

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

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

Print Date: *January 25, 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 841.76 square miles and contains 39 census tracts. There are over 60 thousand households in the region and has a total population of 175,766 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 67 thousand buildings in the region with a total building replacement value (excluding contents) of 11,792 (millions of dollars). Approximately 99.00 % of the buildings (and 90.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,342 and 420 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 67 thousand buildings in the region which have an aggregate total replacement value of 11,792 (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 75% 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 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

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 1,942 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 15 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	345	0.57	35	0.71	20	1.23	4	1.30	0	1.55
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.00	0	0.00	0	0.01	0	0.00	0	0.00
Industrial	27	0.05	3	0.05	1	0.09	0	0.10	0	0.06
Other Residential	587	0.97	70	1.41	36	2.20	4	1.26	0	0.99
Religion	13	0.02	1	0.02	1	0.03	0	0.03	0	0.03
Single Family	59,417	98.39	4,854	97.80	1,576	96.44	284	97.31	15	97.37
Total	60,393		4,963		1,634		292		16	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	46,353	76.75	3635	73.23	633	38.72	45	15.38	1	6.86
Steel	107	0.18	10	0.21	7	0.41	1	0.36	0	0.53
Concrete	90	0.15	10	0.20	5	0.29	1	0.20	0	0.13
Precast	56	0.09	6	0.12	5	0.31	1	0.46	0	0.19
RM	12,122	20.07	950	19.15	764	46.75	189	64.78	4	28.27
URM	1,466	2.43	309	6.23	193	11.80	52	17.95	10	63.33
MH	200	0.33	43	0.86	28	1.71	3	0.86	0	0.69
Total	60,393		4,963		1,634		292		16	

*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	57	0	0	57
EOCs	0	0	0	0
PoliceStations	7	0	0	7
FireStations	6	0	0	6

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	30	0	0	30	30
	Bridges	194	0	0	194	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
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	5	0	0	5	5
	Runways	5	0	0	5	5

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	3	0	0	3	3
Waste Water	5	0	0	5	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	14	3
Waste Water	2,137	11	3
Natural Gas	1,425	11	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	60,924	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 4 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 48 people and burn about 3 (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 175,766 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	27	3	0	0
	Total	29	4	0	1
2 PM	Commercial	15	2	0	0
	Commuting	0	0	0	0
	Educational	4	1	0	0
	Hotels	0	0	0	0
	Industrial	4	0	0	0
	Other-Residential	0	0	0	0
	Single Family	4	0	0	0
	Total	26	4	0	1
5 PM	Commercial	14	2	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	0	0	0	0
	Single Family	10	1	0	0
	Total	28	4	1	1

Economic Loss

The total economic loss estimated for the earthquake is 117.42 (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 104.15 (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 82 % 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	2.06	0.06	0.06	2.23
	Capital-Related	0.00	0.02	1.97	0.04	0.02	2.05
	Rental	2.61	0.28	1.35	0.01	0.01	4.25
	Relocation	0.27	0.01	0.07	0.00	0.01	0.36
	Subtotal	2.88	0.34	5.45	0.11	0.10	8.87
Capital Stock Losses							
	Structural	14.96	0.42	2.41	0.32	0.24	18.35
	Non_Structural	48.28	2.14	4.98	0.86	0.55	56.81
	Content	15.90	0.53	2.61	0.51	0.30	19.86
	Inventory	0.00	0.00	0.11	0.13	0.01	0.25
	Subtotal	79.13	3.10	10.12	1.82	1.10	95.27
	Total	82.01	3.43	15.57	1.93	1.20	104.15

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	800.08	\$0.00	0.00
	Bridges	257.20	\$0.24	0.09
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	0.20	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.00	0.01
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.18	8.42
	Subtotal	108.30	0.20	
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	26.43	\$2.27	8.59
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	2.30	
	Total	1342.70	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	96.90	\$3.97	4.09
	Distribution Line	71.20	\$0.06	0.09
	Subtotal	168.14	\$4.03	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$6.44	1.99
	Distribution Line	42.70	\$0.05	0.11
	Subtotal	365.75	\$6.48	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.05	0.18
	Subtotal	28.49	\$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	0.40	\$0.02	6.31
	Subtotal	0.39	\$0.02	
	Total	562.77	\$10.59	

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)	-0.03
Second Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.11
Third Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

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The total value of the lifeline inventory is over 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

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System	Component	# locations/ # Segments	Replacement value (millions of dollars)
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	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

