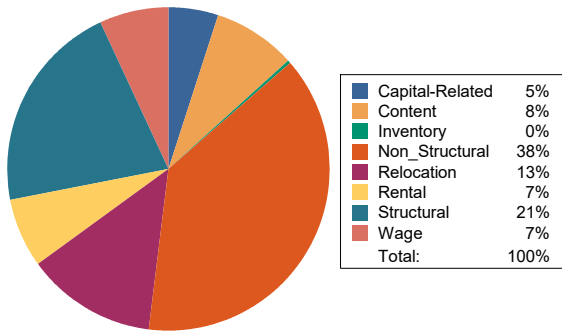
The total economic loss estimated for the earthquake is 163.50 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 150.07 (millions of dollars); 32 % 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 55 % 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)

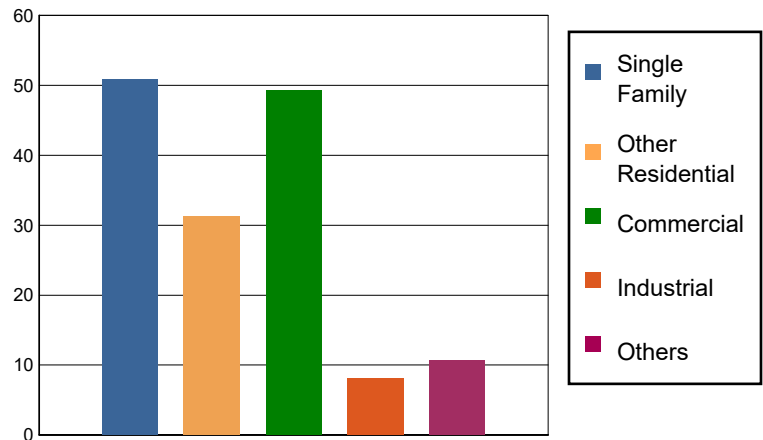


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.7107	8.2700	0.3867	1.0174	10.3848
	Capital-Related	0.0000	0.3021	6.6273	0.2360	0.2232	7.3886
	Rental	1.6746	2.8090	5.3446	0.1710	0.3262	10.3254
	Relocation	5.5324	4.0987	6.7941	0.8036	2.5171	19.7459
	Subtotal	7.2070	7.9205	27.0360	1.5973	4.0839	47.8447
Capital Stock Losses							
	Structural	11.0086	7.6515	8.3399	2.2169	2.4607	31.6776
	Non_Structural	26.9424	14.1218	10.4967	2.6235	3.2299	57.4143
	Content	5.6177	1.5355	3.2739	1.4204	0.8713	12.7188
	Inventory	0.0000	0.0000	0.1014	0.3018	0.0093	0.4125
	Subtotal	43.5687	23.3088	22.2119	6.5626	6.5712	102.2232
	Total	50.78	31.23	49.25	8.16	10.66	150.07

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	61050.5655	0.0000	0.00
	Bridges	25786.0121	0.0058	0.00
	Tunnels	11.6546	0.0000	0.00
	Subtotal	86848.2322	0.0058	
Railways	Segments	6007.3949	0.0000	0.00
	Bridges	4602.5152	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	106.5200	0.6318	0.59
	Subtotal	10716.4301	0.6318	
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	54.2469	0.3375	0.62
	Subtotal	54.2469	0.3375	
Ferry	Facilities	18.6340	0.0000	0.00
	Subtotal	18.6340	0.0000	
Port	Facilities	468.7276	2.7663	0.59
	Subtotal	468.7276	2.7663	
Airport	Facilities	764.8066	6.6447	0.87
	Runways	3968.0351	0.0000	0.00
	Subtotal	4732.8417	6.6447	
Total		102,839.11	10.39	

Table 13: Utility System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	7864.0505	0.0000	0.00
	Facilities	6503.3306	3.0454	0.05
	Distribution Lines	5817.4600	0.0000	0.00
	Subtotal	20184.8411	3.0454	
Waste Water	Pipelines	8009.9171	0.0000	0.00
	Facilities	45331.8082	0.0000	0.00
	Distribution Lines	3490.4760	0.0000	0.00
	Subtotal	56832.2013	0.0000	
Natural Gas	Pipelines	1549.2475	0.0000	0.00
	Facilities	8.8998	0.0000	0.00
	Distribution Lines	2326.9840	0.0000	0.00
	Subtotal	3885.1313	0.0000	
Oil Systems	Pipelines	231.6181	0.0000	0.00
	Facilities	62.5660	0.0000	0.00
	Subtotal	294.1841	0.0000	
Electrical Power	Facilities	28300.8067	0.0000	0.00
	Subtotal	28300.8067	0.0000	
Communication	Facilities	178.8830	0.0000	0.00
	Subtotal	178.8830	0.0000	
	Total	109,676.05	3.05	

Appendix A: County Listing for the Region

- Abbeville,SC
- Aiken,SC
- Allendale,SC
- Anderson,SC
- Bamberg,SC
- Barnwell,SC
- Beaufort,SC
- Berkeley,SC
- Calhoun,SC
- Charleston,SC
- Cherokee,SC
- Chester,SC
- Chesterfield,SC
- Clarendon,SC
- Colleton,SC
- Darlington,SC
- Dillon,SC
- Dorchester,SC
- Edgefield,SC
- Fairfield,SC
- Florence,SC
- Georgetown,SC
- Greenville,SC
- Greenwood,SC
- Hampton,SC
- Horry,SC
- Jasper,SC
- Kershaw,SC
- Lancaster,SC



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Laurens,SC
Lee,SC
Lexington,SC
McCormick,SC
Marion,SC
Marlboro,SC
Newberry,SC
Oconee,SC
Orangeburg,SC
Pickens,SC
Richland,SC
Saluda,SC
Spartanburg,SC
Sumter,SC
Union,SC
Williamsburg,SC
York,SC

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
South Carolina	Abbeville	25,417	1,739	570	2,309
	Aiken	160,099	13,569	3,084	16,654
	Allendale	10,419	633	249	882
	Anderson	187,126	15,499	4,815	20,315
	Bamberg	15,987	1,291	319	1,611
	Barnwell	22,621	1,487	523	2,010
	Beaufort	162,233	19,460	3,344	22,804
	Berkeley	177,843	14,648	2,561	17,210
	Calhoun	15,175	1,075	221	1,297
	Charleston	350,209	37,719	11,002	48,722
	Cherokee	55,342	3,469	1,271	4,741
	Chester	33,140	2,174	768	2,942
	Chesterfield	46,734	2,909	973	3,882
	Clarendon	34,971	2,346	461	2,807
	Colleton	38,892	2,889	889	3,778
	Darlington	68,681	4,594	1,601	6,195
	Dillon	32,062	1,696	622	2,319
	Dorchester	136,555	12,315	2,003	14,319
	Edgefield	26,985	2,043	558	2,601
	Fairfield	23,956	1,844	403	2,247
	Florence	136,885	10,038	4,100	14,139
	Georgetown	60,158	6,258	1,695	7,954
	Greenville	451,225	40,658	13,075	53,733
	Greenwood	69,661	5,577	2,015	7,593
	Hampton	21,090	1,183	390	1,574
	Horry	269,291	30,556	6,034	36,590
	Jasper	24,777	1,404	449	1,854
	Kershaw	61,697	4,788	1,159	5,947
	Lancaster	76,652	5,902	1,439	7,342
	Laurens	66,537	4,677	1,440	6,117
	Lee	19,220	998	328	1,326
	Lexington	262,391	23,838	5,680	29,518
McCormick	10,233	889	157	1,047	
Marion	33,062	2,043	814	2,858	
Marlboro	28,933	1,651	544	2,196	
Newberry	37,508	3,139	823	3,962	
Oconee	74,273	6,753	1,689	8,442	
Orangeburg	92,501	6,143	2,296	8,440	
Pickens	119,224	9,454	2,618	12,072	
Richland	384,504	37,567	10,651	48,218	

	Saluda	19,875	1,522	297	1,820
	Spartanburg	284,307	23,592	8,785	32,377
	Sumter	107,456	7,873	2,524	10,398
	Union	28,961	2,090	652	2,742
	Williamsburg	34,423	1,967	559	2,527
	York	226,073	20,568	4,747	25,316
Total Region		4,625,364	404,527	111,197	515,747



FEMA

RiskMAP
Increasing Resilience Together

HAZUS. Earthquake Global Risk Report

Region Name: SC_EQ_QAQC

Earthquake Scenario: EQ_500

Print Date: July 21, 2022

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

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

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FEMA

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.

