Hazus-MH: Earthquake Event Report

Region Name: highway 30

Earthquake Scenario: Scenario 1: No landslide hazard (landslide hazards set to 0 out of 10)

Print Date: May 01, 2012

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

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General Description of the Region

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The earthquake loss estimates provided in this report was based on a region that includes 2 county(ies) from the following state(s):

Oregon

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

The geographical size of the region is 611.27 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 8,968 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 598 (millions of dollars). Approximately 93.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,290 and 274 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 598 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 67% 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 0 hospitals in the region with a total bed capacity of 0 beds. There are 6 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 35 hazardous material sites, 0 military installations and 0 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 1,564.00 (millions of dollars). This inventory includes over 196 kilometers of highways, 19 bridges, 4,997 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	19	291.00
	Segments	13	892.90
	Tunnels	0	0.00
		Subtotal	**1,183.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	31	91.80
	Tunnels	0	0.00
		Subtotal	**91.80**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	7	14.00
		Subtotal	**14.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**1,291.00**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	50.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**50.00**
Waste Water	Distribution Lines	NA	30.00
	Facilities	2	150.50
	Pipelines	0	0.00
		Subtotal	**180.50**
Natural Gas	Distribution Lines	NA	20.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**20.00**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	124.30
		Subtotal	**124.30**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**374.80**

Earthquake Scenario

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

	f
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-123.34
Latitude of Epicenter	46.12
Earthquake Magnitude	6.70
Depth (Km)	2.00
Rupture Length (Km)	25.59
Rupture Orientation (degrees)	150.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 1,317 buildings will be at least moderately damaged. This is over 29.00 % of the buildings in the region. There are an estimated 92 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.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9	0.45	6	0.48	6	0.66	3	0.85	1	1.23
Commercial	49	2.39	36	2.99	48	5.49	27	7.58	10	11.11
Education	3	0.13	2	0.17	2	0.28	1	0.39	1	0.58
Government	2	0.11	1	0.06	1	0.08	0	0.08	0	0.09
Industrial	28	1.37	17	1.40	22	2.56	12	3.47	4	4.82
Other Residential	523	25.63	394	32.47	456	52.18	256	72.93	67	72.48
Religion	4	0.17	3	0.27	4	0.46	2	0.65	1	0.96
Single Family	1,425	69.75	755	62.16	335	38.29	49	14.05	8	8.73
Total	**2,042**		**1,215**		**874**		**351**		**93**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,649	80.76	917	75.49	414	47.40	59	16.74	8	9.04
Steel	25	1.20	15	1.27	29	3.33	19	5.55	8	8.47
Concrete	25	1.23	18	1.51	24	2.78	15	4.23	5	5.01
Precast	18	0.90	10	0.83	17	1.92	12	3.53	4	4.57
RM	3	0.16	1	0.10	2	0.23	1	0.42	0	0.39
URM	34	1.66	30	2.50	41	4.68	25	7.11	13	13.54
MH	288	14.09	222	18.30	347	39.66	219	62.42	55	58.97
Total	**2,042**		**1,215**		**874**		**351**		**93**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% 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	0	0	0	0
Schools	6	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	0
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

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	13	0	0	13	13
	Bridges	19	1	0	18	18
	Tunnels	0	0	0	0	0
Railways	Segments	31	0	0	31	31
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
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	0	0	0	0	0
Ferry	Facilities	1	1	0	1	1
Port	Facilities	7	5	0	7	7
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

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	0	0	0	0	0
Waste Water	2	2	0	0	2
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	0	1
Communication	0	0	0	0	0

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,499	236	59
Waste Water	1,499	119	30
Natural Gas	999	41	10
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,452	75	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 0.02 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 50.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 800 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 27 households to be displaced due to the earthquake. Of these, 17 people (out of a total population of 8,968) 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	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	12	2	0	0
	Single Family	6	1	0	0
	Total	**18**	**3**	**0**	**0**
2 PM	Commercial	9	2	0	1
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	3	1	0	0
	Single Family	2	0	0	0
	Total	**20**	**5**	**1**	**1**
5 PM	Commercial	10	3	0	1
	Commuting	1	1	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	4	1	0	0
	Single Family	2	0	0	0
	Total	**18**	**5**	**2**	**1**

Economic Loss

The total economic loss estimated for the earthquake is 126.80 (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 59.12 (millions of dollars); 20 % 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	0.00	0.17	1.91	0.09	0.09	2.27
	Capital-Related	0.00	0.07	1.91	0.06	0.04	2.07
	Rental	0.56	0.44	0.79	0.02	0.05	1.86
	Relocation	2.10	1.45	1.18	0.11	0.52	5.36
	Subtotal	**2.66**	**2.14**	**5.79**	**0.28**	**0.69**	**11.57**
Capital Stock Losses							
	Structural	3.38	1.72	1.94	0.41	0.67	8.12
	Non_Structural	15.46	5.68	5.20	1.29	1.65	29.29
	Content	5.05	0.96	2.28	0.80	0.75	9.84
	Inventory	0.00	0.00	0.09	0.19	0.02	0.30
	Subtotal	**23.89**	**8.37**	**9.51**	**2.70**	**3.09**	**47.55**
	Total	**26.54**	**10.51**	**15.30**	**2.98**	**3.79**	**59.12**