Scenario Name	Cheraw M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-103.42
Latitude of Epicenter	38.28
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	44.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 445 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 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	385	0.59	13	0.88	5	1.33	1	1.46	0	1.61
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	31	0.05	1	0.06	0	0.09	0	0.10	0	0.04
Other Residential	664	1.02	24	1.62	8	2.12	0	0.86	0	0.53
Religion	14	0.02	0	0.03	0	0.03	0	0.03	0	0.03
Single Family	64,264	98.32	1,453	97.41	382	96.42	47	97.55	2	97.79
Total	65,360		1,492		396		48		2	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	49,651	75.96	911	61.10	99	24.91	5	11.28	0	0.00
Steel	120	0.18	3	0.22	1	0.32	0	0.26	0	0.31
Concrete	101	0.15	3	0.22	1	0.22	0	0.12	0	0.02
Precast	64	0.10	3	0.17	2	0.40	0	0.57	0	0.10
RM	13,398	20.50	393	26.32	211	53.38	28	58.33	0	3.14
URM	1,777	2.72	162	10.84	76	19.08	14	28.95	2	96.19
MH	249	0.38	17	1.13	7	1.69	0	0.48	0	0.23
Total	65,360		1,492		396		48		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	57	0	0	57
EOCs	0	0	0	0
PoliceStations	7	0	0	7
FireStations	6	0	0	6

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	30	0	0	30	30
	Bridges	194	0	0	194	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
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	5	0	0	5	5
	Runways	5	0	0	5	5

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	3	0	0	3	3
Waste Water	5	0	0	5	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	5	1
Waste Water	2,137	4	1
Natural Gas	1,425	4	1
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	60,924	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 3 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 175,766 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	6	1	0	0
	Total	6	1	0	0
2 PM	Commercial	3	0	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	1	0	0	0
	Total	6	1	0	0
5 PM	Commercial	3	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	6	1	0	0

Economic Loss

The total economic loss estimated for the earthquake is 19.20 (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 17.76 (millions of dollars); 11 % 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 81 % 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	0.48	0.01	0.01	0.51
	Capital-Related	0.00	0.00	0.45	0.01	0.00	0.47
	Rental	0.56	0.03	0.28	0.00	0.00	0.87
	Relocation	0.06	0.00	0.02	0.00	0.00	0.08
	Subtotal	0.62	0.04	1.23	0.02	0.02	1.93
Capital Stock Losses							
	Structural	3.37	0.09	0.59	0.08	0.05	4.18
	Non_Structural	8.17	0.32	0.81	0.11	0.09	9.49
	Content	1.68	0.05	0.30	0.05	0.03	2.12
	Inventory	0.00	0.00	0.01	0.01	0.00	0.03
	Subtotal	13.22	0.46	1.72	0.25	0.18	15.83
	Total	13.84	0.51	2.94	0.27	0.20	17.76

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	800.08	\$0.00	0.00
	Bridges	257.20	\$0.04	0.02
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	0.00	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.01	0.69
	Subtotal	108.30	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	26.43	\$0.50	1.91
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	0.50	
	Total	1342.70	0.60	

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	96.90	\$0.53	0.55
	Distribution Line	71.20	\$0.02	0.03
	Subtotal	168.14	\$0.55	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$0.30	0.09
	Distribution Line	42.70	\$0.02	0.04
	Subtotal	365.75	\$0.31	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.02	0.06
	Subtotal	28.49	\$0.02	
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	0.40	\$0.00	0.49
	Subtotal	0.39	\$0.00	
	Total	562.77	\$0.88	

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	-0.01
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.02
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.03
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.03
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.03
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.03

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

Earthquake Scenario: *Frontal M7.0 CEUS Event*

Print Date: *January 25, 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 841.76 square miles and contains 39 census tracts. There are over 60 thousand households in the region and has a total population of 175,766 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 67 thousand buildings in the region with a total building replacement value (excluding contents) of 11,792 (millions of dollars). Approximately 99.00 % of the buildings (and 90.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,342 and 420 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 67 thousand buildings in the region which have an aggregate total replacement value of 11,792 (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 75% 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 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

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 1,993 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 17 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	341	0.57	37	0.74	22	1.30	4	1.35	0	1.64
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.00	0	0.00	0	0.01	0	0.00	0	0.00
Industrial	27	0.05	3	0.05	1	0.09	0	0.09	0	0.05
Other Residential	592	0.98	68	1.35	34	2.02	4	1.17	0	0.99
Religion	13	0.02	1	0.02	1	0.03	0	0.03	0	0.03
Single Family	59,303	98.38	4,917	97.83	1,608	96.55	302	97.36	17	97.29
Total	60,279		5,026		1,665		310		18	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	46,321	76.84	3671	73.05	629	37.79	44	14.19	1	4.90
Steel	105	0.17	11	0.23	8	0.46	1	0.40	0	0.62
Concrete	89	0.15	10	0.20	5	0.29	1	0.21	0	0.15
Precast	55	0.09	6	0.12	5	0.32	1	0.47	0	0.21
RM	12,048	19.99	975	19.39	796	47.78	206	66.37	6	32.61
URM	1,454	2.41	313	6.23	197	11.86	55	17.61	11	60.82
MH	206	0.34	39	0.78	25	1.51	2	0.76	0	0.69
Total	60,279		5,026		1,665		310		18	