South Carolina

Note:

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

The geographical size of the region is 30,836.68 square miles and contains 1,098 census tracts. There are over 1,801 thousand households in the region which has a total population of 4,625,364 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 1,976 thousand buildings in the region with a total building replacement value (excluding contents) of 515,767 (millions of dollars). Approximately 93.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 102,839 and 109,676 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1,976 thousand buildings in the region which have an aggregate total replacement value of 515,767 (millions of dollars). Appendix B provides a general distribution of the ~~buildings of building Total Regionally~~ found in the region, wood frame construction makes up 68% 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 119 hospitals in the region with a total bed capacity of 14,830 beds. There are 1,805 schools, 1,113 fire stations, 327 police stations and 52 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 18,593 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 212,515.00 (millions of dollars). This inventory includes over 8,151.77 miles of highways, 9,398 bridges, 28,892.51 miles of pipes.

Table 1: Transportation System Lifeline

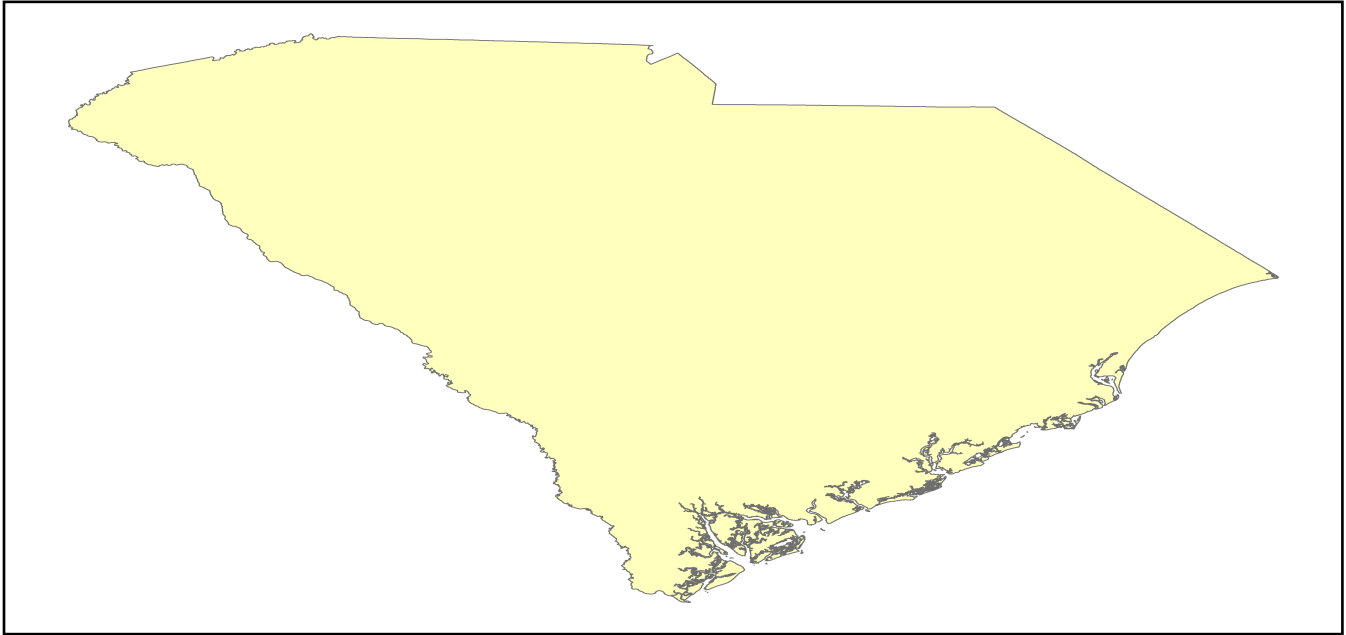
System	Component	Inventory # Location # Segments	Replacement v (millions of)
Highway	Bridges	9,398	25786.0121
	Segments	3,093	61050.5655
	Tunnels	4	11.6546
		Subtotal	86848.2322
Railways	Bridges	1,086	4602.5152
	Facilities	40	106.5200
	Segments	3,075	6007.3949
	Tunnels	0	0.0000
		Subtotal	10716.4301
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	0.0000
Bus	Facilities	40	54.2469
		Subtotal	54.2469
Ferry	Facilities	14	18.6340
		Subtotal	18.6340
Port	Facilities	175	468.7276
		Subtotal	468.7276
Airport	Facilities	73	764.8066
	Runways	90	3968.0351
		Subtotal	4732.8417
		Total	102,839.10

Table 2: Utility System Lifeline Inventory

System	Component	# Locations Segments	Replacement v (millions of
Potable Water	Distribution Lines	NA	5817.4600
	Facilities	1,798	6503.3306
	Pipelines	69,676	7864.0505
		Subtotal	
Waste Water	Distribution Lines	NA	3490.4760
	Facilities	374	45331.8082
	Pipelines	70,839	8009.9171
		Subtotal	
Natural Gas	Distribution Lines	NA	2326.9840
	Facilities	6	8.8998
	Pipelines	329	1549.2475
		Subtotal	
Oil Systems	Facilities	35	62.5660
	Pipelines	22	231.6181
		Subtotal	
Electrical Power	Facilities	67	28300.8067
		Subtotal	
Communication	Facilities	202	178.8830
		Subtotal	
		Total	109,676.00

Earthquake Scenario

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



Scenario Name	EQ_500
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter	NA
Probabilistic Return	500.00
Longitude of Epicente	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.30
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 102,633 buildings will be at least moderately damaged. This is over 5.00 % of the buildings in the region. There are an estimated 2,610 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

