

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *Chase Gulch M6.75 CEUS Event*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Chase Gulch M6.75 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.62
Latitude of Epicenter	39.00
Earthquake Magnitude	6.75
Depth (Km)	10.00
Rupture Length (Km)	27.86
Rupture Orientation (degrees)	157.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 2,784 buildings will be at least moderately damaged. This is over 29.00 % of the total number of buildings in the region. There are an estimated 206 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	7	0.15	3	0.13	4	0.21	2	0.26	1	0.29
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	1	0.03	1	0.03	1	0.04	0	0.05	0	0.06
Other Residential	137	2.92	117	5.59	218	12.23	174	21.83	63	30.51
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	4,532	96.91	1,968	94.25	1,560	87.52	619	77.86	143	69.13
Total	4,677		2,088		1,783		795		207	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,561	76.14	1696	81.22	1,118	62.68	293	36.89	47	22.71
Steel	2	0.05	1	0.04	1	0.07	1	0.08	0	0.11
Concrete	2	0.03	1	0.03	1	0.04	0	0.05	0	0.04
Precast	1	0.02	0	0.02	1	0.03	0	0.06	0	0.06
RM	893	19.09	225	10.80	386	21.63	287	36.06	67	32.44
URM	87	1.86	50	2.39	60	3.36	40	5.05	29	14.12
MH	131	2.80	115	5.50	217	12.19	173	21.81	63	30.51
Total	4,677		2,088		1,783		795		207	

*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 6: 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	3	0	0	2
EOCs	0	0	0	0
PoliceStations	3	0	0	1
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	1	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	1	0	0	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	688	172
Waste Water	3,527	544	136
Natural Gas	2,351	582	145
Oil	0	0	0

Table 10: 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	5,894	304	101	0	0	0
Electric Power		1,198	933	547	155	1

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 2 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 76 households to be displaced due to the earthquake. Of these, 14 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	1	0	0	0
	Industrial	0	0	0	0
	Other-Residential	4	1	0	0
	Single Family	25	5	1	1
	Total	30	6	1	1
2 PM	Commercial	9	2	0	1
	Commuting	0	0	0	0
	Educational	2	1	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	1	0	0	0
	Single Family	6	1	0	0
	Total	21	5	1	1
5 PM	Commercial	10	3	0	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	10	2	0	1
	Total	23	6	1	1

Economic Loss

The total economic loss estimated for the earthquake is 165.45 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 139.22 (millions of dollars); 6 % 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 92 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.25	0.97	0.07	0.04	1.33
	Capital-Related	0.00	0.11	0.99	0.04	0.02	1.15
	Rental	4.14	0.35	0.54	0.01	0.01	5.04
	Relocation	0.44	0.02	0.03	0.00	0.01	0.49
	Subtotal	4.58	0.72	2.52	0.11	0.08	8.01
Capital Stock Losses							
	Structural	19.03	1.37	1.07	0.28	0.26	22.01
	Non_Structural	71.90	4.43	2.85	1.02	0.59	80.79
	Content	24.68	0.98	1.55	0.60	0.36	28.17
	Inventory	0.00	0.00	0.07	0.16	0.02	0.25
	Subtotal	115.61	6.77	5.54	2.06	1.24	131.22
	Total	120.18	7.50	8.06	2.17	1.31	139.22

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.13	0.93
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.10	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$5.05	31.83
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	5.00	
	Total	1268.60	5.20	

Table 14: 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 Line	117.60	\$3.10	2.63
	Subtotal	117.55	\$3.10	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$12.88	19.94
	Distribution Line	70.50	\$2.45	3.47
	Subtotal	135.13	\$15.33	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$2.62	5.57
	Subtotal	47.02	\$2.62	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$21.04	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.56
Second Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-4.75
Third Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.12
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.12
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.12
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.12

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

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Earthquake Scenario: *Frontal M7.0 CEUS Event*

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Transportation and Utility Lifeline Inventory

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The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