*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	57	0	0	57
EOCs	0	0	0	0
PoliceStations	7	0	0	7
FireStations	6	0	0	6

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	30	0	0	30	30
	Bridges	194	0	0	194	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
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	5	0	0	5	5
	Runways	5	0	0	5	5

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	3	0	0	3	3
Waste Water	5	0	0	5	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	15	4
Waste Water	2,137	12	3
Natural Gas	1,425	12	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	60,924	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 3 ignitions that will burn about 0.03 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 63 people and burn about 4 (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 30 households to be displaced due to the earthquake. Of these, 5 people (out of a total population of 175,766 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	28	4	0	1
	Total	30	4	0	1
2 PM	Commercial	16	2	0	0
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	3	0	0	0
	Other-Residential	0	0	0	0
	Single Family	4	0	0	0
	Total	28	4	0	1
5 PM	Commercial	15	2	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	0	0	0	0
	Single Family	11	1	0	0
	Total	29	4	1	1

Economic Loss

The total economic loss estimated for the earthquake is 113.62 (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 103.71 (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 81 % 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	2.24	0.06	0.07	2.41
	Capital-Related	0.00	0.01	2.14	0.04	0.02	2.21
	Rental	2.70	0.29	1.47	0.01	0.01	4.47
	Relocation	0.28	0.01	0.08	0.00	0.01	0.37
	Subtotal	2.98	0.35	5.92	0.11	0.10	9.47
Capital Stock Losses							
	Structural	15.52	0.44	2.61	0.33	0.26	19.15
	Non_Structural	47.68	2.11	5.08	0.79	0.55	56.21
	Content	14.89	0.50	2.52	0.46	0.28	18.66
	Inventory	0.00	0.00	0.11	0.11	0.01	0.23
	Subtotal	78.08	3.04	10.32	1.69	1.10	94.24
	Total	81.06	3.39	16.25	1.80	1.21	103.71

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	800.08	\$0.00	0.00
	Bridges	257.20	\$0.31	0.12
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	0.30	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.00	0.02
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.16	7.37
	Subtotal	108.30	0.20	
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	26.43	\$1.86	7.03
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	1.90	
	Total	1342.70	2.30	

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	96.90	\$3.00	3.09
	Distribution Line	71.20	\$0.07	0.09
	Subtotal	168.14	\$3.06	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$4.40	1.36
	Distribution Line	42.70	\$0.05	0.12
	Subtotal	365.75	\$4.45	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.06	0.20
	Subtotal	28.49	\$0.06	
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	0.40	\$0.02	5.80
	Subtotal	0.39	\$0.02	
	Total	562.77	\$7.59	

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)	-0.03
Second Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.11
Third Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.14

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

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

Print Date: *January 25, 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 841.76 square miles and contains 39 census tracts. There are over 60 thousand households in the region and has a total population of 175,766 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 67 thousand buildings in the region with a total building replacement value (excluding contents) of 11,792 (millions of dollars). Approximately 99.00 % of the buildings (and 90.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,342 and 420 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 67 thousand buildings in the region which have an aggregate total replacement value of 11,792 (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 75% 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 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

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 8,177 buildings will be at least moderately damaged. This is over 12.00 % of the total number of buildings in the region. There are an estimated 228 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	262	0.56	63	0.52	56	0.91	19	1.11	3	1.21
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	22	0.05	5	0.04	4	0.06	1	0.07	0	0.04
Other Residential	478	1.02	125	1.04	75	1.21	17	0.96	2	0.78
Religion	10	0.02	2	0.02	2	0.03	0	0.03	0	0.02
Single Family	46,248	98.35	11,901	98.38	6,056	97.79	1,718	97.84	223	97.94
Total	47,023		12,098		6,193		1,756		228	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	36,814	78.29	9833	81.28	3,468	56.00	504	28.71	46	20.31
Steel	84	0.18	17	0.14	18	0.29	5	0.30	1	0.38
Concrete	66	0.14	19	0.16	15	0.25	4	0.24	0	0.18
Precast	39	0.08	10	0.08	13	0.20	6	0.35	1	0.26
RM	8,899	18.93	1749	14.46	2,242	36.20	1,040	59.24	99	43.44
URM	941	2.00	423	3.50	399	6.44	188	10.70	80	35.01
MH	179	0.38	46	0.38	38	0.62	8	0.47	1	0.42
Total	47,023		12,098		6,193		1,756		228	

*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	57	0	0	48
EOCs	0	0	0	0
PoliceStations	7	0	0	7
FireStations	6	0	0	6

