

HAZUS-MH: Earthquake Event Report



Region Name: *Larimer County*

Earthquake Scenario: *1882 M6.6 Rocky Mtn National Park*

Print Date: *January 30, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

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

The geographical size of the region is 2,629.93 square miles and contains 56 census tracts. There are over 97 thousand households in the region and has a total population of 251,494 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 84 thousand buildings in the region with a total building replacement value (excluding contents) of 15,215 (millions of dollars). Approximately 99.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,424 and 924 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 84 thousand buildings in the region which have an aggregate total replacement value of 15,215 (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 69% 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 3 hospitals in the region with a total bed capacity of 383 beds. There are 95 schools, 7 fire stations, 8 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 136 dams identified within the region. Of these, 51 of the dams are classified as 'high hazard'. The inventory also includes 18 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 3,348.00 (millions of dollars). This inventory includes over 486 kilometers of highways, 450 bridges, 16,603 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	450	218.40
	Segments	120	1,736.70
	Tunnels	1	0.30
	Subtotal		1,955.40
Railways	Bridges	2	0.30
	Facilities	3	6.30
	Segments	62	117.40
	Tunnels	0	0.00
	Subtotal		124.00
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	1	1.10
	Subtotal		1.10
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	8	42.30
	Runways	10	301.50
	Subtotal		343.80
		Total	2,424.20

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	166.00
	Facilities	2	64.60
	Pipelines	0	0.00
	Subtotal		230.60
Waste Water	Distribution Lines	NA	99.60
	Facilities	10	646.00
	Pipelines	0	0.00
	Subtotal		745.60
Natural Gas	Distribution Lines	NA	66.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		66.40
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	7	0.70
	Subtotal		0.70
	Total		1,256.80

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	1882 M6.6 Rocky Mtn National Park
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.74
Latitude of Epicenter	40.41
Earthquake Magnitude	6.60
Depth (Km)	10.00
Rupture Length (Km)	21.58
Rupture Orientation (degrees)	45.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 10,171 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 421 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	6	0.01	1	0.01	1	0.02	0	0.02	0	0.01
Commercial	537	0.87	164	1.28	163	2.18	69	3.06	18	4.25
Education	10	0.02	2	0.02	2	0.03	0	0.02	0	0.01
Government	8	0.01	2	0.02	2	0.03	1	0.04	0	0.06
Industrial	59	0.10	18	0.14	20	0.27	8	0.34	1	0.25
Other Residential	5,535	8.95	1,837	14.29	1,617	21.57	373	16.55	46	10.94
Religion	19	0.03	4	0.03	4	0.05	2	0.07	0	0.10
Single Family	55,697	90.02	10,826	84.21	5,687	75.86	1,800	79.90	355	84.38
Total	61,871		12,855		7,497		2,253		421	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	45,687	73.84	9094	70.74	3,399	45.33	675	29.98	105	24.85
Steel	246	0.40	64	0.50	76	1.01	30	1.34	10	2.36
Concrete	249	0.40	77	0.60	69	0.92	24	1.08	5	1.30
Precast	96	0.15	28	0.22	41	0.54	22	0.99	4	0.87
RM	10,995	17.77	1777	13.82	2,145	28.62	1,022	45.34	178	42.29
URM	1,263	2.04	459	3.57	398	5.30	180	7.98	89	21.08
MH	3,334	5.39	1356	10.55	1,369	18.27	299	13.29	31	7.25
Total	61,871		12,855		7,497		2,253		421	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 383 hospital beds available for use. On the day of the earthquake, the model estimates that only 212 hospital beds (55.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 85.00% of the beds will be back in service. By 30 days, 99.00% 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	3	0	0	2
Schools	95	0	0	95
EOCs	1	0	0	1
PoliceStations	8	0	0	8
FireStations	7	0	0	7

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	120	0	0	120	120
	Bridges	450	0	0	450	450
	Tunnels	1	0	0	1	1
Railways	Segments	62	0	0	62	62
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	3	0	0	3	3
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	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	0	0	8	8
	Runways	10	0	0	10	10

