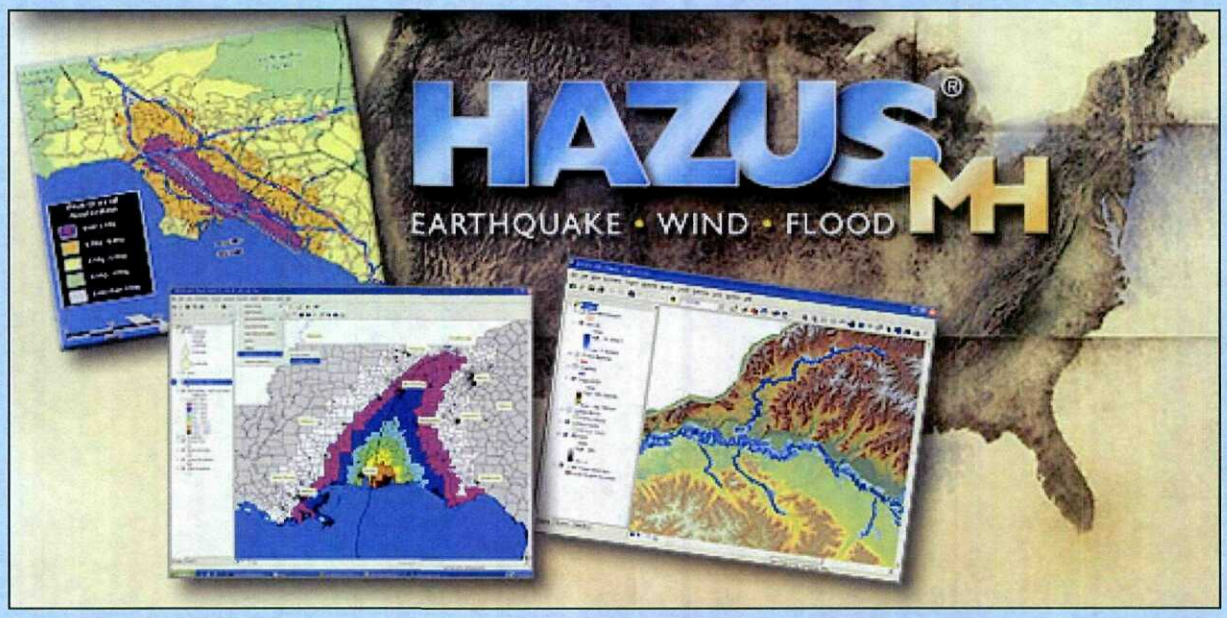
Colorado HAZUS
Earthquake Loss Estimates



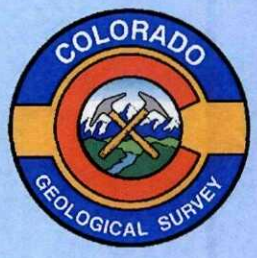
COLORADO GEOLOGICAL SURVEY

HAZUS Final Report

Loss Estimates for Earthquake Scenarios in Colorado using HAZUS-MH

Compiled by Lauren Heerschap

May 2006



Loss Estimates for Earthquake Scenarios in Colorado using Hazus-MH

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File Sizes

Report: 6.85 MB
Appendices: 3.88 MB
Statewide PGA Maps: 12.1 MB
County Maps: 345 MB
One Sample HAZUS pdf report: 0.35 MB
Power Point Presentation: 30-50 MB

Total = 400-450 MB

1. Introduction

1a. Perceived Seismic Hazard in Colorado

Colorado's largest historical earthquake surprised residents in the northern part of the state during the evening of November 7, 1882. Ground shaking was felt throughout much of Colorado and Wyoming, extending east to Salina, Kansas and west to Salt Lake City, Utah. Without modern seismometers in place, the exact magnitude and location of this earthquake was difficult to pinpoint, but geologists one hundred years later have consulted newspapers and personal accounts to estimate where the ground shaking originated. Placed at a magnitude 6.6 and centered near Estes Park in north-central Colorado, this earthquake is historical proof that strong earthquakes can and do occur in Colorado. If there were to be a repeat of this event today, damages and losses would be significantly greater due to increases in population and infrastructure throughout the state. A program called HAZUS-MH (Hazards U.S. – Multi-Hazard) developed by the Federal Emergency Management Agency (FEMA) can estimate losses from natural disasters such as earthquakes. HAZUS estimates that a magnitude 6.6 earthquake near Estes Park would result in $2.8 billion in direct economic losses, 193 casualties requiring hospitalization, 35024 buildings sustaining at least moderate damage, 2656 displaced households, and 2844 households without electricity. Other known faults in Colorado produce HAZUS estimates that are even more devastating, exceeding $20 billion in losses and 5000 casualties.

A strong earthquake in Colorado would be comparable to Hurricane Katrina considering the lack of government preparedness and the myriad of unforeseen consequences brought on by such a large-scale event. Unlike hurricanes, however, earthquakes give no warning of their approach and provide no time for evacuations. The ground shakes violently and destroys structures that are not built to withstand seismic activity, trapping, injuring, or killing people who are inside. Structures become unsafe, forcing residents to seek temporary or permanent shelter elsewhere. Water and electricity are cut off, roads and bridges become impassable, and fires can ignite from ruptured gas lines. Huge amounts of debris are generated from damaged structures that must be removed before emergency access and rebuilding can begin. Earthquakes can be major disasters, and they pose a very real threat to many areas of Colorado. The first step towards preparedness is to create awareness of what could happen – that is what this report seeks to accomplish.

Although Colorado is hundreds of miles away from the closest plate boundary, where earthquakes normally concentrate, our state has witnessed over 15 damaging earthquakes since the mid-1800's when historical records began in Colorado (**Figure 1,** see **Appendix A** for information about earthquake magnitudes and intensities). When all recordable magnitudes are included, there have been over 500 earthquakes in Colorado since documentation began (**Figure 2**). In 1882, the strongest historical earthquake in Colorado shook cities across the Intermountain West with an estimated magnitude of 6.6 and an epicenter in the vicinity of Rocky Mountain National Park. In the 1960's, multiple earthquakes up to a magnitude 5.3 shook the Denver area in the vicinity of the Rocky Mountain Arsenal and caused damage in several communities. Magnitude 3 to 4 earthquakes are actually quite common throughout the state. (See **References** for links to Colorado earthquake information websites.)

Earthquakes are caused by sudden releases of energy along faults in the earth's crust. Faults normally concentrate along tectonic plate boundaries but are also found anywhere that has experienced deformation, or changes, in the upper portion of the crust. Colorado's tumultuous geologic history has riddled the crust with numerous faults, but geologists have historically categorized them as ancient and inactive, posing no seismic threat. While this is the case for many Colorado faults, field studies since the 1960's have classified over 90 faults in Colorado as Quaternary faults, having moved more recently than 1.6 million years ago (**Figure 2**). Five identified Holocene faults, with movement more recent than 15,000 years, are now recognized as well. (See **Appendix B** for more details about Colorado faults included in this study.)

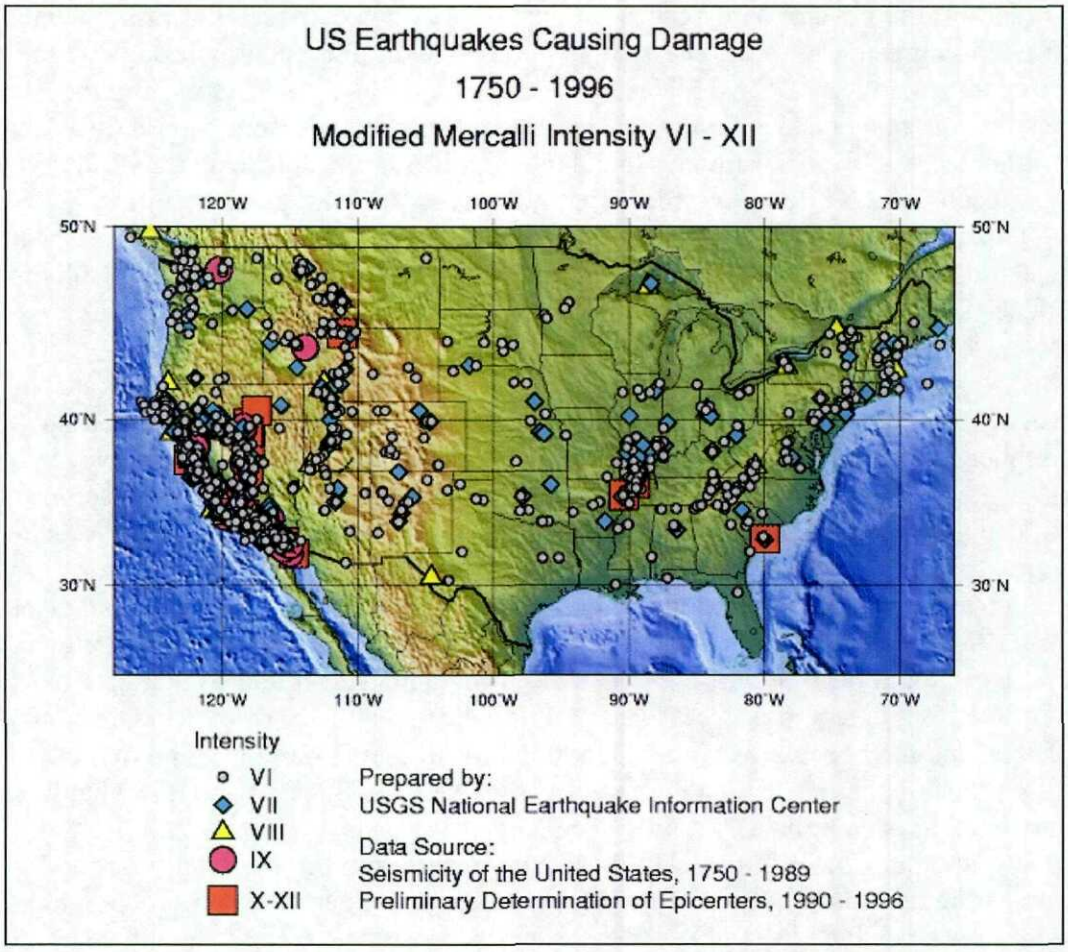

Figure 1 – From the United States Geological Survey, http://earthquake.usgs.gov/regional/states/us_damage_eq.php

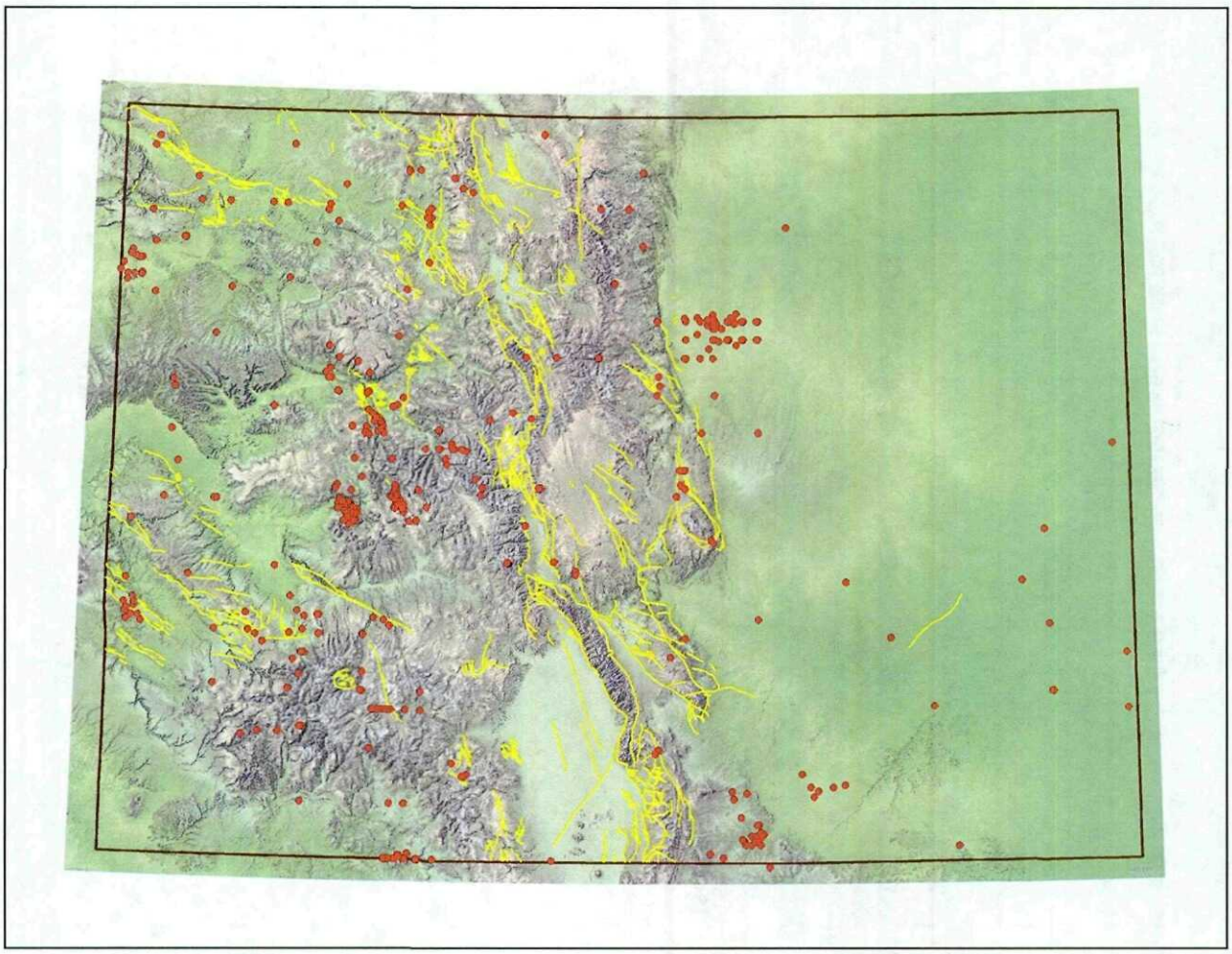

Figure 2 – Shaded relief map of Colorado showing historical seismicity 1870-2004 as red dots and known Quaternary faults as yellow lines.

Despite our growing knowledge about faults and historical earthquakes in Colorado, information about the *probability* of strong earthquakes is lacking. Seismic hazard maps (**Figure 3**) produced by the United States Geological Survey (USGS) show very low probabilities of ground shaking because of low levels of historical seismicity and the recognition of only three potentially active faults in the state (Cheraw, North Sangre de Cristo, and South Sawatch Faults). These faults are included in the USGS database because they are the only ones to have been studied with enough detail to obtain slip rate and recurrence interval estimates, which average movement along the fault through time. Colorado has thus been ranked behind states such as Alabama, Ohio, New Jersey, and Connecticut in estimates of Annualized Earthquake Losses (AEL) calculated by FEMA. Exclusion of other potentially damaging faults from databases that calculate seismic hazard can result in lower hazard estimates than exist in reality. Lack of fault-specific data should *not* result in a lack of earthquake awareness and preparedness in this state.

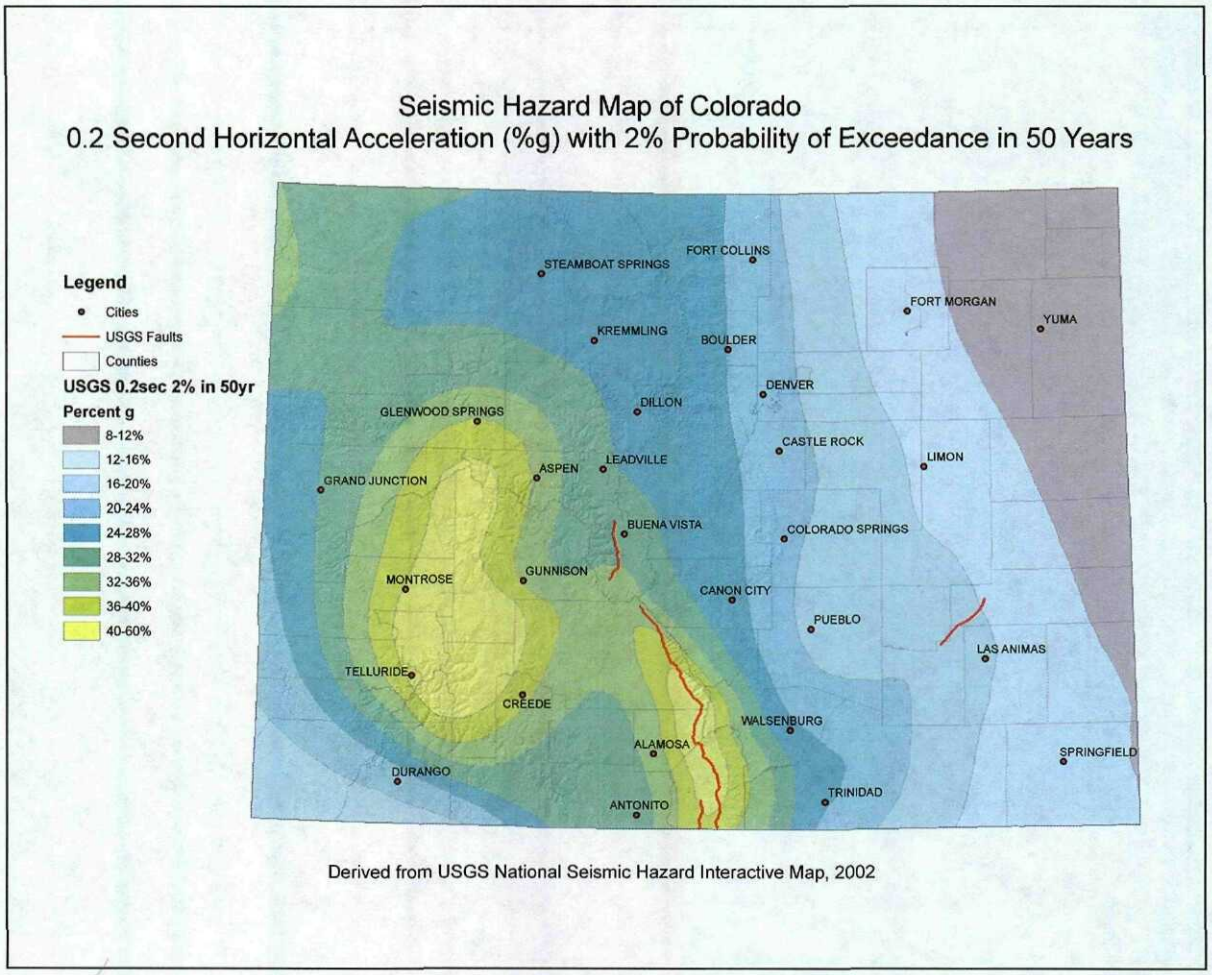

Figure 3 – Hazard map derived from the USGS Seismic Hazards Mapping Program interactive maps. The contours illustrate ground shaking values that have a 2% probability of occurring in a 50-year period. Red lines indicate the three faults included in the USGS fault database: South Sawatch, North Sangre de Cristo, and Cheraw Faults.

1b. Goal of HAZUS-MH Earthquake Loss Estimation in Colorado

In response to the need for more earthquake information, the Colorado Geological Survey (CGS), in collaboration with the Federal Emergency Management Agency (FEMA) District VIII Natural Hazards Specialist, has conducted a series of scenarios that estimate losses that could occur in the event of an actual earthquake. These scenarios used a sophisticated program called HAZUS-MH (Hazards U.S. Multi-Hazard) that was developed by FEMA under contract with the National Institute of Building Sciences (NIBS). HAZUS estimates earthquake damage and loss by calculating ground shaking and its anticipated effects on structures and populations. Included in this report are preliminary scenario results and maps on a state and county level that illustrate what would happen if an earthquake were to occur at a specific time, location, and magnitude. The goal of these earthquake scenarios is to increase awareness of the potential consequences that a strong earthquake would have in Colorado. It is our hope at CGS that local governments and emergency managers can use these loss estimates to better plan for mitigation, response, and recovery in the event of an earthquake. These

preliminary scenarios can serve as a foundation for more detailed and accurate scenarios at the county or city level.

2. HAZUS-MH Methodology

2a. HAZUS Loss Estimation Methodology

HAZUS-MH (MR1, 2005 edition) is the updated version of HAZUS software developed throughout the 1990's by the NIBS and FEMA as part of the National Earthquake Hazards Reduction Program (NEHERP). HAZUS-MH is capable of estimating losses from earthquakes, hurricane winds, and floods. The standardized loss estimation software has become a routine component of state and local government emergency management procedures and is mandatory for response and recovery in an actual emergency. HAZUS uses geographic information system (GIS) software to organize and map hazard scenario results. When an epicenter and earthquake magnitude are chosen in a study region, loss estimation calculations use inventory data and hazard parameters to assign ground shaking values to buildings and grid cells throughout the region. Ground shaking values then lead to calculations of probable damage states of buildings and corresponding casualty estimates based on building and occupancy type. Further estimates of economic loss, repair costs, public shelter needs, and induced physical damage such as fires and debris generation are also calculated. After each scenario, HAZUS can compile reports in various formats that summarize losses. Results can be mapped in GIS to show the extent and magnitude of physical damages or socioeconomic losses. For further information about HAZUS history and capabilities, see the FEMA HAZUS website (http://www.fema.gov/hazus/) and the NIBS program overview (http://nibs.org/hazusweb/overview/overview.php).

2b. Data Inventory

HAZUS accesses databases containing a national inventory of building and demographic information. The default inventory for HAZUS was compiled by business information powerhouse Dun & Bradstreet and earthquake engineering firms Risk Management Solutions, Inc., Dames & Moore, and EQE International. This inventory includes the general building stock, essential facilities, transportation lifeline systems, and utility lifeline systems.

The general building stock dataset includes residential, commercial, educational, industrial, religious, agricultural, and government buildings. Databases include information about building type (**Table 1**), number of stories, seismic design code, occupancy type (residential, business, educational, etc.), and time of occupancy (day or night). Also included are building replacement values, business disruption costs, and repair rates and costs. Buildings in the default database are not considered individually but as groups in census tracts according to building type and occupancy class. Building classes are then characterized by probabilities of damage that were calculated from observations of different structure types during ground shaking.

Table 1 – Building Types

No.	Label	Description	Height			
			Range		Typical	
			Name	Stories	Stories	Feet
1	W1	Wood, Light Frame (≤ 5,000 sq. ft.)		1-2	1	14
2	W2	Wood, Commercial and Industrial (> 5,000 sq. ft.)		All	2	24
3	S1L	Steel Moment Frame	Low-Rise	1-3	2	24
4	S1M		Mid-Rise	4-7	5	60
5	S1H		High-Rise	8+	13	156
6	S2L	Steel Braced Frame	Low-Rise	1-3	2	24
7	S2M		Mid-Rise	4-7	5	60
8	S2H		High-Rise	8+	13	156
9	S3	Steel Light Frame		All	1	15
10	S4L	Steel Frame with Cast-in-Place Concrete Shear Walls	Low-Rise	1-3	2	24
11	S4M		Mid-Rise	4-7	5	60
12	S4H		High-Rise	8+	13	156
13	S5L	Steel Frame with Unreinforced Masonry Infill Walls	Low-Rise	1-3	2	24
14	S5M		Mid-Rise	4-7	5	60
15	S5H		High-Rise	8+	13	156
16	C1L	Concrete Moment Frame	Low-Rise	1-3	2	20
17	C1M		Mid-Rise	4-7	5	50
18	C1H		High-Rise	8+	12	120
19	C2L	Concrete Shear Walls	Low-Rise	1-3	2	20
20	C2M		Mid-Rise	4-7	5	50
21	C2H		High-Rise	8+	12	120
22	C3L	Concrete Frame with Unreinforced Masonry Infill Walls	Low-Rise	1-3	2	20
23	C3M		Mid-Rise	4-7	5	50
24	C3H		High-Rise	8+	12	120
25	PC1	Precast Concrete Tilt-Up Walls		All	1	15
26	PC2L	Precast Concrete Frames with Concrete Shear Walls	Low-Rise	1-3	2	20
27	PC2M		Mid-Rise	4-7	5	50
28	PC2H		High-Rise	8+	12	120
29	RM1L	Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms	Low-Rise	1-3	2	20
30	RM1M		Mid-Rise	4+	5	50
31	RM2L	Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms	Low-Rise	1-3	2	20
32	RM2M		Mid-Rise	4-7	5	50
33	RM2H		High-Rise	8+	12	120
34	URML	Unreinforced Masonry Bearing Walls	Low-Rise	1-2	1	15
35	URM M		Mid-Rise	3+	3	35
36	MH	Mobile Homes		All	1	10

From HAZUS-MH Technical Manual, Chapter 3.

The essential facilities inventory includes data about medical care facilities, fire stations, police stations, and schools. These facilities have key roles in emergency response following a disaster and should be functional after an earthquake. Schools are included because they are commonly used as public shelters for displaced households in emergencies. Since there are relatively few facilities in each census tract, damage to essential facilities is evaluated on a building-by-building basis and can thus be individually mapped for specific scenarios.

Transportation lifeline systems include highways, railways, light rail, bus systems, ports, ferries, and airports. These can be further broken down into components such as highway bridges, segments, and tunnels or airport terminals and runways.

The utility lifeline systems inventory includes potable water, wastewater, electric power, communications, oil, and natural gas information for pipelines and facilities. Due to post-911 security issues, most utility pipeline information has been removed from the mapping tables but is still present for damage analysis.

The population and demographic inventory for HAZUS is from the 2000 U.S. Census. Each county is broken down into census tracts, and information is available about population, number of households, age distribution, gender, race, household

income, population distribution during daytime versus nighttime, renters versus house owners, construction dates of residential units, property value, and student population. Some of this information may seem superfluous, but it is vital for social earthquake loss estimates such as displaced households and people seeking public shelter. The HAZUS model is based on statistical behavior of certain gender and age groups during actual earthquakes, along with renter versus owner willingness to leave damaged structures.

As thorough as HAZUS default databases are, there are additional data types that are missing from inventories. High potential loss facilities such as dams and nuclear power plants are not included because more detailed engineering information would be needed to make accurate loss estimates. Military facilities are also missing but would add significant dollar amounts to loss estimates in regions such as Colorado Springs. New buildings, constructed after 2000, are not in the dataset. Explosive growth throughout Colorado is therefore not accurately portrayed in these preliminary scenarios. HAZUS allows for inventory improvements by including building inventory tools and advanced engineering modules where the user can add region-specific inventories. The loss estimates presented in this report use only the default datasets but could be improved through inventory streamlining in the future.