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	30	0	0	30	30
	Bridges	194	0	0	194	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	1	0	1	1
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	5	0	0	5	5
	Runways	5	0	0	5	5

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	3	0	0	2	3
Waste Water	5	2	0	2	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	3	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	37	9
Waste Water	2,137	29	7
Natural Gas	1,425	31	8
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	60,924	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 7 ignitions that will burn about 0.06 sq. mi 0.01 % of the region's total area.) The model also estimates that the fires will displace about 141 people and burn about 9 (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 293 households to be displaced due to the earthquake. Of these, 52 people (out of a total population of 175,766) 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	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	6	1	0	0
	Single Family	147	26	3	6
	Total	155	28	3	6
2 PM	Commercial	74	15	2	4
	Commuting	0	0	0	0
	Educational	24	5	1	1
	Hotels	0	0	0	0
	Industrial	11	2	0	0
	Other-Residential	1	0	0	0
	Single Family	19	3	0	1
	Total	129	26	3	6
5 PM	Commercial	69	15	2	4
	Commuting	1	1	2	0
	Educational	3	1	0	0
	Hotels	0	0	0	0
	Industrial	7	1	0	0
	Other-Residential	2	0	0	0
	Single Family	57	10	1	2
	Total	139	28	5	7

Economic Loss

The total economic loss estimated for the earthquake is 577.72 (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 523.63 (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 85 % 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	0.13	7.81	0.21	0.24	8.39
	Capital-Related	0.00	0.06	7.44	0.13	0.08	7.70
	Rental	12.53	1.48	5.22	0.04	0.05	19.33
	Relocation	1.31	0.04	0.27	0.01	0.04	1.66
	Subtotal	13.84	1.70	20.74	0.39	0.41	37.07
Capital Stock Losses							
	Structural	69.90	1.76	9.52	1.05	0.94	83.17
	Non_Structural	249.17	12.28	23.05	3.71	2.56	290.78
	Content	90.11	3.91	13.37	2.44	1.56	111.39
	Inventory	0.00	0.00	0.59	0.59	0.04	1.22
	Subtotal	409.19	17.95	46.53	7.79	5.10	486.56
	Total	423.03	19.65	67.27	8.18	5.51	523.63

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	800.08	\$0.00	0.00
	Bridges	257.20	\$1.89	0.73
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	1.90	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.01	0.65
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.66	31.10
	Subtotal	108.30	0.70	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	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	26.43	\$3.44	13.02
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	3.40	
	Total	1342.70	6.00	

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	96.90	\$11.91	12.29
	Distribution Line	71.20	\$0.17	0.23
	Subtotal	168.14	\$12.07	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$35.68	11.05
	Distribution Line	42.70	\$0.13	0.31
	Subtotal	365.75	\$35.81	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.14	0.49
	Subtotal	28.49	\$0.14	
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	0.40	\$0.06	16.70
	Subtotal	0.39	\$0.06	
	Total	562.77	\$48.08	

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

	LOSS	Total	%
First Year			
	Employment Impact	129	0.25
	Income Impact	(4)	-0.16
Second Year			
	Employment Impact	39	0.08
	Income Impact	(13)	-0.54
Third Year			
	Employment Impact	0	0.00
	Income Impact	(18)	-0.70
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(18)	-0.70
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(18)	-0.70
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(18)	-0.70

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

Earthquake Scenario: *Mosquito M7.0 CEUS Event*

Print Date: *January 25, 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 841.76 square miles and contains 39 census tracts. There are over 60 thousand households in the region and has a total population of 175,766 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 67 thousand buildings in the region with a total building replacement value (excluding contents) of 11,792 (millions of dollars). Approximately 99.00 % of the buildings (and 90.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,342 and 420 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 67 thousand buildings in the region which have an aggregate total replacement value of 11,792 (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 75% 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 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

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 1,983 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 16 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	342	0.57	37	0.73	21	1.27	4	1.34	0	1.67
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.00	0	0.00	0	0.01	0	0.00	0	0.00
Industrial	27	0.05	3	0.05	1	0.09	0	0.09	0	0.05
Other Residential	590	0.98	69	1.37	35	2.09	4	1.22	0	1.06
Religion	13	0.02	1	0.02	1	0.03	0	0.03	0	0.03
Single Family	59,333	98.38	4,897	97.81	1,606	96.51	295	97.32	16	97.18
Total	60,307		5,007		1,664		303		17	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	46,307	76.78	3665	73.20	647	38.87	47	15.44	1	6.43
Steel	105	0.17	11	0.23	8	0.45	1	0.40	0	0.65
Concrete	90	0.15	10	0.20	5	0.29	1	0.21	0	0.15
Precast	56	0.09	6	0.12	5	0.31	1	0.46	0	0.20
RM	12,085	20.04	963	19.24	779	46.80	197	65.12	5	30.48
URM	1,462	2.42	310	6.20	194	11.69	53	17.57	10	61.33
MH	203	0.34	41	0.81	26	1.59	2	0.80	0	0.76
Total	60,307		5,007		1,664		303		17	