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	2	0	0	2	2
Waste Water	10	4	0	1	9
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	7	2	0	7	7

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	8,302	147	37
Waste Water	4,981	116	29
Natural Gas	3,321	124	31
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	97,164	0	0	0	0	0
Electric Power		2,844	2,026	1,020	240	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 11 ignitions that will burn about 0.04 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 55 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 831 households to be displaced due to the earthquake. Of these, 189 people (out of a total population of 251,494) 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	3	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	18	5	1	1
	Industrial	6	1	0	0
	Other-Residential	52	9	1	1
	Single Family	143	27	3	6
	Total	222	43	5	10
2 PM	Commercial	196	45	6	13
	Commuting	0	0	0	0
	Educational	23	5	1	1
	Hotels	4	1	0	0
	Industrial	41	9	1	2
	Other-Residential	7	1	0	0
	Single Family	26	5	1	1
	Total	297	66	9	18
5 PM	Commercial	149	34	5	10
	Commuting	0	0	1	0
	Educational	4	1	0	0
	Hotels	5	1	0	0
	Industrial	26	5	1	1
	Other-Residential	20	3	0	1
	Single Family	56	11	1	2
	Total	260	56	8	15

Economic Loss

The total economic loss estimated for the earthquake is 887.27 (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 753.31 (millions of dollars); 15 % 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 68 % 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	7.81	30.41	0.85	0.71	39.77
	Capital-Related	0.00	3.33	25.64	0.50	0.24	29.71
	Rental	13.10	14.37	12.99	0.38	0.33	41.16
	Relocation	1.37	0.23	0.75	0.04	0.11	2.50
	Subtotal	14.46	25.74	69.77	1.77	1.38	113.14
Capital Stock Losses							
	Structural	64.81	14.13	25.54	4.20	2.79	111.48
	Non_Structural	226.82	71.72	65.93	12.45	6.92	383.84
	Content	75.81	18.63	34.80	8.35	4.15	141.74
	Inventory	0.00	0.00	1.20	1.78	0.13	3.11
	Subtotal	367.44	104.48	127.47	26.79	13.99	640.17
	Total	381.90	130.23	197.24	28.56	15.38	753.31

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,736.67	\$0.00	0.00
	Bridges	218.40	\$0.71	0.32
	Tunnels	0.32	\$0.00	0.47
	Subtotal	1955.40	0.70	
Railways	Segments	117.38	\$0.00	0.00
	Bridges	0.26	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	6.34	\$1.18	18.53
	Subtotal	124.00	1.20	
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	1.06	\$0.08	7.28
	Subtotal	1.10	0.10	
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	42.29	\$4.87	11.52
	Runways	301.48	\$0.00	0.00
	Subtotal	343.80	4.90	
	Total	2424.20	6.80	

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	64.60	\$8.01	12.39
	Distribution Line	166.00	\$0.66	0.40
	Subtotal	230.64	\$8.67	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	646.00	\$115.77	17.92
	Distribution Line	99.60	\$0.52	0.52
	Subtotal	745.64	\$116.29	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	66.40	\$0.56	0.84
	Subtotal	66.41	\$0.56	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$1.55	0.73
	Subtotal	213.40	\$1.55	
Communication	Facilities	0.70	\$0.07	9.88
	Subtotal	0.68	\$0.07	
	Total	1,256.77	\$127.13	

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

	LOSS	Total	%
First Year			
	Employment Impact	262	0.26
	Income Impact	(5)	-0.13
Second Year			
	Employment Impact	96	0.10
	Income Impact	(18)	-0.45
Third Year			
	Employment Impact	0	0.00
	Income Impact	(23)	-0.59
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(23)	-0.60
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(23)	-0.60
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(23)	-0.60

Appendix A: County Listing for the Region

Larimer,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Larimer	251,494	12,774	2,441	15,215
Total State		251,494	12,774	2,441	15,215
Total Region		251,494	12,774	2,441	15,215