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	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Frontal M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.16
Latitude of Epicenter	39.68
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	156.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 1,402 buildings will be at least moderately damaged. This is over 15.00 % of the total number of buildings in the region. There are an estimated 51 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	7	0.11	3	0.15	4	0.36	2	0.66	1	1.26
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	1	0.02	1	0.03	1	0.07	0	0.11	0	0.19
Other Residential	305	4.79	151	8.50	176	17.13	63	19.61	13	24.61
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	6,060	95.08	1,619	91.32	849	82.45	256	79.62	38	73.94
Total	6,373		1,773		1,030		321		52	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4,794	75.22	1341	75.62	498	48.39	75	23.33	6	12.40
Steel	2	0.04	1	0.04	1	0.11	1	0.21	0	0.48
Concrete	2	0.03	1	0.03	1	0.07	0	0.13	0	0.20
Precast	1	0.02	0	0.02	1	0.06	0	0.14	0	0.22
RM	1,154	18.10	227	12.80	301	29.27	156	48.63	19	37.62
URM	121	1.90	55	3.08	52	5.05	26	8.03	13	24.56
MH	299	4.70	149	8.41	176	17.05	63	19.54	13	24.51
Total	6,373		1,773		1,030		321		52	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	1
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	1	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	1	0	0	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	113	28
Waste Water	3,527	89	22
Natural Gas	2,351	95	24
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 26 households to be displaced due to the earthquake. Of these, 4 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	2	0	0	0
	Single Family	12	2	0	1
	Total	15	3	0	1
2 PM	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	0	0	0	0
	Single Family	2	0	0	0
	Total	10	2	0	1
5 PM	Commercial	6	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	5	1	0	0
	Total	12	3	0	1

Economic Loss

The total economic loss estimated for the earthquake is 75.85 (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 58.59 (millions of dollars); 8 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 87 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.15	0.81	0.05	0.03	1.04
	Capital-Related	0.00	0.07	0.80	0.03	0.01	0.90
	Rental	1.83	0.27	0.40	0.00	0.01	2.52
	Relocation	0.19	0.01	0.02	0.00	0.00	0.23
	Subtotal	2.02	0.49	2.03	0.08	0.05	4.68
Capital Stock Losses							
	Structural	8.43	0.61	0.78	0.21	0.14	10.16
	Non_Structural	28.07	1.93	1.89	0.63	0.28	32.79
	Content	9.01	0.38	0.93	0.35	0.16	10.83
	Inventory	0.00	0.00	0.04	0.09	0.01	0.13
	Subtotal	45.51	2.92	3.63	1.27	0.58	53.92
	Total	47.52	3.42	5.66	1.35	0.64	58.59

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.02	0.17
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$3.84	24.22
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	3.80	
	Total	1268.60	3.90	

Table 14: 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 Line	117.60	\$0.51	0.43
	Subtotal	117.55	\$0.51	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$12.05	18.65
	Distribution Line	70.50	\$0.40	0.57
	Subtotal	135.13	\$12.45	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.43	0.91
	Subtotal	47.02	\$0.43	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$13.39	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.65
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-1.99
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.56
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.56
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.56
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.56

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *Golden M6.5 CEUS Event Normal*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1, 238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Golden M6.5 CEUS Event Normal
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.22
Latitude of Epicenter	39.74
Earthquake Magnitude	6.50
Depth (Km)	10.00
Rupture Length (Km)	18.20
Rupture Orientation (degrees)	157.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 278 buildings will be at least moderately damaged. This is over 3.00 % of the total number of buildings in the region. There are an estimated 1 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	14	0.16	1	0.20	1	0.33	0	0.46	0	0.71
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	3	0.03	0	0.04	0	0.07	0	0.10	0	0.09
Other Residential	556	6.51	95	12.88	54	22.16	3	10.34	0	8.52
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	7,965	93.30	637	86.88	190	77.45	28	89.09	1	90.67
Total	8,537		734		245		31		1	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6,152	72.05	479	65.25	79	32.10	5	16.25	0	0.00
Steel	4	0.05	0	0.06	0	0.10	0	0.11	0	0.18
Concrete	3	0.03	0	0.05	0	0.06	0	0.05	0	0.04
Precast	2	0.02	0	0.03	0	0.08	0	0.16	0	0.08
RM	1,633	19.12	120	16.42	88	35.80	17	53.69	0	9.71
URM	196	2.29	40	5.40	24	9.78	6	19.47	1	81.54
MH	548	6.42	94	12.79	54	22.08	3	10.26	0	8.45
Total	8,537		734		245		31		1	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	12	3
Waste Water	3,527	9	2
Natural Gas	2,351	10	3
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 1 household to be displaced due to the earthquake. Of these, 0 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	0	0	0	0
	Single Family	2	0	0	0
	Total	2	0	0	0
2 PM	Commercial	1	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	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0
5 PM	Commercial	1	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	0	0	0	0
	Single Family	1	0	0	0
	Total	2	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 13.01 (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 10.69 (millions of dollars); 6 % 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 87 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.01	0.10	0.01	0.01	0.13
	Capital-Related	0.00	0.01	0.10	0.00	0.00	0.11
	Rental	0.29	0.02	0.06	0.00	0.00	0.37
	Relocation	0.03	0.00	0.00	0.00	0.00	0.04
	Subtotal	0.32	0.04	0.27	0.01	0.01	0.65
Capital Stock Losses							
	Structural	1.43	0.09	0.12	0.04	0.03	1.70
	Non_Structural	5.26	0.24	0.31	0.13	0.08	6.02
	Content	1.93	0.05	0.19	0.08	0.05	2.29
	Inventory	0.00	0.00	0.01	0.02	0.00	0.03
	Subtotal	8.61	0.38	0.62	0.27	0.16	10.03
	Total	8.93	0.42	0.89	0.28	0.17	10.69