*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	57	0	0	57
EOCs	0	0	0	0
PoliceStations	7	0	0	7
FireStations	6	0	0	6

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	30	0	0	30	30
	Bridges	194	0	0	194	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
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	5	0	0	5	5
	Runways	5	0	0	5	5

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	3	0	0	3	3
Waste Water	5	0	0	5	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	15	4
Waste Water	2,137	12	3
Natural Gas	1,425	13	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	60,924	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 3 ignitions that will burn about 0.03 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 63 people and burn about 4 (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 29 households to be displaced due to the earthquake. Of these, 5 people (out of a total population of 175,766 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	28	3	0	1
	Total	30	4	0	1
2 PM	Commercial	16	2	0	0
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	3	0	0	0
	Other-Residential	0	0	0	0
	Single Family	4	0	0	0
	Total	27	4	0	1
5 PM	Commercial	15	2	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	0	0	0	0
	Single Family	11	1	0	0
	Total	29	4	1	1

Economic Loss

The total economic loss estimated for the earthquake is 110.96 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 101.47 (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 82 % 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	2.20	0.06	0.07	2.36
	Capital-Related	0.00	0.01	2.10	0.04	0.02	2.17
	Rental	2.68	0.28	1.42	0.01	0.01	4.40
	Relocation	0.27	0.01	0.07	0.00	0.01	0.37
	Subtotal	2.95	0.34	5.80	0.11	0.10	9.30
Capital Stock Losses							
	Structural	15.33	0.43	2.54	0.32	0.25	18.88
	Non_Structural	46.92	2.04	4.90	0.77	0.54	55.17
	Content	14.29	0.47	2.41	0.44	0.27	17.90
	Inventory	0.00	0.00	0.10	0.11	0.01	0.22
	Subtotal	76.54	2.95	9.96	1.64	1.07	92.17
	Total	79.49	3.29	15.76	1.75	1.18	101.47

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	800.08	\$0.00	0.00
	Bridges	257.20	\$0.32	0.12
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	0.30	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.00	0.02
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.15	6.98
	Subtotal	108.30	0.10	
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	26.43	\$1.82	6.87
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	1.80	
	Total	1342.70	2.30	

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	96.90	\$2.84	2.94
	Distribution Line	71.20	\$0.07	0.10
	Subtotal	168.14	\$2.91	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$4.16	1.29
	Distribution Line	42.70	\$0.05	0.13
	Subtotal	365.75	\$4.22	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.06	0.20
	Subtotal	28.49	\$0.06	
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	0.40	\$0.02	5.44
	Subtotal	0.39	\$0.02	
	Total	562.77	\$7.21	

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)	-0.03
Second Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.11
Third Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.14
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.14
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.14
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.14

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

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

Print Date: *January 25, 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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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 841.76 square miles and contains 39 census tracts. There are over 60 thousand households in the region and has a total population of 175,766 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 67 thousand buildings in the region with a total building replacement value (excluding contents) of 11,792 (millions of dollars). Approximately 99.00 % of the buildings (and 90.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,342 and 420 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 67 thousand buildings in the region which have an aggregate total replacement value of 11,792 (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 75% 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 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

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 1,239 buildings will be at least moderately damaged. This is over 2.00 % of the total number of buildings in the region. There are an estimated 7 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	362	0.58	26	0.75	13	1.27	2	1.33	0	1.74
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.00	0	0.00	0	0.01	0	0.00	0	0.00
Industrial	29	0.05	2	0.05	1	0.09	0	0.09	0	0.05
Other Residential	616	0.98	54	1.55	25	2.36	2	1.22	0	1.03
Religion	14	0.02	1	0.02	0	0.03	0	0.03	0	0.03
Single Family	61,577	98.36	3,375	97.61	1,024	96.25	163	97.33	7	97.14
Total	62,601		3,458		1,064		168		8	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	47,886	76.49	2398	69.36	359	33.74	23	13.69	1	7.51
Steel	112	0.18	8	0.23	4	0.41	1	0.34	0	0.61
Concrete	95	0.15	7	0.20	3	0.26	0	0.17	0	0.11
Precast	60	0.10	5	0.13	3	0.33	1	0.47	0	0.17
RM	12,648	20.20	746	21.58	528	49.60	107	63.66	1	15.98
URM	1,584	2.53	259	7.49	147	13.78	35	20.85	6	74.90
MH	217	0.35	35	1.00	20	1.89	1	0.82	0	0.72
Total	62,601		3,458		1,064		168		8	

*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	57	0	0	57
EOCs	0	0	0	0
PoliceStations	7	0	0	7
FireStations	6	0	0	6