2c. Analysis

The scenario results and maps presented in this report represent three years of HAZUS analysis by CGS for the state of Colorado. As improvements in the HAZUS software became available, scenarios were re-run to create the best possible loss estimates with the inventories provided. CGS added Colorado-specific data in the form of soil maps and landslide maps, so our scenarios represent a Level 2 hazard analysis as described on the FEMA website (**Figure 4**).

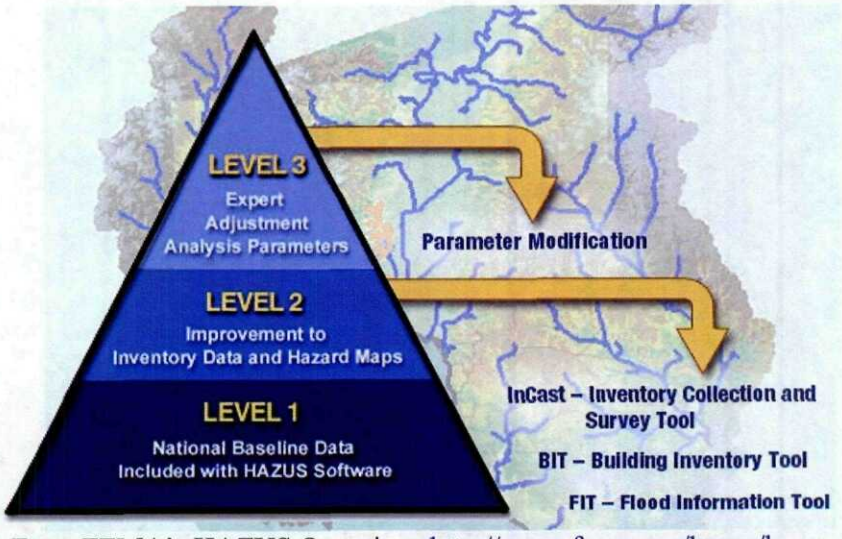

Figure 4 - From FEMA's HAZUS Overview, http://www.fema.gov/hazus/hz_overview.shtm.

Because earthquake probability is poorly understood in Colorado, CGS chose to run deterministic scenarios. These essentially describe what would happen if an earthquake were to occur with a specific epicenter and magnitude. Deterministic scenarios gave us the opportunity to analyze potential earthquake consequences

throughout the state, along actual faults as well as randomly chosen epicenters. This report includes three types of scenarios: state-wide scenarios for maximum credible earthquakes (MCE's) on selected faults, county scenarios for epicenters selected in the center of each county, and county "worst-case scenarios" for MCE events on selected faults that result in the highest losses in each county.

Parameters chosen for each scenario include latitude and longitude of the earthquake epicenter, earthquake magnitude, fault geometry, type of fault motion (normal, reverse, strike-slip), and attenuation function. Attenuation is a measure of how seismic waves are dampened with distance from the epicenter, and its rate changes according to rock type, density, and variation in the crust. This attenuation function has turned out to be a central factor in Colorado earthquake modeling because Colorado lies in a poorly understood zone between what is characterized by the USGS as the Western U.S. (WUS) zone and the Central Eastern U.S. (CEUS) zone. According to the USGS seismic hazard mapping program, most of Colorado lies in the CEUS attenuation zone and only the Rio Grande Rift zone in the San Luis Valley lies in the WUS zone (**Figure 5**). We have therefore used the CEUS function for all of our scenarios except for the five counties in and around the San Luis Valley (Alamosa, Conejos, Costilla, Rio Grande, and Saguache) and the major North Sangre de Cristo fault that borders the valley.

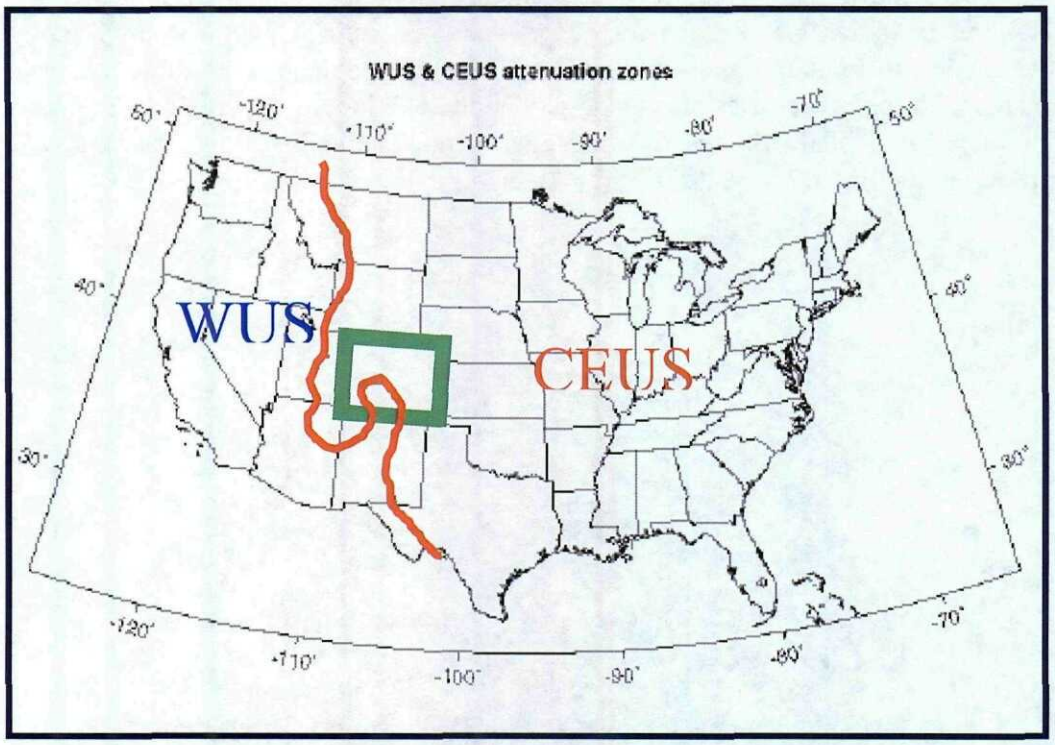

Figure 5 - From USGS documentation for the 1996 Seismic Hazard Maps, http://earthquake.usgs.gov/research/hazmaps/publications/hazmapsdoc/june96doc.html

CGS obtained and modified soil and landslide maps to more accurately portray ground behavior in an earthquake. We derived our soil map from the state geologic map by Ogden Tweto (USGS, 1979). Rock types were classified into 5 groups, following 1997 NEHRP and Universal Building Codes (hard rock, rock, very dense soil and soft

rock, stiff soils, and soft soils). HAZUS could then calculate ground shaking based on rock and soil class more accurately than with its default single soil type. CGS also imported landslide maps in an effort to portray ground failure due to shaking, especially in the many steep landslide-prone areas of our state. We classified regions on the landslide maps to correspond with susceptibility values that HAZUS would recognize. Unfortunately the landslide maps did not appear to significantly affect results. The soil maps, however, play a major role in determining ground shaking patterns and damage, as can be seen on the Peak Ground Acceleration (PGA) maps included in this report.

The faults and epicenters chosen for this study include 18 mapped Quaternary faults and two epicenters from historical earthquake events (**Figure 6**). Faults were chosen for HAZUS scenarios based on field studies of greater detail compared to other faults, proximity to highly populated urban areas, or mapped lengths that correspond to high MCE magnitudes. (See **Appendix B** for details about faults and epicenters chosen for analysis.)

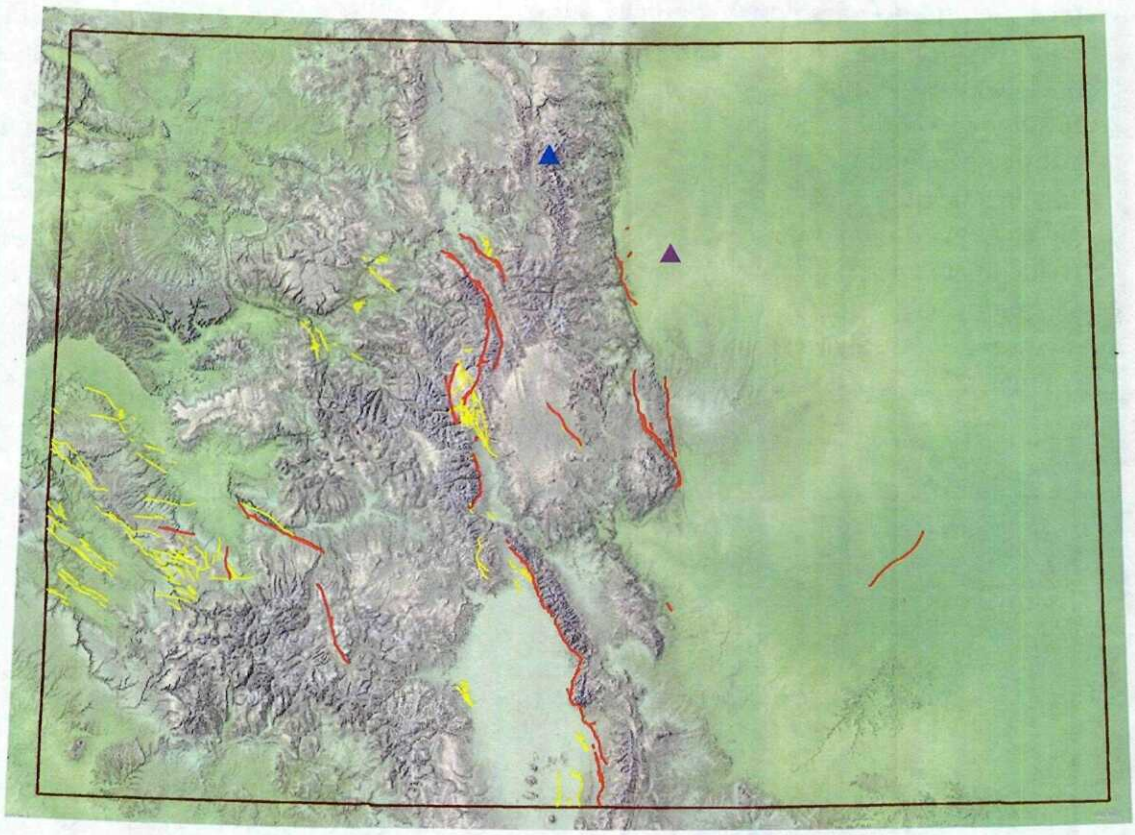

Figure 6 - Known Quaternary faults (yellow) and selected Quaternary faults for HAZUS scenarios (red). Two historical epicenters, the Rocky Mountain Arsenal Epicenter (purple triangle) and the 1882 Rocky Mountain National Park Epicenter (blue triangle) were also included in scenarios.

2d. Explanation of Results

HAZUS is capable of producing a variety of results depending on the modules that are chosen during analysis. These results can then be viewed through automatically generated reports or mapped to the desired degree of detail. Results are organized into categories of direct physical damage (to buildings, essential facilities, transportation systems, utility systems), induced physical damage (debris generated, fires ignited, inundation, HazMat contamination), direct economic losses (all inventory value lost and repair costs), indirect economic losses (loss of income generation), and social losses (casualties, displaced households, and shelter needs).

2d.i. Results Tables

The summary tables provided in this report (**Appendices C and D**) show scenario results that CGS believes are most important. Our results are not stated as ranges because they are estimates, and a certain degree of uncertainty is assumed to be part of any such estimate. These assumptions are further addressed in the next section. In the summary tables, **Economic Loss** is stated in millions of dollars and is the sum of building, utility, and transportation direct economic loss estimates. **Economic Loss Ratio** is a percentage calculated by dividing total economic loss by the region's total inventory value, then multiplying by 100. This loss ratio often provides a more relevant figure for representing the direct economic impact of a disaster. **Buildings with at least Moderate Damage** estimates the number of buildings with a probability of damage state at the moderate level or above (see **Appendix F** for descriptions of building damage states). Also provided is the percentage of moderately or greater damaged buildings in relation to the total number of buildings in a given region, illustrating the regional effects of an earthquake. **Casualties Requiring Hospitalization** is a sum of Severity Levels 2, 3, and 4 estimated by HAZUS (**Table 2**).

Table 2 – Injury Severity Levels

Injury Severity Level	Injury Description
Severity 1	Injuries requiring basic medical aid that could be administered by paraprofessionals. These types of injuries would require bandages or observation. Some examples are: a sprain, a severe cut requiring stitches, a minor burn (first degree or second degree on a small part of the body), or a bump on the head without loss of consciousness. Injuries of lesser severity that could be self treated are not estimated by HAZUS.
Severity 2	Injuries requiring a greater degree of medical care and use of medical technology such as x-rays or surgery, but not expected to progress to a life threatening status. Some examples are third degree burns or second degree burns over large parts of the body, a bump on the head that causes loss of consciousness, fractured bone, dehydration or exposure.
Severity 3	Injuries that pose an immediate life threatening condition if not treated adequately and expeditiously. Some examples are: uncontrolled bleeding, punctured organ, other internal injuries, spinal column injuries, or crush syndrome.
Severity 4	Instantaneously killed or mortally injured

From HAZUS Technical Manual, Chapter 13.

The program calculates casualties for three times of day: 2am, 2pm, and 5pm to represent populations in various infrastructure types at nighttime, daytime, and commuting time. Our summary tables include the Level 2-4 sum for the time of day with greatest casualties, which varied between regions and scenarios. Casualty estimates take into consideration building type and occupancy during these different times of day, potential highway bridge occupancy, as well as statistics from previous earthquakes.
Displaced Households is an estimate of the number of households that will vacate their residence due to loss of building function, habitability, *perceived* habitability, or utility functionality. These households will need to find alternative short-term and possibly long-term shelter. The number of **People Seeking Public Shelter** is also estimated and included in our summary tables because this number is extremely important to emergency response organizations. HAZUS estimates are based on statistics showing that only a portion of displaced persons will seek public shelter due to the availability of friends' and family members' homes, hotels, or vehicles for short-term shelter. Statistics also show that most pre-disaster homeless will seek public shelter, and that people living in single-family homes are more likely to tolerate damage and stay in their homes than those renting parts of multi-family structures. **Households without Water** estimates the number of households that will not have running potable water through calculations of damage state probabilities and functionalities for potable water facilities and pipelines. **Households without Electric Power** considers damage probabilities and functionalities for electricity facilities and distribution circuits. Zeroes that are present in these final two columns bring to light the incomplete and patchy nature of the default inventory. Many counties do not have sufficient water or power inventory information to form an accurate estimate.

2d.ii. Reports

Automatically-generated reports can be saved following each HAZUS scenario. These reports can focus on specific types of damage or can include all modules that were analyzed. CGS saved a Global Summary Report for each scenario run. An example summary report is included in **Appendix G.** Since these reports are approximately 20 pages each, we have chosen to not include them all. Instead, results were extracted and compiled into our results tables as described in the previous section.

2d.iii. Results Maps

The organization of HAZUS into ArcView GIS software allows the user to map an impressive variety of results. Any inventory item, imported hazard map, or loss estimate calculation completed by HAZUS can be mapped. Since inventories and results are organized into data tables, loss estimation results can also be displayed as spreadsheets.

Included in this report are statewide maps showing peak ground acceleration (PGA) in colored grid cells for each fault and epicenter analyzed. **Figure 7** is an example of one PGA map; the full collection of statewide PGA maps is in **Appendix C.** PGA values are expressed in %g, where *g* is acceleration due to gravity. For example, the maximum PGA represented on a map might be 1.25, which means that the most violent ground shaking was 125% of the force produced by gravity. Forces this strong are able to toss objects into the air. Yellows, oranges, and reds on the PGA maps represent

ground acceleration values in excess of 20%g, usually the threshold for structural damage. Ground shaking is obviously strongest in areas closest to the epicenter and ruptured fault, but patterns are also evident that correspond to soil types that CGS imported into HAZUS. Softer soils amplify seismic waves and perform poorly for foundations when compared to solid rock. The blue-to-red prismatic color ramp was used throughout all of our PGA maps, but specific color shades correspond to slightly different values to accommodate the variety between scenarios.

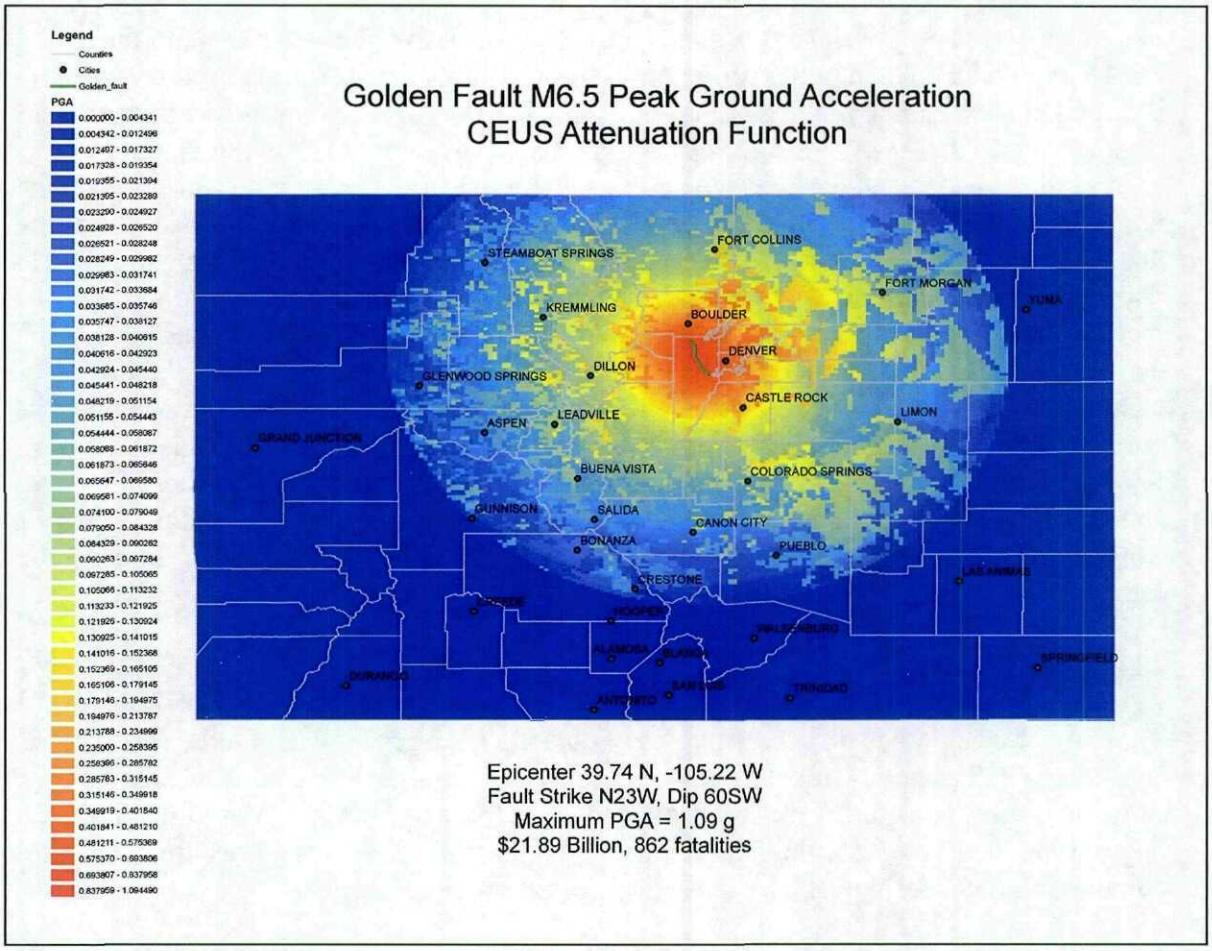

Figure 7 – Sample PGA map for a scenario on the Golden Fault, Magnitude 6.5.

For scenarios at the county level, maps are included in this report (**Appendix E**) that show damage to a variety of facilities and losses within census tracts. A similar blue-to-red color ramp was used when mapping facilities, with oranges and reds representing more damage. Given the exhaustive possibilities for mapping HAZUS results, we have chosen a standard set of results to map for each county. Facilities illustrated on county scenario maps are: schools, hospitals, fire stations, and police stations; highway bridges; airport facilities; waste water facilities; electric power facilities; and building-related economic loss per census tract. Values that are mapped for each facility represent the probability that structural damage will be extensive or greater (see **Appendix F** for descriptions of damage states). Each map legend contains a label "Probability Damage > Extensive" and a list of percentage values. Facilities

mapped as red symbols have a 50% chance or higher of sustaining extensive to complete damage for the earthquake magnitude and epicenter with which they are mapped. We chose to map the probability of damages being at least extensive rather than "at least slight" or "at least moderate" because structures that sustain extensive damage are likely to be structurally unsafe and will require partial to total rebuilding. Mapping worst-case facility damage for worst-case earthquake scenarios allows for visualization of the full impact of what is possible. Counties consisting of more than one census tract also have a map showing building-related economic loss per census tract. Census tract polygon colors range from gray to red to illustrate low to high amounts, respectively, of monetary loss due to damaged buildings and loss of business activity within those buildings. Economic losses are stated in thousands of dollars, so $650250 in a map legend means that a census tract sustained over $650 million in losses.

2e. Assumptions and Limitations

It is important to understand that HAZUS is a loss *estimation* methodology and that uncertainties are inherent in this type of analysis. Earthquake engineers and scientists continue to learn about earthquakes and their effects on buildings and societies. Any modeling effort such as this requires simplifications and approximations of reality for scenario analyses to be possible. Incomplete, inaccurate, or outdated inventory and demographic data also add to the uncertainty of results. Uncertainty in loss estimates provided by HAZUS are off by *at best* a factor of two and possibly greater. The soil maps added into our scenarios increase accuracy of results, but the lack of up-to-date region-specific inventories and the unknowns surrounding our choice of attenuation function keep uncertainty levels high. Only a real earthquake event in the state will truly test loss estimation results. Nevertheless, aggregate results such as total economic loss and numbers of casualties still provide a credible estimate of the potential consequences of an earthquake in Colorado.

Uncertainty is also introduced with the understanding that maximum credible earthquake (MCE) magnitudes used in HAZUS scenarios are calculated from mapped fault lengths. The longer the fault, the larger the MCE magnitude. These MCE magnitudes are possible if the entire fault length ruptures in a single earthquake event. Many longer faults such as the Sangre de Cristo Fault in Colorado, the Wasatch Fault in Utah, and the San Andreas Fault in California are actually combinations of many smaller fault segments. History has shown that large portions of a fault can rupture in a single event, such as the 1906 San Francisco Earthquake that offset 290 miles of the San Andreas Fault (http://quake.wr.usgs.gov/info/1906/index.html). However, it is more probable that fault segments will rupture in separate smaller earthquake events. Behavior of faults in Colorado is so poorly understood that CGS feels it is safe to use MCE magnitudes obtained from mapped fault lengths.

A similar fault-related simplification was introduced by our choice of earthquake epicenter at the midpoint of each fault. An earthquake's epicenter, the location where a fault initially ruptures, is not a predictable point nor is it statistically shown to usually be at the midpoint or endpoints of faults. On longer faults, the epicenter location can have a large effect on damages and losses that result because ground shaking is most violent in the area immediately around the epicenter. If an epicenter is located in a downtown area of a highly populated city, more damage will result than if the epicenter had been out in

rural farmlands, even when the same fault was responsible for the earthquake. Our choice of a fault's midpoint for each scenario epicenter is a simplification necessary for large numbers of scenarios to be run. (See **Appendix B** for further discussion of epicenters.)

The scenario results and maps presented in this report should therefore be viewed as approximations of what could be possible in an actual earthquake. Maps showing probabilities of damage to various facilities are meant to illustrate how emergency response capabilities and utility functionality could affect a county. Maps showing ground shaking show the regional extent and possible patterns of damaging ground motions. Numbers presented in our summary tables should be considered as our best estimates-to-date. County and city planners should recognize that results calculated by HAZUS could be *overestimates or underestimates* of what could actually occur.

3. Statewide Scenarios and Ground-Shaking Maps

With the most recent version of HAZUS-MH and improved computer processing speed, we were able to run scenarios with all Colorado counties at once. We ran these statewide scenarios for MCE's centered on midpoints of selected faults and for the historical epicenters from the 1882 Earthquake and Rocky Mountain Arsenal earthquakes. HAZUS computes ground shaking using a calculation involving attenuation function, soil type, and distance away from the epicenter. Its radius of ground shaking extends to approximately 200 km away from a fault rupture, and this elliptical radius is visible on the ground acceleration (PGA) maps included in **Appendix C**. With all counties included in these scenarios, ground shaking and its associated damages is calculated in any affected county and added to the total loss estimate. These loss estimates are summarized in the Statewide Summary Table in the appendix and are ranked by total economic loss in **Table 3** below.

The severity ranking in Table 3 illustrates how faults that are close to urban centers in the Front Range are capable of causing much higher losses than those in less populated areas. Smaller earthquake magnitudes such as a M6.5 on the Golden Fault can cause greater damage than larger magnitudes such as a M7.5 on the N Sangre de Cristo Fault solely because of the proximity of the fault to high-inventory regions. This illustrates the concept of seismic *risk* versus *hazard*. Seismic hazard is associated with ground shaking probabilities while seismic risk considers the population and built environment that could sustain losses due to ground shaking. Colorado's Front Range carries a high seismic risk but a highly uncertain seismic hazard.

Loss estimates for statewide scenarios also illustrate the large impact that attenuation function has on scenario results. The N Sangre de Cristo fault is the only fault in Colorado that lies within the WUS attenuation zone according to the USGS (**Figure 5**). It is also Colorado's longest fault (128 miles) and one of the few that displays evidence of Holocene movement (within the past 15,000 years). This fault has the potential to create the highest ground shaking in Colorado, with a MCE magnitude of 7.5. When computed with a WUS attenuation function, the N Sangre de Cristo Fault is estimated to cause $767 *Million* in total economic loss. When computed with a CEUS attenuation function, the loss estimate jumps to $8.02 *Billion*. This is over 10 times

greater than losses estimated with the WUS function! The CEUS-WUS discrepancy is echoed in other scenarios to a lesser degree where CEUS results are, on average, 3 to 4 times greater than WUS results. Clearly, an attenuation function appropriate for Colorado is sorely needed before seismic characteristics can be understood and predicted in this state.