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.00	0.03
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$1.05	6.60
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	1.00	
	Total	1268.60	1.10	

Table 14: 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 Line	117.60	\$0.05	0.05
	Subtotal	117.55	\$0.05	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$1.14	1.76
	Distribution Line	70.50	\$0.04	0.06
	Subtotal	135.13	\$1.18	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.05	0.10
	Subtotal	47.02	\$0.05	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$1.28	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.12
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.36
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.46
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.46
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.46
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-0.46

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *Mosquito M7.0 CEUS Event*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Mosquito M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.16
Latitude of Epicenter	39.38
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	9.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 2,308 buildings will be at least moderately damaged. This is over 24.00 % of the total number of buildings in the region. There are an estimated 293 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	6	0.10	2	0.10	3	0.20	3	0.45	3	1.04
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	1	0.02	0	0.03	1	0.05	1	0.08	0	0.15
Other Residential	226	4.11	137	7.92	186	13.54	100	15.51	59	20.11
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	5,276	95.78	1,592	91.95	1,184	86.21	539	83.96	231	78.70
Total	5,508		1,732		1,373		642		294	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4,174	75.78	1335	77.10	829	60.36	292	45.54	84	28.48
Steel	2	0.03	0	0.03	1	0.05	1	0.14	1	0.38
Concrete	1	0.02	0	0.03	1	0.04	1	0.09	1	0.20
Precast	1	0.02	0	0.02	0	0.03	0	0.07	0	0.16
RM	1,004	18.23	211	12.16	307	22.38	217	33.85	118	40.28
URM	105	1.91	49	2.82	50	3.67	31	4.88	31	10.48
MH	221	4.01	136	7.85	185	13.46	99	15.43	59	20.01
Total	5,508		1,732		1,373		642		294	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	2	0	1
FireStations	3	0	0	2

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	2	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	1	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	339	85
Waste Water	3,527	268	67
Natural Gas	2,351	286	72
Oil	0	0	0

Table 10: 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	5,894	22	0	0	0	0
Electric Power		714	575	352	104	1

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 0.02 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 144 households to be displaced due to the earthquake. Of these, 26 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	1	0	0	0
	Industrial	1	0	0	0
	Other-Residential	5	1	0	0
	Single Family	35	9	1	2
	Total	42	10	1	3
2 PM	Commercial	15	4	1	1
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	4	1	0	0
	Other-Residential	1	0	0	0
	Single Family	6	1	0	0
	Total	27	7	1	2
5 PM	Commercial	16	5	1	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	2	1	0	0
	Other-Residential	2	0	0	0
	Single Family	14	3	0	1
	Total	34	10	2	3

Economic Loss

The total economic loss estimated for the earthquake is 169.29 (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 134.68 (millions of dollars); 7 % 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 88 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.34	1.56	0.10	0.05	2.04
	Capital-Related	0.00	0.15	1.54	0.05	0.01	1.76
	Rental	4.06	0.62	0.70	0.01	0.03	5.41
	Relocation	0.42	0.02	0.03	0.00	0.01	0.48
	Subtotal	4.48	1.13	3.83	0.16	0.09	9.70
Capital Stock Losses							
	Structural	19.21	1.35	1.55	0.39	0.25	22.76
	Non_Structural	67.05	4.95	4.67	1.47	0.52	78.65
	Content	18.83	1.06	2.27	0.80	0.29	23.26
	Inventory	0.00	0.00	0.09	0.21	0.02	0.31
	Subtotal	105.09	7.36	8.58	2.87	1.08	124.98
	Total	109.57	8.50	12.41	3.03	1.17	134.68