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.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	892.86	$0.00	0.00
	Bridges	290.98	$10.65	3.66
	Tunnels	0.00	$0.00	0.00
	Subtotal	**1183.80**	**10.60**	
Railways	Segments	91.85	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**91.80**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	1.33	$0.56	42.20
	Subtotal	**1.30**	**0.60**	
Port	Facilities	13.98	$4.73	33.87
	Subtotal	**14.00**	**4.70**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**1291.00**	**15.90**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	50.00	$1.06	2.13
	Subtotal	**49.97**	**$1.06**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	150.50	$38.42	25.53
	Distribution Lines	30.00	$0.53	1.78
	Subtotal	**180.50**	**$38.96**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	20.00	$0.18	0.92
	Subtotal	**19.99**	**$0.18**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	124.30	$11.54	9.28
	Subtotal	**124.30**	**$11.54**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**374.76**	**$51.74**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Clatsop,OR

Columbia,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Clatsop	2,973	161	26	188
	Columbia	5,995	341	69	410
Total State		**8,968**	**502**	**95**	**598**
Total Region		**8,968**	**502**	**95**	**598**

Hazus-MH: Earthquake Event Report

Region Name: highway 30

Earthquake Scenario: Scenario 2: Detailed landslide hazard (landslides hazards mapped on lidar)

Print Date: May 01, 2012

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

Disclaimer:

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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Note:
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Hazus-MH: Earthquake Event Report

Region Name: hwy30_ls_suscept_new_fault

Earthquake Scenario: fake_gales_creek_M6.7

Print Date: May 01, 2012

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For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 6 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 35 hazardous material sites, 0 military installations and 0 nuclear power plants.

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	Segments	13	892.90
	Tunnels	0	0.00
		Subtotal	**1,183.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	31	91.80
	Tunnels	0	0.00
		Subtotal	**91.80**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	7	14.00
		Subtotal	**14.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**1,291.00**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	50.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**50.00**
Waste Water	Distribution Lines	NA	30.00
	Facilities	2	150.50
	Pipelines	0	0.00
		Subtotal	**180.50**
Natural Gas	Distribution Lines	NA	20.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**20.00**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	124.30
		Subtotal	**124.30**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**374.80**

Earthquake Scenario

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

	f
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-123.34
Latitude of Epicenter	46.12
Earthquake Magnitude	6.70
Depth (Km)	2.00
Rupture Length (Km)	25.59
Rupture Orientation (degrees)	150.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 1,653 buildings will be at least moderately damaged. This is over 36.00 % of the buildings in the region. There are an estimated 179 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.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	8	0.45	5	0.47	5	0.65	5	0.72	2	0.93
Commercial	44	2.36	31	2.94	43	5.26	38	5.79	14	7.81
Education	2	0.12	2	0.16	2	0.26	2	0.32	1	0.42
Government	2	0.11	1	0.07	1	0.08	0	0.06	0	0.06
Industrial	26	1.40	15	1.41	20	2.47	17	2.57	6	3.36
Other Residential	483	25.88	348	32.93	419	50.83	348	53.66	99	55.19
Religion	3	0.16	3	0.26	4	0.44	3	0.54	1	0.71
Single Family	1,298	69.53	652	61.75	330	40.02	236	36.35	56	31.52
Total	**1,866**		**1,056**		**825**		**649**		**179**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,490	79.84	787	74.55	408	49.48	294	45.24	69	38.62
Steel	22	1.20	13	1.27	26	3.16	25	3.82	10	5.51
Concrete	22	1.19	16	1.47	22	2.66	21	3.21	7	3.72
Precast	17	0.90	9	0.82	15	1.84	16	2.42	5	3.07
RM	3	0.15	1	0.10	2	0.22	2	0.31	1	0.31
URM	31	1.66	26	2.47	37	4.46	33	5.15	16	8.67
MH	281	15.06	204	19.31	315	38.18	259	39.85	72	40.10
Total	**1,866**		**1,056**		**825**		**649**		**179**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% 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	0	0	0	0
Schools	6	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	0
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

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	13	0	0	13	13
	Bridges	19	1	0	18	18
	Tunnels	0	0	0	0	0
Railways	Segments	31	0	0	31	31
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
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	0	0	0	0	0
Ferry	Facilities	1	1	0	1	1
Port	Facilities	7	5	0	7	7
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