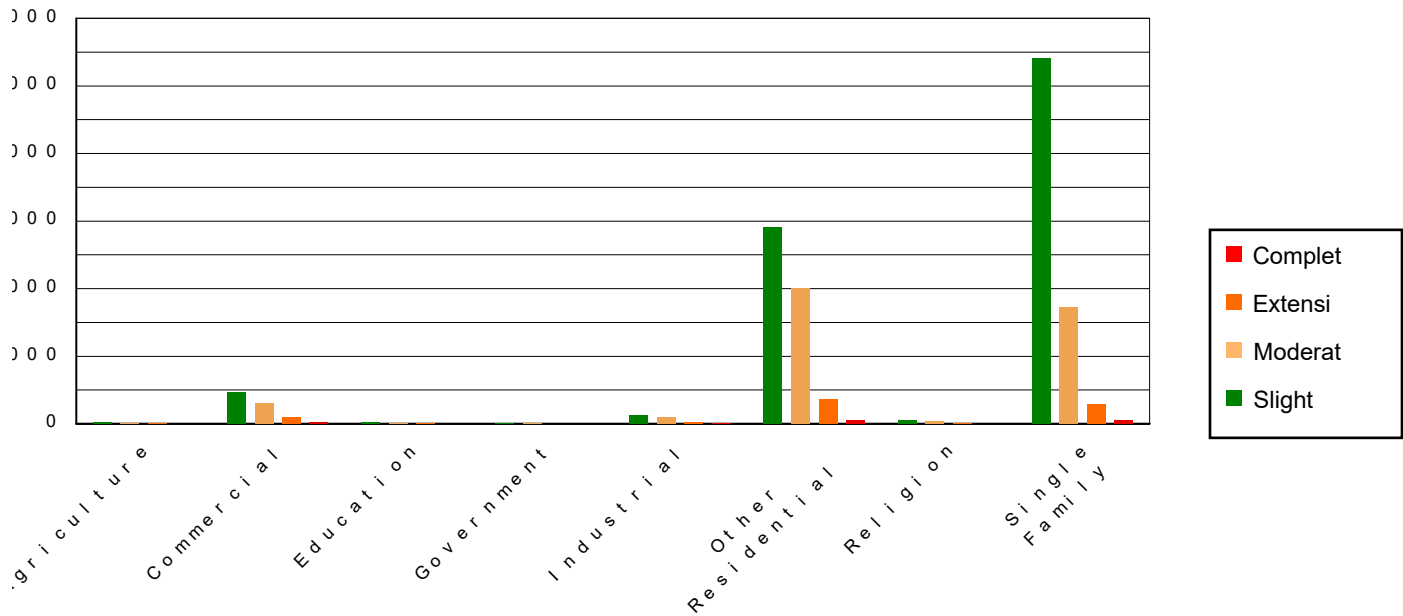


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	4728.43	0.28	594.15	0.33	307.62	0.37	76.42	0.48	12.38	0.47
Commercial	74299.41	4.39	9270.83	5.13	6136.32	7.30	1828.22	11.45	386.22	14.79
Education	2931.54	0.17	355.36	0.20	241.90	0.29	69.65	0.44	15.55	0.60
Government	2760.98	0.16	311.85	0.17	207.27	0.25	56.73	0.36	11.17	0.43
Industrial	21663.05	1.28	2506.91	1.39	1766.28	2.10	526.34	3.30	105.42	4.04
Other Residential	340779.66	20.12	58303.13	32.27	40227.27	47.85	7307.75	45.78	980.19	37.55
Religion	10112.45	0.60	1116.61	0.62	646.82	0.77	190.34	1.19	41.77	1.60
Single Family	1236115.63	73.00	108214.22	59.90	34528.22	41.07	5906.15	37.00	1057.79	40.52
Total	1,693,391		180,673		84,062		15,962		2,610	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1210386.66	71.48	100924.11	55.86	27604.03	32.84	3150.95	19.74	181.33	6.95
Steel	53531.16	3.16	5913.43	3.27	4431.38	5.27	1256.50	7.87	233.23	8.93
Concrete	9538.25	0.56	1101.59	0.61	888.63	1.06	237.79	1.49	41.06	1.57
Precast	3531.83	0.21	409.18	0.23	427.45	0.51	188.74	1.18	23.47	0.90
RM	14420.49	0.85	1191.95	0.66	1178.96	1.40	484.49	3.04	35.20	1.35
URM	117183.89	6.92	19179.05	10.62	12685.33	15.09	4309.89	27.00	1336.99	51.22
MH	284798.86	16.82	51953.75	28.76	36845.92	43.83	6333.24	39.68	759.23	29.08
Total	1,693,391		180,673		84,062		15,962		2,610	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 14,830 hospital beds available for use. On the day of the earthquake, the model estimates that only 11,698 hospital beds (79.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 90.00% of the beds will be back in service. By 30 days, 97.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classifica	Total	# Facilities		
		At Least Mod Damage > 50%	Complete Damage > 50	With Functionali
Hospitals	119	7	0	107
Schools	1,805	66	0	1,606
EOCs	52	1	0	49
PoliceStations	327	9	0	303
FireStations	1,113	21	0	1,029

Transportation Lifeline Damage

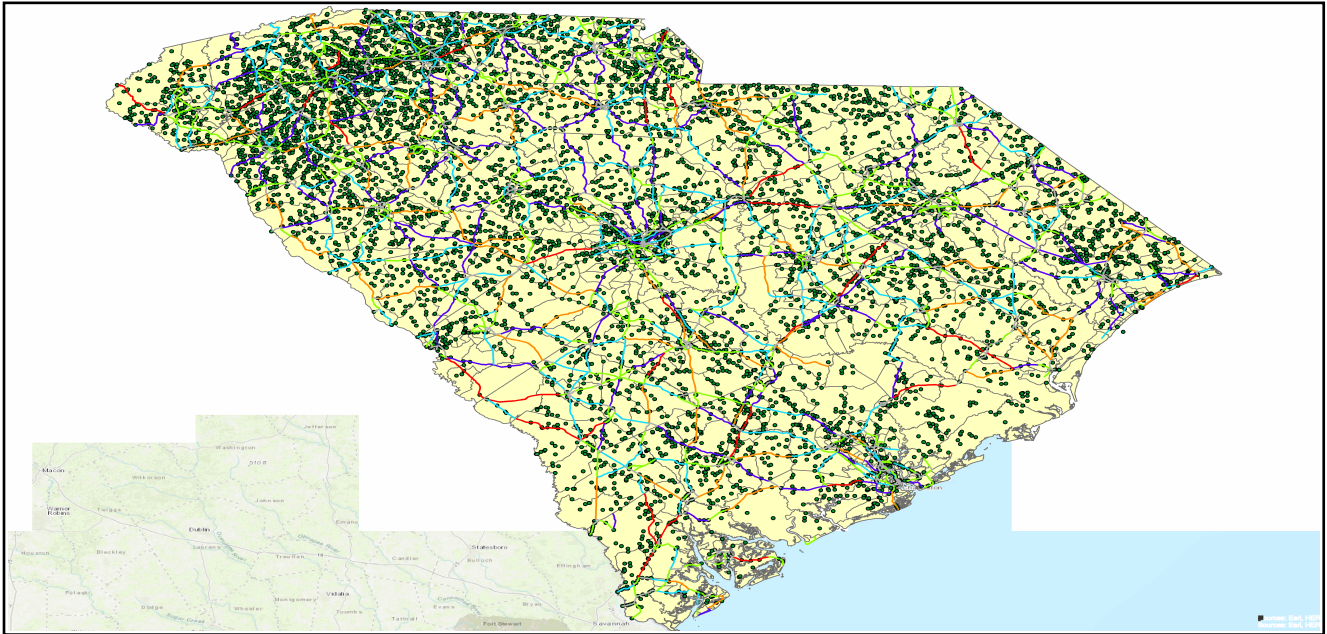


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Location Segments	With at Le Mod. Damag	With Compl Damage	With Functionality	
					After Day 1	After Day 7
Highway	Segments	3,093	0	0	3,093	3,093
	Bridges	9,398	1	0	9,398	9,398
	Tunnels	4	0	0	4	4
Railways	Segments	3,075	0	0	3,075	3,075
	Bridges	1,086	0	0	1,086	1,086
	Tunnels	0	0	0	0	0
	Facilities	40	5	0	40	40
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	40	8	0	40	40
Ferry	Facilities	14	0	0	14	14
Port	Facilities	175	15	0	175	175
Airport	Facilities	73	2	0	73	73
	Runways	90	0	0	90	90

Table 6 provides damage estimates for the transportation syst

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. 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 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Le Moderate Dam	With Comple Damage	with Functionality >	
				After Day 1	After Day
Potable Water	1,798	83	0	1,700	1,798
Waste Water	374	0	0	0	0
Natural Gas	6	0	0	0	0
Oil Systems	35	0	0	0	0
Electrical Power	67	0	0	0	0
Communication	202	0	0	0	0

Table 8 : Expected Utility System Pipeline

System	Total Pipe Length (m)	Number o Leaks	Number of Breaks
Potable Water	16,176	0	0
Waste Water	10,851	0	0
Natural Gas	1,663	0	0
Oil	203	0	0

Table 9: Expected Potable Water and Electric Power System Perform

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 3	At Day 9
Potable Wat						
Electric Po						

Induced Earthquake Damage

Fire Following Earthquake

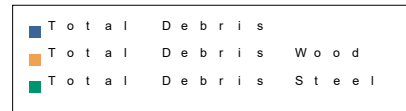
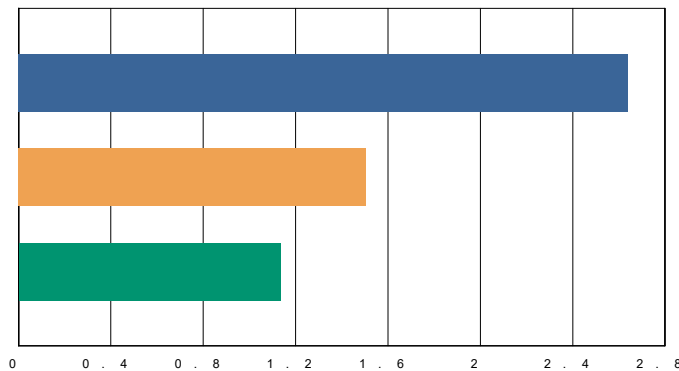
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.32 sq. mi 0.00 % of the region's total area.)