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

Print Date: *January 30, 2006*

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	Segments	120	1,736.70
	Tunnels	1	0.30
	Subtotal		1,955.40
Railways	Bridges	2	0.30
	Facilities	3	6.30
	Segments	62	117.40
	Tunnels	0	0.00
	Subtotal		124.00
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	1	1.10
	Subtotal		1.10
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	8	42.30
	Runways	10	301.50
	Subtotal		343.80
		Total	2,424.20

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	166.00
	Facilities	2	64.60
	Pipelines	0	0.00
	Subtotal		230.60
Waste Water	Distribution Lines	NA	99.60
	Facilities	10	646.00
	Pipelines	0	0.00
	Subtotal		745.60
Natural Gas	Distribution Lines	NA	66.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		66.40
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	7	0.70
	Subtotal		0.70
	Total		1,256.80

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 3,609 buildings will be at least moderately damaged. This is over 4.00 % of the total number of buildings in the region. There are an estimated 28 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	7	0.01	1	0.01	1	0.02	0	0.03	0	0.04
Commercial	704	0.95	126	1.75	94	3.08	26	4.76	2	7.40
Education	13	0.02	1	0.02	1	0.02	0	0.02	0	0.02
Government	10	0.01	2	0.02	1	0.03	0	0.04	0	0.05
Industrial	73	0.10	15	0.21	13	0.44	4	0.72	0	0.96
Other Residential	6,916	9.34	1,357	18.83	986	32.40	141	26.26	8	27.17
Religion	24	0.03	3	0.04	2	0.06	0	0.08	0	0.11
Single Family	66,333	89.54	5,703	79.12	1,947	63.94	365	68.09	19	64.25
Total	74,079		7,208		3,044		536		29	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	53,651	72.42	4442	61.62	808	26.55	57	10.67	2	5.87
Steel	319	0.43	52	0.73	44	1.46	10	1.84	1	2.92
Concrete	330	0.45	55	0.77	34	1.11	7	1.22	0	1.11
Precast	128	0.17	24	0.33	27	0.89	11	2.04	1	2.19
RM	13,686	18.48	1169	16.21	997	32.75	260	48.47	5	17.54
URM	1,704	2.30	367	5.10	237	7.78	67	12.52	13	46.13
MH	4,261	5.75	1099	15.25	897	29.46	125	23.24	7	24.23
Total	74,079		7,208		3,044		536		29	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 383 hospital beds available for use. On the day of the earthquake, the model estimates that only 300 hospital beds (78.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 94.00% of the beds will be back in service. By 30 days, 100.00% 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	3	0	0	3
Schools	95	0	0	95
EOCs	1	0	0	1
PoliceStations	8	0	0	8
FireStations	7	0	0	7

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	120	0	0	120	120
	Bridges	450	0	0	450	450
	Tunnels	1	0	0	1	1
Railways	Segments	62	0	0	62	62
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	3	0	0	3	3
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	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	0	0	8	8
	Runways	10	0	0	10	10

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	2	0	0	2	2
Waste Water	10	0	0	9	10
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	7	0	0	7	7

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	8,302	23	6
Waste Water	4,981	18	4
Natural Gas	3,321	19	5
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	97,164	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 5 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 44 people and burn about 2 (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 149 households to be displaced due to the earthquake. Of these, 36 people (out of a total population of 251,494) 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	1	0	0	0
	Industrial	2	0	0	0
	Other-Residential	17	2	0	0
	Single Family	36	4	0	1
	Total	57	7	0	1
2 PM	Commercial	62	10	1	2
	Commuting	0	0	0	0
	Educational	6	1	0	0
	Hotels	0	0	0	0
	Industrial	16	2	0	0
	Other-Residential	2	0	0	0
	Single Family	5	1	0	0
	Total	92	15	1	3
5 PM	Commercial	44	7	1	1
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	10	2	0	0
	Other-Residential	6	1	0	0
	Single Family	14	2	0	0
	Total	76	12	1	2