Table 3 – State-wide Scenario Rankings

Rank	Fault	Earthquake Magnitude	Economic Loss in State
1	Rampart Range	7	$23.1 Billion
2	Golden	6.5	$21.9 Billion
3	Ute Pass	7	$16.8 Billion
4	Rocky Mountain Arsenal	6.25	$14.9 Billion
5	Walnut Creek	6	$9.70 Billion
6	N Sangre de Cristo	7.5 CEUS	$8.02 Billion
7	Frontal	7	$6.73 Billion
8	Mosquito	7	$6.19 Billion
9	South Sawatch	7.25	$4.74 Billion
10	Chase Gulch (East-Side)	6.75	$3.76 Billion
11	North Sawatch	7	$3.62 Billion
12	Williams Fork	6.75	$3.48 Billion
13	1882 Rocky Mtn National Park	6.6	$2.76 Billion
14	Cheraw	7	$1.26 Billion
15	Cimarron	6.75	$808 Million
16	N Sangre de Cristo	7.5 WUS	$767 Million
17	Valmont	5	$712 Million
18	Busted Boiler	6.5	$694 Million
19	Cannibal	7	$675 Million
20	Goodpasture	6	$479 Million
21	Roubideau Creek East	5.5	$94.2 Million

See Appendix C summary table for further details on statewide scenario results.

4. Random Earthquakes by County

4a. Purpose of Random Earthquake Scenarios

Earthquakes inherently carry a high degree of uncertainty, not only in time but also in location. Regions that receive a lot of attention from seismologists and geologists can still bring surprises, such as the 1999 Hector Mine M7.1 earthquake in California that occurred along a fault that was not considered to be active (no evidence of rupture within the past 10,000 years -http://pasadena.wr.usgs.gov/hector/report.html). Many historical earthquakes in the United States have occurred far away from plate boundaries where faults still have not been mapped over 100 years later. Examples include the 1886 Charleston, South Carolina earthquake with an intensity (MMI) of X; the 1755 Cape Ann/Boston, Massachusetts earthquake with MMI of VIII; and the 1811-1812 New Madrid, Missouri earthquakes with estimated magnitudes up to M8.1. And we cannot forget our very own 1882 earthquake that occurred somewhere near Estes Park at an estimated magnitude of M6.6. Since a seismometer network was not in place in the 1800's (and still is lacking in Colorado), the epicenter of the 1882 earthquake is extremely difficult to pinpoint. Our state's largest historical earthquake, therefore, is not associated with any known fault and may never be understood well enough to be accurately located.

Uncertainties and surprises in earthquake occurrences have led the USGS to include what they call "Background Source Zones" when calculating and creating their national seismic hazard maps. The Rocky Mountain region is a zone of interest because of its extremely short record of historical seismicity. Including a background, or random, earthquake source in hazard mapping is a way of saying that a region has the potential for damaging earthquakes even if significant earthquakes have not occurred very often in the past.

4b. Colorado's Random Earthquake Scenarios

CGS has run HAZUS scenarios for this random (background) earthquake in each Colorado county (see summary table in **Appendix D** and maps in **Appendix E**). Each scenario was run for a M6.5 event with an epicenter located in the geographic center of the county. The fault geometry for each scenario assumed a N30°W fault strike (its mapped alignment relative to North) and a 60°SW dip (the subsurface steepness of the fault plane, with 0° being horizontal and 90° being vertical). Normal faulting was chosen as the type of displacement for each scenario. We chose these parameters because most faults that have been studied in Colorado are normal faults oriented towards the northwest, with relatively steeply-dipping fault planes. A magnitude of 6.5 was chosen to portray consequences of a significant but highly uncertain event.

Due to the variation in urban center distribution within each county, loss estimates using a random epicenter at each county's geographic center yielded a variety of results. Counties such as Denver, Mesa, and Pueblo have cities located close to their geographic centers, which resulted in devastating HAZUS loss estimates.

These random earthquake scenario results serve to illustrate potential consequences of earthquakes from unknown sources. We have included a random scenario for each county in Colorado because many counties are not within the radius of damage from an actual fault analyzed in HAZUS. Fault locations and characteristics are

so poorly understood in Colorado that there could quite easily be other faults that do not reach the surface, or have not yet been discovered or recognized as active. The USGS uses background, or random, earthquakes in their seismic hazard analyses, so a thorough analysis in Colorado should be equally as inclusive.

5. Worst-Case Scenarios by County

5a. Why a Worst-Case Scenario?

The majority of HAZUS scenarios performed by CGS were deterministic scenarios for county-level regions analyzed with parameters for actual faults. Our sources for potential seismicity included eighteen faults and two epicenters from historical earthquakes (see **Appendix B**). For the faults and fault scarp, we selected epicenters at the midpoint of each fault trace, recognizing that this is a simplification because fault rupture could initiate anywhere along a fault. Whenever possible, we used fault geometry derived from field studies of each fault to ensure that HAZUS calculations involved realistic information.

We organized scenarios by fault or epicenter, running scenarios for county regions that would be affected by the 200-km radius of ground shaking that HAZUS allows. Earthquake magnitudes for each fault-county combination included the MCE derived from fault length and incrementally smaller magnitudes down to M5.0, the lowest allowable HAZUS magnitude. Lower magnitudes yielded results that are valuable in light of the higher probability attached to lower magnitude events. However, we have included only results from the MCE magnitude scenarios in this report to illustrate worst-case, yet possible, scenarios. Region-specific scenarios showing the range of loss estimates from different magnitudes can be performed for local governments if desired. Due to high uncertainties in our understanding of earthquake probabilities in Colorado, scenarios and maps that visualize worst possible situations can inform emergency managers and planners that there is too much at stake for seismic hazards to be ignored.

5b. Scenario Results

Appendix D includes the Earthquake Summary Table showing random earthquakes and at least one worst-case scenario earthquake for each county. Some counties contain several faults or are close enough to several faults that two or more worst-case scenarios were included in the table. **Table 4** contains a ranking of worst-case county scenarios based on the Economic Loss Ratio. As explained above, this ratio is a percentage of a region's total inventory value (buildings, transportation, and utilities) that is lost during an earthquake. Ranking scenarios by loss ratio is a more accurate depiction of the impact that a disaster can have on a county level than pure dollar amounts of economic loss, since county inventory values vary so widely. $500 million lost in Denver County has an entirely different effect than $500 million lost in Hinsdale County. The scenarios included in Table 4 are only those with loss ratios greater than 10%.

Table 4 – County Scenario Rankings by Loss Ratio

Rank	County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)
1	Summit	Frontal	7.00	1,345.36	32.15%
2	Chaffee	S Sawatch	7.25	665.16	28.26%
3	El Paso	Rampart	7.00	9,013.76	27.67%
4	Lake	N Sawatch	7.00	302.50	27.53%
5	Lake	Mosquito	7.00	298.86	27.20%
6	Teller	Ute Pass	7.00	523.85	26.83%
7	Summit	Mosquito	7.00	1,056.71	25.26%
8	El Paso	Ute Pass	7.00	8,216.92	25.23%
9	Alamosa	N Sangre de Cristo	7.5 CEUS	433.09	23.54%
10	Denver	Golden	6.50	7,510.48	19.24%
11	Chaffee	N Sangre de Cristo	7.5 CEUS	425.76	18.09%
12	Jefferson	Golden	6.50	5,881.32	16.42%
13	Custer	N Sangre de Cristo	7.5 CEUS	138.38	15.77%
14	Adams	Rocky Mtn Arsenal	6.25	3,148.06	14.97%
15	Denver	Rocky Mtn Arsenal	6.25	5,557.58	14.24%
16	Otero	Cheraw	7.00	415.54	14.16%
17	Douglas	Rampart	7.00	1,848.03	13.49%
18	Ouray	Busted Boiler	6.50	104.19	13.33%
19	Montrose	Cimarron	6.75	497.40	13.18%
20	Arapahoe	Golden	6.50	3,900.99	12.10%
21	Denver	Rampart	7.00	4,652.06	11.92%
22	Arapahoe	Rampart	7.00	3,835.78	11.90%
23	Eagle	Frontal	7.00	571.47	11.40%
24	Fremont	N Sangre de Cristo	7.5 CEUS	393.64	10.47%
25	Hinsdale	Cannibal	7.00	35.15	10.12%

Scenarios for the North Sangre de Cristo fault included in Table 4 were run with a CEUS attenuation function. We analyzed counties in the San Luis Valley for both CEUS and WUS functions, and due to the discrepancy in ground shaking produced by the two functions, the CEUS scenarios always resulted in greater losses.

6. Use of HAZUS Loss Estimates

6a. Ignorance is NOT Bliss

The statewide, random county, and worst-case county scenarios presented in this report illustrate the magnitude of destruction and loss that could result from strong earthquakes in Colorado. These scenarios are hypothetical, but at the same time they represent our best knowledge-to-date about what *could* happen in our state. Until further fault studies increase our understanding of earthquake probabilities, these HAZUS

scenarios are our only source of information about potential seismic impacts throughout the state.

Areas such as Colorado, with a sparse record of historical earthquakes, are especially prone to voluntary ignorance about seismic hazards. It is easy and comfortable to assume that because our state has had only one significant earthquake (the 1882 M6.6 in northern Colorado) since settlement, we do not have a seismic hazard worthy of much attention. It is also assumed that since Colorado is hundreds of miles away from the closest plate boundaries, we will not experience much movement of the earth's crust. But it is precisely regions such as Colorado that could sustain considerable losses from an earthquake because we are not prepared. The purpose of these HAZUS scenarios was to increase awareness of realistic potential consequences *and* to use this information to better prepare for a disaster.

6b. Mitigation, Preparedness, Response, and Recovery

Natural hazards mitigation involves organized efforts to reduce long-term risks to people and property. The goal of mitigation is to save lives, keep lifelines functional and intact, and keep buildings as undamaged and accessible as possible. Earthquake hazards mitigation actions include upgrading or retrofitting buildings, planning proper land use, changing and enforcing building codes, and identifying vulnerable facilities (Table 5). Prioritization of mitigation strategies is necessary for them to be realistically implemented. HAZUS scenarios can be powerful tools for evaluating cost effectiveness of different mitigation efforts. Scenarios at the county or city level can estimate losses before and after hypothetical building retrofitting, and the changes in loss estimates can be weighed against the cost of retrofitting. This application of HAZUS could be useful throughout Colorado where many historical buildings are made of unreinforced masonry, a building type proven to perform very poorly in earthquakes. Scenarios can similarly be run before and after hypothetical building code changes to see how higher seismic building codes for all building types would reduce risk. FEMA has prepared an excellent publication titled "A Guide to Using HAZUS for Mitigation" that can be downloaded from http://www.fema.gov/hazus/pdf/hazus_for_mitigation.pdf for further information.

Table 5 – Potential Uses of HAZUS for Mitigation

Uses of HAZUS	Type of Loss Estimate	Data Requirements	Audience	Output	Comments
1. Raise public awareness of earthquake threat and consequences	Regional Scenario	Level 1 or Level 2 with soils map	General public, elected officials, emergency managers, land use planners	Casualties, economic loss	
2. Create political understanding and build constituencies	Local or Regional Scenarios	Level 2, soils map, building inventory, regional utilities or transportation systems	General public, elected officials, emergency managers, land use planners	Casualties, utility disruption, regional transportation damage dollar loss	
3. Understand relative risk, planning, siting, and access issues	Local or Regional Scenarios	Level 2, detailed geology, lifelines, transportation	Land use planners, regional agencies, growth management agencies, utilities	Peak Ground Acceleration (PGA)/ Peak Ground Velocity (PGV)/ Peak Ground Deformation (PGD)	Requires input from a geologist
4. Understand extent of injuries and fatalities	Multiple Scenarios	Level 2, detailed geology and building inventory, essential facilities, schools, hospitals	Medical agencies, emergency managers, risk managers	Casualties by structure type	Requires input from a geologist
5. Assess performance of emergency shelters	Local Scenario	Level 2, detailed geology and building inventory	Land use planners, risk managers, emergency planners	Structural damage	Requires input from a geologist
6. Assess performance of fire stations	Local Scenario	Level 2, detailed geology, fire station inventory, water system	Fire officials, emergency managers, planners	Number of ignitions, area burned, essential facilities damage, water utility damage	Requires input from a geologist, water system engineer, structural engineer to classify structures
7. Identify infrastructure vulnerability	Regional Scenario	Level 2, detailed geology and building inventory	Utility companies, emergency planners, transportation agencies	Utility damage and recovery, transportation system damage	Requires input from a geologist, structural engineers and architects
8. Understand overall building damage	Local Scenario	Level 2, detailed building inventory, essential facilities, schools, hospitals	Land use planners, elected officials, emergency and facility managers	Damage by building type and location, utility, transportation system damage	Requires input from engineers, architects, building officials and planners
9 Set mitigation program priorities	Local Scenario	Level 2, detailed geology, building inventory	Land use planners, risk managers, fire safety officials	Multiple runs of building damage	Requires input from a geologist, structural engineers and architects

From FEMA's Guide to Using HAZUS for Mitigation, 2002.

Reducing earthquake losses must begin before the earthquake. In addition to mitigation efforts, proper preparedness can help reduce the impact and severity of a disaster. Emergency managers can use HAZUS loss estimates to increase their understanding of the scope of damages in their region. Probabilities of damage and functionality of essential facilities can help emergency personnel realize current limitations and formulate emergency response plans. Projected numbers of casualties can help predict demand on medical resources. Estimates of displaced households and people seeking public shelter can assist planners in organizing shelter availability and readiness. Projected patterns of water shortages and power outages can help emergency response personnel to set priorities for effective recovery.

In the event of an earthquake, HAZUS scenarios can provide rapid estimates of projected losses for emergency responders and government agencies. Estimates of dollar losses can help State and Federal governments plan for immediate and long-term assistance. HAZUS-generated maps can provide guidance about areas where greatest damages are likely to be and can show the probable functionality of essential facilities shortly after the earthquake. The exposure of utility and transportation lifelines to ground shaking can be mapped, along with the distribution of probable economic losses in the affected region. Induced effects of an earthquake, such as debris generated and fires ignited, can also be estimated to help response and recovery efforts.

6c. Customized HAZUS Scenarios

The scenarios included in this report are a standardized set of desktop exercises intended to motivate interest in more detailed region-specific scenarios. The accuracy of a HAZUS loss estimate is only as good as the inventory being used, and only the national default dataset has been used so far with Colorado scenarios. The best way to improve HAZUS results would be to update building, utility, transportation, and demographic inventories for county- or city-level regions. Considering Colorado's explosive growth rate, county scenarios along the Front Range would especially benefit from updated inventories. Since data currently being used is from the year 2000 Census, six years of urban growth is not represented in our loss estimates.

Other data missing from current inventories includes high potential loss facilities such as dams and power plants. Specific engineering parameters would be needed for these to be included in loss estimates, but for certain counties they would be valuable scenarios to consider. Colorado poses an interesting challenge to loss estimates related to water reservoirs, dams, and pipelines due to the extensive pipeline network bringing water from the Western Slope to the Front Range. Earthquakes in the western and central mountains could potentially affect the Front Range water supply if pipelines were disrupted. Military facilities are also missing from the inventory and would add to potential losses in certain counties.

CGS has the capability to perform a variety of customized scenarios for local governments if requested. In addition to inventory improvements listed above, these region-specific scenarios can include better soil and landslide susceptibility maps and can further experiment with attenuation functions. Mitigation scenarios such as cost-benefit analyses of building retrofitting would be useful tools for high-risk counties. Earthquake magnitudes lower than the maximum credible magnitude can be analyzed for a complete range of potential losses.

References and Links

Colorado Earthquake Information

Colorado Division of Emergency Management Earthquake Information: http://www.dola.state.co.us/oem/PublicInformation/earthquake.htm

CGS Earthquake Homepage: http://geosurvey.state.co.us/Default.aspx?tabid=108

CGS Earthquake, Fault, and Fold Internet Map Server: http://geosurvey.state.co.us/Default.aspx?tabid=270

Kirkham, R.M. and Rogers, W.P., 1999, Colorado earthquake information: 1867-1996: Colorado Geological Survey Bulletin 52, CD-ROM.

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Matthews, V., 2003, The challenges of evaluating earthquake hazard in Colorado, in Boyer, D.B., Santi, P.M., Rogers, W.P., Engineering Geology in Colorado – Contributions, Trends, and Case Histories, Association of Engineering Geologists Special Publication No. 15, 22p.

Matthews, V., 2002, We don't have earthquakes in Colorado do we?: RockTalk, Colorado Geological Survey, v. 5, no. 2, 12 p. http://geosurvey.state.co.us/pubs/rocktalk/rtv5n2.pdf

Matthews, V., 1973, A reappraisal of the seismic-risk classification of Colorado: Mountain Geologist, v. 10, p. 111-115.

Tweto, Ogden, 1979, Geologic map of Colorado: U.S. Geological Survey, scale 1:500,000.

USGS Colorado Earthquake Information: http://earthquake.usgs.gov/regional/states.php?regionID=6&region=Colorado

USGS Earthquake Hazards Mapping Program: http://earthquake.usgs.gov/research/hazmaps/products_data/48_States/index.php

Widmann, B.L., Kirkham, R.M., and Rogers, W.P., 1998, Preliminary Quaternary fault and fold map and database of Colorado: Colorado Geological Survey Open-File Report 98-8, 331 p.

HAZUS Background and Applications

California Geological Survey "Estimation of Future Earthquake Losses in California": http://www.consrv.ca.gov/cgs/rghm/loss/index.htm

FEMA HAZUS Overview: http://www.fema.gov/hazus/hz_overview.shtm

FEMA Earthquake Model Overview: http://www.fema.gov/hazus/hz_eq.shtm

Guide to Using HAZUS for Mitigation: http://www.fema.gov/hazus/pdf/hazus_for_mitigation.pdf

Helena, Montana HAZUS Analysis Project: http://www.hazus.org/BigSkyHUG/Documents/Helena_Area_HAZUS_Analysis_Project.pdf

NIBS Program Overview: http://nibs.org/hazusweb/overview/overview.php

NIBS Earthquake Methodology: http://nibs.org/hazusweb/overview/pubs.php

Natural Hazards Center "Worst-Case Thinking, An Idea Whose Time Has Come": http://www.colorado.edu/hazards/o/jan05/jan05a.html

Nevada Bureau of Mines and Geology Open-File Report 06-1: http://www.nbmg.unr.edu/dox/of061/of061.htm

Southern California Earthquake Center Puente Hills Earthquake Study: http://www.scec.org/research/050525puentehills.html

Wyoming Geological Survey Seismological Study: http://www.wrds.uwyo.edu/wrds/wsgs/hazards/quakes/seischar/Platte.pdf

More references and links are found in Appendices.

Appendix A
Earthquake Magnitudes and Intensities

The size and location of an earthquake can be measured through two different methods. ***Magnitude*** depicts the energy released by an earthquake, which is quantified by a network of seismographs around the world. Seismographs record the timing, strength, and types of seismic waves reaching them, and when at least three receive a signal the magnitude and origin of the waves can be determined. Earthquake magnitude is traditionally stated as Richter magnitude, where each number indicates local ground shaking 10 times stronger than the previous number. On this scale, M 3.0 is generally the threshold where an earthquake is felt, and M5.5 is the threshold where damage starts to occur. ***Intensity*** is a measure of an earthquake's effects upon people and property. Earthquake intensity is most commonly classified using the Modified Mercalli Intensity Scale that assigns a roman numeral to an event (**Table A-1**). Reports and observations obtained from newspapers, diaries, interviews, and inspections of structural damage and natural features are compiled for all areas where an earthquake was felt. Highest intensities are usually observed closest to the epicenter, but the entire pattern of observed intensities can reveal information about the nature of the earthquake (**Figure A-1**). Since instrumental recordings by modern seismographs were not available before the 1930's, studies of historical earthquakes rely on intensity values to better understand a region's earthquake history.

Table A-1: Modified Mercalli Intensity Scale

I	Not felt except by very few under favorable conditions.
II	Felt by only a few people at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt noticeably by those indoors, especially on upper floors of buildings. May not be recognized as an earthquake. Vibration feels like a truck passing by. Standing cars may rock slightly.
IV	Felt indoors by many, outdoors by some. At night, some people are awakened. Dishes, windows, and doors rattle. Feels like a heavy truck striking the building. Standing cars are noticeably rocked.
V	Felt by nearly everyone, with many awakened at night. Some dishes and windows are broken. Unstable objects are overturned. Pendulum clocks may stop. Trees might shake, and liquids might spill out of open containers.
VI	Felt by all, with many frightened. People have trouble walking. Some heavy furniture is moved and objects fall from shelves. Slight damage to structures, including cracked and fallen plaster.
VII	People have difficulty standing. Drivers can feel their cars shaking. Loose bricks fall from buildings. Slight to moderate damage in well-built buildings; considerable damage in poorly built structures.

VIII Drivers have trouble steering. Houses might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Hillsides might slide if wet. Water levels in wells might change.

IX All buildings, including well-built structures, suffer considerable damage. Houses shift off of foundations. Some underground pipes are broken.

X Most buildings and foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown onto the banks of rivers and lakes. Large fissures can break ground. Railroad tracks are bent slightly.

XI Most buildings collapse. Many bridges are destroyed. Underground pipelines are destroyed. Railroad tracks are badly bent.

XII Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples.

(Table derived from USGS and FEMA descriptions of intensity)

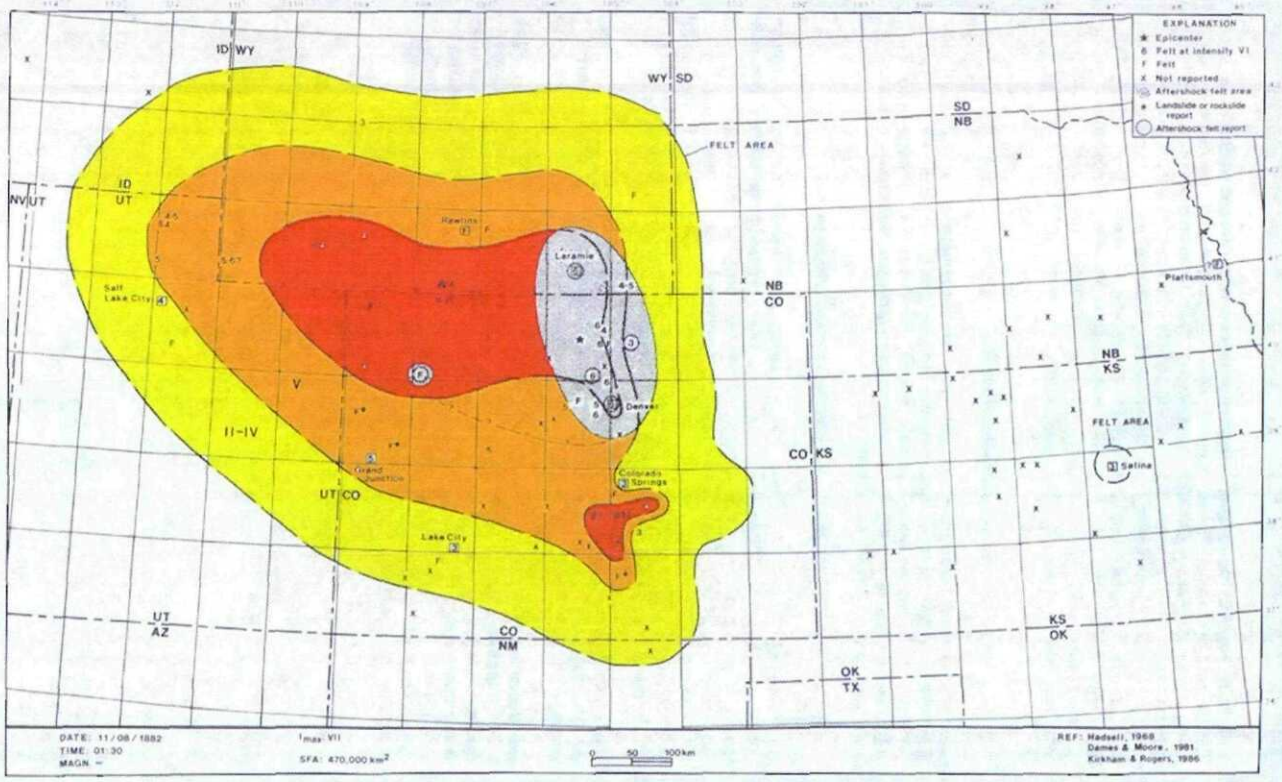

Figure A-1 – Sample Isoseismal Map, showing intensity contours for the 1882 Northern Colorado Earthquake, from Kirkham and Rogers (1986).

Ground shaking produced by an earthquake can also be depicted as Peak Ground Acceleration (PGA). This value is given in % g, or the percentage of gravitational force that a particle on the ground experiences during earthquake ground motions. PGA is an important measure of ground shaking because building codes incorporate a maximum allowed horizontal force that can be related to PGA. Relationships between earthquake intensity, potential damage, and PGA are not absolute but can be approximated (**Table A-2**). Ground acceleration is highly affected by surface material, with softer soils amplifying seismic waves up to two times greater than rock. Colors represented in the table are consistent with PGA values mapped for our statewide HAZUS scenarios.