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	30	0	0	30	30
	Bridges	194	0	0	194	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
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	5	0	0	5	5
	Runways	5	0	0	5	5

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	3	0	0	3	3
Waste Water	5	0	0	5	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	10	3
Waste Water	2,137	8	2
Natural Gas	1,425	9	2
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	60,924	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 2 ignitions that will burn about 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 54 people and burn about 3 (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 14 households to be displaced due to the earthquake. Of these, 2 people (out of a total population of 175,766) 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	17	2	0	0
	Total	18	2	0	0
2 PM	Commercial	9	1	0	0
	Commuting	0	0	0	0
	Educational	3	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	0	0	0	0
	Single Family	2	0	0	0
	Total	16	2	0	0
5 PM	Commercial	9	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	6	1	0	0
	Total	17	2	0	0

Economic Loss

The total economic loss estimated for the earthquake is 64.11 (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 58.51 (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 82 % 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	0.02	1.32	0.04	0.04	1.42
	Capital-Related	0.00	0.01	1.26	0.02	0.01	1.30
	Rental	1.62	0.15	0.82	0.00	0.00	2.61
	Relocation	0.16	0.00	0.04	0.00	0.01	0.22
	Subtotal	1.79	0.19	3.45	0.07	0.06	5.55
Capital Stock Losses							
	Structural	9.42	0.27	1.52	0.19	0.16	11.56
	Non_Structural	27.13	1.17	2.71	0.42	0.32	31.74
	Content	7.64	0.25	1.26	0.24	0.15	9.54
	Inventory	0.00	0.00	0.05	0.06	0.00	0.12
	Subtotal	44.19	1.69	5.54	0.91	0.63	52.96
	Total	45.98	1.88	8.99	0.97	0.69	58.51

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	800.08	\$0.00	0.00
	Bridges	257.20	\$0.16	0.06
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	0.20	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.00	0.01
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.09	4.22
	Subtotal	108.30	0.10	
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	26.43	\$1.30	4.93
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	1.30	
	Total	1342.70	1.60	

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	96.90	\$1.67	1.72
	Distribution Line	71.20	\$0.05	0.06
	Subtotal	168.14	\$1.72	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$2.24	0.69
	Distribution Line	42.70	\$0.04	0.09
	Subtotal	365.75	\$2.28	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.04	0.14
	Subtotal	28.49	\$0.04	
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	0.40	\$0.01	2.96
	Subtotal	0.39	\$0.01	
	Total	562.77	\$4.04	

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	0	-0.02
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.06
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.08
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.08
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.08
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.08

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

Earthquake Scenario: *Rampart M7 Douglas CEUS Event*

Print Date: *June 28, 2005*

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

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For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 hazardous material sites, 0 military installations and 0 nuclear power plants.

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The total value of the lifeline inventory is over 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

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System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

Scenario Name	Rampart M7 Douglas 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 22,731 buildings will be at least moderately damaged. This is over 34.00 % of the total number of buildings in the region. There are an estimated 1,530 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	133	0.52	70	0.37	104	0.69	69	1.12	28	1.84
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	1	0.00	1	0.00	1	0.00	0	0.01	0	0.01
Industrial	11	0.04	6	0.03	8	0.05	5	0.08	2	0.14
Other Residential	206	0.80	148	0.79	163	1.08	117	1.91	63	4.11
Religion	5	0.02	3	0.02	4	0.03	2	0.04	1	0.05
Single Family	25,458	98.62	18,525	98.79	14,817	98.15	5,911	96.84	1,437	93.85
Total	25,814		18,752		15,097		6,104		1,531	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	20,768	80.45	16,400	87.46	10,602	70.23	2,520	41.29	375	24.52
Steel	40	0.15	18	0.10	33	0.22	23	0.37	11	0.74
Concrete	34	0.13	20	0.11	28	0.19	17	0.28	6	0.39
Precast	20	0.08	9	0.05	18	0.12	15	0.25	6	0.37
RM	4,568	17.70	1,900	10.13	3,786	25.08	3,022	49.51	754	49.27
URM	358	1.39	372	1.98	553	3.66	423	6.93	324	21.19
MH	26	0.10	34	0.18	76	0.50	83	1.36	54	3.53
Total	25,814		18,752		15,097		6,104		1,531	

*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	57	6	0	9
EOCs	0	0	0	0
PoliceStations	7	1	0	1
FireStations	6	2	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	30	0	0	30	30
	Bridges	194	26	0	170	176
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	1	0	1	1
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	5	4	1	3	3
	Runways	5	0	0	5	5

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	3	3	0	0	3
Waste Water	5	4	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	4	0	3	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	458	115
Waste Water	2,137	362	91
Natural Gas	1,425	387	97
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	60,924	3,183	302	0	0	0
Electric Power		18,030	12,072	5,913	1,489	24