Economic Loss

The total economic loss estimated for the earthquake is 236.73 (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 205.95 (millions of dollars); 16 % 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 61 % 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	0.66	10.49	0.39	0.24	11.79
	Capital-Related	0.00	0.28	8.30	0.24	0.08	8.90
	Rental	3.24	2.87	5.14	0.19	0.08	11.52
	Relocation	0.33	0.07	0.28	0.02	0.03	0.74
	Subtotal	3.58	3.89	24.22	0.84	0.43	32.95
Capital Stock Losses							
	Structural	16.72	4.27	8.97	1.93	0.91	32.80
	Non_Structural	54.91	18.13	20.19	5.01	1.98	100.22
	Content	19.07	4.50	10.74	3.33	1.23	38.88
	Inventory	0.00	0.00	0.36	0.70	0.04	1.11
	Subtotal	90.69	26.91	40.25	10.98	4.17	173.00
	Total	94.27	30.80	64.47	11.82	4.60	205.95

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,736.67	\$0.00	0.00
	Bridges	218.40	\$0.20	0.09
	Tunnels	0.32	\$0.00	0.00
	Subtotal	1955.40	0.20	
Railways	Segments	117.38	\$0.00	0.00
	Bridges	0.26	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	6.34	\$0.73	11.45
	Subtotal	124.00	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	1.06	\$0.04	3.49
	Subtotal	1.10	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	42.29	\$2.55	6.02
	Runways	301.48	\$0.00	0.00
	Subtotal	343.80	2.50	
	Total	2424.20	3.50	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	64.60	\$3.23	5.00
	Distribution Line	166.00	\$0.10	0.06
	Subtotal	230.64	\$3.33	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	646.00	\$23.49	3.64
	Distribution Line	99.60	\$0.08	0.08
	Subtotal	745.64	\$23.57	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	66.40	\$0.09	0.13
	Subtotal	66.41	\$0.09	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$0.27	0.13
	Subtotal	213.40	\$0.27	
Communication	Facilities	0.70	\$0.01	2.06
	Subtotal	0.68	\$0.01	
	Total	1,256.77	\$27.27	

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

	LOSS	Total	%
First Year			
	Employment Impact	25	0.03
	Income Impact	(1)	-0.04
Second Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.12
Third Year			
	Employment Impact	0	0.00
	Income Impact	(6)	-0.16
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(6)	-0.16
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(6)	-0.16
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(6)	-0.16

Appendix A: County Listing for the Region

Larimer,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Larimer	251,494	12,774	2,441	15,215
Total State		251,494	12,774	2,441	15,215
Total Region		251,494	12,774	2,441	15,215

HAZUS-MH: Earthquake Event Report



Region Name: *Larimer County*

Earthquake Scenario: *Valmont M5.0 CEUS Event*

Print Date: *January 30, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

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

The geographical size of the region is 2,629.93 square miles and contains 56 census tracts. There are over 97 thousand households in the region and has a total population of 251,494 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 84 thousand buildings in the region with a total building replacement value (excluding contents) of 15,215 (millions of dollars). Approximately 99.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,424 and 924 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 84 thousand buildings in the region which have an aggregate total replacement value of 15,215 (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 69% 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 3 hospitals in the region with a total bed capacity of 383 beds. There are 95 schools, 7 fire stations, 8 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 136 dams identified within the region. Of these, 51 of the dams are classified as 'high hazard'. The inventory also includes 18 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 3,348.00 (millions of dollars). This inventory includes over 486 kilometers of highways, 450 bridges, 16,603 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	450	218.40
	Segments	120	1,736.70
	Tunnels	1	0.30
	Subtotal		1,955.40
Railways	Bridges	2	0.30
	Facilities	3	6.30
	Segments	62	117.40
	Tunnels	0	0.00
	Subtotal		124.00
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	1	1.10
	Subtotal		1.10
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	8	42.30
	Runways	10	301.50
	Subtotal		343.80
		Total	2,424.20