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	0	0	0	0	0
Waste Water	2	2	0	0	2
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	0	1
Communication	0	0	0	0	0

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,499	236	59
Waste Water	1,499	119	30
Natural Gas	999	41	10
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,452	75	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 0.03 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 50.00% 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 1,200 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 109 households to be displaced due to the earthquake. Of these, 70 people (out of a total population of 8,968) 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	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	14	3	0	0
	Single Family	18	3	0	0
	Total	**33**	**6**	**0**	**1**
2 PM	Commercial	12	3	0	1
	Commuting	0	0	0	0
	Educational	7	2	0	1
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	3	1	0	0
	Single Family	5	1	0	0
	Total	**29**	**7**	**1**	**2**
5 PM	Commercial	12	3	1	1
	Commuting	1	1	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	5	1	0	0
	Single Family	7	1	0	0
	Total	**27**	**7**	**2**	**2**

Economic Loss

The total economic loss estimated for the earthquake is 176.41 (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 101.59 (millions of dollars); 17 % 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 70 % 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	0.00	0.30	2.35	0.11	0.12	2.88
	Capital-Related	0.00	0.13	2.33	0.07	0.05	2.57
	Rental	1.39	0.67	0.98	0.03	0.06	3.14
	Relocation	4.94	1.70	1.46	0.13	0.68	8.91
	Subtotal	**6.33**	**2.80**	**7.13**	**0.33**	**0.92**	**17.51**
Capital Stock Losses							
	Structural	9.22	2.17	2.51	0.49	0.92	15.32
	Non_Structural	32.24	7.80	7.27	1.73	2.41	51.45
	Content	9.42	1.60	3.54	1.13	1.20	16.88
	Inventory	0.00	0.00	0.14	0.27	0.03	0.43
	Subtotal	**50.88**	**11.57**	**13.46**	**3.62**	**4.55**	**84.09**
	Total	**57.21**	**14.37**	**20.59**	**3.95**	**5.47**	**101.59**

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.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	892.86	$5.01	0.56
	Bridges	290.98	$10.65	3.66
	Tunnels	0.00	$0.00	0.00
	Subtotal	**1183.80**	**15.70**	
Railways	Segments	91.85	$0.66	0.71
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**91.80**	**0.70**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	1.33	$0.56	42.20
	Subtotal	**1.30**	**0.60**	
Port	Facilities	13.98	$4.74	33.88
	Subtotal	**14.00**	**4.70**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**1291.00**	**21.60**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	50.00	$1.06	2.13
	Subtotal	**49.97**	**$1.06**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	150.50	$39.89	26.50
	Distribution Lines	30.00	$0.53	1.78
	Subtotal	**180.50**	**$40.42**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	20.00	$0.18	0.92
	Subtotal	**19.99**	**$0.18**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	124.30	$11.54	9.28
	Subtotal	**124.30**	**$11.54**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**374.76**	**$53.21**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Clatsop,OR

Columbia,OR

Hazus-MH: Earthquake Event Report

Region Name: highway 30

Earthquake Scenario: Scenario 3: Almost maximum (landslide hazards set to 9 out of 10)

Print Date: May 01, 2012

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

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake 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 earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 2 county(ies) from the following state(s):

Oregon

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

The geographical size of the region is 611.27 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 8,968 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 598 (millions of dollars). Approximately 93.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,290 and 274 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 598 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 67% 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 0 hospitals in the region with a total bed capacity of 0 beds. There are 6 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 1 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 35 hazardous material sites, 0 military installations and 0 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 1,564.00 (millions of dollars). This inventory includes over 196 kilometers of highways, 19 bridges, 4,997 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	19	291.00
	Segments	13	892.90
	Tunnels	0	0.00
		Subtotal	**1,183.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	31	91.80
	Tunnels	0	0.00
		Subtotal	**91.80**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	1	1.30
		Subtotal	**1.30**
Port	Facilities	7	14.00
		Subtotal	**14.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**1,291.00**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	50.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**50.00**
Waste Water	Distribution Lines	NA	30.00
	Facilities	2	150.50
	Pipelines	0	0.00
		Subtotal	**180.50**
Natural Gas	Distribution Lines	NA	20.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**20.00**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	124.30
		Subtotal	**124.30**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**374.80**