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.12	0.81
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.10	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$4.18	26.34
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	4.20	
	Total	1268.60	4.30	

Table 14: 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 Line	117.60	\$1.52	1.30
	Subtotal	117.55	\$1.52	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$26.30	40.71
	Distribution Line	70.50	\$1.21	1.71
	Subtotal	135.13	\$27.50	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$1.29	2.74
	Subtotal	47.02	\$1.29	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$30.32	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.54
Second Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-4.69
Third Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.04
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.04
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.04
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(5)	-6.04

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *N Sangre M7.5 WUS Shallow-Ext*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	N Sangre M7.5 WUS Shallow-Ext
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.63
Latitude of Epicenter	37.90
Earthquake Magnitude	7.50
Depth (Km)	10.00
Rupture Length (Km)	100.00
Rupture Orientation (degrees)	161.00
Attenuation Function	WUS Shallow Crustal Event - Extensional

Building Damage

Building Damage

HAZUS estimates that about 132 buildings will be at least moderately damaged. This is over 1.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	15	0.16	1	0.26	0	0.33	0	0.43	0	0.99
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	3	0.03	0	0.04	0	0.04	0	0.05	0	0.04
Other Residential	560	6.15	85	27.33	58	48.74	5	40.77	0	47.59
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	8,529	93.66	224	72.38	60	50.89	8	58.75	0	51.38
Total	9,107		310		119		13		1	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6,549	71.91	147	47.31	18	14.89	1	6.82	0	0.00
Steel	5	0.05	0	0.09	0	0.14	0	0.16	0	0.71
Concrete	3	0.04	0	0.05	0	0.04	0	0.03	0	0.03
Precast	2	0.03	0	0.04	0	0.06	0	0.11	0	0.02
RM	1,765	19.38	56	18.10	32	27.01	5	35.66	0	2.94
URM	231	2.54	22	7.14	11	9.14	2	16.47	0	48.73
MH	552	6.06	85	27.29	58	48.71	5	40.74	0	47.58
Total	9,107		310		119		13		1	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	47	12
Waste Water	3,527	37	9
Natural Gas	2,351	40	10
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

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

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0
2 PM	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	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
5 PM	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	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 4.17 (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 2.67 (millions of dollars); 8 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 88 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.04	0.00	0.00	0.05
	Capital-Related	0.00	0.00	0.04	0.00	0.00	0.05
	Rental	0.09	0.01	0.02	0.00	0.00	0.11
	Relocation	0.01	0.00	0.00	0.00	0.00	0.01
	Subtotal	0.10	0.02	0.10	0.00	0.00	0.22
Capital Stock Losses							
	Structural	0.44	0.08	0.04	0.01	0.01	0.58
	Non_Structural	1.21	0.15	0.07	0.02	0.01	1.48
	Content	0.32	0.02	0.03	0.01	0.01	0.39
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	1.98	0.25	0.15	0.05	0.03	2.45
	Total	2.08	0.27	0.24	0.05	0.03	2.67

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.00	0.02
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$0.53	3.36
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	0.50	
	Total	1268.60	0.50	

Table 14: 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 Line	117.60	\$0.21	0.18
	Subtotal	117.55	\$0.21	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$0.40	0.62
	Distribution Line	70.50	\$0.17	0.24
	Subtotal	135.13	\$0.57	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.18	0.38
	Subtotal	47.02	\$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	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$0.96	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.03
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.10
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.12
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.12
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.12
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-0.12

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *N Sawatch M7.0 CEUS Event*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	N Sawatch M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.39
Latitude of Epicenter	39.15
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	147.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 1,256 buildings will be at least moderately damaged. This is over 13.00 % of the total number of buildings in the region. There are an estimated 53 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	8	0.11	2	0.15	3	0.37	2	0.69	1	1.30
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	1	0.02	1	0.03	1	0.07	0	0.12	0	0.20
Other Residential	295	4.33	150	10.08	181	20.09	68	22.56	14	26.45
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	6,503	95.53	1,333	89.73	718	79.47	230	76.64	38	72.04
Total	6,807		1,485		903		300		53	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,127	75.32	1093	73.60	420	46.54	67	22.40	6	11.25
Steel	2	0.04	1	0.04	1	0.12	1	0.22	0	0.50
Concrete	2	0.03	1	0.04	1	0.08	0	0.13	0	0.21
Precast	1	0.02	0	0.02	1	0.06	0	0.13	0	0.23
RM	1,244	18.28	194	13.04	256	28.38	142	47.41	21	39.46
URM	141	2.08	48	3.25	43	4.81	22	7.21	12	21.99
MH	289	4.24	149	10.01	181	20.03	68	22.49	14	26.36
Total	6,807		1,485		903		300		53	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	1
FireStations	3	0	0	2