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	166.00
	Facilities	2	64.60
	Pipelines	0	0.00
	Subtotal		230.60
Waste Water	Distribution Lines	NA	99.60
	Facilities	10	646.00
	Pipelines	0	0.00
	Subtotal		745.60
Natural Gas	Distribution Lines	NA	66.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		66.40
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	7	0.70
	Subtotal		0.70
	Total		1,256.80

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	Valmont M5.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.20
Latitude of Epicenter	40.03
Earthquake Magnitude	5.00
Depth (Km)	10.00
Rupture Length (Km)	1.41
Rupture Orientation (degrees)	75.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 50 buildings will be at least moderately damaged. This is over 0.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9	0.01	0	0.00	0	0.00	0	0.01	0	0.00
Commercial	942	1.11	6	3.23	2	4.78	0	8.91	0	8.85
Education	15	0.02	0	0.01	0	0.01	0	0.00	0	0.00
Government	13	0.02	0	0.02	0	0.03	0	0.04	0	0.04
Industrial	105	0.12	0	0.25	0	0.35	0	0.62	0	0.20
Other Residential	9,338	11.03	55	28.01	15	30.60	0	9.25	0	2.20
Religion	29	0.03	0	0.05	0	0.06	0	0.08	0	0.08
Single Family	74,199	87.65	134	68.43	31	64.17	3	81.09	0	88.62
Total	84,650		196		48		3		0	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	58,889	69.57	66	33.79	5	10.68	0	0.00	0	0.00
Steel	425	0.50	1	0.57	0	0.63	0	0.78	0	0.00
Concrete	424	0.50	2	0.86	0	0.66	0	0.55	0	0.00
Precast	188	0.22	2	0.86	1	1.79	0	3.98	0	0.00
RM	16,049	18.96	48	24.73	18	38.52	2	49.38	0	0.00
URM	2,351	2.78	27	13.68	9	19.02	1	38.25	0	100.00
MH	6,325	7.47	50	25.51	14	28.70	0	7.05	0	0.00
Total	84,650		196		48		3		0	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 383 hospital beds available for use. On the day of the earthquake, the model estimates that only 380 hospital beds (99.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% 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	3	0	0	3
Schools	95	0	0	95
EOCs	1	0	0	1
PoliceStations	8	0	0	8
FireStations	7	0	0	7

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	120	0	0	120	120
	Bridges	450	0	0	450	450
	Tunnels	1	0	0	1	1
Railways	Segments	62	0	0	62	62
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	3	0	0	3	3
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	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	0	0	8	8
	Runways	10	0	0	10	10

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	2	0	0	2	2
Waste Water	10	0	0	10	10
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	7	0	0	7	7

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	8,302	0	0
Waste Water	4,981	0	0
Natural Gas	3,321	0	0
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	97,164	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

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

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 251,494) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0
2 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0
5 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	1	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 11.43 (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 6.75 (millions of dollars); 6 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 60 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

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

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.15	0.00	0.00	0.16
	Capital-Related	0.00	0.00	0.11	0.00	0.00	0.11
	Rental	0.04	0.01	0.07	0.00	0.00	0.11
	Relocation	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	0.04	0.02	0.33	0.01	0.00	0.40
Capital Stock Losses							
	Structural	0.23	0.05	0.14	0.02	0.01	0.44
	Non_Structural	1.83	0.57	0.88	0.27	0.06	3.62
	Content	1.08	0.22	0.66	0.20	0.06	2.22
	Inventory	0.00	0.00	0.02	0.04	0.00	0.07
	Subtotal	3.14	0.83	1.71	0.54	0.13	6.35
	Total	3.18	0.85	2.04	0.54	0.13	6.75

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,736.67	\$0.00	0.00
	Bridges	218.40	\$0.00	0.00
	Tunnels	0.32	\$0.00	0.00
	Subtotal	1955.40	0.00	
Railways	Segments	117.38	\$0.00	0.00
	Bridges	0.26	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	6.34	\$0.20	3.14
	Subtotal	124.00	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	1.06	\$0.01	0.59
	Subtotal	1.10	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	42.29	\$0.68	1.61
	Runways	301.48	\$0.00	0.00
	Subtotal	343.80	0.70	
	Total	2424.20	0.90	

