





Hazus: Earthquake Global Risk Report

Region Name:

EQPlan_1886

Earthquake Scenario:

M7.3-SCEMD Statewide Scenario v1

Print Date:

September 28, 2018

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 77,549 and 32,557 (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 108 hospitals in the region with a total bed capacity of 14,840 beds. There are 1,550 schools, 482 fire stations, 205 police stations and 47 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 4 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 110,106.00 (millions of dollars). This inventory includes over 8,151.77 miles of highways, 9,957 bridges, 361,480.09 miles of pipes.





System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	9,957	8425.3019
	Segments	3,093	61050.5655
	Tunnels	0	0.0000
		Subtotal	69475.8674
Railways	Bridges	23	109.4035
	Facilities	40	106.5200
	Segments	1,922	4044.9645
	Tunnels	0	0.0000
		Subtotal	4260.8880
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	0.0000
Bus	Facilities	44	39.3272
		Subtotal	39.3272
Ferry	Facilities	14	18.6340
-		Subtotal	18.6340
Port	Facilities	88	175.7360
		Subtotal	175.7360
Airport	Facilities	58	617.7580
•	Runways	78	2961.1920
		Subtotal	3578.9500
		Total	77,549.40





Table 2: Utility System	Lifeline Inventory
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System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5817.4600
	Facilities	1,798	6503.3306
	Pipelines	0	0.0000
		Subtotal	12320.7906
Waste Water	Distribution Lines	NA	3490.4760
	Facilities	2,577	410.1064
	Pipelines	0	0.0000
		Subtotal	3900.5824
Natural Gas	Distribution Lines	NA	2326.9840
	Facilities	1	893.8000
	Pipelines	0	0.0000
		Subtotal	3220.7840
Oil Systems	Facilities	35	62.5660
	Pipelines	0	0.0000
		Subtotal	62.5660
Electrical Power	Facilities	433	12873.7600
		Subtotal	12873.7600
Communication	Facilities	202	178.8830
		Subtotal	178.8830
		Total	32,557.40





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	M7.3-SCEMD Statewide Scenario v1
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	7.30
Depth (km)	0.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	







Direct Earthquake Damage

Building Damage

Hazus estimates that about 288,275 buildings will be at least moderately damaged. This is over 15.00 % of the buildings in the region. There are an estimated 40,068 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	3728.37	0.26	819.21	0.33	678.54	0.38	301.73	0.42	191.14	0.48
Commercial	60586.50	4.21	11143.20	4.46	10496.55	5.94	5513.94	7.71	4180.81	10.43
Education	2395.36	0.17	421.61	0.17	408.52	0.23	219.23	0.31	169.29	0.42
Government	2271.87	0.16	387.13	0.16	368.57	0.21	187.88	0.26	132.56	0.33
Industrial	18044.65	1.25	2810.20	1.13	2810.07	1.59	1578.26	2.21	1324.82	3.31
Other Residential	261967.71	18.21	66138.50	26.48	68694.24	38.89	31259.15	43.69	19538.41	48.76
Religion	8587.14	0.60	1436.28	0.58	1134.74	0.64	560.24	0.78	389.59	0.97
Single Family	1081083.63	75.14	166600.75	66.71	92062.49	52.11	31932.82	44.63	14142.30	35.29
Total	1,438,665		249,757		176,654		71,553		40,069	





	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1060174.78	73.69	161641.24	64.72	85046.64	48.14	26800.10	37.45	8584.32	21.42
Steel	43493.73	3.02	6835.50	2.74	7459.85	4.22	4202.26	5.87	3374.36	8.42
Concrete	7603.41	0.53	1291.18	0.52	1512.67	0.86	801.73	1.12	598.32	1.49
Precast	2861.02	0.20	439.65	0.18	606.80	0.34	416.22	0.58	256.97	0.64
RM	11914.79	0.83	1434.78	0.57	1939.22	1.10	1334.50	1.87	687.79	1.72
URM	97836.41	6.80	20853.03	8.35	17754.53	10.05	9571.72	13.38	8679.46	21.66
МН	214781.08	14.93	57261.50	22.93	62334.00	35.29	28426.72	39.73	17887.70	44.64
Total	1,438,665		249,757		176,654		71,553		40,069	

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

*Note:

RM Reinforced Masonry

URM Unreinforced Masonry

MH Manufactured Housing





Essential Facility Damage

Before the earthquake, the region had 14,840 hospital beds available for use. On the day of the earthquake, the model estimates that only 8,857 hospital beds (60.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 74.00% of the beds will be back in service. By 30 days, 88.00% will be operational.

		# Facilities				
Classification	Total	At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1		
Hospitals	108	19	4	77		
Schools	1,550	285	52	1,121		
EOCs	47	7	2	35		
PoliceStations	205	27	7	162		
FireStations	482	96	16	345		

Table 5: Expected Damage to Essential Facilities





Transportation Lifeline Damage







System	Component	Locations/	With at Least	With Complete	With Fun	ctionality > 50 %	
		Segments	Mod. Damage	Damage	After Day 1	After Day 7	
Highway	Segments	3,093	0	0	3,093	3,093	
	Bridges	9,957	453	92	9,507	9,707	
	Tunnels	0	0	0	0	0	
Railways	Segments	1,922	0	0	1,922	1,922	
	Bridges	23	0	0	23	23	
	Tunnels	0	0	0	0	0	
	Facilities	40	11	0	35	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	44	3	0	43	43	
Ferry	Facilities	14	1	0	14	14	
Port	Facilities	88	52	0	70	88	
Airport	Facilities	58	7	0	54	56	
	Runways	78	0	0	78	78	

Table 6: Expected Damage to the Transportation Systems

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.