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	1	0	0	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	126	32
Waste Water	3,527	100	25
Natural Gas	2,351	107	27
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 25 households to be displaced due to the earthquake. Of these, 4 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	2	0	0	0
	Single Family	10	2	0	1
	Total	13	3	0	1
2 PM	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	0	0	0	0
	Single Family	2	0	0	0
	Total	9	2	0	1
5 PM	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	4	1	0	0
	Total	11	2	0	1

Economic Loss

The total economic loss estimated for the earthquake is 66.92 (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 50.40 (millions of dollars); 8 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 87 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.15	0.75	0.04	0.02	0.97
	Capital-Related	0.00	0.06	0.75	0.02	0.01	0.84
	Rental	1.61	0.26	0.35	0.00	0.01	2.24
	Relocation	0.17	0.01	0.02	0.00	0.00	0.20
	Subtotal	1.78	0.48	1.87	0.07	0.04	4.25
Capital Stock Losses							
	Structural	7.44	0.63	0.70	0.18	0.12	9.08
	Non_Structural	23.89	1.94	1.69	0.53	0.20	28.23
	Content	7.20	0.36	0.79	0.28	0.11	8.73
	Inventory	0.00	0.00	0.03	0.07	0.01	0.11
	Subtotal	38.52	2.93	3.21	1.06	0.43	46.15
	Total	40.31	3.41	5.08	1.14	0.47	50.40

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.03	0.18
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$2.43	15.32
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	2.40	
	Total	1268.60	2.50	

Table 14: 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 Line	117.60	\$0.57	0.48
	Subtotal	117.55	\$0.57	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$12.57	19.46
	Distribution Line	70.50	\$0.45	0.64
	Subtotal	135.13	\$13.02	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.48	1.02
	Subtotal	47.02	\$0.48	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$14.07	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.57
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.73
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.22
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.22
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.22
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.22

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *Rampart M7.0 CEUS Event*

Print Date: *January 31, 2006*

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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Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

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For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
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	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Rampart M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-104.92
Latitude of Epicenter	39.06
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	171.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 620 buildings will be at least moderately damaged. This is over 6.00 % of the total number of buildings in the region. There are an estimated 4 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	11	0.14	2	0.20	2	0.36	0	0.49	0	0.78
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	2	0.03	0	0.04	0	0.07	0	0.10	0	0.11
Other Residential	386	5.01	155	12.67	144	27.44	22	24.03	1	28.51
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	7,307	94.82	1,065	87.08	378	72.14	69	75.38	3	70.60
Total	7,706		1,223		524		92		5	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,718	74.20	821	67.15	163	31.11	12	12.78	0	7.21
Steel	3	0.04	1	0.06	1	0.13	0	0.16	0	0.37
Concrete	2	0.03	1	0.05	0	0.08	0	0.09	0	0.08
Precast	2	0.02	0	0.03	0	0.07	0	0.15	0	0.11
RM	1,437	18.65	195	15.91	179	34.24	47	50.63	1	13.96
URM	164	2.13	52	4.23	37	7.00	11	12.25	2	49.84
MH	379	4.92	154	12.58	143	27.36	22	23.95	1	28.42
Total	7,706		1,223		524		92		5	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	56	14
Waste Water	3,527	44	11
Natural Gas	2,351	47	12
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 3 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 14,523 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	1	0	0	0
	Single Family	4	0	0	0
	Total	5	1	0	0
2 PM	Commercial	1	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	0	0	0	0
	Single Family	1	0	0	0
	Total	3	0	0	0
5 PM	Commercial	2	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	0	0	0	0
	Single Family	1	0	0	0
	Total	4	1	0	0