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 16 ignitions that will burn about 0.17 sq. mi 0.02 % of the region's total area.) The model also estimates that the fires will displace about 165 people and burn about 11 (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 1,785 households to be displaced due to the earthquake. Of these, 327 people (out of a total population of 175,766 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	6	2	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	28	8	1	3
	Other-Residential	37	8	1	2
	Single Family	587	135	18	35
	Total	660	153	21	40
2 PM	Commercial	349	95	15	30
	Commuting	0	1	1	0
	Educational	106	29	5	9
	Hotels	0	0	0	0
	Industrial	207	60	9	18
	Other-Residential	6	1	0	0
	Single Family	85	20	3	5
	Total	753	205	33	62
5 PM	Commercial	357	97	16	29
	Commuting	54	69	121	23
	Educational	11	3	0	1
	Hotels	0	0	0	0
	Industrial	129	38	6	11
	Other-Residential	14	3	0	1
	Single Family	230	53	7	14
	Total	797	263	151	79

Economic Loss

The total economic loss estimated for the earthquake is 1,848.03 (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 1,671.30 (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 82 % 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	1.10	29.45	0.97	0.94	32.45
	Capital-Related	0.00	0.47	28.81	0.56	0.30	30.15
	Rental	40.30	6.34	16.57	0.16	0.32	63.70
	Relocation	4.23	0.14	0.84	0.02	0.15	5.39
	Subtotal	44.54	8.05	75.68	1.71	1.71	131.69
Capital Stock Losses							
	Structural	223.91	7.87	33.96	4.46	4.14	274.33
	Non_Structural	782.28	46.63	88.09	15.87	10.88	943.76
	Content	243.59	12.61	45.25	9.61	5.97	317.03
	Inventory	0.00	0.00	1.90	2.41	0.19	4.49
	Subtotal	1,249.78	67.11	169.20	32.35	21.17	1,539.61
	Total	1,294.31	75.16	244.87	34.07	22.88	1,671.30

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	800.08	\$0.00	0.00
	Bridges	257.20	\$16.35	6.36
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	16.30	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.05	2.84
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.75	35.42
	Subtotal	108.30	0.80	
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	26.43	\$13.79	52.18
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	13.80	
	Total	1342.70	30.90	

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	96.90	\$28.90	29.82
	Distribution Line	71.20	\$2.06	2.89
	Subtotal	168.14	\$30.96	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$111.35	34.47
	Distribution Line	42.70	\$1.63	3.82
	Subtotal	365.75	\$112.98	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$1.74	6.12
	Subtotal	28.49	\$1.74	
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	0.40	\$0.10	26.13
	Subtotal	0.39	\$0.10	
	Total	562.77	\$145.79	

Table 15. Indirect Economic Impact with outside aid

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

LOSS	Total	%

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792

HAZUS-MH: Earthquake Event Report



Region Name: *Douglas County*

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

Print Date: *June 30, 2005*

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 841.76 square miles and contains 39 census tracts. There are over 60 thousand households in the region and has a total population of 175,766 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 67 thousand buildings in the region with a total building replacement value (excluding contents) of 11,792 (millions of dollars). Approximately 99.00 % of the buildings (and 90.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,342 and 420 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 67 thousand buildings in the region which have an aggregate total replacement value of 11,792 (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 75% 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 57 schools, 6 fire stations, 7 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 41 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,762.00 (millions of dollars). This inventory includes over 224 kilometers of highways, 194 bridges, 7,123 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	194	257.20
	Segments	30	800.10
	Tunnels	0	0.00
	Subtotal		1,057.30
Railways	Bridges	7	1.90
	Facilities	1	2.10
	Segments	79	104.30
	Tunnels	0	0.00
	Subtotal		108.30
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	5	26.40
	Runways	5	150.70
	Subtotal		177.20
		Total	1,342.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	71.20
	Facilities	3	96.90
	Pipelines	0	0.00
	Subtotal		168.10
Waste Water	Distribution Lines	NA	42.70
	Facilities	5	323.00
	Pipelines	0	0.00
	Subtotal		365.80
Natural Gas	Distribution Lines	NA	28.50
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		28.50
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		562.80