(# of Locations								
System	Total #	With at Least	With Complete	with Functionality > 50 %					
		Moderate Damage	Damage	After Day 1	After Day 7				
Potable Water	1,798	227	11	1,511	1,735				
Waste Water	2,577	692	25	1,557	2,294				
Natural Gas	1	0	0	1	1				
Oil Systems	35	8	0	27	27				
Electrical Power	433	32	0	292	324				
Communication	202	34	2	184	200				

Table 7 : Expected Utility System Facility Damage

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

Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
180,740	29924	7481
108,444	15032	3758
72,296	5150	1287
0	0	0
	Total Pipelines Length (miles) 180,740 108,444 72,296 0	Total Pipelines Length (miles)Number of Leaks180,74029924108,4441503272,296515000

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of	Number of Households without Service						
	Households	At Day 1	At Day 3	At Day 7	At Day 30	At Day 90		
Potable Water	4 004 404	210,350	202,719	192,373	142,003	0		
Electric Power		221,923	126,070	52,819	12,400	1,580		





Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.67 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 499 people and burn about 184 (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 10,916,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 48.00% 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 436,640 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 41,268 households to be displaced due to the earthquake. Of these, 26,956 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;

Injuries will require medical attention but hospitalization is not needed. Injuries will require hospitalization but are not considered life-threatening

Injuries will require hospitalization and can become life threatening if not

- Severity Level 1:
- · Severity Level 2:
- · Severity Level 3:
 - promptly treated. vel 4: Victims are killed by the earthquake.
- 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	168.14	47.87	7.25	14.27
	Commuting	1.19	1.40	2.60	0.49
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	258.92	75.25	11.62	22.88
	Other-Residential	5056.07	1225.51	131.14	246.05
	Single Family	5133.66	1200.36	139.41	266.92
	Total	10,618	2,550	292	551
2 PM	Commercial	9835.51	2798.86	425.63	831.58
	Commuting	10.73	12.63	23.36	4.42
	Educational	4034.16	1182.98	190.15	370.42
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1918.33	557.93	86.75	168.85
	Other-Residential	1050.40	253.12	27.15	49.37
	Single Family	1100.34	261.98	32.84	58.56
	Total	17,949	5,067	786	1,483
5 PM	Commercial	7066.09	2017.45	310.11	596.28
	Commuting	193.11	227.30	420.35	79.53
	Educational	373.96	107.58	17.14	33.45
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1198.95	348.70	54.22	105.53
	Other-Residential	1891.79	465.17	52.37	95.72
	Single Family	2056.89	492.88	61.78	110.04
	Total	12,781	3,659	916	1,021





Economic Loss

The total economic loss estimated for the earthquake is 40,347.47 (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 39,060.62 (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 loss. Table 11 below provides a summary of the losses associated with the building damage.



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	165.8564	1115.6256	50.5753	81.7970	1,413.8543
	Capital-Related	0.0000	70.5603	946.9617	30.9847	18.7495	1,067.2562
	Rental	428.0696	422.2405	524.2035	16.2052	38.1425	1,428.8613
	Relocation	1484.6196	490.7845	832.1627	82.2211	295.0819	3,184.8698
	Subtotal	1912.6892	1149.4417	3418.9535	179.9863	433.7709	7094.8416
Capital Stock Losses							
	Structural	2507.3566	996.7701	1232.1243	295.6261	315.2388	5,347.1159
	Non_Structural	10182.5836	4046.0144	3440.5150	1049.9175	897.1567	19,616.1872
	Content	3056.3198	916.2224	1701.2487	676.3358	450.8791	6,801.0058
	Inventory	0.0000	0.0000	53.3513	141.5612	6.5565	201.4690
	Subtotal	15746.2600	5959.0069	6427.2393	2163.4406	1669.8311	31965.7779
	Total	17658.95	7108.45	9846.19	2343.43	2103.60	39060.62





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.

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	61050.5655	0.0000	0.00
	Bridges	8425.3019	198.0725	2.35
	Tunnels	0.0000	0.0000	0.00
	Subtotal	69475.8674	198.0725	
Railways	Segments	4044.9645	0.0000	0.00
	Bridges	109.4035	0.1109	0.10
	Tunnels	0.0000	0.0000	0.00
	Facilities	106.5200	18.8550	17.70
	Subtotal	4260.8880	18.9659	
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	39.3272	4.5166	11.48
	Subtotal	39.3272	4.5166	
Ferry	Facilities	18.6340	3.7570	20.16
	Subtotal	18.6340	3.7570	
Port	Facilities	175.7360	62.4218	35.52
	Subtotal	175.7360	62.4218	
Airport	Facilities	617.7580	95.3963	15.44
	Runways	2961.1920	0.0000	0.00
	Subtotal	3578.9500	95.3963	
l	Total	77,549.40	383.13	

Table 12: Transportation System Economic Losses

(Millions of dollars)





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	6503.3306	508.7209	7.82
	Distribution Lines	5817.4600	134.6581	2.31
	Subtotal	12320.7906	643.3790	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	410.1064	45.7696	11.16
	Distribution Lines	3490.4760	67.6422	1.94
	Subtotal	3900.5824	113.4118	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	893.8000	0.0179	0.00
	Distribution Lines	2326.9840	23.1737	1.00
	Subtotal	3220.7840	23.1916	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	62.5660	5.4642	8.73
	Subtotal	62.5660	5.4642	
Electrical Power	Facilities	12873.7600	104.6675	0.81
	Subtotal	12873.7600	104.6675	
Communication	Facilities	178.8830	13.6054	7.61
	Subtotal	178.8830	13.6054	
	Total	32,557.37	903.72	





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





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

			Building Value (millions of dollars)		
State	County Name	Population	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





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