Economic Loss

The total economic loss estimated for the earthquake is 25.94 (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 20.50 (millions of dollars); 7 % 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 88 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.04	0.25	0.02	0.01	0.32
	Capital-Related	0.00	0.02	0.25	0.01	0.00	0.28
	Rental	0.62	0.07	0.15	0.00	0.00	0.84
	Relocation	0.06	0.00	0.01	0.00	0.00	0.08
	Subtotal	0.68	0.13	0.65	0.03	0.02	1.51
Capital Stock Losses							
	Structural	2.91	0.26	0.26	0.08	0.06	3.57
	Non_Structural	9.82	0.63	0.57	0.21	0.12	11.35
	Content	3.43	0.10	0.30	0.12	0.07	4.02
	Inventory	0.00	0.00	0.01	0.03	0.00	0.05
	Subtotal	16.15	0.99	1.14	0.44	0.25	18.98
	Total	16.84	1.12	1.79	0.47	0.28	20.50

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.02	0.17
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$2.12	13.39
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	2.10	
	Total	1268.60	2.10	

Table 14: 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 Line	117.60	\$0.25	0.21
	Subtotal	117.55	\$0.25	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$2.64	4.08
	Distribution Line	70.50	\$0.20	0.28
	Subtotal	135.13	\$2.83	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.21	0.45
	Subtotal	47.02	\$0.21	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$3.30	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.23
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.69
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.89
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.89
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.89
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.89

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *S Sawatch M7.25 CEUS Event*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	S Sawatch M7.25 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.18
Latitude of Epicenter	38.75
Earthquake Magnitude	7.25
Depth (Km)	10.00
Rupture Length (Km)	65.31
Rupture Orientation (degrees)	148.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 1,419 buildings will be at least moderately damaged. This is over 15.00 % of the total number of buildings in the region. There are an estimated 61 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	7	0.11	2	0.15	4	0.36	2	0.62	1	1.20
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	1	0.02	1	0.03	1	0.07	0	0.10	0	0.19
Other Residential	227	3.48	156	9.69	217	21.70	91	25.39	18	28.72
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	6,288	96.39	1,448	90.12	779	77.87	264	73.89	43	69.89
Total	6,523		1,607		1,001		357		61	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,036	77.20	1186	73.80	426	42.53	62	17.24	5	8.07
Steel	2	0.03	1	0.04	1	0.11	1	0.20	0	0.47
Concrete	2	0.03	1	0.04	1	0.07	0	0.12	0	0.20
Precast	1	0.02	0	0.02	1	0.05	0	0.12	0	0.21
RM	1,135	17.40	214	13.29	307	30.66	178	49.86	25	40.41
URM	127	1.94	51	3.20	49	4.93	25	7.13	13	22.00
MH	221	3.38	155	9.62	217	21.64	91	25.33	18	28.64
Total	6,523		1,607		1,001		357		61	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	1
FireStations	3	0	0	2

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	1	0	0	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	183	46
Waste Water	3,527	145	36
Natural Gas	2,351	155	39
Oil	0	0	0

Table 10: 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	5,894	1	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 28 households to be displaced due to the earthquake. Of these, 5 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	2	0	0	0
	Single Family	11	2	0	1
	Total	14	3	0	1
2 PM	Commercial	6	1	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	0	0	0	0
	Single Family	2	0	0	0
	Total	10	2	0	1
5 PM	Commercial	6	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	4	1	0	0
	Total	12	3	0	1

Economic Loss

The total economic loss estimated for the earthquake is 72.20 (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 55.27 (millions of dollars); 9 % 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 87 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.16	0.83	0.05	0.03	1.06
	Capital-Related	0.00	0.07	0.83	0.03	0.01	0.93
	Rental	1.80	0.28	0.41	0.00	0.01	2.50
	Relocation	0.19	0.01	0.02	0.00	0.00	0.22
	Subtotal	1.99	0.51	2.08	0.08	0.05	4.72
Capital Stock Losses							
	Structural	8.32	0.76	0.80	0.21	0.14	10.23
	Non_Structural	25.78	2.22	1.86	0.58	0.24	30.68
	Content	7.86	0.38	0.85	0.31	0.13	9.53
	Inventory	0.00	0.00	0.03	0.08	0.01	0.12
	Subtotal	41.96	3.36	3.54	1.17	0.51	50.56
	Total	43.95	3.88	5.63	1.26	0.56	55.27

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.05	0.32
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$2.70	17.01
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	2.70	
	Total	1268.60	2.70	