Earthquake Scenario

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

Scenario Name	Ute Pass M7.0 Douglas 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 9,491 buildings will be at least moderately damaged. This is over 14.00 % of the total number of buildings in the region. There are an estimated 259 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	221	0.49	72	0.54	76	1.08	31	1.41	5	1.91
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.00	0	0.00	0	0.01	0	0.01	0	0.01
Industrial	18	0.04	6	0.04	6	0.08	2	0.11	0	0.13
Other Residential	371	0.83	141	1.07	130	1.85	48	2.20	7	2.52
Religion	9	0.02	3	0.02	3	0.04	1	0.04	0	0.05
Single Family	44,048	98.61	12,917	98.31	6,839	96.95	2,096	96.24	248	95.38
Total	44,668		13,138		7,054		2,178		260	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	35,840	80.24	10614	80.79	3,683	52.21	492	22.60	37	14.24
Steel	68	0.15	20	0.15	25	0.36	9	0.42	2	0.73
Concrete	56	0.13	21	0.16	21	0.29	7	0.33	1	0.32
Precast	34	0.08	10	0.08	15	0.21	9	0.39	1	0.43
RM	7,741	17.33	1968	14.98	2,784	39.46	1,413	64.88	125	47.99
URM	855	1.91	442	3.37	434	6.15	210	9.66	89	34.21
MH	75	0.17	63	0.48	93	1.31	37	1.72	5	2.07
Total	44,668		13,138		7,054		2,178		260	

*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	57	0	0	42
EOCs	0	0	0	0
PoliceStations	7	0	0	6
FireStations	6	1	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	30	0	0	30	30
	Bridges	194	5	0	193	194
	Tunnels	0	0	0	0	0
Railways	Segments	79	0	0	79	79
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
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	5	1	0	5	5
	Runways	5	0	0	5	5

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	3	2	0	1	3
Waste Water	5	2	0	1	5
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	3	0	4	4

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,562	118	30
Waste Water	2,137	94	23
Natural Gas	1,425	100	25
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	60,924	0	0	0	0	0
Electric Power		2,062	1,200	451	81	3

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 6 ignitions that will burn about 0.06 sq. mi 0.01 % of the region's total area.) The model also estimates that the fires will displace about 89 people and burn about 6 (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 364 households to be displaced due to the earthquake. Of these, 67 people (out of a total population of 175,766) 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	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	5	1	0	0
	Other-Residential	9	2	0	0
	Single Family	170	31	4	7
	Total	187	34	4	8
2 PM	Commercial	105	22	3	6
	Commuting	0	0	0	0
	Educational	31	7	1	2
	Hotels	0	0	0	0
	Industrial	39	8	1	2
	Other-Residential	1	0	0	0
	Single Family	24	4	1	1
	Total	200	42	6	11
5 PM	Commercial	102	22	3	6
	Commuting	11	13	24	5
	Educational	3	1	0	0
	Hotels	0	0	0	0
	Industrial	25	5	1	1
	Other-Residential	3	1	0	0
	Single Family	66	12	1	3
	Total	211	54	29	15

Economic Loss

The total economic loss estimated for the earthquake is 652.44 (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 578.86 (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 81 % 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	0.37	12.36	0.39	0.38	13.50
	Capital-Related	0.00	0.16	11.93	0.23	0.12	12.44
	Rental	14.55	2.06	7.56	0.07	0.10	24.34
	Relocation	1.52	0.05	0.39	0.01	0.06	2.03
	Subtotal	16.07	2.64	32.24	0.70	0.66	52.31
Capital Stock Losses							
	Structural	80.24	2.58	13.96	1.85	1.56	100.19
	Non_Structural	260.19	13.85	29.90	5.38	3.47	312.79
	Content	87.84	3.84	15.14	3.30	1.91	112.03
	Inventory	0.00	0.00	0.65	0.84	0.06	1.54
	Subtotal	428.27	20.26	59.64	11.37	7.00	526.55
	Total	444.35	22.90	91.88	12.07	7.66	578.86

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	800.08	\$0.00	0.00
	Bridges	257.20	\$4.45	1.73
	Tunnels	0.00	\$0.00	0.00
	Subtotal	1057.30	4.50	
Railways	Segments	104.32	\$0.00	0.00
	Bridges	1.85	\$0.01	0.46
	Tunnels	0.00	\$0.00	0.00
	Facilities	2.11	\$0.47	22.31
	Subtotal	108.30	0.50	
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	26.43	\$7.41	28.03
	Runways	150.74	\$0.00	0.00
	Subtotal	177.20	7.40	
	Total	1342.70	12.30	

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	96.90	\$14.88	15.36
	Distribution Line	71.20	\$0.53	0.75
	Subtotal	168.14	\$15.42	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	323.00	\$44.88	13.89
	Distribution Line	42.70	\$0.42	0.98
	Subtotal	365.75	\$45.30	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	28.50	\$0.45	1.58
	Subtotal	28.49	\$0.45	
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	0.40	\$0.07	17.14
	Subtotal	0.39	\$0.07	
	Total	562.77	\$61.23	

Table 15. Indirect Economic Impact with outside aid

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

LOSS	Total	%

Appendix A: County Listing for the Region

Douglas,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Douglas	175,766	10,657	1,135	11,792
Total State		175,766	10,657	1,135	11,792
Total Region		175,766	10,657	1,135	11,792