Table A-2: Generalized Relationships Between PGA and Intensity

Perceived Shaking	Not Felt	Very Weak	Weak	Light	Moderate	Strong	Very Strong	Violent	Extreme
Potential Damage	None	None	None	Very Slight	Slight	Moderate	Extensive	Complete	Complete/Collapse
Peak Ground Acceleration (%g)	**<0.17**	**0.17-1.4**	**1.4-3.9**	**3.9-9.2**	**9.2-18**	**18-34**	**34-65**	**65-124**	**>124**
Modified Mercalli Intensity	**I**	**II-III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X+**

Additional Information:

USGS Earthquake Hazards Information:

- Measuring earthquake severity: http://pubs.usgs.gov/gip/earthq4/severitygip.html
- What is peak ground acceleration? http://earthquake.usgs.gov/research/hazmaps/haz101/faq/parm01.php
- What is %g and its relationship to building damage? http://earthquake.usgs.gov/research/hazmaps/haz101/faq/parm02.php
- Clickable list of earthquake topics: http://earthquake.usgs.gov/learning/topics.php

Appendix B
Colorado Faults Analyzed in HAZUS Scenarios

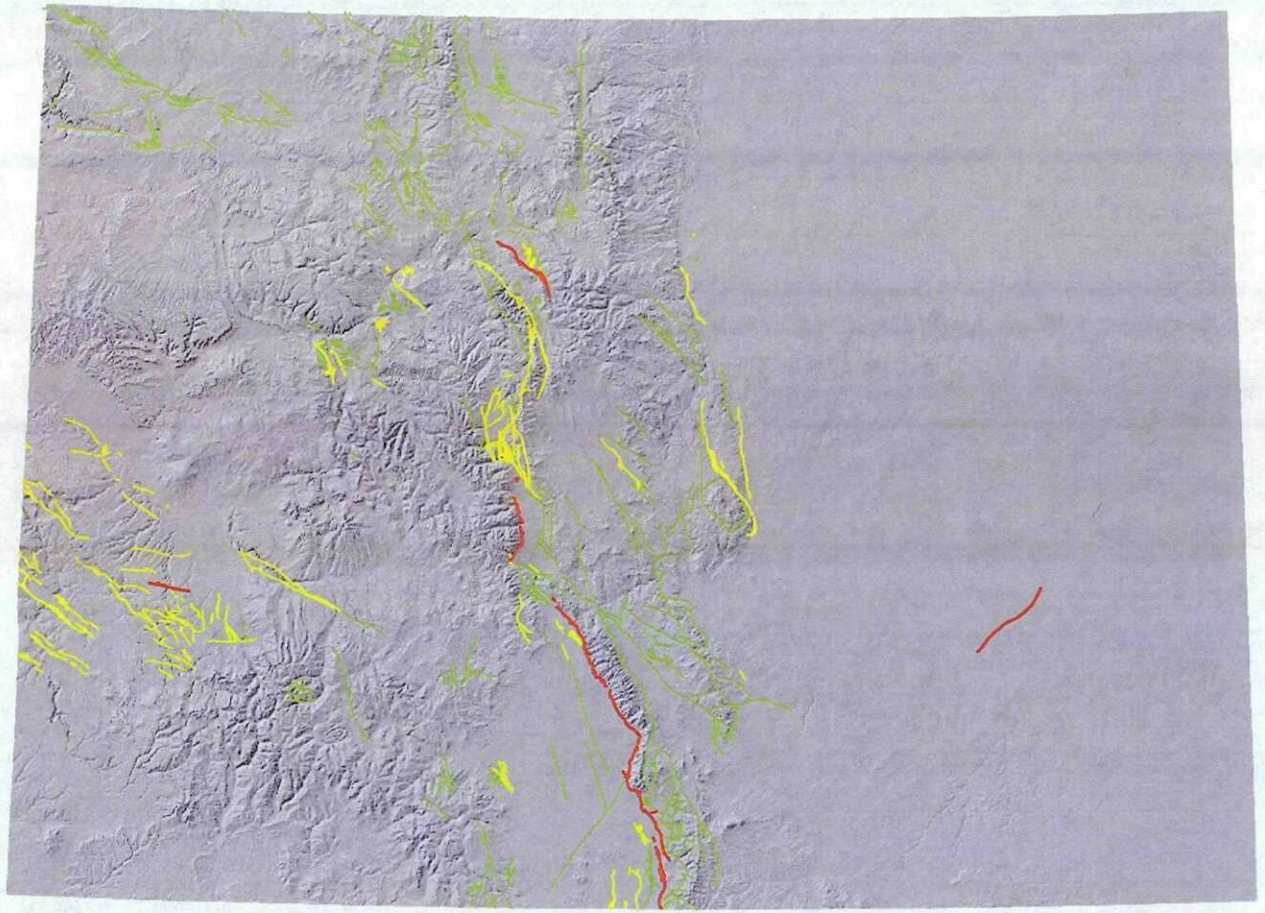

Figure B-1 – Digital elevation model with known Cenozoic faults (<65 Ma) in green, Quaternary faults (<1.6 Ma) in yellow, and Holocene faults (<15 Ka) in red. Ma = Million years ago, Ka = Thousand years ago.

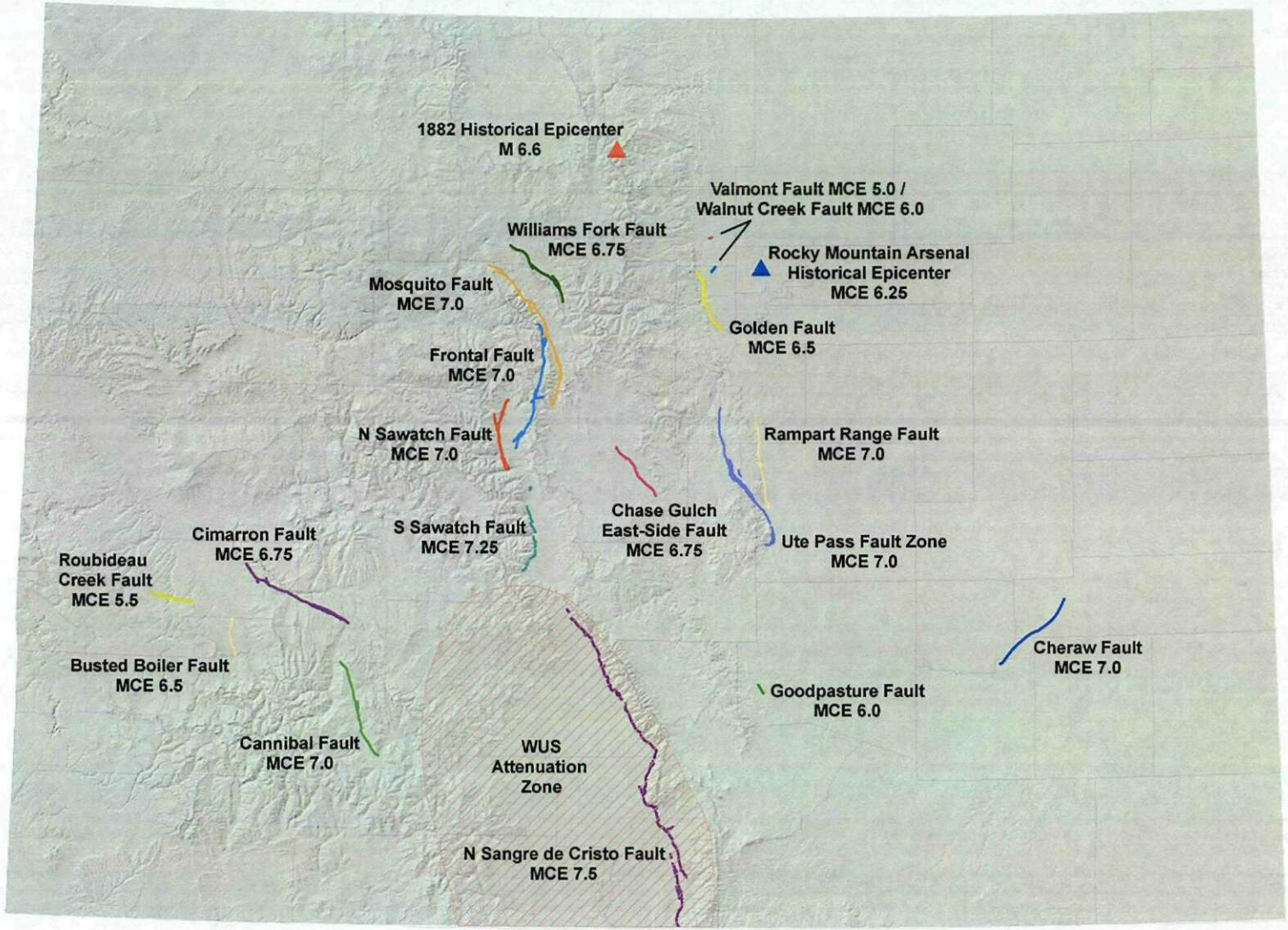

Figure B-2 – Faults included in HAZUS analysis were selected from Quaternary and Holocene faults. MCE is the Maximum Credible Earthquake for each fault. The San Luis Valley comprises the WUS Attenuation Zone, with the rest of Colorado analyzed as a CEUS Attenuation Zone.

Fault Parameters for HAZUS Scenarios

Geographic coordinates use North American Datum 1983

1882 Historical Earthquake – Rocky Mountain National Park Epicenter:

Epicenter: (40.41, -105.74); Strike = 45 (N45°E); Dip = +60 (60°NW); Max. Magnitude = 6.6

Busted Boiler Fault:

Epicenter (38.24, -107.86); Strike = 175 (N5°W); Dip = +60 (60°SW); Max. Magnitude = 6.5

Cannibal Fault:

Epicenter (37.94, -107.16); Strike = 160 (N20°W); Dip = +60 (60°SW); Max. Magnitude = 7.0

Chase Gulch Fault:

Epicenter (39.00, -105.62); Strike = 157 (N23°W); Dip = -60 (60°NE); Max. Magnitude = 6.75

Cheraw Fault:

Epicenter (38.28, -103.42); Strike = 44 (N44°E); Dip = +66 (66°NW); Max. Magnitude = 7.0

Cimarron Fault:

Epicenter (38.41, -107.48); Strike = 122 (N58°W); Dip = -70 (70°NE); Max. Magnitude = 6.75

Frontal (Gore) Fault:

Epicenter (39.68, -106.16); Strike = 156 (N24°W); Dip = -75 (75°NE); Max. Magnitude = 7.0

Golden Fault:

Epicenter (39.74, -105.22); Strike = 157 (N23°W); Dip = +60 (60°SW); Max. Magnitude = 6.5

Goodpasture Fault:

Epicenter (38.05, -104.91); Strike = 148 (N32°W); Dip = -60 (60°NE); Max. Magnitude = 6.0

Mosquito Fault:

Epicenter (39.38, -106.16); Strike = 9 (N9°E); Dip = +70 (70°NW); Max. Magnitude = 7.0

Rampart Range Fault:

Epicenter (39.06, -104.92); Strike = 171 (N9°W); Dip = +60 (60°SW); Max. Magnitude = 7.0

Rocky Mountain Arsenal Historical Epicenter:
Epicenter (39.90, -104.90); Strike = 130 (N50°W); Dip = +60 (60°SW); Max. Magnitude = 6.25

Roubideau Creek Fault:
Epicenter (38.41, -108.19); Strike = 106 (N74°W); Dip = -65 (65°NE); Max. Magnitude = 5.5

N Sangre de Cristo Fault:
Epicenter (37.90, -105.63); Strike = 161 (N19°W); Dip = +60 (60°SW); Max. Magnitude = 7.5

N Sawatch Fault:
Epicenter (39.15, -106.39); Strike = 147 (N33°W); Dip = -72 (72°NE); Max. Magnitude = 7.0

S Sawatch Fault:
Epicenter (38.75, -106.18); Strike = 148 (N32°W); Dip = -70 (70°NE); Max. Magnitude = 7.25

Ute Pass Fault:
Epicenter (38.92, -105.00); Strike = 152 (N28°W); Dip = +50 (50°SW); Max. Magnitude = 7.0

Valmont Fault:
Epicenter (40.03, -105.20); Strike = 75 (N75°E); Dip = -80 (80°SE); Max. Magnitude = 5.0

Walnut Creek Fault:
Epicenter (39.88, -105.15); Strike = 31 (N31°E); Dip = +80 (80°NW); Max. Magnitude = 6.5

Williams Fork Fault:
Epicenter (39.87, -106.15); Strike = 140 (N40°W); Dip = -60 (60°NE); Max. Magnitude = 6.75

Fault parameters are best understood if faults are envisioned as geometric planes, where rock masses on either side remain locked until stress is suddenly released and an earthquake occurs. A fault is a three-dimensional feature commonly mapped as two-dimensional lines, or fault traces, where the fault intersects the ground surface. The fault parameters used in HAZUS analyses were compiled from a variety of sources. Fault geometries such as strike, dip, and length were obtained from the CGS Colorado Late Cenozoic Fault and Fold Database, an Internet Map Server available to the public via the link below. This map server is a collection of all available information regarding Colorado's Cenozoic-or-younger faults. Many of the faults selected for HAZUS analysis have had field studies conducted along them, such as paleoseismic trenching or detailed mapping. Mapping a fault's surface exposure provides information about its length and strike, or orientation relative to north. The Maximum Credible Earthquake (MCE) is inferred from the mapped length of a fault based on magnitude-length relationships developed by Wells and Coppersmith (1994). Fault dip, the steepness of the fault plane under the surface, is derived from field studies where dip was directly measured, or it is estimated from other characteristics of the fault such as type of displacement or material displaced.

The epicenter chosen for HAZUS analysis is the approximate midpoint of each mapped fault trace. An earthquake's epicenter is the surface location above the subsurface point where fault rupture first initiated. Higher ground shaking levels normally occur immediately around an epicenter and are gradually dampened as distance from the epicenter increases. Epicenter locations are never predictable before an earthquake because a fault under stress can rupture at any given point along its length and depth. Fault planes that dip beneath the surface at an angle other than vertical will have epicenters that are not located directly along the fault trace. Epicenter location has a major effect on damages caused by an earthquake, as discussed in the text (Section 2e). We recognize that our choice of epicenter location at the midpoint of a fault trace is an approximation necessary for the use of HAZUS loss estimation methodology.

Two epicenters from historical earthquakes in Colorado were also analyzed to estimate losses if a repeat event were to occur today. The November, 1882 Earthquake occurred somewhere in northern Colorado, most commonly believed to have had an epicenter in the vicinity of Rocky Mountain National Park. The 1882 epicenter and magnitude (M6.6) chosen for our HAZUS analysis is from Kirkham and Rogers (1986). The other historical earthquake event analyzed in HAZUS was actually a swarm of earthquakes that occurred throughout the 1960's and early 1970's in the vicinity of the Rocky Mountain Arsenal northeast of Denver. These earthquakes are believed to have been induced by high-pressure injection of waste water into wells at the arsenal. Epicenters were distributed over a 15 km-long swath that yields a MCE of 6.25 according to Wells and Coppersmith (1994) curves. Our HAZUS epicenter was selected from the approximate center of the swath.

For more information:

Faults:
CGS Earthquakes Homepage: **http://geosurvey.state.co.us/Default.aspx?tabid=108**
CGS Colorado Late Cenozoic Fault and Fold Database and Internet Map Server: **http://geosurvey.state.co.us/Default.aspx?tabid=453**
CGS Colorado Earthquake Map Server: **http://geosurvey.state.co.us/Default.aspx?tabid=270**

CGS Earthquake Publications List: **http://geosurvey.state.co.us/Default.aspx?tabid=296**

Widmann, B.L., Kirkham, R.M., and Rogers, W.P., 1998, Preliminary Quaternary fault and fold map and database of Colorado: Colorado Geological Survey Open-File Report 98-8, 331 p.

Kirkham, R.M. and Rogers, W.P., 2000, Colorado Earthquake Information, 1867-1996: Colorado Geological Survey Bulletin 52, CD-ROM.

1882 Earthquake:
USGS Summary: http://earthquake.usgs.gov/regional/states/events/1882_11_08_spence.php

Kirkham, R.M. and Rogers, W.P., 1986, An interpretation of the November 7, 1882 earthquake, in Rogers, W.P. and Kirkham, R.M., eds., Contributions to Colorado tectonics and seismicity – A 1986 update: Colorado Geological Survey Special Publication 28, p. 122-144.

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Rocky Mountain Arsenal Earthquakes, 1960-70's:
CGS Summary: http://geosurvey.state.co.us/portals/0/Rocky%20Mountain%20Arsenal%20Web.pdf
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WUS Attenuation Functions
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Munson, C.G. and Thurber, C.H., 1997, Analysis of the attenuation of strong ground motion on the island of Hawaii: Bulletin of the Seismological Society of America, vol. 87, no. 4, pp. 945-960.

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Youngs, R.R., Chiou, S.J., Silva, W.L. and Humphrey, J.R., 1997, Strong ground motion attenuation relationships for subduction zone earthquakes: Seismological Research Letters, Jan/Feb.

CEUS Attenuation Functions

Frankel, A., Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S. and Hopper, M., 1996, National Seismic-Hazard Maps: Documentation June 1996: USGS Open-File Report 96-532, United States Geological Survey.

Sayv, J., 1998, Ground motion attenuation in the eastern North America: Lawrence Livermore National Laboratory.

Toro, G.R., Abrahamson, N.A. and Schneider, J.F., 1997, Engineering model of strong ground motions from earthquakes in the Central and Eastern United States: Seismological Research Letters, Jan/Feb.

Magnitude-Length Relationships

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Appendix C
Statewide Scenario Results and Maps

Fault	Earthquake Magnitude	Economic Loss in State ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Busted Boiler	6.5	694.02	0.19%	8,239 (1%)	107	693	179	12	3,295
Cannibal	7	674.66	0.19%	10,762 (1%)	46	458	117	1	561
Chase Gulch	6.75	3,760.43	1.04%	50,498 (4%)	263	4,373	1,111	304	1,198
Cheraw	7	1,260.53	0.35%	17,472 (1%)	141	1,317	354	3,055	6,291
Cimarron	6.75	807.50	0.22%	10,070 (1%)	142	1,037	262	708	1,863
Frontal	7	6,733.82	1.87%	73,922 (5%)	737	8,765	2,111	1,569	10,100
Golden	6.5	21,890.05	6.08%	213,115 (16%)	4,134	42,952	10,769	6,421	232,559
Goodpasture	6	478.59	0.13%	5,842 (<1%)	16	203	56	0	1,521
Mosquito	7	6,189.80	1.72%	70,083 (5%)	609	7,785	1,901	411	11,782
Rampart Range	7	23,046.35	6.40%	237,595 (17%)	5,058	46,717	11,343	22,364	157,654
Rocky Mountain Arsenal	6.25	14,867.04	4.13%	151,902 (11%)	2,507	28,461	7,416	1,702	112,994
Roubideau Creek East	5.5	94.23	<0.01%	665 (<1%)	1	10	2	0	0
N Sangre de Cristo	7.5 WUS	767.07	0.21%	11,639 (1%)	91	721	190	239	476
N Sangre de Cristo	7.5 CEUS	8,020.95	2.23%	93,178 (7%)	1,655	15,918	4,105	1,397	5,132
North Sawatch	7	3,617.52	1.01%	46,739 (3%)	287	4,086	1,002	695	5,880
South Sawatch	7.25	4,742.32	1.32%	62,251 (5%)	463	6,127	1,551	2,146	7,841
Ute Pass	7	16,774.21	4.66%	179,782 (13%)	3,314	31,676	7,757	19,057	126,754
Valmont	5	711.46	0.20%	1,853 (<1%)	4	77	19	0	0
Walnut Creek	6	9,704.00	2.70%	94,660 (7%)	894	12,483	3,219	0	106,167
Williams Fork	6.75	3,482.99	0.97%	42,225 (3%)	254	3,807	936	125	2,865
1882 Rocky Mtn National Park	6.6	2,761.30	0.77%	35,024 (3%)	193	2,656	658	0	2,844

Copy or provide link to all statewide PGA maps here
12.1 MB Folder: "Statewide PGA Maps"

Appendix D
County Scenario Summary

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Adams	Random	6.50	853.52	4.06%	12,185 (12%)	105	931	246	1,013	923
Adams	Golden	6.50	1,589.25	7.56%	21,656 (21%)	257	2,194	597	0	5,691
Adams	Rocky Mtn Arsenal	6.25	3,148.06	14.97%	34,723 (34%)	623	4,764	1,231	811	80,388
Alamosa	Random	6.5 WUS	152.22	8.28%	1,628 (35%)	15	144	40	316	0
Alamosa	N Sangre de Cristo	7.5 WUS	142.06	7.72%	1,342 (29%)	19	137	37	51	0
Arapahoe	Random	6.50	2,350.41	7.29%	28,526 (19%)	317	4,927	1,197	0	1,126
Arapahoe	Golden	6.50	3,900.99	12.10%	42,239 (28%)	885	9,835	2,373	190	4,752
Arapahoe	Rampart	7.00	3,835.78	11.90%	42,105 (28%)	892	9,250	2,191	374	0
Archuleta	Random	6.50	341.25	17.51%	2,110 (44%)	16	129	30	11	2,723
Archuleta	Cannibal	7.00	42.09	2.16%	461 (10%)	1	10	2	0	0
Baca	Random	6.50	119.80	6.54%	1,011 (53%)	8	68	14	112	1,725
Baca	Cheraw	7.00	2.14	0.12%	42 (2%)	0	0	0	0	0
Bent	Random	6.50	72.32	6.69%	826 (44%)	7	49	12	0	1,787
Bent	Cheraw	7.00	18.08	1.67%	192 (10%)	0	3	0	0	0
Boulder	Random	6.50	3,282.58	15.83%	28,018 (30%)	434	5,290	1,267	315	55,571
Boulder	Golden	6.50	1,489.54	7.18%	15,073 (16%)	136	1,880	445	0	7,554
Chaffee	Random	6.50	288.32	12.25%	2,770 (39%)	17	132	32	2	3,302
Chaffee	S Sawatch	7.25	665.16	28.26%	5,321 (76%)	121	919	233	1,953	6,057
Chaffee	N Sangre de Cristo	7.50	425.76	18.09%	3,935 (56%)	134	759	195	2,207	2,061
Cheyenne	Random	6.50	51.12	3.52%	427 (45%)	2	15	2	0	786
Cheyenne	Cheraw	7.00	8.57	0.59%	35 (4%)	0	0	0	0	0
Clear Creek	Random	6.50	175.44	10.74%	1,483 (33%)	11	64	13	0	3,337
Clear Creek	Golden	6.50	42.88	2.63%	342 (8%)	1	6	1	0	0

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Conejos	Random	6.5 WUS	26.37	2.27%	656 (21%)	1	10	2	0	0
Conejos	N Sangre de Cristo	7.5 WUS	9.88	0.85%	451 (15%)	2	5	1	0	0
Costilla	Random	6.5 WUS	20.66	2.04%	482 (33%)	2	16	5	2	0
Costilla	N Sangre de Cristo	7.5 WUS	51.60	5.10%	714 (48%)	13	101	24	188	476
Crowley	Random	6.50	91.11	13.66%	966 (74%)	28	143	37	200	1,211
Crowley	Cheraw	7.00	55.19	8.28%	693 (53%)	12	54	14	5	881
Custer	Random	6.50	148.28	16.90%	1,489 (60%)	10	83	17	78	1,363
Custer	N Sangre de Cristo	7.50	138.38	15.77%	1,572 (63%)	19	128	27	31	1,085
Delta	Random	6.50	287.66	10.12%	3,453 (33%)	23	194	49	0	5,515
Delta	Cimarron	6.75	53.14	1.87%	861 (8%)	1	9	2	0	0
Denver	Random	6.50	14,227.75	36.44%	73,314 (51%)	5,841	37,053	9,900	94,819	182,596
Denver	Golden	6.50	7,510.48	19.24%	56,664 (39%)	1,959	20,014	5,360	5,511	60,801
Denver	Rampart	7.00	4,652.06	11.92%	38,815 (27%)	993	12,255	3,229	287	0
Denver	Rocky Mtn Arsenal	6.25	5,557.58	14.24%	45,403 (32%)	1,257	13,992	3,809	909	6,803
Denver	Walnut Creek	6.00	3,152.92	8.08%	26,336 (18%)	395	5,779	1,599	0	290
Dolores	Random	6.50	26.18	5.08%	474 (45%)	1	11	2	0	694
Dolores	Cannibal	7.00	0.90	0.17%	28 (3%)	0	0	0	0	0
Douglas	Random	6.50	2,036.54	14.87%	23,914 (36%)	326	1,716	312	324	38,419
Douglas	Rampart	7.00	1,848.03	13.49%	22,731 (34%)	493	1,785	327	3,183	18,030
Eagle	Random	6.50	599.67	11.96%	5,120 (36%)	70	832	168	755	7,002
Eagle	Frontal	7.00	571.47	11.40%	3,880 (27%)	120	812	163	50	1,469
El Paso	Random	6.50	4,254.96	13.06%	48,244 (31%)	903	8,292	1,968	1,173	51,038
El Paso	Rampart	7.00	9,013.76	27.67%	80,644 (52%)	2,496	19,660	4,657	18,538	135,366
El Paso	Ute Pass	7.00	8,216.92	25.23%	76,253 (50%)	2,193	17,892	4,290	18,970	118,308
Elbert	Random	6.50	72.84	3.00%	823 (12%)	6	14	2	0	549

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Elbert	Rampart	7.00	98.88	4.07%	1,320 (19%)	21	36	6	0	0
Fremont	Random	6.50	299.14	7.96%	3,468 (24%)	31	293	80	0	1,783
Fremont	N Sangre de Cristo	7.50	393.64	10.47%	4,901 (34%)	89	629	170	13	790
Garfield	Random	6.50	252.92	5.34%	2,492 (18%)	27	237	53	0	3,316
Garfield	N Sawatch	7.00	76.57	1.62%	977 (7%)	4	47	10	0	0
Gilpin	Random	6.50	133.28	18.38%	1,067 (40%)	9	46	9	0	1,826
Gilpin	Golden	6.50	40.11	5.53%	323 (12%)	1	5	0	0	0
Grand	Random	6.50	194.88	6.22%	1,615 (21%)	11	86	17	44	913
Grand	Williams Fork	6.75	184.15	5.88%	1,389 (18%)	12	94	18	125	929
Gunnison	Random	6.50	164.33	6.13%	1,494 (23%)	24	306	83	0	239
Gunnison	N Sangre de Cristo	7.50	100.28	3.74%	1,001 (15%)	19	217	59	0	0
Hinsdale	Random	6.50	45.10	12.99%	627 (58%)	3	19	3	0	330
Hinsdale	Cannibal	7.00	35.15	10.12%	576 (53%)	2	15	2	0	294
Huerfano	Random	6.50	146.52	7.55%	1,193 (33%)	5	36	9	3	2,245
Huerfano	N Sangre de Cristo	7.50	83.97	4.33%	874 (25%)	5	28	7	0	0
Jackson	Random	6.50	88.91	9.36%	610 (62%)	5	35	7	67	609
Jackson	1882 RMNP	6.60	3.66	0.39%	49 (5%)	0	0	0	0	0
Jefferson	Random	6.50	5,111.00	14.27%	50,103 (29%)	603	6,403	1,403	345	113,457
Jefferson	Golden	6.50	5,881.32	16.42%	54,824 (32%)	828	8,306	1,839	927	153,809
Kiowa	Random	6.50	45.31	3.97%	483 (72%)	7	59	10	117	584
Kiowa	Cheraw	7.00	11.36	1.00%	182 (27%)	1	4	0	0	0
Kit Carson	Random	6.50	100.24	4.45%	1,192 (43%)	10	83	18	33	519
Kit Carson	Cheraw	7.00	11.25	0.50%	179 (6%)	0	3	0	0	0
La Plata	Random	6.50	640.28	14.86%	5,520 (32%)	64	632	162	0	8,925
La Plata	Cannibal	7.00	53.12	1.23%	916 (5%)	1	18	4	0	0