Earthquake Scenario

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

	f
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-123.34
Latitude of Epicenter	46.12
Earthquake Magnitude	6.70
Depth (Km)	2.00
Rupture Length (Km)	25.59
Rupture Orientation (degrees)	150.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 1,666 buildings will be at least moderately damaged. This is over 36.00 % of the buildings in the region. There are an estimated 181 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.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	8	0.45	5	0.47	5	0.64	5	0.71	2	0.92
Commercial	44	2.36	31	2.95	43	5.25	38	5.74	14	7.73
Education	2	0.12	2	0.16	2	0.26	2	0.31	1	0.42
Government	2	0.11	1	0.07	1	0.08	0	0.06	0	0.07
Industrial	26	1.39	15	1.41	20	2.47	17	2.56	6	3.33
Other Residential	480	25.87	346	32.91	419	50.75	352	53.38	100	54.93
Religion	3	0.16	3	0.26	4	0.44	3	0.53	1	0.70
Single Family	1,291	69.54	650	61.77	331	40.10	242	36.71	58	31.90
Total	**1,856**		**1,053**		**826**		**659**		**182**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,483	79.88	785	74.60	409	49.56	300	45.51	71	38.95
Steel	22	1.20	13	1.27	26	3.16	25	3.78	10	5.45
Concrete	22	1.20	15	1.47	22	2.66	21	3.17	7	3.68
Precast	17	0.90	9	0.82	15	1.84	16	2.40	6	3.04
RM	3	0.15	1	0.10	2	0.22	2	0.31	1	0.30
URM	31	1.66	26	2.47	37	4.45	34	5.10	16	8.58
MH	279	15.02	203	19.26	315	38.11	262	39.72	73	39.99
Total	**1,856**		**1,053**		**826**		**659**		**182**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% 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	0	0	0	0
Schools	6	1	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	0
FireStations	3	0	0	2

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

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	13	0	0	13	13
	Bridges	19	1	0	18	18
	Tunnels	0	0	0	0	0
Railways	Segments	31	0	0	31	31
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
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	0	0	0	0	0
Ferry	Facilities	1	1	0	1	1
Port	Facilities	7	5	0	6	7
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

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	0	0	0	0	0
Waste Water	2	2	0	0	2
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	0	1
Communication	0	0	0	0	0

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,499	236	59
Waste Water	1,499	119	30
Natural Gas	999	41	10
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,452	75	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 0.03 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 50.00% 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 1,240 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 111 households to be displaced due to the earthquake. Of these, 71 people (out of a total population of 8,968) 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	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	15	3	0	0
	Single Family	19	3	0	0
	Total	**34**	**6**	**0**	**1**
2 PM	Commercial	12	3	0	1
	Commuting	0	0	0	0
	Educational	7	2	0	1
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	3	1	0	0
	Single Family	5	1	0	0
	Total	**29**	**7**	**1**	**2**
5 PM	Commercial	12	3	1	1
	Commuting	1	1	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	5	1	0	0
	Single Family	7	1	0	0
	Total	**27**	**7**	**2**	**2**

Economic Loss

The total economic loss estimated for the earthquake is 210.70 (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 102.80 (millions of dollars); 17 % 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 71 % 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	0.00	0.30	2.36	0.11	0.13	2.90
	Capital-Related	0.00	0.13	2.34	0.07	0.05	2.59
	Rental	1.42	0.68	0.99	0.03	0.06	3.17
	Relocation	5.02	1.72	1.46	0.13	0.69	9.02
	Subtotal	**6.44**	**2.82**	**7.15**	**0.34**	**0.93**	**17.68**
Capital Stock Losses							
	Structural	9.38	2.19	2.52	0.51	0.92	15.52
	Non_Structural	32.72	7.86	7.30	1.78	2.41	52.07
	Content	9.54	1.61	3.55	1.18	1.20	17.09
	Inventory	0.00	0.00	0.14	0.28	0.03	0.45
	Subtotal	**51.64**	**11.67**	**13.51**	**3.74**	**4.57**	**85.12**
	Total	**58.08**	**14.49**	**20.66**	**4.07**	**5.49**	**102.80**

Transportation and Utility Lifeline Losses

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

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	892.86	$32.85	3.68
	Bridges	290.98	$10.65	3.66
	Tunnels	0.00	$0.00	0.00
	Subtotal	**1183.80**	**43.50**	
Railways	Segments	91.85	$1.33	1.45
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**91.80**	**1.30**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	1.33	$0.62	46.67
	Subtotal	**1.30**	**0.60**	
Port	Facilities	13.98	$5.16	36.90
	Subtotal	**14.00**	**5.20**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**1291.00**	**50.60**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	50.00	$1.06	2.13
	Subtotal	**49.97**	**$1.06**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	150.50	$43.96	29.21
	Distribution Lines	30.00	$0.53	1.78
	Subtotal	**180.50**	**$44.50**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	20.00	$0.18	0.92
	Subtotal	**19.99**	**$0.18**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	124.30	$11.54	9.28
	Subtotal	**124.30**	**$11.54**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**374.76**	**$57.28**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Clatsop,OR

Columbia,OR

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Oregon					
	Clatsop	2,973	161	26	188
	Columbia	5,995	341	69	410
Total State		**8,968**	**502**	**95**	**598**
Total Region		**8,968**	**502**	**95**	**598**