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	64.60	\$0.34	0.53
	Distribution Line	166.00	\$0.00	0.00
	Subtotal	230.64	\$0.35	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	646.00	\$3.44	0.53
	Distribution Line	99.60	\$0.00	0.00
	Subtotal	745.64	\$3.44	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	66.40	\$0.00	0.00
	Subtotal	66.41	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$0.00	0.00
	Subtotal	213.40	\$0.00	
Communication	Facilities	0.70	\$0.00	0.37
	Subtotal	0.68	\$0.00	
	Total	1,256.77	\$3.79	

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	0.00
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	0.00

Appendix A: County Listing for the Region

Larimer,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Larimer	251,494	12,774	2,441	15,215
Total State		251,494	12,774	2,441	15,215
Total Region		251,494	12,774	2,441	15,215

HAZUS-MH: Earthquake Event Report



Region Name: *Larimer County*

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

Print Date: *January 30, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

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

The geographical size of the region is 2,629.93 square miles and contains 56 census tracts. There are over 97 thousand households in the region and has a total population of 251,494 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 84 thousand buildings in the region with a total building replacement value (excluding contents) of 15,215 (millions of dollars). Approximately 99.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,424 and 924 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 84 thousand buildings in the region which have an aggregate total replacement value of 15,215 (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 69% 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 3 hospitals in the region with a total bed capacity of 383 beds. There are 95 schools, 7 fire stations, 8 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 136 dams identified within the region. Of these, 51 of the dams are classified as 'high hazard'. The inventory also includes 18 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 3,348.00 (millions of dollars). This inventory includes over 486 kilometers of highways, 450 bridges, 16,603 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	450	218.40
	Segments	120	1,736.70
	Tunnels	1	0.30
	Subtotal		1,955.40
Railways	Bridges	2	0.30
	Facilities	3	6.30
	Segments	62	117.40
	Tunnels	0	0.00
	Subtotal		124.00
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	1	1.10
	Subtotal		1.10
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	8	42.30
	Runways	10	301.50
	Subtotal		343.80
		Total	2,424.20

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	166.00
	Facilities	2	64.60
	Pipelines	0	0.00
	Subtotal		230.60
Waste Water	Distribution Lines	NA	99.60
	Facilities	10	646.00
	Pipelines	0	0.00
	Subtotal		745.60
Natural Gas	Distribution Lines	NA	66.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		66.40
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	7	0.70
	Subtotal		0.70
	Total		1,256.80

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

Building Damage

Building Damage

HAZUS estimates that about 3,053 buildings will be at least moderately damaged. This is over 4.00 % of the total number of buildings in the region. There are an estimated 21 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	7	0.01	1	0.02	1	0.03	0	0.04	0	0.05
Commercial	734	0.97	117	1.81	80	3.07	19	4.51	1	6.49
Education	13	0.02	1	0.02	1	0.02	0	0.02	0	0.02
Government	11	0.01	1	0.02	1	0.03	0	0.04	0	0.05
Industrial	77	0.10	14	0.22	11	0.44	3	0.72	0	0.89
Other Residential	7,121	9.44	1,266	19.66	895	34.21	119	28.66	6	30.65
Religion	24	0.03	3	0.04	2	0.07	0	0.08	0	0.11
Single Family	67,416	89.41	5,037	78.21	1,626	62.13	274	65.93	13	61.73
Total	75,402		6,441		2,617		416		21	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	54,379	72.12	3878	60.20	658	25.15	44	10.51	2	8.02
Steel	326	0.43	50	0.78	41	1.56	9	2.09	1	3.45
Concrete	341	0.45	50	0.78	29	1.11	5	1.25	0	1.06
Precast	137	0.18	22	0.34	23	0.88	8	1.94	0	1.52
RM	14,031	18.61	1059	16.45	836	31.95	189	45.37	2	10.89
URM	1,769	2.35	343	5.33	210	8.04	56	13.37	10	47.53
MH	4,420	5.86	1039	16.12	819	31.31	106	25.47	6	27.53
Total	75,402		6,441		2,617		416		21	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 383 hospital beds available for use. On the day of the earthquake, the model estimates that only 308 hospital beds (80.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 95.00% of the beds will be back in service. By 30 days, 100.00% 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	3	0	0	3
Schools	95	0	0	95
EOCs	1	0	0	1
PoliceStations	8	0	0	8
FireStations	7	0	0	7