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Lake	Random	6.50	274.37	24.97%	1,983 (68%)	39	344	86	48	2,610
Lake	Mosquito	7.00	298.86	27.20%	2,213 (75%)	54	479	120	320	2,616
Lake	N Sawatch	7.00	302.50	27.53%	2,185 (74%)	55	458	114	693	2,573
Larimer	Random	6.50	1,357.50	7.18%	17,869 (21%)	171	1,663	407	21	1,198
Larimer	1882 RMNP	6.60	887.27	4.70%	10,171 (12%)	93	831	189	0	2,844
Las Animas	Random	6.50	33.82	0.91%	345 (6%)	1	5	1	0	0
Las Animas	N Sangre de Cristo	7.50	31.63	0.85%	576 (10%)	1	20	6	0	0
Lincoln	Random	6.50	118.13	6.33%	818 (41%)	19	136	28	1,268	672
Lincoln	Cheraw	7.00	22.48	1.20%	371 (19%)	1	9	2	0	0
Logan	Random	6.50	346.75	11.34%	3,838 (58%)	91	629	166	372	2,095
Logan	Rocky Mtn Arsenal	6.25	2.12	0.00%	63 (1%)	0	0	0	0	0
Mesa	Random	6.50	2,122.40	23.47%	20,611 (54%)	545	4,152	1,145	18	35,626
Mesa	Cimarron	6.75	55.36	0.61%	1,265 (3%)	2	30	8	0	0
Mineral	Random	6.50	74.41	11.15%	688 (71%)	5	36	6	34	336
Mineral	Cannibal	7.00	43.13	6.46%	546 (56%)	3	19	3	1	267
Moffat	Random	6.50	36.09	1.30%	348 (8%)	1	6	1	12	251
Moffat	Frontal	7.00	5.11	0.18%	77 (2%)	0	0	0	0	0
Montezuma	Random	6.50	259.84	8.45%	2,903 (33%)	17	122	33	0	5,304
Montezuma	Cannibal	7.00	9.80	0.32%	234 (3%)	0	1	0	0	0
Montrose	Random	6.50	256.99	6.81%	3,361 (28%)	24	183	49	0	0
Montrose	Cimarron	6.75	497.40	13.18%	4,969 (41%)	130	856	213	708	1,863
Morgan	Random	6.50	1,384.96	25.63%	5,359 (62%)	132	921	244	1,316	6,410
Morgan	Rocky Mtn Arsenal	6.25	21.84	0.40%	272 (3%)	0	2	0	0	0
Otero	Random	6.50	334.00	11.38%	2,945 (44%)	39	329	88	2,804	4,935
Otero	Cheraw	7.00	415.54	14.16%	3,676 (55%)	78	588	166	3,050	5,410

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Ouray	Random	6.50	147.27	18.84%	746 (40%)	6	30	6	0	1,390
Ouray	Busted Boiler	6.50	104.19	13.33%	598 (32%)	4	18	3	0	1,305
Park	Random	6.50	152.72	5.44%	2,356 (25%)	7	53	7	116	575
Park	Chase Gulch	6.75	165.45	5.90%	2,784 (29%)	8	76	14	304	1,198
Park	Mosquito	7.00	169.29	6.03%	2,308 (24%)	15	144	26	22	714
Phillips	Random	6.50	74.10	6.44%	800 (47%)	7	50	9	5	1,520
Phillips	Rocky Mtn Arsenal	6.25	0.00	0.00%	0 (0%)	0	0	0	0	0
Pitkin	Random	6.50	375.02	16.86%	1,567 (24%)	20	204	41	0	4,611
Pitkin	N Sawatch	7.00	168.78	7.59%	1,060 (16%)	14	100	20	0	616
Prowers	Random	6.50	209.69	9.09%	2,383 (51%)	42	296	82	109	1,788
Prowers	Cheraw	7.00	60.89	2.64%	777 (16%)	5	31	9	0	0
Pueblo	Random	6.50	2,315.75	21.99%	21,293 (47%)	515	4,079	1,255	410	43,103
Pueblo	N Sangre de Cristo	7.50	483.70	4.59%	6,793 (15%)	124	739	224	0	0
Pueblo	Ute Pass	7.00	288.21	2.74%	4,327 (10%)	29	248	75	0	0
Rio Blanco	Random	6.50	51.43	3.28%	647 (27%)	4	31	7	0	0
Rio Blanco	Frontal	7.00	6.69	0.43%	132 (5%)	0	2	0	0	0
Rio Grande	Random	6.5 WUS	88.75	4.98%	1,556 (33%)	18	145	41	0	0
Rio Grande	Cannibal	7.0 CEUS	36.60	2.05%	629 (13%)	2	18	5	0	0
Routt	Random	6.50	461.55	14.82%	2,665 (34%)	70	347	69	0	3,934
Routt	Frontal	7.00	55.99	1.80%	626 (8%)	4	32	6	0	0
Saguache	Random	6.5 WUS	53.11	3.50%	1,145 (48%)	8	65	17	139	625
Saguache	N Sangre de Cristo	7.5 WUS	25.23	1.66%	421 (18%)	2	12	3	0	0
San Juan	Random	6.50	20.06	5.43%	214 (42%)	1	6	1	0	241
San Juan	Cannibal	7.00	2.36	0.64%	38 (7%)	0	0	0	0	0
San Miguel	Random	6.50	32.62	2.40%	324 (10%)	1	10	2	0	466

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
San Miguel	Busted Boiler	6.50	36.15	2.65%	201 (6%)	1	13	2	0	0
Sedgwick	Random	6.50	62.77	5.86%	659 (59%)	7	79	17	48	1,075
Sedgwick	Rocky Mtn Arsenal	6.25	0.00	0.00%	0 (0%)	0	0	0	0	0
Summit	Random	6.50	829.99	19.84%	4,028 (37%)	67	602	116	0	7,071
Summit	Frontal	7.00	1,345.36	32.15%	6,602 (60%)	179	1,379	267	1,491	7,862
Summit	Mosquito	7.00	1,056.71	25.26%	5,177 (47%)	117	849	162	69	6,861
Teller	Random	6.50	255.40	13.08%	2,849 (30%)	13	90	18	0	6,043
Teller	Ute Pass	7.00	523.85	26.83%	5,099 (54%)	65	514	104	87	6,384
Washington	Random	6.50	71.76	3.34%	784 (42%)	7	49	7	85	819
Washington	Rocky Mtn Arsenal	6.25	1.09	0.00%	5 (0%)	0	0	0	0	0
Weld	Random	6.50	944.83	6.61%	13,382 (25%)	125	1,414	393	0	887
Weld	Rocky Mtn Arsenal	6.25	501.92	3.51%	6,871 (13%)	42	322	80	0	1,610
Yuma	Random	6.50	201.22	7.64%	2,069 (60%)	40	325	68	1,261	1,161
Yuma	Cheraw	7.00	3.29	0.13%	84 (2%)	0	0	0	0	0

Note: Zeroes in columns showing "Households without Water" and "Households without Electric Power" do not consistently represent zero affected households. Incomplete inventory data for water pipelines and electricity lifelines causes inaccurate calculations of affected households.

Appendix E
County Scenario Maps

Link to folder "County Maps" (approx. 345 MB)

Appendix F
Descriptions of Building State Damage

As described in Section 2b of this report, the general building stock included in the HAZUS inventory is organized into model building types. Structures that are not identified as essential facilities (schools, hospitals, police and fire stations) are grouped according to building type, occupancy, and seismic code within census tracts for HAZUS analysis. Essential facilities are analyzed individually. Building damage predictions are calculated based on structure fragility curves derived from engineering studies of building displacement resulting from ground shaking (**Figure E-1**). HAZUS predicts structural and nonstructural damage, but for the purposes of this study only structural damage is being reported.

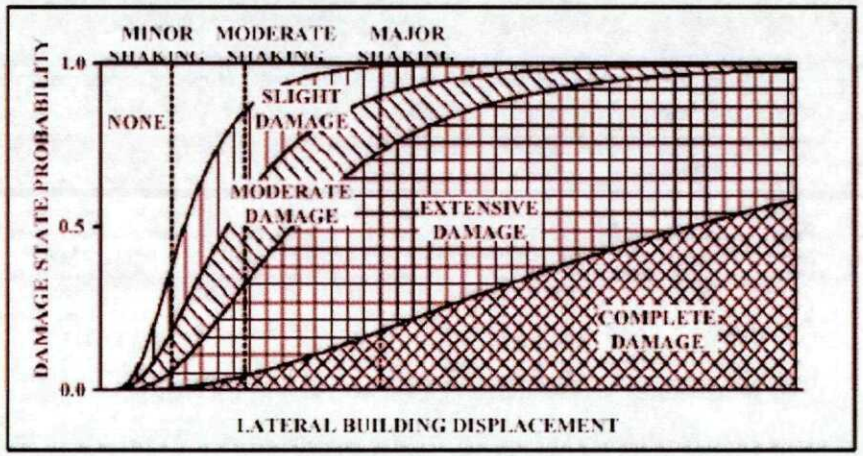


Figure E-1 – Sample fragility curve used in HAZUS calculations, from HAZUS User Manual Chapter 9.

Structural damage predictions are stated as probabilities of different damage states: None, Slight, Moderate, Extensive, and Complete. The probability damage states (PDS) for a single building group should add up to 1:

PDS None + PDS Slight + PDS Moderate + PDS Extensive + PDS Complete = 1

HAZUS also states PDS in terms of the damage state met or exceeded in a given group of buildings: At Least Slight, At Least Moderate, and At Least Extensive. We found this final category, "At Least Extensive", to be the most meaningful for generating large amounts of preliminary scenario maps at the county level. Visualizing essential facilities color-coded with a probability of sustaining damages that are extensive or complete is a powerful tool for estimating the extent of earthquake damage.

Examples of building damage states are summarized below, copied from the HAZUS-MH Technical Manual Chapter 5. For the sake of brevity, this is not a complete list of all building types and their damage states. Three building types were chosen due to their quantity in Denver County (**Figure E-2**). Further information can be provided upon request.

Wood, Light Frame (W1):

Slight Structural Damage: Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.

Moderate Structural Damage: Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.

Extensive Structural Damage: Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations; partial collapse of "room-over-garage" or other "soft-story" configurations; small foundations cracks.

Complete Structural Damage: Structure may have large permanent lateral displacement, may collapse, or be in imminent danger of collapse due to cripple wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks. Approximately 3% of the total area of W1 buildings with Complete damage is expected to be collapsed.

Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms (RM1):

Slight Structural Damage: Diagonal hairline cracks on masonry wall surfaces; larger cracks around door and window openings in walls with large proportion of openings; minor separation of walls from the floor and roof diaphragms.

Moderate Structural Damage: Most wall surfaces exhibit diagonal cracks; some of the shear walls have exceeded their yield capacities indicated by larger diagonal cracks. Some walls may have visibly pulled away from the roof.

Extensive Structural Damage: In buildings with relatively large area of wall openings most shear walls have exceeded their yield capacities and some of the walls have exceeded their ultimate capacities indicated by large, through-the-wall diagonal cracks and visibly buckled wall reinforcement. The plywood diaphragms may exhibit cracking and separation along plywood joints. Partial collapse of the roof may result from failure of the wall-to-diaphragm anchorages or the connections of beams to walls.

Complete Structural Damage: Structure has collapsed or is in imminent danger of collapse due to failure of the wall anchorages or due to failure of the wall panels. Approximately 13%(low-rise) or 10%(mid-rise) of the total area of RM1 buildings with Complete damage is expected to be collapsed.

Unreinforced Masonry Bearing Walls (URM):

Slight Structural Damage: Diagonal, stair-step hairline cracks on masonry wall surfaces; larger cracks around door and window openings in walls with large proportion of openings; movements of lintels; cracks at the base of parapets.

Moderate Structural Damage: Most wall surfaces exhibit diagonal cracks; some of the walls exhibit larger diagonal cracks; masonry walls may have visible separation from diaphragms; significant cracking of parapets; some masonry may fall from walls or parapets.

Extensive Structural Damage: In buildings with relatively large area of wall openings most walls have suffered extensive cracking. Some parapets and gable end walls have fallen. Beams or trusses may have moved relative to their supports.
Complete Structural Damage: Structure has collapsed or is in imminent danger of collapse due to in-plane or out-of-plane failure of the walls. Approximately 15% of the total area of URM buildings with Complete damage is expected to be collapsed.

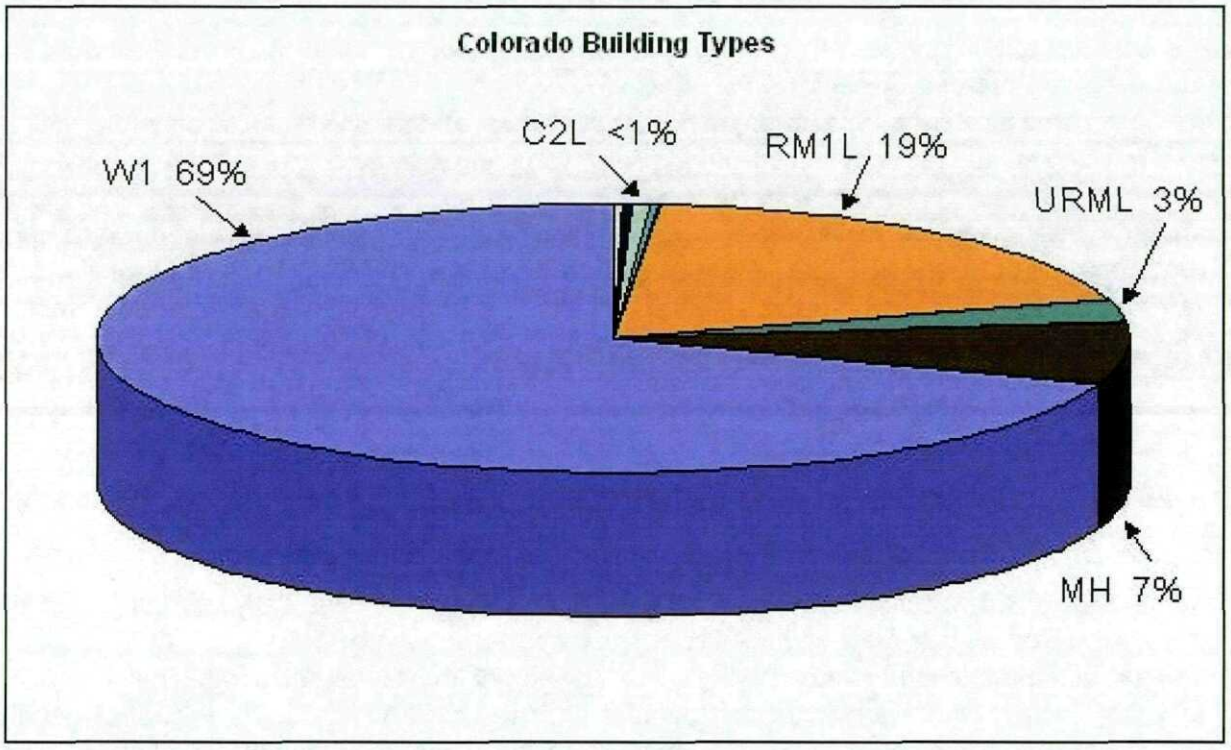


Figure E-2 – Distribution of building types in Colorado, derived from HAZUS default inventory of building stock. W1 is Wood-Light Frame, RM1 is Reinforced Masonry Bearing Walls, URM is Unreinforced Masonry Bearing Walls, MH is MobileHomes, and C2 is Concrete Shear Walls. See Table 1 in Section 2b for a complete list of building types.

Appendix G
Sample Summary Report Generated by HAZUS

Link to Sample pdf report (340 KB)

Appendix H
Faults and Historical Earthquakes by County

The following list contains summaries for each county illustrating population data, population changes, county size, total inventory value, emergency management contact information, Cenozoic faults within county boundaries, historical earthquakes within county boundaries, and a list of HAZUS scenario results performed for the county. Demographic data is from the 2000 U.S. Census or updated county websites and Colorado Emergency Management County Information:
http://www.dola.state.co.us/oem/Mitigation/plan/04%20%20County%20Descriptions%20final.pdf

Fault information and historical seismicity data is from the Colorado Earthquake Map Server (http://geosurvey.state.co.us/Default.aspx?tabid=270) and Colorado Late Cenozoic Fault and Fold Database and Internet Map Server (http://geosurvey.state.co.us/Default.aspx?tabid=453).

Time of most recent fault activity is in parentheses after the fault name: H = Holocene, LQ = Late Quaternary, MLQ = Middle to Late Quaternary, Q = Quaternary, LC = Late Cenozoic. Earthquake event identification numbers can be found in the earthquake database table.

Highlighted HAZUS scenarios are those listed as Worst Case Scenarios in Appendix D. Results listed include fatalities, monetary loss, and the loss ratio (total economic loss/region inventory x 100). Several counties include HAZUS results for the Anton Scarp, a feature under investigation in the Eastern Plains. Due to uncertainty of the feature's classification as a tectonic fault, results were not included in overall HAZUS results summaries.

Adams County
Population: 374,891 Growth since 1990: 37.3%
County Size: 1,198 square miles Inventory: $21,025.00 M
Contact:

Adams County Office of Emergency Management
4201 E. 72nd Ave.
Commerce City, CO 80022
(303)289-5441

Faults within County: Rocky Mountain Arsenal (uncertain)
Historical Earthquakes: 1962 to 1972 Rocky Mountain Arsenal Earthquakes (#98-99, 103-105, 107-143, 145-147, 150-152, 154-188, 190-209, 219, 228-229, 233, 237, 239-241, 246-247, 251, 253-303, 305-306, 308-309, 311-327, 330-334, 336, 339-340, 342, 344-346, 348-350); June 10, 1978 NE of Denver (#363); Mar.-Sept. 1981 NE of Denver (#369-371); Mar.-Sept. 1982 NE of Denver (#374-375); Feb. 25, 1984 NE of Denver (#380); Nov. 8, 1989 NE Denver (#446)

Faults analyzed for County: Golden (Q), Rampart (MLQ), RM Arsenal, Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), 1882 Historical Epicenter

HAZUS Loss Estimates:

Golden Fault:	**M6.5 – 51 fatal, $1.59 Billion (-7.6%)**
Rampart Fault:	M7.0 – 26 fatal, $774 Million (-3.7%)
RM Arsenal:	**M6.25 – 130 fatal, $3.15 Billion (-15.0%)**
Ute Pass:	M7.0 – 12 fatal, $496 Million (-2.4%)
Valmont:	M5.0 – 0 fatal, $64.1 Million (-0.3%)
Walnut Creek:	M6.0 – 20 fatal, $1.28 Billion (-6.1%)
1882 RMNP epc:	M6.6 – 1 fatal, $150 Million (-0.7%)

Alamosa County

Population: 15,336 Growth since 1990: 9.9%

County Size: 723 square miles Inventory: $1,839.50 M

Contact:

Alamosa County Office
PO Box 178
Alamosa, CO 81101
(719)589-4848

Faults within County: Alamosa Horst Fault Zone East (LC), Alamosa Horst Fault Zone West (LC), Manassa (LC), North Sangre de Cristo (H)

Historical Earthquakes: Dec. 28, 2003 Blanca-Ft. Garland (#562-563)

Faults analyzed for County: N Sangre de Cristo (H)

HAZUS Loss Estimates:

N Sangre de Cristo:	**M7.5 WUS – 4 fatal, $142 Million (-7.7%)**
	M7.5 CEUS – 18 fatal, $433 Million (-23.5%)

Arapahoe County

Population: 524,414 Growth since 1990: 24.6%

County Size: 818 square miles Inventory: $32,232.30 M

Contact:

Arapahoe County Government
5334 S. Prince Street
Littleton, CO 80166

(303)795-4400
Faults within County: None known
Historical Earthquakes: None
Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Golden (Q), Rampart (MLQ), RM Arsenal, Ute Pass (MLQ), Walnut Creek (Q)
HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 9 fatal, $678 Million (-2.1%)
Cheraw:	M7.0 – 0 fatal, $57.9 Million (-0.2%)
[redacted]	[redacted]
[redacted]	[redacted]
RM Arsenal:	M6.25 – 74 fatal, $2.63 Billion (-8.2%)
Ute Pass:	M7.0 – 67 fatal, $2.11 Billion (-6.5%)
Walnut Creek:	M6.0 – 17 fatal, $1.25 Billion (-3.9%)

Archuleta County
Population: 9,898 Growth since 1990: 85.2%
County Size: 1,364 square miles Inventory: $1,948.70 M
Contact:
Department of Emergency Management
449 San Juan St. or PO Box 1507
Pagosa Springs, CO 81147
(970)264-8300
Faults within County: None
Historical Earthquakes: Feb. 12, 1882 Pagosa Springs (#6); May 12, 1882 Pagosa Springs (#7); Jan. 23, 1966 Dulce, NM (#210, 212-218, 220, 222-227)
Faults analyzed for County: Cannibal Fault (LQ), N Sangre de Cristo (H)
HAZUS Loss Estimates:

[redacted]	[redacted]
N Sangre de Cristo:	M7.5 WUS – 0 fatal, $1.04 Million (-0.0%)
	M7.5 CEUS – 1 fatal, $28.1 Million (-1.4%)

Baca County
Population: 4,517 Growth since 1990: -0.9%
County Size: 2,559 square miles Inventory: $1,831.70 M

Contact:

Baca County Courthouse
741 Main Street
Springfield, CO 81073
(719)523-6532

Faults within County: None
Historical Earthquakes: None
Faults analyzed for County: Cheraw (H)
HAZUS Loss Estimates:

Cheraw: M7.0 – 0 fatal, $2.14 Million (-0.1%)

Bent County

Population: 9,898 Growth since 1990: 85.2%
County Size: 1,517 square miles Inventory: $1,081.00 M

Contact:

Bent County Courthouse
725 Carson Avenue or PO Box 350
Las Animas, CO 81054
(719)456-1600

Faults within County: None
Historical Earthquakes: None
Faults analyzed for County: Cheraw (H)
HAZUS Loss Estimates:

Cheraw: M7.0 – 0 fatal, $18.1 Million (-1.7%)

Boulder County

Population: 214,978 Growth since 1990: 29.3%
County Size: 741 square miles Inventory: $20,737.40 M

Contact:

Boulder Office of Emergency Management
1805 33rd Street
Boulder, CO 80301
(303)441-3390

Faults within County: Rock Creek (Q), Valmont (MLQ)

Historical Earthquakes: Oct. 12, 1916 Boulder (#29)
Faults analyzed for County: Frontal (LQ), Golden (Q), Mosquito (LQ), Rocky Mountain Arsenal Epicenter, Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), Williams Fork (H), 1882 Historical Epicenter
HAZUS Loss Estimates:

Frontal:	M7.0 – 3 fatal, $330 Million (-1.6%)
Golden:	M6.5 – 24 fatal, $ 1.49 Billion (-7.2%)
Mosquito:	M7.0 – 2 fatal, $252 Million (-1.2%)
Rocky Mtn Arsenal:	M6.25 – 11 fatal, $1.10 Billion (-5.3%)
Ute Pass:	M7.0 – 2 fatal, $245 Million (-1.2%)
Valmont:	M5.0 – 0 fatal, $411 Million (-2.0%)
Walnut Creek:	M6.0 – 10 fatal, $1.21 Billion (-5.8%)
Williams Fork:	M6.75 – 1 fatal, $233 Million (-1.1%)
1882 Earthquake:	M6.6 RMNP – 2 fatal, $328 Million (-1.6%)

Chaffee County
Population: 16,242 Growth since 1990: 28.1%
County Size: 1,039 square miles Inventory: $2,354.10 M
Contact:

Chaffee County Commissioners
PO Box 699 or 104 Crestone Ave.
Salida, CO 81201
(719)539-2218

Faults within County: Buena Vista (Q), Missouri Park (LQ), North Sawatch (LQ), Northeastern Boundary Faults (MLQ), Poncha Pass (LC), Shavano Peak (Q), South Sawatch (H), Twin Lakes Faults (Q), Upper Arkansas Valley Faults (LC)
Historical Earthquakes: Nov. 15, 1901 Buena Vista (#20); Feb.-July, 1921 Garfield (#34-47); Dec. 19, 1966 Aspen (#242); July 20, 1987 Taylor Park (#435); Sept. 14, 1987 Winfield (#437); Aug. 4, 1994 Poncha Springs (#473)
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H)
HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 0 fatal, $33.9 Million (-1.4%)
Frontal:	M7.0 – 0 fatal, $17.5 Million (-0.7%)
Mosquito:	M7.0 – 0 fatal, $65.8 Million (-2.8%)
N Sangre de Cristo:	M7.5 WUS – 9 fatal, $133 Million (-5.7%)
	[illegible]
N Sawatch:	M7.0 – 2 fatal, $153 Million (-6.5%)
S Sawatch:	M7.25 WUS – 21 fatal, $426 Million (-18.1%)

M7.25 CEUS – 26 fatal, $665 Million (-28.3%)

Cheyenne County
Population: 2,088 Growth since 1990: -6.9%
County Size: 1,782 square miles Inventory: $1,450.80 M
Contact:

Cheyenne County Courthouse
51 South 1st St. or PO Box 567
Cheyenne, CO 80810
(719)767-5872

Faults within County: High Plains Grabens (Anton scarp) under investigation
Historical Earthquakes: July 6, 1989 Kit Carson (#445)
Faults analyzed for County: Anton Scarp, Cheraw (H)
HAZUS Loss Estimates:

Anton Scarp: M7.6 – 0 fatal, $27.1 Million (-1.9%)
Cheraw: M7.0 – 0 fatal, $8.57 Million (-0.6%)

Clear Creek County
Population: 9,322 Growth since 1990: 22.4%
County Size: 396 square miles Inventory: $1,632.90 M
Contact:

Clear Creek County Offices
405 Argentine St. or PO Box 2000
Georgetown, CO 80444
(303)679-2300

Faults within County: Floyd Hill (LC), Kennedy Gulch (LC)
Historical Earthquakes: Nov. 9, 1871 Georgetown (#3); 1881 Georgetown (#5); Aug. 5, 1894 Georgetown (#16)
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), N Sawatch (LQ), Ute Pass (MLQ), Williams Fork (H)
HAZUS Loss Estimates:

Chase Gulch: M6.75 – 0 fatal, $9.71 Million (-0.6%)
Frontal: M7.0 – 0 fatal, $38.0 Million (-2.3%)
Golden: M6.5 – 0 fatal, $42.9 Million (-2.6%)
Mosquito: M7.0 – 0 fatal, $31.8 Million (-2.0%)

N Sawatch: M7.0 – 0 fatal, $8.96 Million (-0.6%)
Ute Pass: M7.0 – 0 fatal, $10.6 Million (-0.7%)
Williams Fork: M6.75 – 0 fatal, $31.9 Million (-2.0%)