Debris Generation

The model also estimates that the fires will displace about 243 people and burn about 89 (millions of dollars) of building value. 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 2,639,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 57.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated truckload, it will require 105,560 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



Brick/ Wood

Reinforced Concrete/

Total Deb

Truck Load

1.50

1.13

2.64

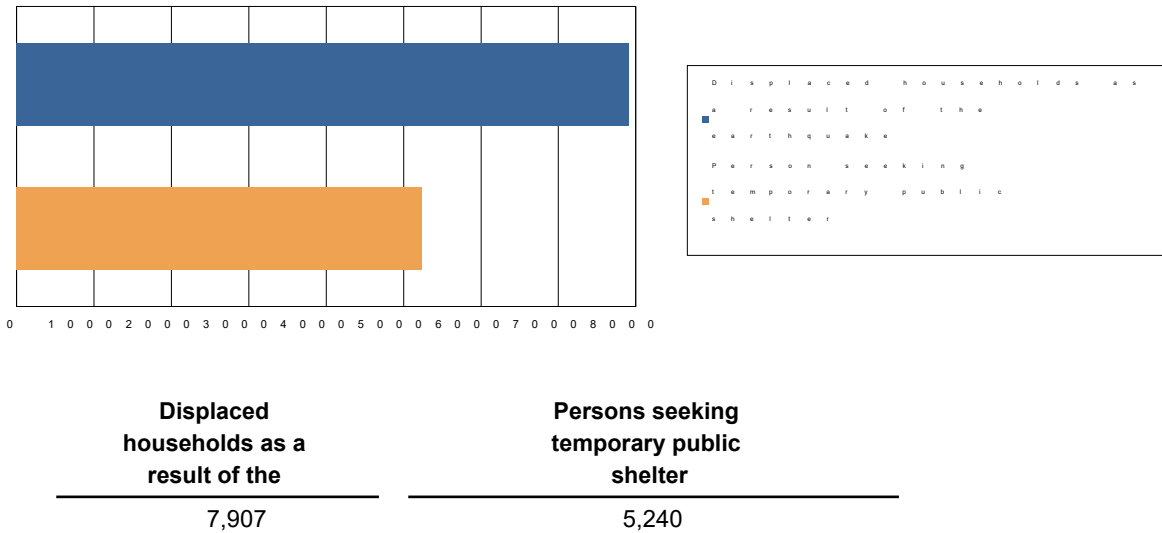
105,560 (@25 tons/

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 7,907 households to be displaced due to the earthquake. Of these, 5,240 people (out of a total population of 40,000) will require temporary public shelter.

Displaced Households / Persons Seeking Short Term Public Shelter



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.

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	32.46	6.82	0.86	1.69
	Commuting	0.05	0.06	0.10	0.02
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	36.42	7.45	0.92	1.80
	Other-Residential	930.31	167.37	16.84	32.40
	Single Family	927.22	162.21	18.32	35.66
	Total	1,926	344	37	72
2 PM	Commercial	1889.41	396.00	50.22	97.54
	Commuting	0.43	0.51	0.94	0.18
	Educational	631.22	137.13	18.42	35.61
	Hotels	0.00	0.00	0.00	0.00
	Industrial	269.19	55.32	6.91	13.36
	Other-Residential	189.50	34.01	3.48	6.45
	Single Family	193.42	34.69	4.12	7.64
	Total	3,173	658	84	161
5 PM	Commercial	1353.30	285.35	36.67	70.14
	Commuting	8.54	10.06	18.59	3.52
	Educational	77.07	16.96	2.30	4.46
	Hotels	0.00	0.00	0.00	0.00
	Industrial	168.24	34.57	4.32	8.35
	Other-Residential	352.22	65.35	7.01	13.01
	Single Family	365.92	66.54	7.95	14.75
	Total	2,325	479	77	114



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Economic Loss

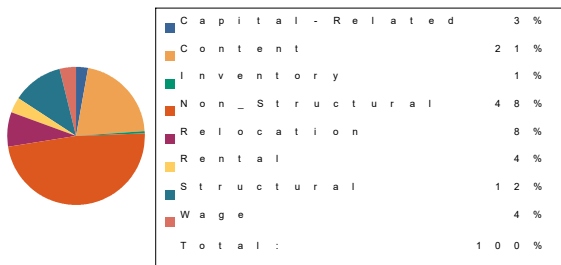
The total economic loss estimated for the earthquake is 11,650.05 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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

The total building-related losses were 11,056.31 (millions of dollars); 18 % 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

Earthquake Losses by Loss Type (\$ millions)



Earthquake Losses by Occupancy Type (\$ millions)

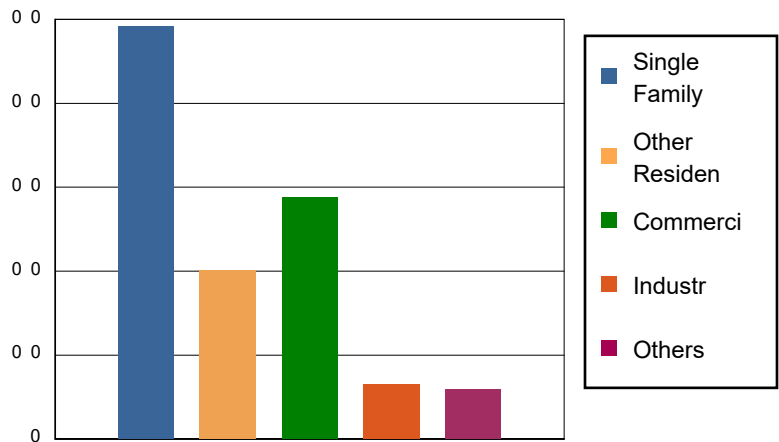


Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Categor	Area	Single Family	Other Residen	Commerci	Industri	Others	Total
Income Losses							
	Wage	0.0000	43.3128	340.0428	14.1829	25.8754	423.4139
	Capital-Related	0.0000	18.4297	280.5182	8.7192	5.7872	313.4543
	Rental	96.3343	125.2727	173.3798	5.3309	11.4679	411.7856
	Relocation	338.1745	146.5939	276.5369	29.0037	89.5911	879.9001
	Subtotal	434.5088	333.6091	1070.4777	57.2367	132.7216	2028.5539
Capital Stock Losses							
	Structural	565.9998	261.3578	335.6069	78.7972	81.7720	1,323.5337
	Non-Structural	2768.3569	1110.5644	919.6724	279.3580	236.6748	5,314.6265
	Content	1147.6676	301.4495	539.6456	200.0384	141.3708	2,330.1719
	Inventory	0.0000	0.0000	15.8956	41.8023	1.7282	59.4261
	Subtotal	4482.0243	1673.3717	1810.8205	599.9959	461.5458	9027.7582
	Total	4916.53	2006.98	2881.30	657.23	594.27	11056.31

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	61050.5655	0.0000	0.00
	Bridges	25786.0121	57.1594	0.22
	Tunnels	11.6546	0.0029	0.02
	Subtotal	86848.2322	57.1623	
Railways	Segments	6007.3949	0.0000	0.00
	Bridges	4602.5152	0.5014	0.01
	Tunnels	0.0000	0.0000	0.00
	Facilities	106.5200	14.3266	13.45
	Subtotal	10716.4301	14.8280	
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	54.2469	7.3266	13.51
	Subtotal	54.2469	7.3266	
Ferry	Facilities	18.6340	0.0000	0.00
	Subtotal	18.6340	0.0000	
Port	Facilities	468.7276	75.4653	16.10
	Subtotal	468.7276	75.4653	
Airport	Facilities	764.8066	120.0603	15.70
	Runways	3968.0351	0.0000	0.00
	Subtotal	4732.8417	120.0603	
Total		102,839.11	274.84	

Table 13: Utility System Economic Losses

(Millions of dollars)

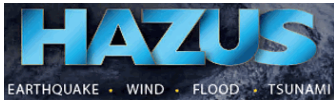
System	Component	Inventory Valu	Economic Loss	Loss Ratio
Potable Water	Pipelines	7864.0505	0.0000	0.00
	Facilities	6503.3306	318.9019	4.90
	Distribution Lines	5817.4600	0.0000	0.00
	Subtotal	20184.8411	318.9019	
Waste Water	Pipelines	8009.9171	0.0000	0.00
	Facilities	45331.8082	0.0000	0.00
	Distribution Lines	3490.4760	0.0000	0.00
	Subtotal	56832.2013	0.0000	
Natural Gas	Pipelines	1549.2475	0.0000	0.00
	Facilities	8.8998	0.0000	0.00
	Distribution Lines	2326.9840	0.0000	0.00
	Subtotal	3885.1313	0.0000	
Oil Systems	Pipelines	231.6181	0.0000	0.00
	Facilities	62.5660	0.0000	0.00
	Subtotal	294.1841	0.0000	
Electrical Power	Facilities	28300.8067	0.0000	0.00
	Subtotal	28300.8067	0.0000	
Communication	Facilities	178.8830	0.0000	0.00
	Subtotal	178.8830	0.0000	
	Total	109,676.05	318.90	