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	120	0	0	120	120
	Bridges	450	0	0	450	450
	Tunnels	1	0	0	1	1
Railways	Segments	62	0	0	62	62
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	3	0	0	3	3
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	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	0	0	8	8
	Runways	10	0	0	10	10

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	2	0	0	2	2
Waste Water	10	0	0	10	10
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	7	0	0	7	7

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	8,302	25	6
Waste Water	4,981	20	5
Natural Gas	3,321	21	5
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	97,164	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 0.02 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 2 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 115 households to be displaced due to the earthquake. Of these, 27 people (out of a total population of 251,494) 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	1	0	0	0
	Industrial	2	0	0	0
	Other-Residential	15	2	0	0
	Single Family	28	3	0	0
	Total	46	5	0	1
2 PM	Commercial	46	7	1	1
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	13	2	0	0
	Other-Residential	2	0	0	0
	Single Family	4	1	0	0
	Total	69	10	1	2
5 PM	Commercial	33	5	0	1
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	8	1	0	0
	Other-Residential	5	1	0	0
	Single Family	11	1	0	0
	Total	58	8	1	1

Economic Loss

The total economic loss estimated for the earthquake is 177.66 (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 158.82 (millions of dollars); 18 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 60 % 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	0.76	8.65	0.33	0.20	9.95
	Capital-Related	0.00	0.32	7.04	0.20	0.07	7.63
	Rental	2.61	2.61	4.20	0.16	0.06	9.64
	Relocation	0.27	0.06	0.23	0.02	0.03	0.61
	Subtotal	2.88	3.76	20.12	0.69	0.36	27.82
Capital Stock Losses							
	Structural	13.51	3.73	7.31	1.60	0.78	26.93
	Non_Structural	41.68	14.35	15.15	3.67	1.55	76.40
	Content	12.97	3.21	7.50	2.34	0.88	26.89
	Inventory	0.00	0.00	0.26	0.49	0.03	0.78
	Subtotal	68.16	21.29	30.21	8.11	3.24	131.00
	Total	71.04	25.05	50.34	8.80	3.60	158.82

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,736.67	\$0.00	0.00
	Bridges	218.40	\$0.18	0.08
	Tunnels	0.32	\$0.00	0.00
	Subtotal	1955.40	0.20	
Railways	Segments	117.38	\$0.00	0.00
	Bridges	0.26	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	6.34	\$0.40	6.32
	Subtotal	124.00	0.40	
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	1.06	\$0.02	2.05
	Subtotal	1.10	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	42.29	\$1.74	4.12
	Runways	301.48	\$0.00	0.00
	Subtotal	343.80	1.70	
	Total	2424.20	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	64.60	\$1.99	3.08
	Distribution Line	166.00	\$0.11	0.07
	Subtotal	230.64	\$2.10	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	646.00	\$14.08	2.18
	Distribution Line	99.60	\$0.09	0.09
	Subtotal	745.64	\$14.17	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	66.40	\$0.10	0.14
	Subtotal	66.41	\$0.10	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$0.12	0.06
	Subtotal	213.40	\$0.12	
Communication	Facilities	0.70	\$0.01	1.22
	Subtotal	0.68	\$0.01	
	Total	1,256.77	\$16.50	

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	(4)	-0.09
Third Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.12
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.12
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.12
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.12

Appendix A: County Listing for the Region

Larimer,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Larimer	251,494	12,774	2,441	15,215
Total State		251,494	12,774	2,441	15,215
Total Region		251,494	12,774	2,441	15,215