Conejos County
Population: 8,407 Growth since 1990: 12.7%
County Size: 1,290 square miles Inventory: $1,162.40 M
Contact:
Conejos County Courthouse
PO Box 157
Conejos, CO 81129
(719)376-5772
Faults within County: Conejos River Faults (LC), Cumbres (LC), La Jara Reservoir (LC), Los Mogotes Volcano Faults (LC)
Historical Earthquakes: Oct. 7, 1952 Antonito (#82)
Faults analyzed for County: N Sangre de Cristo (H)
HAZUS Loss Estimates:
[redacted]
M7.5 CEUS – 3 fatal, $56.3 Million (-4.8%)

Costilla County
Population: 3,688 Growth since 1990: 14.8%
County Size: 1,229 square miles Inventory: $1,013.40 M
Contact:
Costilla County Courthouse
352 Main St. or PO Box 100
San Luis, CO 81152
(719)672-3372
Faults within County: Alvarado (LC), Culebra Range Faults (LC), Garcia (LQ), La Veta Faults (LC), Mesita (LQ), N Basaltic Hills Faults (Q), N Sangre de Cristo (H), S Sangre de Cristo-San Pedro Mesa Section (LQ)
Historical Earthquakes: Dec. 28, 2003 Gardner-Ft. Garland (#560-561)
Faults analyzed for County: N Sangre de Cristo (H)
HAZUS Loss Estimates:
[redacted]
M7.5 CEUS – 4 fatal, $85.2 Million (-8.4%)

Crowley County
Population: 5,838 Growth since 1990: 39.8%
County Size: 803 square miles Inventory: $666.90 M
Contact:

Crowley County Courthouse
603 Main #2
Ordway, CO 81063
(719)267-5555

Faults within County: Cheraw (H)
Historical Earthquakes: Dec. 4, 1870 Pueblo-Ft. Reynolds (#1); Nov. 28, 1955 Fowler-Sugar City (#88)
Faults analyzed for County: Cheraw (H)
HAZUS Loss Estimates:

Cheraw: **M7.0 – 2 fatal, $55.2 Million (-8.3%)**

Custer County
Population: 3,700 Growth since 1990: 81.9%
County Size: 737 square miles Inventory: $877.60 M
Contact:

Custer County Office of Emergency Management
PO Box 1351
Westcliffe, CO 81252
(719)783-2270

Faults within County: Alvarado (LC), Dead Mule Gulch (LC), Ilse (LC), Johnson Gulch (LC), Rosita (LC), Round Mountain (LC), Silver Cliff Graben (LC), Westcliffe (LC), Wet Mountain (LC)
Historical Earthquakes: Oct. 23, 1888 Wet Mountains (#12); Feb. 18, 1925 Wetmore (#52)
Faults analyzed for County: Goodpasture (Q), N Sangre de Cristo (H)
HAZUS Loss Estimates:

Goodpasture: M6.0 – 0 fatal, $6.2 Million (-0.7%)
N Sangre de Cristo M7.5 WUS – 1 fatal, $28.5 Million (-3.3%)
M7.5 CEUS – 4 fatal, $138 Million (-15.8%)

Delta County

Population: 27,834 Growth since 1990: 32.7%
County Size: 1,157 square miles Inventory: $2,841.30 M
Contact:

Delta County Office of Emergency Management
555 Palmer Street
Delta, CO 81416
(970)874-2004

Faults within County: Bridgeport (Q), Escalante (Q), Little Dominguez Creek (Q)
Historical Earthquakes: Sept. 9, 1944 Montrose-Basalt (#75-border); Jan. 12, 1967 Somerset (#243-border); Sept. 26, 1994 Somerset Coal Bump (#479); Nov. 2, 1994 Somerset Coal Bump (#480); Jan. 1, 1995 Somerset Coal Bump (#483); Mar. 14, 1995 Somerset Coal Bump (#485); Nov. 5, 2001 Paonia-Somerset (#533); Dec. 4, 2001 Paonia-Somerset (#534); Mar.-Apr. 2002 Paonia-Somerset (#538-540); June-Dec. 2002 Paonia-Somerset (#543, 546-549, 551-552); Jan.-Aug. 2003 Paonia-Somerset (#555, 557-558)
Faults analyzed for County: Cimarron (LQ, Q), Roubideau Creek (H)
HAZUS Loss Estimates:

[redacted]: M6.75 – 0 fatal, $53.1 Million (-1.9%)
Roubideau: M5.5 – 0 fatal, $5.93 Million (-0.2%)

Denver City and County
Population: 554,636 Growth since 1990: 18.6%
County Size: 155 square miles Inventory: $39,039.40 M
Contact:

Denver Office of Emergency Management
1437 Bannock Street, Room 3
Denver, CO
(720)865-7600

Faults within County: None
Historical Earthquakes: Dec. 29, 1901 Denver (#21); Jan. 27, 1923 Denver (#49); Jan. 4, 1924 Denver (#50); June 5, 1963 RM Arsenal (#140); Numerous 1960's RM Arsenal shocks NE of Denver
Faults analyzed for County: Anton Scarp, Chase Gulch (LQ), Cheraw (H), Frontal (LQ), Golden (Q), Mosquito (LQ), Rampart (MLQ), Rocky Mountain Arsenal Epicenter, N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), Williams Fork (H), 1882 Historical Epicenter
HAZUS Loss Estimates:

Anton Scarp: M6.7 – 172 fatal, $3.05 Billion (-7.8%)
Chase Gulch: M6.75 – 13 fatal, $1.01 Billion (-2.6%)
Cheraw: M7.0 – 0 fatal, $8.02 Million (-0.0%)

Frontal:	M7.0 – 30 fatal, $1.48 Billion (-3.8%)
Golden:	**M6.5 – 416 fatal, $7.51 Billion (-19.2%)**
Mosquito:	M7.0 – 25 fatal, $1.32 Billion (-3.4%)
Rampart:	**M7.0 – 203 fatal, $4.65 Billion (-11.9%)**
RM Arsenal:	**M6.25 – 262 fatal, $5.56 Billion (-14.2%)**
	M6.0 – 126 fatal, $3.89 Billion (-10.0%)
	M5.5 – 10 fatal, $1.41 Billion (-3.6%)
	M5.0 – 1 fatal, $544 Million (-1.4%)
N Sangre de Cristo:	M7.5 WUS – 0 fatal, $69.9 Million (-0.2%)
	M7.5 CEUS – 48 fatal, $1.47 Billion (-3.8%)
N Sawatch:	M7.0 – 7 fatal, $652 Million (-1.7%)
S Sawatch:	M7.25 – 12 fatal, $866 Million (-2.2%)
Ute Pass:	M7.0 – 84 fatal, $2.75 Billion (-7.0%)
Valmont:	M5.0 – 0 fatal, $98.4 Million (-0.3%)
Walnut Creek:	**M5.0 – 75 fatal, $3.15 Billion (-8.1%)**
Williams Fork:	M6.75 – 10 fatal, $850 Million (-2.2%)
1882 Earthquake:	M6.6 RMNP – 5 fatal, $527 Million (-1.4%)

Dolores County

Population: 1,848 Growth since 1990: 22.6%

County Size: 1,077 square miles Inventory: $515.70 M

Contact:

Dolores County Courthouse
409 N. Main St. or PO Box 608
Dove Creek, CO 81324
(970)677-2383

Faults within County: None

Historical Earthquakes: Feb. 12, 1967 Rico (#248); Sept. 9, 1987 Rico (#436)

Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ)

HAZUS Loss Estimates:

Busted Boiler:	M6.5 – 0 fatal, $0.85 Million (-0.2%)
Cannibal:	**M7.0 – 0 fatal, $0.90 Million (-0.2%)**

Douglas County

Population: 175,766 Growth since 1990: 191%
County Size: 843 square miles Inventory: $13,697.50 M
Contact:

Douglas County Office of Emergency Management
4000 Justice Way
Castle Rock, CO 80109
(303)660-7589

Faults within County: Kennedy Gulch (LC), Oil Creek (LC), Perry Park-Jarre Canyon (LC), Rampart Range (MLQ), Ute Pass (MLQ)
Historical Earthquakes: Sept. 14, 1965 S of Denver (#189); Dec. 25, 1994 Palmer Lake (#482)
Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Frontal (LQ), Golden (Q), Mosquito (LQ), Rampart (MLQ), N Sawatch (LQ), Ute Pass (MLQ)
HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 1 fatal, $117 Million (-0.9%)
Cheraw:	M7.0 – 0 fatal, $19.2 Million (-0.1%)
Frontal:	M7.0 – 1 fatal, $114 Million (-0.8%)
Golden:	M6.5 – 7 fatal, $578 Million (-4.2%)
Mosquito:	M7.0 – 1 fatal, $111 Million (-0.8%)
[redacted]	[redacted]
N Sawatch:	M7.0 – 0 fatal, $64.1 Million (-0.5%)
Ute Pass:	M7.0 – 15 fatal, $652 Million (-4.8%)

Eagle County
Population: 47,990 Growth since 1990: 90.0%
County Size: 1,694 square miles Inventory: $5,014.90 M
Contact:

Eagle County Emergency Management
PO Box 850
Eagle, CO 81631
(970)328-8603

Faults within County: Basalt Mountain (LC), Burns Faults (MLQ), Dotsero Faults (LC), Frontal (LQ), Gore (LC), Greenhorn Mountain (Q), Gypsum Faults (LC), Leadville (Q), Red Hill Faults (Q)
Historical Earthquakes: Apr. 3, 1946 Riland (#80); May 30, 1965 Tennessee Pass (#161); Apr. 3, 1966 South Park Blast (#221-border); Sept. 12, 1990 Vail (#449)
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sawatch (LQ), S Sawatch (H), Williams Fork (H)
HAZUS Loss Estimates:

Chase Gulch: M6.75 – 0 fatal, $33.9 Million (-0.7%)
Frontal: M7.0 – 26 fatal, $572 Million (-11.4%)
Mosquito: M7.0 – 15 fatal, $417 Million (-8.3%)
N Sawatch: M7.0 – 9 fatal, $387 Million (-7.7%)
S Sawatch: M7.25 – 2 fatal, $146 Million (-2.9%)
Williams Fork: M6.75 – 5 fatal, $207 Million (-4.1%)

El Paso County
Population: 543,818 Growth since 1990: 30.2%
County Size: 2,158 square miles Inventory: $32,570.60 M
Contact:
El Paso Board of County Commissioners
27 E. Vermijo Ave.
Colorado Springs, CO 80903
(719)520-7276
Faults within County: Colorado Springs Faults (LC), Rampart Range (MLQ), Ute Pass (MLQ)
Historical Earthquakes: Dec. 23 and 31, 1995 Manitou Springs (#492, 493); Jan. 1997 Woodland Park (#497-499); Apr. 18, 1998 Woodland Park (#503); July 22, 2001 Woodland Park (#515); Feb. 19, 2003 Woodland Park (#556)
Faults analyzed for County: Chase Gulch (LQ), Cheraw (H), Goodpasture (Q), Rampart (MLQ), N Sangre de Cristo (H), S Sawatch (H), Ute Pass (MLQ)
HAZUS Loss Estimates:
Chase Gulch: M6.75 – 8 fatal, $636 Million (-2.0%)
Cheraw: M7.0 – 4 fatal, $353 Million (-1.1%)
Goodpasture: M6.0 – 0 fatal, $103 Million (-0.3%)
Rampart: M7.0 – 545 fatal, $9.01 Billion (-27.7%)
M6.0 – 20 fatal, $1.67 Billion (-5.1%)
N Sangre de Cristo: M7.5 WUS – 1 fatal, $90.8 Million (-0.3%)
M7.5 CEUS – 125 fatal, $2.12 Billion (-6.5%)
S Sawatch: M7.25 – 11 fatal, $659 Million (-2.0%)
Ute Pass: M7.0 – 477 fatal, $8.22 Billion (-25.2%)
M6.0 – 27 fatal, $1.91 Billion (-5.9%)

Elbert County
Population: 19,872 Growth since 1990: 106.0%

County Size: 1,865 square miles Inventory: $2,431.60 M
Contact:

Elbert County Emergency Management
(303)621-2027

Faults within County: None
Historical Earthquakes: Oct. 13, 1966 E of Castle Rock (#236)
Faults analyzed for County: Cheraw (H), Golden (Q), Rampart (MLQ), Ute Pass (MLQ)
HAZUS Loss Estimates:

Cheraw: M7.0 – 0 fatal, $5.3 Million (-0.2%)
Golden: M6.5 – 0 fatal, $15.6 Million (-0.6%)
Rampart: M7.0 – 3 fatal, $98.9 Million (-4.1%)
Ute Pass: M7.0 – 1 fatal, $44.3 Million (-1.8%)

Fremont County
Population: 46,145 Growth since 1990: 43.0%
County Size: 1,502 square miles Inventory: $3,759.70 M
Contact:

Fremont County Emergency Services
615 Macon Ave., Rm. #204
Cañon City, CO 81212

Faults within County: Alvarado (LC), Bare Hills (LC), Box Canyon and Quarry Faults (LC), Coaldale-Wellsville (LC), Currant Creek (LC), Dead Mule Gulch (LC), Fourmile Creek (LC), High Park (LC), Iron Mountain (LC), Isle (LC), Parkdale Faults (LC), Pleasant Valley (LC), Rice Mountain (LC), Salida South (LC), Tanner Peak (LC), Texas Creek (LC), Thompson Mountain (LC), Westcliffe (LC), Wet Mountain (LC)
Historical Earthquakes: Mar. 16, 1985 Salida (#402); Apr. 16, 1987 Howard (#434)
Faults analyzed for County: Chase Gulch (LQ), Goodpasture (Q), Rampart (MLQ), N Sangre de Cristo (H), S Sawatch (H), Ute Pass (MLQ)
HAZUS Loss Estimates:

Chase Gulch: M6.75 – 1 fatal, $79.5 Million (-2.1%)
Goodpasture: M6.0 – 0 fatal, $56.1 Million (-1.5%)
Rampart: M7.0 – 2 fatal, $127 Million (-3.4%)
N Sangre de Cristo: M7.5 WUS – 3 fatal, $89.6 Million (-2.4%)
[redacted]
S Sawatch: M7.25 – 2 fatal, $121 Million (-3.2%)
Ute Pass: M7.0 – 3 fatal, $184 Million (-4.9%)

Garfield County
Population: 48,503 Growth since 1990: 46.1%
County Size: 2,958 square miles Inventory: $4,735.50 M
Contact:

Garfield County Department of Emergency Management
109 8th St. #307
Glenwood Springs, CO 81601
(970)945-9789

Faults within County: Canyon Creek (LC), Causeway (LC), Consolidated Reservoir (LC), Grand Hogback Faults-Freeman Creek (Q), Grand Hogback-Fourmile Creek (H), Grand Hogback-SW Glenwood (LQ), Grand Hogback Faults-SW Glenwood (LC), Heuschkel Park Faults (LC), Lookout Mountain Faults (LC), Missouri Heights Faults (LC), Possum Creek (LC), Red Canyon (LC), Spring Valley Faults (LC), West Coal Creek (LC)
Historical Earthquakes: Jan. 15, 1889 Glenwood Springs (#13); Dec. 21, 1906 New Castle (#24); Dec. 29-30, 1920 New Castle (#30-33); Jan. 31, 1946 Glenwood Springs (#79); Sept. 10, 1969 Rulison AEC Test (#329); Jan. 7, 1971 Glenwood Springs (#341); Nov. 22, 1982 Rifle (#376); Apr.-May 1984 Carbondale Earthquakes (#381-399); Oct. 19, 1990 New Castle (#450-451); Dec. 12, 1990 New Castle (#453); Mar. 8, 1994 Douglas Pass (#472); Dec. 5, 2000 Carbondale (#514); Aug. 2001 Glenwood Springs Earthquakes (#516-519); Mar. 19, 2002 Douglas Pass (#536); Feb. 8, 2006 Glenwood Springs (#578)
Faults analyzed for County: Frontal (LQ), Mosquito (LQ), N Sawatch (LQ)
HAZUS Loss Estimates:

Frontal:	M7.0 – 0 fatal, $35.3 Million (-0.8%)
Mosquito:	M7.0 – 0 fatal, $35.3 Million (-0.8%)
N Sawatch:	**M7.0 – 1 fatal, $76.6 Million (-1.6%)**

Gilpin County
Population: 4,757 Growth since 1990: 55.0%
County Size: 149 square miles Inventory: $725.30 M
Contact:

Gilpin County Commissioners
203 Eureka St., 2nd Floor or PO Box 366
Central City, CO 80427
(303)582-5214

Faults within County: Floyd Hill Fault Zone (LC)
Historical Earthquakes: None
Faults analyzed for County: Frontal (LQ), Golden (Q), Williams Fork (H)

HAZUS Loss Estimates:

Frontal:	M7.0 – 0 fatal, $10.8 Million (-1.5%)
Golden:	**M6.5 – 0 fatal, $40.1 Million (-5.5%)**
Williams Fork:	M6.75 – 0 fatal, $9.96 Million (-1.4%)

Grand County
Population: 12,442 Growth since 1990: 56.2%
County Size: 1,840 square miles Inventory: $3,131.50 M
Contact:

Grand County Courthouse
308 Byers Ave. or PO Box 264
Hot Sulphur Springs, CO 80451
(970)725-3347

Faults within County: Antelope Pass (LC), Barger Gulch (LC), Gore (LC), Granby Basin Faults (LC), Granby Faults West (LC), Kremmling Faults West (LC), Laramie River (LC), Parshall (LC), Rabbit Ears Pass Faults (LC), Rabbit Ears Range (LC), Sheephorn Mountain Faults (LC), Trail Ridge (LC), Troublesome Creek (LC), Williams Fork Mountains (H), Williams Fork Valley Faults (MLQ), Williams Fork Valley Faults East (LC)
Historical Earthquakes: Aug. 4, 1964 Dillon (#149)
Faults analyzed for County: Frontal (LQ), Mosquito (LQ), N Sawatch (LQ), Williams Fork (H), 1882 Historical Epicenter
HAZUS Loss Estimates:

Frontal:	M7.0 – 2 fatal, $157 Million (-5.0%)
Mosquito:	M7.0 – 0 fatal, $47.2 Million (-1.5%)
N Sawatch:	M7.0 – 0 fatal, $24.1 Million (-0.8%)
Williams Fork:	**M6.75 – 2 fatal, $184 Million (-5.9%)**
1882 RMNP:	M6.6 – 0 fatal, $110 Million (-3.5%)

Gunnison County
Population: 14,012 Growth since 1990: 35.9%
County Size: 3,238 square miles Inventory: $2,681.30 M
Contact:

Gunnison County Commissioners
200 East Virginia Ave.
Gunnison, CO 81230
(970)641-0248

Faults within County: Cimarron (Q, LQ, LC), Red Rocks (Q), Treasure Mountain (LC)
Historical Earthquakes: July 1886 Cimarron (#11); Sept. 9, 1944 Montrose-Basalt (#75); Oct. 12, 1960 Montrose-Ridgway (#93); Sept. 4, 1966 Cimarron Ridge (#234); Jan. 12, 1967 Somerset (#243); Aug. 14, 1983 Cimarron (#377); Apr.-Oct. 1986 Crested Butte Earthquakes (#404-430, 432-433); Dec. 26, 1991 Powderhorn (#460-461); Sept. 26, 1994 Somerset Coal Bump (#479); Nov. 2, 1994 Somerset Coal Bump (#480); Jan. 1, 1995 Somerset Coal Bump (#483); Mar. 14, 1995 Somerset Coal Bump (#485); Nov. 5, 2001 Paonia-Somerset (#533); Dec. 4, 2001 Paonia-Somerset (#534); Mar.-Apr. 2002 Paonia-Somerset (#538-540); June-Dec. 2002 Paonia-Somerset (#543, 546-549, 551-552); Jan.-Aug. 2003 Paonia-Somerset (#555, 557-558); Apr.-Nov. 2004 Paonia-Somerset (#564-567, 569)
Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ), Cimarron (LQ,Q), Roubideau Creek (H), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H)
HAZUS Loss Estimates:

Busted Boiler:	M6.5 – 0 fatal, $13.1 Million (-0.5%)
Cannibal:	M7.0 – 2 fatal, $70.1 Million (-2.6%)
Cimarron:	M6.75 – 1 fatal, $67.6 Million (-2.5%)
Mosquito:	M7.0 – 0 fatal, $32.4 Million (-1.2%)
Roubideau Cr.:	M5.5 – 0 fatal, $0.5 Million (-0.0%)
N Sangre de Cristo:	M7.5 WUS – 0 fatal, $4.2 Million (-0.2%)
	M7.5 CEUS – 4 fatal, $100 Million (-3.7%)
N Sawatch:	M7.0 – 1 fatal, $46.2 Million (-1.7%)
S Sawatch:	M7.25 – 2 fatal, $88.3 Million (-3.3%)

Hinsdale County
Population: 790 Growth since 1990: 69.2%
County Size: 1,124 square miles Inventory: $347.30 M
Contact:

Hinsdale County Courthouse
PO Box 277
Lake City, CO 81235
(970)944-2225

Faults within County: Cannibal (LQ), Lake City Caldera Faults (LC)
Historical Earthquakes: Aug. 3, 1955 Lake City (#85-87)
Faults analyzed for County: Busted Boiler (H), Cannibal (LQ), Cimarron (LQ)
HAZUS Loss Estimates:

Busted Boiler:	M6.5 – 0 fatal, $1.1 Million (-0.3%)
Cannibal:	**M7.0 – 0 fatal, $35.2 Million (-10.1%)**
Cimarron:	M6.75 – 0 fatal, $1.9 Million (-0.6%)

Huerfano County
Population: 7,960 Growth since 1990: 30.8%
County Size: 1,592 square miles Inventory: $1,939.50 M
Contact:

Huerfano County Courthouse
401 Main St.
Walsenburg, CO 81089
(719)738-2370

Faults within County: Alvarado (LC), Bear Creek (LC), Farista Faults (LC), Greenhorn (LC), Ilse (LC), La Veta Faults West (LC), Westcliffe (LC), Wet Mountains South (LC)
Historical Earthquakes: None
Faults analyzed for County: Cheraw (H), Goodpasture (Q), N Sangre de Cristo (H)
HAZUS Loss Estimates:

Cheraw: M7.0 – 0 fatal, $4.6 Million (-0.2%)
Goodpasture: M6.0 – 0 fatal, $10.1 Million (-0.5%)
N Sangre de Cristo: M7.5 WUS – 0 fatal, $19.0 Million (-1.0%)
M7.5 CEUS – 1 fatal, $84.0 Million (-4.3%)

Jackson County
Population: 1,557 Growth since 1990: -1.7%
County Size: 1,620 square miles Inventory: $949.70 M
Contact:

Jackson County Courthouse
404 4th St. or PO Box 1019
Walden, CO 80480
(970)723-4660

Faults within County: Arapahoe Ridge Faults (LC), East Independence Mountain (LC), North Park Faults NW and W (LC), Park Range Faults (LC), Rabbit Ears Range (LC), Sierra Madre Range Faults (LC), Spring Creek (LC), Trail Ridge (LC), Walden Faults (LC), West Independence Mountain (LC)
Historical Earthquakes: Oct. 3, 1948 Walden (#81)
Faults analyzed for County: Frontal (LQ), Williams Fork (H), 1882 Historical Epicenter
HAZUS Loss Estimates:

Frontal: M7.0 – 0 fatal, $3.0 Million (-0.3%)

Williams Fork:	M6.75 – 0 fatal, $2.3 Million (-0.2%)
1882 RMNP:	**M6.6 – 0 fatal, $3.7 Million (-0.4%)**

Jefferson County

Population: 527,056 Growth since 1990: 20.2%

County Size: 774 square miles Inventory: $35,828.60 M

Contact:

Jefferson County Department of Emergency Management
800 Jefferson County Parkway
Golden, CO 80419
(303)271-4900

Faults within County: Floyd Hill (LC), Golden (Q), Ken Caryl (LC), Kennedy Gulch (LC), Rock Creek (Q), Walnut Creek (Q)

Historical Earthquakes: Jan. 5, 1965 Rocky Flats (#153); Feb. 16, 1965 N of Denver (#155); Sept. 29, 1965 N of Denver (#192); 1960's-70's RM Arsenal Earthquakes; Nov.-Dec. 1981 Conifer (#372-373); Sept. 21, 1986 Conifer (#431)

Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), Rampart (MLQ), Rocky Mountain Arsenal Epicenter, N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Valmont (MLQ), Walnut Creek (Q), Williams Fork (H)

HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 2 fatal, $307 Million (-0.9%)
Frontal:	M7.0 – 5 fatal, $460 Million (-1.3%)
Golden:	**M6.5 – 174 fatal, $5.88 Billion (-16.4%)**
	M5.5 – 3 fatal, $1.03 Billion (-2.9%)
Mosquito:	M7.0 – 4 fatal, $402 Million (-1.1%)
Rampart:	M7.0 – 25 fatal, $1.30 Billion (-3.6%)
RM Arsenal:	M6.25 – 23 fatal, $1.42 Billion (-4.0%)
N Sangre de Cristo:	M7.5 WUS – 0 fatal, $15.6 Million (-0.0%)
	M7.5 CEUS – 5 fatal, $285 Million (-0.8%)
N Sawatch:	M7.0 – 1 fatal, $206 Million (-0.6%)
S Sawatch:	M7.25 – 2 fatal, $253 Million (-0.7%)
Ute Pass:	M7.0 – 11 fatal, $770 Million (-2.2%)
Valmont:	M5.0 – 0 fatal, $50.4 Million (-0.1%)
Walnut Creek:	M6.0 – 43 fatal, $2.31 Billion (-6.4%)
Williams Fork:	M6.75 – 2 fatal, $274 Million (-0.8%)

Kiowa County
Population: 1,622 Growth since 1990: -3.9%
County Size: 1,872 square miles Inventory: $1,141.60 M
Contact:

Kiowa County Commissioners Office
PO Box 100
Eads, CO 81036
(719)438-5810

Faults within County: Cheraw (H)
Historical Earthquakes: Oct. 15, 1921 Eads (#48); Jan. 10, 2003 Lamar (#554)
Faults analyzed for County: Cheraw (H)
HAZUS Loss Estimates:

Cheraw: M7.0 – 0 fatal, $11.4 Million (-1.0%)

Kit Carson County
Population: 7,987 Growth since 1990: 12.2%
County Size: 2,162 square miles Inventory: $2,252.00 M
Contact:

Kit Carson County Courthouse
PO Box 160
Burlington, CO 80807
(719)346-8139

Faults within County: High Plains Grabens (Anton Scarp) under investigation
Historical Earthquakes: May 27, 1984 Burlington (#400)
Faults analyzed for County: Anton Scarp, Cheraw (H)
HAZUS Loss Estimates:

Anton Scarp: M7.6 – 17 fatal, $285 Million (-12.7%)
[redacted]: M7.0 – 0 fatal, $11.25 Million (-0.5%)

La Plata County
Population: 47,494 Growth since 1990: 36.1%
County Size: 1,690 square miles Inventory: $4,309.40 M
Contact:

La Plata County Office of Emergency Management
1060 E. 2nd Ave.
Durango, CO 81301
(970)382-6274

Faults within County: None
Historical Earthquakes: Aug. 29, 1941 Durango-Bayfield (#72)
Faults analyzed for County: Busted Boiler (H), Cannibal (LQ), Cimarron (LQ,Q)
HAZUS Loss Estimates:

Busted Boiler:	M6.5 – 0 fatal, $14.4 Million (-0.3%)
Cannibal:	M7.0 – 0 fatal, $53.1 Million (-1.2%)
Cimarron:	M6.75 – 0 fatal, $12.3 Million (-0.3%)

Lake County
Population: 7,917 Growth since 1990: 30.0%
County Size: 384 square miles Inventory: $1,098.70 M
Contact:
Lake County Courthouse
505 Harrison Ave. or PO Box 964
Leadville, CO 80461
(719)486-0993

Faults within County: Leadville-NW and S (Q), Mosquito (LQ), North Sawatch (LQ), Northeastern Boundary Faults (MLQ), Sawatch Range Faults (LC), Twin Lakes Reservoir Faults (Q)
Historical Earthquakes: May 23, 1964 Blast at Climax (#148); May 30, 1965 Tennessee Pass (#161)
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Mosquito (LQ), N Sawatch (LQ), S Sawatch (H), Williams Fork (H)
HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 0 fatal, $27.3 Million (-2.5%)
Frontal:	M7.0 – 1 fatal, $69.5 Million (-6.3%)
Mosquito:	M7.0 – 10 fatal, $299 Million (-27.2%)
N Sawatch:	M7.0 – 10 fatal, $303 Million (-27.5%)
S Sawatch:	M7.25 – 6 fatal, $183 Million (-16.7%)
Williams Fork:	M6.75 – 0 fatal, $17.2 Million (-1.6%)

Larimer County
Population: 283,000 Growth since 1990: 35.1%

County Size: 2,640 square miles Inventory: $18,896.00 M
Contact:

Larimer County Emergency Management Office
200 W. Oak St.
Fort Collins, CO 80521
(970)498-5310

Faults within County: Larimer River (LC), Larimer River Valley (LC), Trail Ridge (LC)
Historical Earthquakes: Nov. 8, 1882 North-Central Colorado (#8); Sept. 9, 1903 Estes Park (#22); Oct. 3, 1948 Walden (#81); Nov. 3, 1977 Poudre Canyon (#361)
Faults analyzed for County: Golden (Q), Valmont (MLQ), Williams Fork (H)
HAZUS Loss Estimates:

Golden: M6.5 – 3 fatal, $237 Million (-1.3%)
Valmont: M5.0 – 0 fatal, $11.4 Million (-0.0%)
Williams Fork: M6.75 – 2 fatal, $178 Million (-0.9%)
[illegible] M6.6 – 18 fatal, $887 Million (-4.7%)

Las Animas County
Population: 15,967 Growth since 1990: 10.5%
County Size: 4,773 square miles Inventory: $3,705.50 M
Contact:

Las Animas County Courthouse
200 E. 1st Street, Rm. 207
Trinidad, CO 81082
(719)845-2568

Faults within County: La Veta Faults West (LC)
Historical Earthquakes: Oct. 3, 1966 NE of Trinidad (#235); Sept. 1973 Valdez-Boncarbo (#352-356); May 30, 1976 Pinon Canyon Area (#359); Aug. 17, 1983 NE of Trinidad (#378); Mar. 24, 1989 Mesa de Maya (#442); Apr. 15, 1992 Aguilar (#462); May 2, 1992 Gulnare (#463); Aug. 1, 1996 Tyrone (#494-495); Nov. 1, 1996 Tyrone (#496); Aug.-Sept. 2001 Trinidad Earthquakes (#520-532); Sept. 8, 2003 Aguilar (#559); Jan. 14, 2004 Walsenberg (#562); Mar. 30, 2004 Weston (#563)
Faults analyzed for County: Cheraw (H), N Sangre de Cristo (H)
HAZUS Loss Estimates:

Cheraw: M7.0 – 0 fatal, $3.97 Million (-0.1%)
N Sangre de Cristo: M7.5 WUS – 0 fatal, $3.40 Million (-0.0%)
M7.5 CEUS – 0 fatal, $21.6 Million (-0.9%)

Lincoln County
Population: 6,099 Growth since 1990: 34.4%
County Size: 2,585 square miles Inventory: $1,866.40 M
Contact:

Lincoln County Courthouse
103 3rd Avenue or PO Box 39
Hugo, CO 80821
(719)743-2810

Faults within County: None
Historical Earthquakes: None
Faults analyzed for County: Anton Scarp, Cheraw (H)
HAZUS Loss Estimates:

Anton Scarp: M7.6 – 2 fatal, $59.2 Million (-3.2%)
Cheraw: M7.0 – 0 fatal, $22.5 Million (-1.2%)

Logan County
Population: 21,889 Growth since 1990: 16.7%
County Size: 1,845 square miles Inventory: $3,057.30 M
Contact:

Logan County Courthouse
315 Main St.
Sterling, CO 80751
((970)522-0888

Faults within County: None
Historical Earthquakes: None
Faults analyzed for County: Anton Scarp, Rocky Mountain Arsenal Epicenter
HAZUS Loss Estimates:

Anton Scarp: M7.6 – 20 fatal, $300 Million (-9.8%)
RM Arsenal: 6.25 – 0 fatal, $2.12 Million (-0.0%)

Mesa County
Population: 116,255 Growth since 1990: 24.8%
County Size: 3,309 square miles Inventory: $9,044.60 M

Contact:

Mesa County Emergency Management
544 Rood Avenue or PO Box 20000
Grand Junction, CO 81502
(970)244-1763

Faults within County: Atkinson Mesa (Q), Bangs Canyon (Q), Big Dominguez Creek (Q), Bridgeport (Q), Cactus Park (Q), Glade Park (Q), Granite Creek (Q), Ladder Creek (Q), Little Dolores River (Q), Little Dominguez Creek (Q), Lost Horse Basin (Q), Monitor Creek (Q), Pine Mountain (Q), Redlands Fault Complex (Q), Ryan Creek (Q), Sinbad Valley Graben (Q), Whitewater (Q), Wolf Hill (Q)

Historical Earthquakes: Feb. 28, 1915 Grand Junction (#28); June 24, 1962 Uncompahgre Plateau (#106); Nov. 12, 1971 Grand Junction (#347); Jan. 30, 1975 N of Grand Junction (#358); Dec. 6, 1985 Gateway (#403); Oct. 21, 1990 Palisade (#452); Apr. 23, 1995 Grand Mesa (#491)

Faults analyzed for County: Cimarron (LQ,Q), Roubideau Creek (H)

HAZUS Loss Estimates:

[redacted]: M6.75 – 0 fatal, $53.4 Million (-0.6%)
Roubideau: M5.5 – 0 fatal, $4.71 Million (-0.0%)

Mineral County

Population: 891 Growth since 1990: 48.9%
County Size: 878 square miles Inventory: $667.40 M

Contact:

Mineral County Courthouse
PO Box 70
Creede, CO 81130
(719)658-2331

Faults within County: Cannibal (LQ)

Historical Earthquakes: Apr.-May 1928 Creede Earthquakes (#53-66); May 3, 1957 Creede Area (#91); Jan. 23, 1966 Creede (#211)

Faults analyzed for County: Cannibal (LQ), Cimarron (LQ,Q), N Sangre de Cristo (H)

HAZUS Loss Estimates:

[redacted]: M7.0 – 1 fatal, $43.1 Million (-6.5%)
Cimarron: M6.75 – 0 fatal, $2.75 Million (-0.4%)
N Sangre de Cristo: M7.5 CEUS – 0 fatal, $9.52 Million (-1.4%)

Moffat County

Population: 13,184 Growth since 1990: 16.1%

County Size: 4,754 square miles Inventory: $2,778.00 M
Contact:

Moffat County Courthouse
221 W. Victory Way, Suite 130
Craig, CO 81625

Faults within County: Bakers Peak (LC), Beaver Creek (LC), Browns Park Faults (LC), Craig Faults (LC), Cross Mountain (LC), East (LC), Elk Springs Faults (LC), Elkhead Mountains Faults (LC), Lay Faults (LC), Maybell Faults (LC), Mitten Park (LC), Sawmill Canyon (LC), Sparks Ranch-Uinta (LC), Teepee (LC), Wapiti Peak (LC), Yampa (LC)
Historical Earthquakes: Oct. 1871 Lily Park-Moffat (#2); Dec. 1891 Axial Basin (#14); 1899 Lay (#19); Apr. 1906 Maybell (#23); Summer 1924 Craig (#51); Jul.-Aug. 1942 W Moffat County (#73-74); Jan. 18, 1968 Dinosaur National Monument (#304); Nov. 30, 1978 Craig (#364); Jan. 20, 1979 NW of Craig (#366); Sept. 24, 1983 Browns Park (#379); Feb. 14, 1988 Maybell (#439); Aug. 31, 1988 Cold Spring Mountain (#440); Nov. 15, 1991 Hamilton (#459); Feb. 14, 1994 Craig (#471); Jan. 31, 2002 Axial Basin (#535)
Faults analyzed for County: Frontal (LQ)
HAZUS Loss Estimates:

Frontal: M7.0 – 0 fatal, $5.11 Million (-0.2%)

Montezuma County
Population: 23,830 Growth since 1990: 27.6%
County Size: 2,094 square miles Inventory: $3,074.20 M
Contact:

Montezuma County Courthouse
109 West Main St.
Cortez, CO 81321
(970)565-8317

Faults within County: None
Historical Earthquakes: None
Faults analyzed for County: Cannibal (LQ)
HAZUS Loss Estimates:

Cannibal: M7.0 – 0 fatal, $9.8 Million (-0.3%)

Montrose County
Population: 35,971 Growth since 1990: 36.9%
County Size: 2,246 square miles Inventory: $3,773.90 M
Contact:

Montrose County Courthouse
161 S. Townsend Ave.
Montrose, CO 81401
(970)249-7755

Faults within County: Atkinson Mesa Faults (Q), Big Gypsum Valley Graben Faults (Q), Cimarron (Q, LQ), Clay Creek (Q), Cottonwood Creek Faults (Q), Ellison Gulch Scarp (H), Hanks Creek (Q), Horsefly Creek (Q), Johnson Spring (Q), Love Mesa (Q), Monitor Creek (Q), Montrose Faults SW (Q), Paradox Valley Graben Faults (Q), Pinto Mesa Faults (Q), Red Canyon (Q), Red Rocks (Q), Roubideau Creek (H), Roubideau Creek Faults East (Q), San Miguel Canyon Faults (Q), Sinbad Valley Graben (Q)

Historical Earthquakes: Jan. 13, 1962 Montrose (#97); May 13, 1989 Uravan (#443); May 15, 1992 Olathe (#464); Sept. 13-15, 1994 Norwood (#475-478); Apr. 10, 1998 Paradox Valley (#502); June-Nov. 1999 Paradox Valley (#504-508); Mar.-May 2000 Paradox Valley (#511-512); June 6, 2002 Paradox Valley (#544); Nov. 6, 2004 Naturita (#568)

Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ), Cimarron (LQ,Q), Roubideau Creek (H)

HAZUS Loss Estimates:

Busted Boiler:	M6.5 – 21 fatal, $432 Million (-11.5%)
Cannibal:	M7.0 – 4 fatal, $174 Million (-4.6%)
[illegible]:	M6.75 – 28 fatal, $497 Million (-13.2%)
Roubideau:	M5.5 – 0 fatal, $78.2 Million (-2.1%)

Morgan County

Population: 28,183 Growth since 1990: 23.8%
County Size: 1,294 square miles Inventory: $5,404.70 M

Contact:

Morgan County Courthouse
PO Box 596
Fort Morgan, CO 80701
(970)542-3500

Faults within County: None

Historical Earthquakes: None

Faults analyzed for County: Anton Scarp, Rocky Mountain Arsenal Epicenter

HAZUS Loss Estimates:

Anton Scarp:	M7.6 – 48 fatal, $2.44 Billion (-45.2%)
RM Arsenal:	M6.25 – 0 fatal, $21.8 Million (-0.4%)

Otero County

Population: 19,681 Growth since 1990: 0.6%
County Size: 1,268 square miles Inventory: $2,935.40 M
Contact:

Otero County Courthouse
PO Box 511
La Junta, CO 81050
(719)383-3000

Faults within County: Cheraw (H)
Historical Earthquakes: None
Faults analyzed for County: Cheraw (H)
HAZUS Loss Estimates:

Cheraw: M7.0 – 15 fatal, $416 Million (-14.2%)

Ouray County
Population: 4,030 Growth since 1990: 63.1%
County Size: 542 square miles Inventory: $781.70 M
Contact:

Ouray County Courthouse
PO Bin C
Ouray, CO 81427
(970)325-7320

Faults within County: Busted Boiler (LQ), Cow Creek (LC), Log Hill Mesa Graben Faults (LQ), Montrose Faults SW (Q), Ridgway (Q), Ridgway Quarry Faults (LC)
Historical Earthquakes: Aug. 3, 1897 Ridgway (#18); Nov. 11, 1913 Ridgway Area (#25-27); Oct. 11, 1960 Montrose-Ridway (#92); Feb. 5, 1962 Ridgway-Montrose (#100); Apr. 4, 1967 Montrose (#252); Nov. 19, 1989 Ridgway (#447); Nov. 22, 1989 Ouray (#448); Jan. 17, 1994 Ridgway (#470)
Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ), Cimarron (LQ,Q), Roubideau Creek (H)
HAZUS Loss Estimates:

Busted Boiler: M6.5 – 1 fatal, $104 Million (-13.3%)
Cannibal: M7.0 – 0 fatal, $36.5 Million (-4.7%)
Cimarron: M6.75 – 0 fatal, $32.7 Million (-4.2%)
Roubideau: M5.5 – 0 fatal, $2.8 Million (-0.4%)

Park County

Population: 14,523 Growth since 1990: 102.4%
County Size: 2,166 square miles Inventory: $2,806.30 M
Contact:

Park County Commissioners Office
501 Main St. or PO Box 1373
Fairplay, CO 80440
(719)836-4201

Faults within County: Bare Hills (LC), Chase Gulch-East Side (LQ), Chase Gulch-West Side (LQ), Currant Creek Fault Zone (LC), Eleven Mile (LQ), Elevenmile Canyon Reservoir Faults (LC), Frontal (LQ), Hartsel Faults W (LC), High Park Fault Zone (LC), Ilse (LC), Kaufman Ridge (LC), Northeastern Boundary Faults (MLQ), Pulver Gulch-Rocky Gulch (LC), Schoolmarm Mountain (LC), Tarryall (LC), Thirty-nine Mile Mountain (LC),
Historical Earthquakes: Nov. 27, 1961 South Park (#95-96); Apr. 3, 1966 Blast in South Park (#221)
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), Rampart (MLQ), N Sangre (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Williams Fork (H)
HAZUS Loss Estimates:

[redacted]
Frontal: M7.0 – 1 fatal, $75.9 Million (-2.7%)
Golden: M6.5 – 0 fatal, $13.0 Million (-0.5%)
[redacted]
Rampart: M7.0 – 0 fatal, $25.9 Million (-0.9%)
N Sangre de Cristo: M7.5 WUS – 0 fatal, $4.17 Million (-0.2%)
N Sawatch: M7.0 – 1 fatal, $66.9 Million (-2.4%)
S Sawatch: M7.25 – 1 fatal, $72.2 Million (-2.6%)
Ute Pass: M7.0 – 0 fatal, $34.5 Million (-1.2%)
Williams Fork: M6.75 – 0 fatal, $18.5 Million (-0.7%)

Phillips County
Population: 4,505 Growth since 1990: 6.9%
County Size: 688 square miles Inventory: $1,151.20 M
Contact:

Phillips County Courthouse
221 S. Interocean Ave.
Holyoke, CO 80734
(970)854-2454

Faults within County: None

Historical Earthquakes: None
Faults analyzed for County: Anton Scarp
HAZUS Loss Estimates:

Anton Scarp:	M7.6 – 0 fatal, $17.6 Million (-1.5%)
RM Arsenal:	**M6.25 – 0 fatal, $0 Million (-0.0%)**

Pitkin County
Population: 14,872 Growth since 1990: 17.5%
County Size: 975 square miles Inventory: $2,224.30 M
Contact:

Pitkin County Emergency Management
506 E. Main Street
Aspen, CO 81611
(970)920-5234

Faults within County: Basalt Mountain Fault (Q), Sawatch Range Faults (LC)
Historical Earthquakes: Sept. 17, 1880 Aspen (#4); Apr. 8, 1940 Aspen (#68); Feb. 1941 Aspen (#69-71); Oct. 17, 1960 Aspen (#94); Mar. 5, 1962 Aspen (#101); June 23, 1968 SW of Carbondale (#310); Sept. 24, 1977 SW of Carbondale (#360); May 29, 1978 SW of Carbondale (#362); Apr.-May 1984 Carbondale Earthquakes (#381-399); Apr. 21, 1991 Aspen (#454); July 7-8, 1993 Aspen (#466-469); Oct. 13, 2002 Aspen (#550); Jan. 1, 2003 Aspen (#553)
Faults analyzed for County: Chase Gulch (LQ), Cimarron (LQ,Q), Frontal (LQ), Mosquito (LQ), N Sawatch (LQ), S Sawatch (H), Williams Fork (H)
HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 0 fatal, $10.9 Million (-0.5%)
Cimarron:	M6.75 – 0 fatal, $12.6 Million (-0.6%)
Frontal:	M7.0 – 0 fatal, $32.5 Million (-1.5%)
Mosquito:	M7.0 – 0 fatal, $61.4 Million (-2.8%)
N Sawatch:	**M7.0 – 3 fatal, $169 Million (-7.6%)**
S Sawatch:	M7.25 – 2 fatal, $115 Million (-5.2%)
Williams Fork:	M6.75 – 0 fatal, $13.2 Million (-0.6%)

Prowers County
Population: 14,104 Growth since 1990: 8.5%
County Size: 1,645 square miles Inventory: $2,306.40 M
Contact:

Prowers County Courthouse
310 S. Main St., #215
Lamar, CO 81052
(719)336-8025

Faults within County: None

Historical Earthquakes: Sept. 29, 1928 Holly (#67); Jan. 14, 1956 Lamar (#89-90); Apr. 21, 1968 S of Holly (#307); Jan. 10, 2003 Lamar (#554)

Faults analyzed for County: Cheraw (H)

HAZUS Loss Estimates:

Cheraw: M7.0 – 1 fatal, $60.9 Million (-2.6%)

Pueblo County

Population: 141,472 Growth since 1990: 15.0%

County Size: 2,401 square miles Inventory: $10,530.10 M

Contact:

Pueblo County Department of Emergency Management
320 W. 10th St., B1
Pueblo, CO 81003
(719)583-6200

Faults within County: Goodpasture (Q), Greenhorn (LC), Ilse (LC), Wet Mountain (LC)

Historical Earthquakes: Dec. 4, 1870 Pueblo-Ft. Reynolds (#1); Nov. 13, 1963 Pueblo (#144)

Faults analyzed for County: Cheraw (H), Goodpasture (Q), Rampart (MLQ), N Sangre (H), Ute Pass (MLQ)

HAZUS Loss Estimates:

Cheraw: M7.0 – 2 fatal, $171 Million (-1.6%)
Goodpasture: M6.0 – 1 fatal, $243 Million (-2.3%)
Rampart: M7.0 – 3 fatal, $203 Million (-1.9%)
N Sangre de Cristo: M7.5 WUS – 0 fatal, $25.6 Million (-0.2%)
[redacted]

Rio Blanco County

Population: 6,033 Growth since 1990: -1.1%

County Size: 3,226 square miles Inventory: $1,567.20 M

Contact:

Rio Blanco County Courthouse
PO Box I
Meeker, CO 81641
(970)878-5001

Faults within County: Blue Lake-Heart Lake Faults (LC), Fish Creek Faults (LC), Killarney Faults (Q), West Coal Creek (LC)
Historical Earthquakes: Feb. 21, 1954 Rangely-Grand Junction (#83); July 5-6, 1966 Rangely (#230-232); Feb. 15, 1967 Rangely (#249-250); Apr. 21, 1970 Rangely (#337-338); May 17, 1973 Rio Blanco AEC Test (#351); Mar. 19, 1979 Rangely (#367); Mar. 29, 1979 Rangely (#368); June 30, 1989 Meeker (#444); Nov. 3, 1994 Meeker (#481); Mar.-Apr. 1995 Dinosaur National Monument (#486-490)
Faults analyzed for County: Frontal (LQ)
HAZUS Loss Estimates:

Frontal: M7.0 – 0 fatal, $6.69 Million (-0.4%)

Rio Grande County
Population: 12,711 Growth since 1990: 15.3%
County Size: 913 square miles Inventory: $1,783.20 M
Contact:

Rio Grande County Courthouse
925 6th Street, Rm. 207
Del Norte, CO 81132
(719)657-2744

Faults within County: Del Norte Peak Faults (LC), Monte Vista Faults (Q), Monte Vista Faults West (LC), Summitville Faults (LC)
Historical Earthquakes: Jan. 15, 1988 Summitville (#438); May 10, 1991 Summitville (#455-458)
Faults analyzed for County: Cannibal (LQ), N Sangre de Cristo (H)
HAZUS Loss Estimates:

Cannibal: M7.0 – 0 fatal, $36.6 Million (-2.1%)
N Sangre de Cristo: M7.5 WUS – 0 fatal, $16.3 Million (-0.9%)
M7.5 CEUS – 7 fatal, $124 Million (-7.0%)

Routt County
Population: 19,690 Growth since 1990: 39.8%
County Size: 2,331 square miles Inventory: $3,114.00 M
Contact:

Routt County Office of Emergency Management
135 6th Street or PO Box 773598

Steamboat Springs, CO 80477
(970)870-5551

Faults within County: Blacktail Mountain Faults (LC), Brush Mountain (LC), Diamond Peak Faults (LC), Fish Creek Faults (LC), Gardner Reservoir Faults (LC), Green Ridge (LC), Grouse Mountain (LC), Hahns Peak Faults (LC), Hinman Creek (LC), King Solomon (LC), Kremmling Faults (LC), Lawson Creek (LC), Lester Creek Reservoir (LC), Little Rock Creek (LC), Lone Spring Faults (LC), Milner Faults (LC), Morrison Creek (LC), Newcomer Creek Faults (LC), Park Range Faults (LC), Rabbit Ears Pass Faults (LC), Reed Creek (LC), Sand Mountain (LC), Sierra Madre Range Faults (LC), Silver City Creek (LC), Silver Creek (LC), Spillway (LC), Steamboat Lake (LC), Steamboat Springs Fault Zone (LC), Trail Creek (LC), Twentymile Park Faults (LC), Wheeler Creek (LC), Willow Creek Structural Zone (LC), Yampa (LC)

Historical Earthquakes: Mar. 22, 1895 Steamboat Springs (#17); Feb. 10, 1955 Steamboat Springs (#84); Nov. 1, 1966 Yampa (#238); Jan. 18, 1967 Flat Tops (#245); Mar. 18, 1971 Clark (#343); Mar. 31, 1974 Clark (#357); Apr. 29, 1993 Clark (#465); Feb. 2000 E of Steamboat Springs (#509-510); July 30, 2000 Steamboat Springs (#513); Mar. 23, 2002 Steamboat Springs (#537); Apr. 2002 Steamboat Springs (#541-542)

Faults analyzed for County: Frontal (LQ), Mosquito (LQ), Williams Fork (H), 1882 Rocky Mountain Park Epicenter

HAZUS Loss Estimates:

[redacted]M7.0 – 1 fatal, $56.0 Million (-1.8%)
Mosquito: M7.0 – 0 fatal, $23.2 Million (-0.7%)
Williams Fork: M6.75 – 0 fatal, $40.4 Million (-1.3%)
1882 RMNP: M6.6 – 0 fatal, $16.5 Million (-0.5%)

Saguache County

Population: 6,425 Growth since 1990: 28.1%
County Size: 3,168 square miles Inventory: $1,517.10 M

Contact:

Saguache County Courthouse
PO Box 655
Saguache, CO 81149
(719)655-2231

Faults within County: Alamosa Horst Fault Zone-East (LC), Cimarron Fault-Powderhorn Section (LC), Houselog Creek Faults (LC), Kerber Creek (LC), Lucky Boy (LQ), Mineral Hot Springs (LQ), North Sangre de Cristo (H), Poncha Pass Faults (LC), Saguache Creek Faults (LC), Squaw Creek Faults (LC), Villa Grove Fault Zone (H), Western Boundary (LQ)

Historical Earthquakes: None

Faults analyzed for County: Cannibal (LQ), N Sangre de Cristo (H), S Sawatch (H)

HAZUS Loss Estimates:

Cannibal: M7.0 – 0 fatal, $16.3 Million (-1.1%)

N Sangre de Cristo: **M7.5 WUS – 0 fatal, $25.2 Million (-1.7%)**
M7.5 CEUS – 4 fatal, $104 Million (-6.9%)
S Sawatch: M7.25 – 0 fatal, $28.6 Million (-1.9%)

San Juan County
Population: 570 Growth since 1990: -25.1%
County Size: 389 square miles Inventory: $369.20 M
Contact:
San Juan County Courthouse
PO Box 466
Silverton, CO 81433
(970)387-5766
Faults within County: None
Historical Earthquakes: Nov. 23, 1882 Silverton (#10); Apr. 29, 1945 Silverton (#77-78); Jan. 16, 1967 Silverton (#244); June 18, 2002 SE of Silverton (#545)
Faults analyzed for County: Busted Boiler (LQ), Cannibal (LQ)
HAZUS Loss Estimates:
Busted Boiler: M6.5 – 0 fatal, $0.89 Million (-0.2%)
Cannibal: M7.0 – 0 fatal, $2.36 Million (-0.6%)