FEMA

Appendix A: County Listing for the Region

- Abbeville,SC
- Aiken,SC
- Allendale,SC
- Anderson,SC
- Bamberg,SC
- Barnwell,SC
- Beaufort,SC
- Berkeley,SC
- Calhoun,SC
- Charleston,SC
- Cherokee,SC
- Chester,SC
- Chesterfield,SC
- Clarendon,SC
- Colleton,SC
- Darlington,SC
- Dillon,SC
- Dorchester,SC
- Edgefield,SC
- Fairfield,SC
- Florence,SC
- Georgetown,SC
- Greenville,SC
- Greenwood,SC
- Hampton,SC
- Horry,SC
- Jasper,SC
- Kershaw,SC
- Lancaster,SC



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-
- Laurens,SC
 - Lee,SC
 - Lexington,SC
 - McCormick,SC
 - Marion,SC
 - Marlboro,SC
 - Newberry,SC
 - Oconee,SC
 - Orangeburg,SC
 - Pickens,SC
 - Richland,SC
 - Saluda,SC
 - Spartanburg,SC
 - Sumter,SC
 - Union,SC
 - Williamsburg,SC
 - York,SC

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Resident	Total
South Carolina	Abbeville	25,417	1,739	570	2,309
	Aiken	160,099	13,569	3,084	16,654
	Allendale	10,419	633	249	882
	Anderson	187,126	15,499	4,815	20,315
	Bamberg	15,987	1,291	319	1,611
	Barnwell	22,621	1,487	523	2,010
	Beaufort	162,233	19,460	3,344	22,804
	Berkeley	177,843	14,648	2,561	17,210
	Calhoun	15,175	1,075	221	1,297
	Charleston	350,209	37,719	11,002	48,722
	Cherokee	55,342	3,469	1,271	4,741
	Chester	33,140	2,174	768	2,942
	Chesterfield	46,734	2,909	973	3,882
	Clarendon	34,971	2,346	461	2,807
	Colleton	38,892	2,889	889	3,778
	Darlington	68,681	4,594	1,601	6,195
	Dillon	32,062	1,696	622	2,319
	Dorchester	136,555	12,315	2,003	14,319
	Edgefield	26,985	2,043	558	2,601
	Fairfield	23,956	1,844	403	2,247
	Florence	136,885	10,038	4,100	14,139
	Georgetown	60,158	6,258	1,695	7,954
	Greenville	451,225	40,658	13,075	53,733
	Greenwood	69,661	5,577	2,015	7,593
	Hampton	21,090	1,183	390	1,574
	Horry	269,291	30,556	6,034	36,590
	Jasper	24,777	1,404	449	1,854
	Kershaw	61,697	4,788	1,159	5,947
	Lancaster	76,652	5,902	1,439	7,342
	Laurens	66,537	4,677	1,440	6,117
	Lee	19,220	998	328	1,326
	Lexington	262,391	23,838	5,680	29,518
McCormick	10,233	889	157	1,047	
Marion	33,062	2,043	814	2,858	
Marlboro	28,933	1,651	544	2,196	
Newberry	37,508	3,139	823	3,962	
Oconee	74,273	6,753	1,689	8,442	
Orangeburg	92,501	6,143	2,296	8,440	
Pickens	119,224	9,454	2,618	12,072	
Richland	384,504	37,567	10,651	48,218	



FEMA

	Saluda	19,875	1,522	297	1,820
	Spartanburg	284,307	23,592	8,785	32,377
	Sumter	107,456	7,873	2,524	10,398
	Union	28,961	2,090	652	2,742
	Williamsburg	34,423	1,967	559	2,527
	York	226,073	20,568	4,747	25,316
Total Reg		4,625,364	404,527	111,197	515,747



FEMA

RiskMAP
Increasing Resilience Together

Hazus: Earthquake Global Risk Report

Region Name: MH_EQ_CHS

Earthquake Scenario: M7.1-Charleston fit v5

Print Date: July 27, 2022

Disclaimer:

*This version of Hazus utilizes 2010 Census Data.
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 46 county(ies) from the following state(s):

South Carolina

Note:

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

The geographical size of the region is 30,836.68 square miles and contains 1,098 census tracts. There are over 1,801 thousand households in the region which has a total population of 4,625,364 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 1,976 thousand buildings in the region with a total building replacement value (excluding contents) of 515,767 (millions of dollars). Approximately 93.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 102,839 and 109,676 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1,976 thousand buildings in the region which have an aggregate total replacement value of 515,767 (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 68% 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 119 hospitals in the region with a total bed capacity of 14,830 beds. There are 1,805 schools, 1,113 fire stations, 327 police stations and 52 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 18,593 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 212,515.00 (millions of dollars). This inventory includes over 8,151.77 miles of highways, 9,398 bridges, 28,892.51 miles of pipes.

Table 1: Transportation System Lifeline Inventory

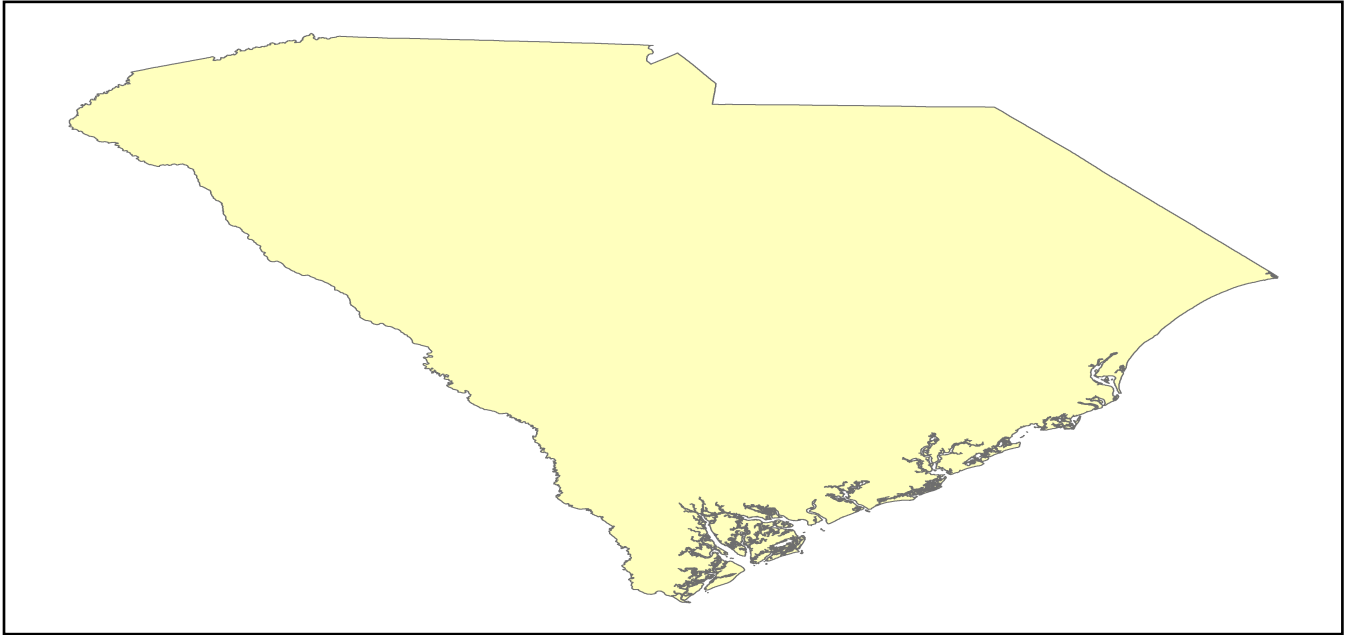
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	9,398	25786.0121
	Segments	3,093	61050.5655
	Tunnels	4	11.6546
	Subtotal		86848.2322
Railways	Bridges	1,086	4602.5152
	Facilities	40	106.5200
	Segments	3,075	6007.3949
	Tunnels	0	0.0000
	Subtotal		10716.4301
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
	Subtotal		0.0000
Bus	Facilities	40	54.2469
	Subtotal		54.2469
Ferry	Facilities	14	18.6340
	Subtotal		18.6340
Port	Facilities	175	468.7276
	Subtotal		468.7276
Airport	Facilities	73	764.8066
	Runways	90	3968.0351
	Subtotal		4732.8417
		Total	102,839.10