Table 14: 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 Line	117.60	\$0.82	0.70
	Subtotal	117.55	\$0.82	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$12.02	18.60
	Distribution Line	70.50	\$0.65	0.92
	Subtotal	135.13	\$12.67	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.70	1.48
	Subtotal	47.02	\$0.70	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$14.19	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.62
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.89
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.43
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.43
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.43
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-2.43

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *Ute Pass M7.0 CEUS Event*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1,238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Ute Pass M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.00
Latitude of Epicenter	38.92
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	152.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 809 buildings will be at least moderately damaged. This is over 8.00 % of the total number of buildings in the region. There are an estimated 8 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	10	0.14	3	0.19	2	0.35	1	0.43	0	0.65
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	2	0.03	1	0.04	0	0.06	0	0.08	0	0.09
Other Residential	327	4.45	165	11.89	176	26.67	37	25.84	3	31.86
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	7,008	95.38	1,222	87.88	480	72.92	105	73.65	6	67.41
Total	7,348		1,391		658		143		9	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,541	75.41	949	68.25	207	31.38	16	11.22	1	6.51
Steel	3	0.04	1	0.06	1	0.12	0	0.14	0	0.30
Concrete	2	0.03	1	0.05	1	0.08	0	0.08	0	0.08
Precast	2	0.02	0	0.03	0	0.07	0	0.13	0	0.10
RM	1,328	18.07	221	15.87	232	35.32	75	52.52	2	22.37
URM	151	2.06	55	3.95	42	6.43	14	10.14	3	38.84
MH	321	4.37	164	11.80	175	26.60	37	25.77	3	31.80
Total	7,348		1,391		658		143		9	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	90	22
Waste Water	3,527	71	18
Natural Gas	2,351	76	19
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 (5 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 14,523 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	1	0	0	0
	Single Family	5	1	0	0
	Total	6	1	0	0
2 PM	Commercial	2	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	0	0	0	0
	Single Family	1	0	0	0
	Total	4	1	0	0
5 PM	Commercial	2	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	0	0	0	0
	Single Family	2	0	0	0
	Total	5	1	0	0

Economic Loss

The total economic loss estimated for the earthquake is 34.50 (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 27.21 (millions of dollars); 7 % 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 88 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.06	0.32	0.02	0.01	0.41
	Capital-Related	0.00	0.02	0.32	0.01	0.01	0.36
	Rental	0.84	0.09	0.19	0.00	0.00	1.13
	Relocation	0.09	0.01	0.01	0.00	0.00	0.10
	Subtotal	0.93	0.18	0.84	0.04	0.03	2.01
Capital Stock Losses							
	Structural	3.91	0.34	0.34	0.10	0.08	4.77
	Non_Structural	12.93	0.88	0.73	0.27	0.15	14.96
	Content	4.66	0.15	0.38	0.15	0.09	5.41
	Inventory	0.00	0.00	0.02	0.04	0.00	0.06
	Subtotal	21.49	1.37	1.46	0.55	0.32	25.20
	Total	22.42	1.55	2.31	0.59	0.35	27.21

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.07	0.49
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.10	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$2.68	16.88
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	2.70	
	Total	1268.60	2.70	

Table 14: 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 Line	117.60	\$0.40	0.34
	Subtotal	117.55	\$0.40	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$3.48	5.38
	Distribution Line	70.50	\$0.32	0.45
	Subtotal	135.13	\$3.80	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.34	0.73
	Subtotal	47.02	\$0.34	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$4.55	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.30
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.91
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.17
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.17
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.17
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.17

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238

HAZUS-MH: Earthquake Event Report



Region Name: *Park County*

Earthquake Scenario: *Williams Fork M6.75 CEUS Event*

Print Date: *January 31, 2006*

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

Colorado

Note:

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

The geographical size of the region is 2,208.22 square miles and contains 5 census tracts. There are over 5 thousand households in the region and has a total population of 14,523 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 1,238 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,268 and 64 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 1, 238 (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 70% 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 (HPL) facilities. 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 3 schools, 3 fire stations, 3 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 20 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 0 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 2 and 3.