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5817.4600
	Facilities	1,798	6503.3306
	Pipelines	69,676	7864.0505
	Subtotal		20184.8411
Waste Water	Distribution Lines	NA	3490.4760
	Facilities	374	45331.8082
	Pipelines	70,839	8009.9171
	Subtotal		56832.2013
Natural Gas	Distribution Lines	NA	2326.9840
	Facilities	6	8.8998
	Pipelines	329	1549.2475
	Subtotal		3885.1313
Oil Systems	Facilities	35	62.5660
	Pipelines	22	231.6181
	Subtotal		294.1841
Electrical Power	Facilities	67	28300.8067
	Subtotal		28300.8067
Communication	Facilities	202	178.8830
	Subtotal		178.8830
		Total	109,676.00

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	M7.1-Charleston fit v5
Type of Earthquake	
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.10
Depth (km)	0.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	

Direct Earthquake Damage

Building Damage

Hazus estimates that about 161,745 buildings will be at least moderately damaged. This is over 8.00 % of the buildings in the region. There are an estimated 12,654 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

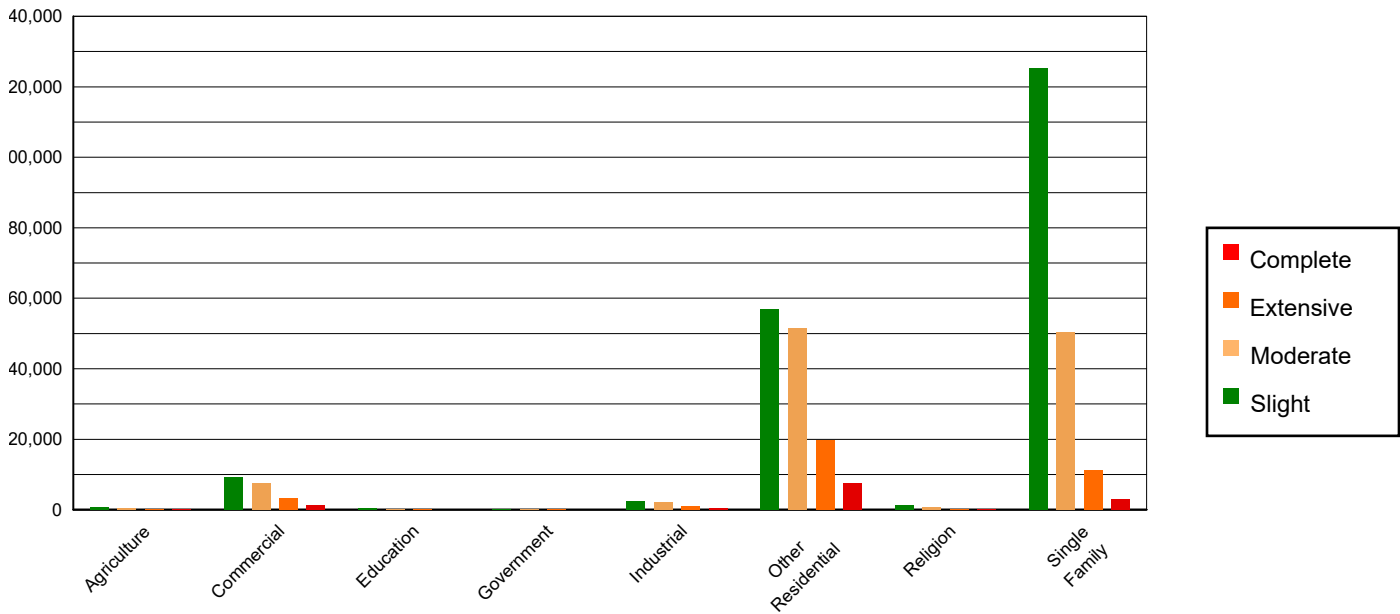


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	4370.41	0.27	661.06	0.34	459.68	0.40	164.62	0.46	63.22	0.50
Commercial	70516.94	4.36	9332.02	4.76	7611.63	6.70	3157.17	8.88	1303.23	10.30
Education	2781.68	0.17	357.21	0.18	301.36	0.27	123.48	0.35	50.27	0.40
Government	2620.61	0.16	314.99	0.16	260.10	0.23	105.84	0.30	46.47	0.37
Industrial	20706.11	1.28	2356.69	1.20	2100.94	1.85	956.65	2.69	447.61	3.54
Other Residential	312011.43	19.28	56865.87	28.98	51594.75	45.45	19584.24	55.07	7541.71	59.60
Religion	9696.27	0.60	1155.11	0.59	795.31	0.70	324.43	0.91	136.88	1.08
Single Family	1196003.67	73.89	125202.28	63.80	50402.99	44.40	11148.30	31.35	3064.75	24.22
Total	1,618,707		196,245		113,527		35,565		12,654	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1171053.58	72.34	119492.68	60.89	43497.80	38.32	7336.73	20.63	866.30	6.85
Steel	50659.34	3.13	5740.17	2.93	5490.92	4.84	2423.22	6.81	1052.05	8.31
Concrete	8965.84	0.55	1106.93	0.56	1118.31	0.99	445.30	1.25	170.92	1.35
Precast	3359.32	0.21	386.64	0.20	473.06	0.42	274.87	0.77	86.80	0.69
RM	13731.80	0.85	1212.09	0.62	1420.34	1.25	778.19	2.19	168.67	1.33
URM	113338.60	7.00	18309.06	9.33	13846.32	12.20	6023.63	16.94	3177.54	25.11
MH	257598.65	15.91	49997.66	25.48	47680.02	42.00	18282.81	51.41	7131.86	56.36
Total	1,618,707		196,245		113,527		35,565		12,654	

*Note:

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

Essential Facility Damage

Before the earthquake, the region had 14,830 hospital beds available for use. On the day of the earthquake, the model estimates that only 11,283 hospital beds (76.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 88.00% of the beds will be back in service. By 30 days, 96.00% 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	119	5	1	103
Schools	1,805	125	0	1,530
EOCs	52	4	0	46
PoliceStations	327	19	0	283
FireStations	1,113	69	0	941

Transportation Lifeline Damage

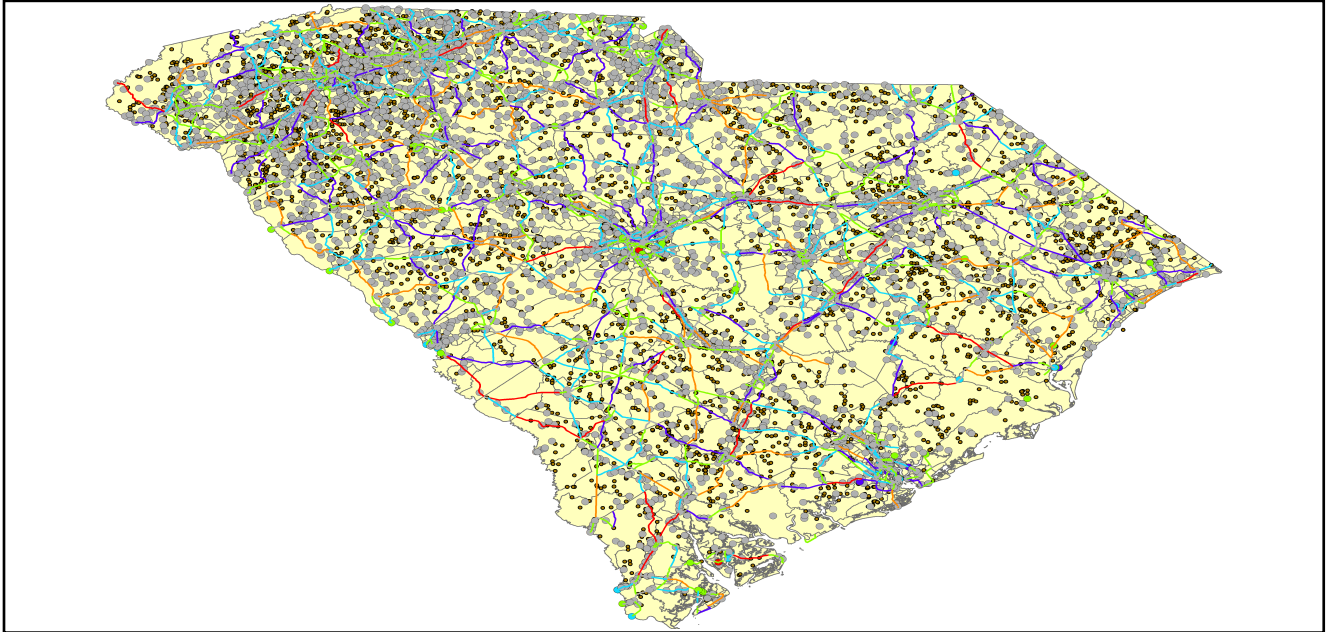


Table 6: Expected Damage to the Transportation Systems

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	3,093	0	0	3,093	3,093
	Bridges	9,398	119	12	9,283	9,324
	Tunnels	4	0	0	4	4
Railways	Segments	3,075	0	0	3,075	3,075
	Bridges	1,086	0	0	1,086	1,086
	Tunnels	0	0	0	0	0
	Facilities	40	2	0	40	40
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	40	4	0	37	40
Ferry	Facilities	14	0	0	14	14
Port	Facilities	175	18	0	169	175
Airport	Facilities	73	5	0	71	72
	Runways	90	0	0	90	90