The total value of the lifeline inventory is over 1,332.00 (millions of dollars). This inventory includes over 265 kilometers of highways, 41 bridges, 11,755 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	41	14.20
	Segments	16	1,148.10
	Tunnels	0	0.00
	Subtotal		1,162.30
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
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	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	3	15.90
	Runways	3	90.40
	Subtotal		106.30
		Total	1,268.60

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	117.60
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		117.60
Waste Water	Distribution Lines	NA	70.50
	Facilities	1	64.60
	Pipelines	0	0.00
	Subtotal		135.10
Natural Gas	Distribution Lines	NA	47.00
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		47.00
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	0	0.00
	Subtotal		0.00
	Total		299.70

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	Williams Fork M6.75 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.15
Latitude of Epicenter	39.87
Earthquake Magnitude	6.75
Depth (Km)	10.00
Rupture Length (Km)	27.86
Rupture Orientation (degrees)	140.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 381 buildings will be at least moderately damaged. This is over 4.00 % of the total number of 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 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	12	0.14	2	0.25	2	0.48	0	0.75	0	1.31
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	2	0.03	0	0.05	0	0.09	0	0.15	0	0.19
Other Residential	501	6.03	114	13.35	83	25.37	9	18.13	1	20.30
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	7,797	93.80	739	86.35	242	74.06	42	80.96	2	78.20
Total	8,312		855		327		52		2	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6,053	72.82	556	64.98	99	30.19	7	12.80	0	4.34
Steel	4	0.05	1	0.07	0	0.15	0	0.20	0	0.52
Concrete	3	0.03	0	0.06	0	0.10	0	0.14	0	0.17
Precast	2	0.02	0	0.03	0	0.10	0	0.22	0	0.22
RM	1,571	18.90	142	16.54	117	35.69	28	53.84	0	17.16
URM	187	2.24	43	5.05	28	8.47	8	14.75	1	57.39
MH	494	5.94	114	13.27	83	25.30	9	18.05	1	20.21
Total	8,312		855		327		52		2	

*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 6: 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	3	0	0	3
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: 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	16	0	0	16	16
	Bridges	41	0	0	41	41
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	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	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

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 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 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 10 provides a summary of the system performance information.

Table 8 : 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	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	5,878	21	5
Waste Water	3,527	16	4
Natural Gas	2,351	18	4
Oil	0	0	0

Table 10: 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	5,894	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% 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 0 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 11 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 14,523) 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 11 provides a summary of the casualties estimated for this earthquake

Table 11: 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	0	0	0	0
	Single Family	2	0	0	0
	Total	3	0	0	0
2 PM	Commercial	1	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	0	0	0	0
	Single Family	0	0	0	0
	Total	2	0	0	0
5 PM	Commercial	1	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	0	0	0	0
	Single Family	1	0	0	0
	Total	2	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 18.52 (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 13.34 (millions of dollars); 8 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 86 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.03	0.19	0.01	0.01	0.23
	Capital-Related	0.00	0.01	0.18	0.01	0.00	0.20
	Rental	0.39	0.05	0.10	0.00	0.00	0.54
	Relocation	0.04	0.00	0.01	0.00	0.00	0.05
	Subtotal	0.43	0.09	0.47	0.02	0.01	1.03
Capital Stock Losses							
	Structural	1.86	0.15	0.18	0.05	0.03	2.28
	Non_Structural	6.31	0.41	0.42	0.16	0.08	7.36
	Content	2.19	0.08	0.23	0.09	0.05	2.63
	Inventory	0.00	0.00	0.01	0.02	0.00	0.03
	Subtotal	10.36	0.63	0.84	0.32	0.16	12.31
	Total	10.79	0.72	1.31	0.34	0.17	13.34

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 13 & 14 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 15 presents the results of the region for the given earthquake.

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,148.13	\$0.00	0.00
	Bridges	14.18	\$0.00	0.02
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1162.30	0.00	
Railways	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	
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	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	15.86	\$1.71	10.81
	Runways	90.44	\$0.00	0.00
	Subtotal	106.30	1.70	
	Total	1268.60	1.70	

Table 14: 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 Line	117.60	\$0.09	0.08
	Subtotal	117.55	\$0.09	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$3.22	4.98
	Distribution Line	70.50	\$0.07	0.11
	Subtotal	135.13	\$3.29	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	47.00	\$0.08	0.17
	Subtotal	47.02	\$0.08	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	299.71	\$3.46	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.15
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.45
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.57
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.57
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.57
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-0.57

Appendix A: County Listing for the Region

Park,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Park	14,523	1,165	73	1,238
Total State		14,523	1,165	73	1,238
Total Region		14,523	1,165	73	1,238