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	1,798	124	0	1,630	1,785
Waste Water	374	0	0	0	0
Natural Gas	6	0	0	0	0
Oil Systems	35	0	0	0	0
Electrical Power	67	0	0	0	0
Communication	202	0	0	0	0

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	16,176	0	0
Waste Water	10,851	0	0
Natural Gas	1,663	0	0
Oil	203	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						
Electric Power						

Induced Earthquake Damage

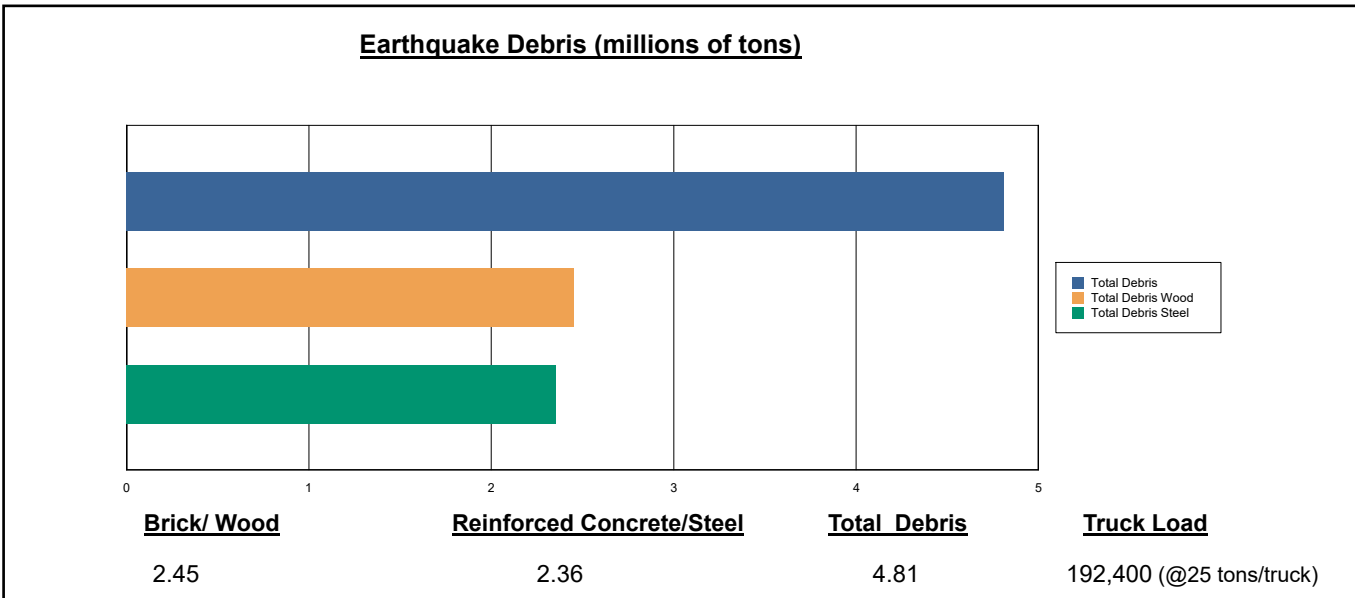
Fire Following Earthquake

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 0.32 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 243 people and burn about 89 (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.

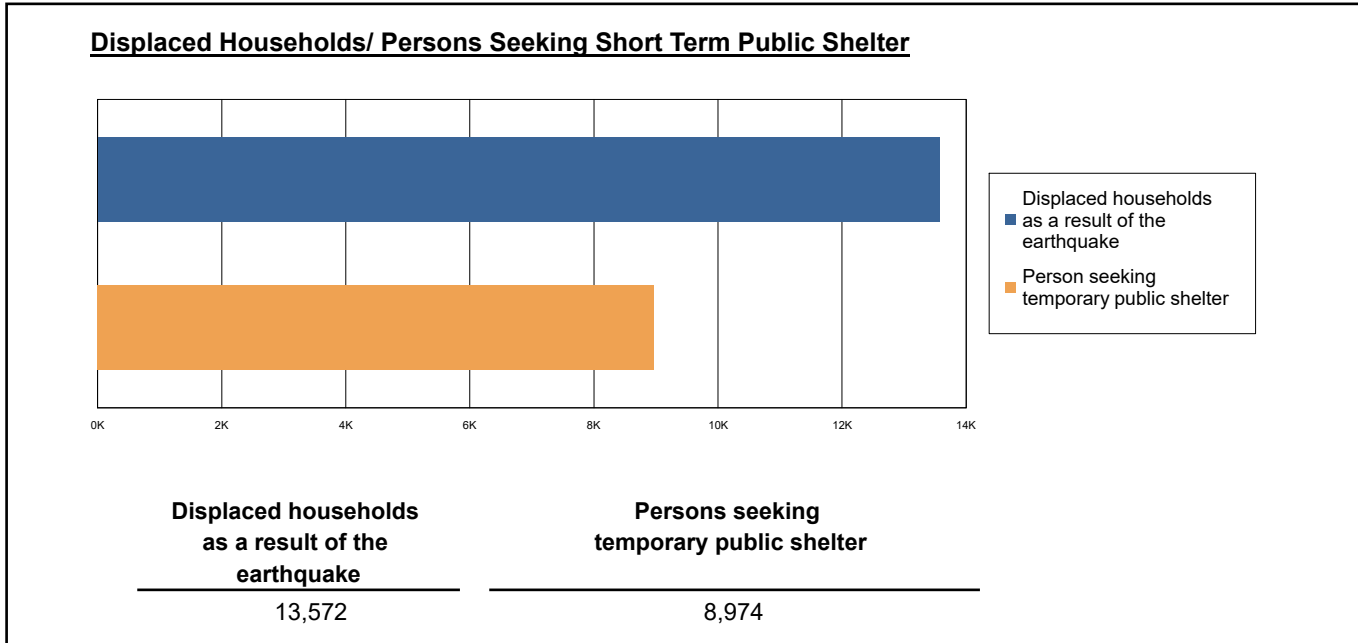
The model estimates that a total of 4,810,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 51.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 192,400 truckloads (@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 13,572 households to be displaced due to the earthquake. Of these, 8,974 people (out of a total population of 4,625,364) 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	78.76	20.18	2.89	5.68
	Commuting	0.28	0.34	0.62	0.12
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	106.45	28.20	4.14	8.14
	Other-Residential	2139.44	450.99	40.99	75.66
	Single Family	1804.61	380.93	47.37	92.36
	Total	4,130	881	96	182
2 PM	Commercial	4685.00	1202.98	173.51	338.24
	Commuting	2.56	3.04	5.58	1.06
	Educational	1496.02	393.32	59.75	116.24
	Hotels	0.00	0.00	0.00	0.00
	Industrial	787.91	209.08	30.93	60.10
	Other-Residential	455.93	96.28	8.82	15.89
	Single Family	394.28	85.64	11.23	20.76
	Total	7,822	1,990	290	552
5 PM	Commercial	3386.69	874.25	127.57	244.99
	Commuting	45.15	53.64	98.51	18.67
	Educational	126.43	31.90	4.73	9.21
	Hotels	0.00	0.00	0.00	0.00
	Industrial	492.44	130.67	19.33	37.56
	Other-Residential	791.70	169.35	16.26	29.45
	Single Family	718.19	156.91	20.64	38.18
	Total	5,561	1,417	287	378



FEMA

Economic Loss

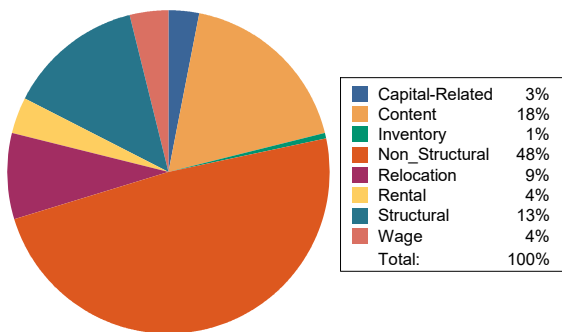
The total economic loss estimated for the earthquake is 17,284.01 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 16,707.20 (millions of dollars); 19 % 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 62 % 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)

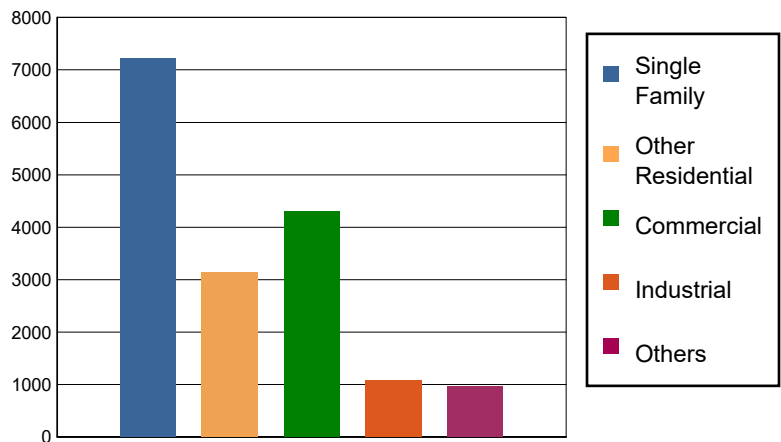


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	69.7551	521.7354	25.6168	41.3617	658.4690
	Capital-Related	0.0000	29.6797	438.1922	15.7468	8.9703	492.5890
	Rental	163.3995	185.1516	262.6436	8.5673	18.4465	638.2085
	Relocation	574.5568	262.4681	413.4158	45.1330	143.1313	1,438.7050
	Subtotal	737.9563	547.0545	1635.9870	95.0639	211.9098	3227.9715
Capital Stock Losses							
	Structural	935.5529	468.9916	554.1012	143.7598	149.3294	2,251.7349
	Non_Structural	4103.2007	1731.2160	1393.8890	465.6734	393.3030	8,087.2821
	Content	1448.1518	394.6629	700.9335	304.2404	202.4606	3,050.4492
	Inventory	0.0000	0.0000	22.4676	64.3316	2.9624	89.7616
	Subtotal	6486.9054	2594.8705	2671.3913	978.0052	748.0554	13479.2278
	Total	7224.86	3141.93	4307.38	1073.07	959.97	16707.20

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	61050.5655	0.0000	0.00
	Bridges	25786.0121	135.9030	0.53
	Tunnels	11.6546	0.0021	0.02
	Subtotal	86848.2322	135.9051	
Railways	Segments	6007.3949	0.0000	0.00
	Bridges	4602.5152	9.7715	0.21
	Tunnels	0.0000	0.0000	0.00
	Facilities	106.5200	11.4328	10.73
	Subtotal	10716.4301	21.2043	
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	54.2469	7.5160	13.86
	Subtotal	54.2469	7.5160	
Ferry	Facilities	18.6340	1.8890	10.14
	Subtotal	18.6340	1.8890	
Port	Facilities	468.7276	79.8310	17.03
	Subtotal	468.7276	79.8310	
Airport	Facilities	764.8066	97.6649	12.77
	Runways	3968.0351	0.0000	0.00
	Subtotal	4732.8417	97.6649	
Total		102,839.11	344.01	

Table 13: Utility System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	7864.0505	0.0000	0.00
	Facilities	6503.3306	232.8027	3.58
	Distribution Lines	5817.4600	0.0000	0.00
	Subtotal	20184.8411	232.8027	
Waste Water	Pipelines	8009.9171	0.0000	0.00
	Facilities	45331.8082	0.0000	0.00
	Distribution Lines	3490.4760	0.0000	0.00
	Subtotal	56832.2013	0.0000	
Natural Gas	Pipelines	1549.2475	0.0000	0.00
	Facilities	8.8998	0.0000	0.00
	Distribution Lines	2326.9840	0.0000	0.00
	Subtotal	3885.1313	0.0000	
Oil Systems	Pipelines	231.6181	0.0000	0.00
	Facilities	62.5660	0.0000	0.00
	Subtotal	294.1841	0.0000	
Electrical Power	Facilities	28300.8067	0.0000	0.00
	Subtotal	28300.8067	0.0000	
Communication	Facilities	178.8830	0.0000	0.00
	Subtotal	178.8830	0.0000	
	Total	109,676.05	232.80	

Appendix A: County Listing for the Region

- Abbeville,SC
- Aiken,SC
- Allendale,SC
- Anderson,SC
- Bamberg,SC
- Barnwell,SC
- Beaufort,SC
- Berkeley,SC
- Calhoun,SC
- Charleston,SC
- Cherokee,SC
- Chester,SC
- Chesterfield,SC
- Clarendon,SC
- Colleton,SC
- Darlington,SC
- Dillon,SC
- Dorchester,SC
- Edgefield,SC
- Fairfield,SC
- Florence,SC
- Georgetown,SC
- Greenville,SC
- Greenwood,SC
- Hampton,SC
- Horry,SC
- Jasper,SC
- Kershaw,SC
- Lancaster,SC



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Laurens,SC
Lee,SC
Lexington,SC
McCormick,SC
Marion,SC
Marlboro,SC
Newberry,SC
Oconee,SC
Orangeburg,SC
Pickens,SC
Richland,SC
Saluda,SC
Spartanburg,SC
Sumter,SC
Union,SC
Williamsburg,SC
York,SC

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
South Carolina	Abbeville	25,417	1,739	570	2,309
	Aiken	160,099	13,569	3,084	16,654
	Allendale	10,419	633	249	882
	Anderson	187,126	15,499	4,815	20,315
	Bamberg	15,987	1,291	319	1,611
	Barnwell	22,621	1,487	523	2,010
	Beaufort	162,233	19,460	3,344	22,804
	Berkeley	177,843	14,648	2,561	17,210
	Calhoun	15,175	1,075	221	1,297
	Charleston	350,209	37,719	11,002	48,722
	Cherokee	55,342	3,469	1,271	4,741
	Chester	33,140	2,174	768	2,942
	Chesterfield	46,734	2,909	973	3,882
	Clarendon	34,971	2,346	461	2,807
	Colleton	38,892	2,889	889	3,778
	Darlington	68,681	4,594	1,601	6,195
	Dillon	32,062	1,696	622	2,319
	Dorchester	136,555	12,315	2,003	14,319
	Edgefield	26,985	2,043	558	2,601
	Fairfield	23,956	1,844	403	2,247
	Florence	136,885	10,038	4,100	14,139
	Georgetown	60,158	6,258	1,695	7,954
	Greenville	451,225	40,658	13,075	53,733
	Greenwood	69,661	5,577	2,015	7,593
	Hampton	21,090	1,183	390	1,574
	Horry	269,291	30,556	6,034	36,590
	Jasper	24,777	1,404	449	1,854
	Kershaw	61,697	4,788	1,159	5,947
	Lancaster	76,652	5,902	1,439	7,342
	Laurens	66,537	4,677	1,440	6,117
	Lee	19,220	998	328	1,326
	Lexington	262,391	23,838	5,680	29,518
McCormick	10,233	889	157	1,047	
Marion	33,062	2,043	814	2,858	
Marlboro	28,933	1,651	544	2,196	
Newberry	37,508	3,139	823	3,962	
Oconee	74,273	6,753	1,689	8,442	
Orangeburg	92,501	6,143	2,296	8,440	
Pickens	119,224	9,454	2,618	12,072	
Richland	384,504	37,567	10,651	48,218	

	Saluda	19,875	1,522	297	1,820
	Spartanburg	284,307	23,592	8,785	32,377
	Sumter	107,456	7,873	2,524	10,398
	Union	28,961	2,090	652	2,742
	Williamsburg	34,423	1,967	559	2,527
	York	226,073	20,568	4,747	25,316
Total Region		4,625,364	404,527	111,197	515,747