San Miguel County
Population: 7,100 Growth since 1990: 80.5%
County Size: 1,291 square miles Inventory: $1,361.60 M
Contact:
San Miguel County
PO Box 1170
Telluride, CO 81435
(970)728-3844
Faults within County: Big Gypsum Valley Graben Faults (Q), Dolores Fault Zone (Q), San Miguel Canyon Faults (Q)
Historical Earthquakes: Jan. 1, 1894 Telluride (#15); Feb. 3, 1970 S of Norwood (#335); Sept. 13-15, 1994 Norwood (#475-478)
Faults analyzed for County: Busted Boiler (LQ), Cimarron (LQ,Q), Roubideau (H)
HAZUS Loss Estimates:
Busted Boiler: M6.5 – 0 fatal, $36.2 Million (-2.7%)
Cimarron: M6.75 – 0 fatal, $7.53 Million (-0.6%)

Roubideau: M5.5 – 0 fatal, $0.81 Million (-0.0%)

Sedgwick County
Population: 2,747 Growth since 1990: 2.1%
County Size: 544 square miles Inventory: $1,071.60 M
Contact:
Sedgwick County Courthouse
315 Cedar St. or PO Box 50
Julesburg, CO 80737
(970)474-2485
Faults within County: None
Historical Earthquakes: None
Faults analyzed for County: Anton Scarp
HAZUS Loss Estimates:
Anton Scarp: M7.6 – 0 fatal, $4.01 Million (-0.4%)
[redacted]

Summit County
Population: 23,548 Growth since 1990: 82.8%
County Size: 612 square miles Inventory: $4,184.10 M
Contact:
Summit County Commissioners Office
208 E. Lincoln Ave. or PO Box 68
Breckenridge, CO 80424
(970)453-3535
Faults within County: Blue River Graben Faults (LC), Blue River Fault West (LC), Frontal (LQ), Gore (LC), Green Mountain Reservoir Faults (LC), Mosquito (LQ), Mount Powell Faults (LC), Sheephorn Mountain Faults (LC)
Historical Earthquakes: Aug. 4, 1964 Dillon (#149); Sept. 12, 1990 Vail (#449)
Faults analyzed for County: Chase Gulch (LQ), Frontal (LQ), Golden (Q), Mosquito (LQ), N Sangre de Cristo (H), N Sawatch (LQ), S Sawatch (H), Ute Pass (MLQ), Williams Fork (H)
HAZUS Loss Estimates:
Chase Gulch: M6.75 – 0 fatal, $73.3 Million (-1.8%)
[redacted]
Golden: M6.5 – 0 fatal, $27.1 Million (-0.7%)

Mosquito:	**M7.0 – 25 fatal, $1.06 Billion (-25.3%)**
N Sawatch:	M7.0 – 3 fatal, $217 Million (-5.2%)
S Sawatch:	M7.25 – 2 fatal, $141 Million (-3.4%)
Ute Pass:	M7.0 – 0 fatal, $42.7 Million (-1.0%)
Williams Fork:	M6.75 – 9 fatal, $436 Million (-10.4%)

Teller County
Population: 22,156 Growth since 1990: 64.9%
County Size: 559 square miles Inventory: $1,952.20 M
Contact:

Teller County Courthouse
PO Box 959
Cripple Creek, CO 80813
(719)689-2988

Faults within County: Bare Hills (LC), Colorado Springs Faults (LC), Fourmile Creek (LC), Hay Creek (LC), High Park Fault Zone (LC), Midland (LC), Oil Creek (LC), Raspberry Mountain (LC), Ute Pass Fault Zone (MLQ)
Historical Earthquakes: Jan. 6, 1979 Divide (#365); Dec. 23 and 31, 1995 Manitou Springs (#492-493); Jan. 1997 Woodland Park (#497-499); Apr. 18, 1998 Woodland Park (#503); July 22, 2001 Woodland Park (#515); Feb. 19, 2003 Woodland Park (#556)
Faults analyzed for County: Chase Gulch (LQ), Rampart Range (MLQ), N Sangre de Cristo (H), S Sawatch (H), Ute Pass (MLQ)
HAZUS Loss Estimates:

Chase Gulch:	M6.75 – 0 fatal, $50.0 Million (-2.6%)
Rampart:	M7.0 – 4 fatal, $260 Million (-13.3%)
N Sangre de Cristo:	M7.5 WUS – 0 fatal, $2.44 Million (-0.1%)
S Sawatch:	M7.25 – 0 fatal, $18.0 Million (-0.9%)
Ute Pass:	**M7.0 – 14 fatal, $524 Million (-26.8%)**

Washington County
Population: 5,048 Growth since 1990: 2.4%
County Size: 2,523 square miles Inventory: $2,148.70 M
Contact:

Washington County Courthouse
150 Ash Ave.
Akron, CO 80720
(970)345-2701

Faults within County: High Plains Grabens under investigation
Historical Earthquakes: None
Faults analyzed for County: Anton Scarp
HAZUS Loss Estimates:

Anton Scarp:	M7.6 – 10 fatal, $228 Million (-10.6%)
RM Arsenal:	M6.25 – 0 fatal, $1.09 Million (-0.0%)

Weld County
Population: 180,936 Growth since 1990: 37.3%
County Size: 3,999 square miles Inventory: $14,295.20 M
Contact:

Weld County Commissioners
915 Tenth Street or PO Box 758
Greeley, CO 80632
(970)336-7204

Faults within County: None
Historical Earthquakes: May 26, 1969 E of Greeley (#328)
Faults analyzed for County: Golden (Q), Rocky Mountain Arsenal Epicenter, Valmont (MLQ), Walnut Creek (Q)
HAZUS Loss Estimates:

Golden:	M6.5 – 3 fatal, $299 Million (-2.1%)
RM Arsenal:	M6.25 – 7 fatal, $502 Million (-3.5%)
Valmont:	M5.0 – 0 fatal, $40.2 Million (-0.3%)
Walnut Creek:	M6.0 – 1 fatal, $212 Million (-1.5%)

Yuma County
Population: 10,018 Growth since 1990: 9.9%
County Size: 2,370 square miles Inventory: $2,633.00 M
Contact:

Yuma County Courthouse
310 Ash Suite A
Wray, CO 80758
(970)332-5796

Faults within County: High Plains Grabens under investigation
Historical Earthquakes: None

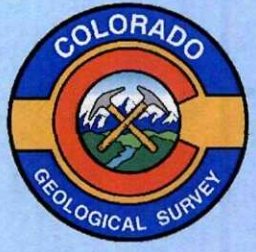
Faults analyzed for County: Anton Scarp

HAZUS Loss Estimates:

Anton Scarp:	M7.6 – 12 fatal, $214 Million (-8.1%)
Cheraw:	**M7.0 – 0 fatal, $3.29 Million (-0.13%)**
RM Arsenal:	M6.25 – 0 fatal, $0.37 Million (-0.0%)

HAZUS Procedures

Fault Parameters
Soil Types
Building Types
Region Inventories



HAZUS Procedures

1. **Create or Open a Study Region**:
    a. The study region defines the Hazus boundary within which a scenario will be run. A statewide scenario will produce statewide results, so each county must be run separately to see these results. If improved inventory becomes available, scenarios can be run for individual census tracts or a combination of census tracts that make up a specific city.
    b. The first Hazus startup window will allow you to choose whether you create a new study region or use an existing region. For the current MR1 version, **state and county-level study regions have already been created.** (Regions are stored in C:\Program Files\HAZUS-MH)
    c. If you are creating a new study region and need to select more than one county or census tract, hold down the Control key.
    d. **A warning about study regions**: Hazus results are only shown for the earthquake scenario that is most recent. If more than one scenario is run for the same study region, the previous results must be saved or they will be lost!
2. **Open Hazus Window:**
    a. When region aggregation is complete, choose 'Open a region' and the ArcView window will open up containing the region. You can add shapefiles such as faults, soils, and landslide susceptibility, but they do not need to be visible for scenarios to run.
    b. You can see if there is a current scenario and set of hazard maps for the study region through 'Hazard' > 'Show Current'.
3. **Add Hazard Maps:**
    a. To add hazard maps that Hazus will recognize during a scenario, go to 'Hazard' > 'Data Maps' > 'Add Maps' and browse for the appropriate maps. These must be .mdb files with a 'type' field or else Hazus will not accept them. To date, two hazard maps have been used in every scenario: 'Geology' > 'CO_Soils' > type: cosoils.mdb in the space, and select 'cosoils_region_1' from the list (Soil map) and 'Landslide Data' > type: nat_co_ls.mdb and select nat_ls_co_II from the list (Landslide susceptibility map).
    b. Once hazard maps are added to the table, you must select them under 'Hazard' > 'Scenario' > 'Define hazard maps' and select the maps from the dropdown lists under each hazard type. Liquefaction and depth to water table have been left as default values for all scenarios to date. It takes up to 20 minutes for the hazard maps to be clipped and applied to large study regions.
4. **Defining Scenarios:**
    a. From the menu bar, choose 'Hazard' > 'Scenario', and you will be given a choice to define a new scenario or to use an already predefined scenario. There are many predefined scenarios that are "re-usable", for all of the faults, epicenters, and random epicenters analyzed through May 2006.

Click on 'Use an already pre-defined scenario' to see the dropdown list. Using these saves you the step of creating more scenarios.

b. If you are making a new scenario, choose 'Hazard' > 'Scenario' > 'Define new scenario', and the scenario wizard will open to guide you through the setup of various parameters.
c. For Seismic Hazard Type, choose 'Arbitrary Event' for a Deterministic scenario or 'Probabilistic Hazard'.
d. **Deterministic:**
    i. Choose the appropriate attenuation coefficient and type of fault motion. Most of the newer Hazus scenarios in the MR1 version have been run with the 'CEUS Event' attenuation function. This is a combination of several functions used by the USGS in their seismic hazard maps, and it produces results that are representative of a worst-case scenario. The only region in Colorado that should be run with a WUS function is the Rio Grande Rift. 'WUS Shallow Crustal Event – Ext.' is the best combination of WUS functions to use.
    ii. In the next window, enter epicenter values that approximate the midpoint of the fault under investigation. See "Hazus Fault Parameters" in the Hazus notebook for a list of epicenters used in previous scenarios. To modify these, go to 'View' > 'Data Frame Properties' and change the map coordinates to decimal degrees. Then select a point along the given fault and note the coordinates.
    iii. Enter earthquake magnitude, leave depth and width at 10. Enter average fault strike as a value between 0 and 180, 0 being directly north, 90 being due east. Enter the fault dip as a value between 0 and 90, with a positive value for NW, W, or SW dips and a negative value for NE, E, or SE dips.
    iv. In the next window, enter the scenario name. This is important in organizing and recognizing each scenario so it must be specific to the fault and magnitude of an event, along with the attenuation function being used.
    v. The final window allows you to review the entered data. Click finish when complete.
e. **Probabilistic:**
    i. Choose either a return period, from 100 to 2500 years, or annualized losses. (There appears to be an error with annualized loss scenarios – the same calculation can be done by running a specific return period then dividing the total economic losses by the number of years in the return period.)
    ii. Choose a driving magnitude. By May 2006, all probabilistic scenarios were run with a M6.5, but the USGS is now using a M7.0 for their hazard maps.
    iii. Name the scenario with specific information so it can be identified.

5. **Running Scenarios:**
    a. If you will be running contour mapping (PGA), go to 'Analysis' – 'Parameters' – 'Contour Interval' first , and change the value to 200 for a better-looking map.
    b. On the menu bar choose 'Analysis' > 'Run' and select the modules you wish to analyze. Most of the scenarios have been run with all modules selected **except** 'Military Installation', 'Advanced Engineering Building Mode' and 'User-supplied Inventory'. If you want to map ground shaking results (PGA), select 'Contour maps' – this adds time to the scenario analysis, but can be a helpful part of the presentation of results.
    c. For planning ahead, most statewide scenarios with contour mapping take between 4-5 hours and are best run overnight. Statewide scenarios without mapping take between 1-2 hours. County scenarios take from 30 minutes to 1 hour with mapping, or between 1 and 6 minutes without mapping.
6. **Handling Results:**
    a. After the Hazus windows say that a scenario is complete, the 'Results' menu is where to go.
    b. To generate a thorough PDF report, go to 'Summary Reports', choose the 'Other' tab, and view the **'Global Summary Report'**. This is a 20-25 page report that summarizes all of the modules analyzed. Page 14 and 15 are where casualties and economic loss are listed, with total economic loss in the paragraph at the top of page 15. Each global report must be exported and saved as a PDF file before another scenario is run for the same region. Only one scenario and its results are saved in a region at a time. In the upper left corner of the report, click the arrow-envelope button and save the entire report as a PDF in C:\Program Files\HAZUS-RESULTS using a name similar to the scenario.
    c. To map results, select a facility or result from the 'Results' dropdown menu. County maps created in the spring of 2006 used 'Ground Motion', 'Essential Facilities', 'Transportation Systems', 'Utility Systems', and 'Building Economic Loss'. We mapped Structural Damage, At Least Extensive, which can be found by navigating to the far right side of any facility's results table. A sample of all possible damage states to map can be found in the Hazus notebook for schools in Mesa County.
        i. To map a damage level, select the column by clicking at its top, then click 'Map'. Default colors will show up, but symbology can be changed as in any other ArcView project.
        ii. Symbology layers are saved in C:\Program Files\HAZUS-DATA\Layers and Epicenters and can be imported by right-clicking the layer in ArcMap > 'Layer Properties' > 'Symbology' > 'Quantities' > 'Graduated Colors'. Click the Import button in the upper right corner, and navigate to the above location to find facilities that already have a symbol/color layer.

iii. You can also create your own symbology manually and can determine how graduated symbols are distributed through the 'Classify' button.

iv. We found it helpful to open all of the results layers you want to map in the original Hazus window, then save the project as a normal ArcView project. Re-opening as the normal ArcView project will make final layout of maps much easier, since Hazus uses a default layout and will not save any other format.

v. When a map is complete, save it under **File – Export Map**, save the maps onto **D:\Hazus Result Maps** into the appropriate county folder. Format as **pdf** with the highest resolution possible (usually 300).

d. To map ground shaking such as **PGA (peak ground acceleration)**, go to Results>Ground Motion or Ground Failure> Contours or Ground Failure Maps> PGA contours. Select 'map', let the colors fill in the region, then 'cancel' (weird, but it's what you do). At this point, save the shapefile by right clicking the layer, going to 'Data' > 'Export Data' and saving in a folder so the raw data is not lost. The default colors are much too coarse, so you have to change the color scheme and classification.

i. You can import the standardized PGA color ramp that was used for most of the statewide PGA maps. Right click the shapefile> Properties> Symbology. Click 'quantities'> 'graduated colors'. Click the 'Import' button in the upper right corner and navigate to C:\Program Files\HAZUS-DATA\PGA Shapefiles and Data, and the 'N_Sangre_MaxPGA.lyr' layer file should show up. This has the greatest PGA value and is therefore the best standard to use. Keep clicking OK, and when the symbology window shows up again, make sure that blue equals 0 ground shaking and that there are no box outlines around the cells. To change, click on the top of the 'symbol' column and flip symbols or go to properties for all symbols to get rid of the gray outline.

ii. If you want to create your own PGA symbology, use the same process as above but do not import the N Sangre layer. Click the 'Classify' button: Method = natural breaks (Jenks), Classes = 50 for a good color distribution, Sampling = add a 0 so the max size is 100,000 and all samples are used. Apply>OK for classification. 'Symbol' button: flip colors so that blue is 0 value, 'properties for all symbols' = no outline color so boxes don't show. Apply>OK. Save this as a layer file if you want to keep this color scheme.

iii. For final map layout, it is easier to save changes in a normal ArcView project instead of the Hazus Arc window. Export the final layout as a jpeg or pdf.

Using and Creating Attenuation Functions:

1. We have experimented with the attenuation functions that are appropriate for Colorado. The USGS seismic hazard maps place most of Colorado in the CEUS zone, with only the Rio Grande Rift lying within the WUS zone. Most of our newer scenarios have used 'CEUS Event' which is a combination of four functions. CEUS results are generally 3-5 times greater than WUS results, so we are presenting worst-case scenarios by using CEUS functions and the maximum credible earthquake magnitudes.
2. If Hazus is re-installed, you must activate the CEUS functions because the program automatically assumes only WUS functions will be used. To activate/create CEUS event: Go to the START button on the desktop, select Programs and get into the Microsoft SQL Server>Enterprise Manager. (if the screen is blank when you open it, look in the bottom left corner and maximize the console)
3. Next, in the "Tree" keep clicking the +'s until you open the "Databases" folder. This folder can take a VERY long time to open, so be patient.
4. Look for a folder called "syHAZUS", then open the table eqAttenFunct.
5. Hazus MR1 should have 34 rows of different functions. The 'FltMechanism' column has letters that represent type of movement: N = normal, S = strike-slip, R = reverse, E = East coast (?), I = interslab, F = subduction interface. These control what can be selected when scenarios are being created, so make sure either N or E is present in the functions you plan on using. The 'EorW' column controls what functions will show up in the drop-down list during scenario creation. Change all values to W if you want all of them to be visible.

Other Helpful Hints:

- All shapefiles and layers need to be in the geographic coordinate system NAD_1983. Use the ArcToolbox to change projections.
- When polishing up maps that contain cities and city names, right click> properties> labels – in 'placement properties' change the buffer from 0 to 1. This keeps city names or other labels from overlapping each other.
- If map layers are not showing or if Hazus is acting sluggish, close and reopen the program.
- To backup regions, create .hpr files through the initial Hazus window options. This is also the only way to delete a region or duplicate a region. If a new version of Hazus is installed, all regions have to be re-created since they are likely to have different inventories.
- The SQL Server can be accessed to change parameters built into Hazus. Go to the Start menu > 'Microsoft SQL Server' > '(local machine)' > 'syHazus' > 'tables' and choose the table you wish to modify.

- There is a Hazus Technical Draft and a User Manual in C:\Program Files\HAZUS-DATA\Earthquake and also on the MR1 CD. These provide thorough directions and background methodology if interested.
- You can email Doug Bausch (Douglas.Bausch@dhs.gov), Pushpendra Johari (PJohari@pbsj.com), Jawhar Bouabid (jbouabid@pbsj.com), or Lauren Heerschap (laurenheerschap@hotmail.com) for help in solving problems.
- Lauren's login and password are 'heerschl' and 'Durango17' in case access is denied to certain files.

Fault Parameters for HAZUS Scenarios

--All scenarios run with 10km Depth and Width unless otherwise noted--

1882 Historical EQ – Rocky Mountain National Park epicenter:
Epicenter: (40.41, -105.74); Strike = 45 (N45E); Dip = +60 (60W);
Max. Magnitude = 7.2

1882 Historical EQ – North Park epicenter:
Epicenter: (40.79, -106.5); Strike = 161 (N19W); Dip = -60 (60E);
Max. Magnitude = 7.2; Depth = 30 km for two scenarios

1882 Historical EQ – Piceance Basin epicenter:
Epicenter: (40.5, -108.0); Strike = 110 (N70W); Dip = +75 (75SW);
Max. Magnitude = 7.2

Anton Scarp (possible fault):
Epicenter (39.6, -102.93); Strike = 140 (N40W); Dip = -60 (60E);
Max. Magnitude = 7.6

Busted Boiler Fault:
Epicenter (38.24, -107.86); Strike = 175 (N5W); Dip = +60 (60W);
Max. Magnitude = 6.5

Cannibal Fault:
Epicenter (37.94, -107.16); Strike = 160 (N20W); Dip = +60 (60W);
Max. Magnitude = 7.0

Chase Gulch Fault:
Epicenter (39.00, -105.62); Strike = 157 (N23W); Dip = -60 (60E);
Max. Magnitude = 6.75

Cheraw Fault:
Epicenter (38.28, -103.42); Strike = 44 (N44E); Dip = +66 (66 NW);
Max. Magnitude = 7.0

Cimarron Fault:
Epicenter (38.41, -107.48); Strike = 122 (N58W); Dip = -70 (70NE);
Max. Magnitude = 6.75

Frontal (Gore) Fault:
Epicenter (39.68, -106.16); Strike = 156 (N24W); Dip = -75 (75 NE);
Max. Magnitude = 7.0

Golden Fault:
Epicenter (39.74, -105.22); Strike = 157 (N23W); Dip = +60 (60 SW);
Max. Magnitude = 6.5

Goodpasture Fault:
Epicenter (38.05, -104.91); Strike = 148 (N32W); Dip = -60 (60NE);
Max. Magnitude = 6.0

Mosquito Fault:
Epicenter (39.38, -106.16); Strike = 9 (N9E); Dip = +70 (70W);
Max. Magnitude = 7.0

Rampart Range Fault:
Epicenter (39.06, -104.92); Strike = 171(N9W); Dip = +60 (60W);
Max. Magnitude = 7.0

Rocky Mountain Arsenal Fault:
Epicenter (39.90, -104.90); Strike = 130 (N50W); Dip = +60 (60SW);
Max. Magnitude = 6.25

Roubideau Creek Fault:
Epicenter (38.41, -108.19); Strike = 106 (N74W); Dip = -65 (65NE);
Max. Magnitude = 5.5

N Sangre de Cristo Fault:
Epicenter (37.90, -105.63); Strike = 161 (N19W); Dip = +60 (60W);
Max. Magnitude = 7.5

N Sawatch Fault:
Epicenter (39.15, -106.39); Strike = 147 (N33W); Dip = -72 (72E);
Max. Magnitude = 7.0

S Sawatch Fault:
Epicenter (38.75, -106.18); Strike = 148 (N32W); Dip = -70 (70E);
Max. Magnitude = 7.25

Ute Pass Fault:
Epicenter (38.92, -105.00); Strike = 152 (N28W); Dip = +50 (50SW);
Max. Magnitude = 7.0

Valmont Fault:
Epicenter (40.03, -105.20); Strike = 75 (N75E); Dip = -80 (80SE);
Max. Magnitude = 5.0

Walnut Creek Fault:
Epicenter (39.88, -105.15); Strike = 31 (N31E); Dip = +80 (80NW);
Max. Magnitude = 6.5

Williams Fork Fault:
Epicenter (39.87, -106.15); Strike = 140 (N40W); Dip = -60 (60NE);
Max. Magnitude = 6.75

SOIL TYPES

Table 1

Comparison between the 1997 UBC Provisions and the simplified site classification working scheme used in this study.

TYPE	Site class	Site class description of 1997 UBC Provisions	Site class description of simplified working scheme used in this study
1	A	Hard rock, eastern United States sites only, $\overline{V}_S$ >1500 (m/s).	(not used)
2	B	Rock, $\overline{V}_S$ is 760 to 1500 (m/s).	Miocene and older strata, and limestone, igneous rocks, and metamorphic rocks, etc..
3	C	Very dense soil and soft rock, $\overline{V}_S$ is 360 to 760 (m/s), Undrained shear strength $u_s \geqq$ 2000 psf ($u_s \geqq$100 kPa) or N$\geqq$50 blows/ft.	Pliocene and Pleistocene strata, and conglomerates, pyroclastic rocks, etc., and geomorphologic lateritic terraces.
4	D	Stiff soils, $\overline{V}_S$ is 180 to 360 (m/s), Stiff soil with undrained shear strength 1000 psf $\leqq u_s \leqq$2000 psf (50 kpa$\leqq u_s \leqq$100 kPa), or 15$\leqq$N$\leqq$50 blows/ft.	Late Pleistocene and Holocene strata, geomorphologic fluvial terrace, and, stiff clays and sandy soils with average SPT N$\geqq$15 in the upper 30m.
5	E	Soft soils, Profile with more than 10ft (3m) of soft clay defined as soil with plasticity index PI>20, moisture content w > 40% and undarined shear strength u_s < 1000 psf (50kPa), or N<15 blows/ft.	Holocene deposits and fills, etc., with average SPT N<15 in the upper 30m.
?	F	Soils requiring site specific evaluations. 1. Soil vulnerable to potential failure or collapse under seismic loading: e.g. liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (10ft (3m) or thicker layer). 3. Very high plasticity clays: (25ft (8m) or thicker layer with plasticity index>75). 4. Very thick soft/medium stiff clays: (120ft (36m) or thicker layer).	(This is not classified in the present study and will be studied in the future.)

Note: The Provisions of 1997 NEHRP and 1997 UBC are similar.

Table 5.1 Model Building Types

No.	Label	Description	Height			
			Range		Typical	
			Name	Stories	Stories	Feet
1	W1	**Wood, Light Frame (≤ 5,000 sq. ft.)**		1 - 2	1	14
2	W2	**Wood, Commercial and Industrial (> 5,000 sq. ft.)**		All	2	24
3	S1L	**Steel Moment Frame**	Low-Rise	1 - 3	2	24
4	S1M		Mid-Rise	4 - 7	5	60
5	S1H		High-Rise	8+	13	156
6	S2L	**Steel Braced Frame**	Low-Rise	1 - 3	2	24
7	S2M		Mid-Rise	4 - 7	5	60
8	S2H		High-Rise	8+	13	156
9	S3	**Steel Light Frame**		All	1	15
10	S4L	**Steel Frame with Cast-in-Place Concrete Shear Walls**	Low-Rise	1 - 3	2	24
11	S4M		Mid-Rise	4 - 7	5	60
12	S4H		High-Rise	8+	13	156
13	S5L	**Steel Frame with Unreinforced Masonry Infill Walls**	Low-Rise	1 - 3	2	24
14	S5M		Mid-Rise	4 - 7	5	60
15	S5H		High-Rise	8+	13	156
16	C1L	**Concrete Moment Frame**	Low-Rise	1 – 3	2	20
17	C1M		Mid-Rise	4 - 7	5	50
18	C1H		High-Rise	8+	12	120
19	C2L	**Concrete Shear Walls**	Low-Rise	1 - 3	2	20
20	C2M		Mid-Rise	4 - 7	5	50
21	C2H		High-Rise	8+	12	120
22	C3L	**Concrete Frame with Unreinforced Masonry Infill Walls**	Low-Rise	1 - 3	2	20
23	C3M		Mid-Rise	4 - 7	5	50
24	C3H		High-Rise	8+	12	120
25	PC1	**Precast Concrete Tilt-Up Walls**		All	1	15
26	PC2L	**Precast Concrete Frames with Concrete Shear Walls**	Low-Rise	1 - 3	2	20
27	PC2M		Mid-Rise	4 - 7	5	50
28	PC2H		High-Rise	8+	12	120
29	RM1L	**Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms**	Low-Rise	1-3	2	20
30	RM1M		Mid-Rise	4+	5	50
31	RM2L	**Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms**	Low-Rise	1 - 3	2	20
32	RM2M		Mid-Rise	4 - 7	5	50
33	RM2H		High-Rise	8+	12	120
34	URML	**Unreinforced Masonry Bearing Walls**	Low-Rise	1 - 2	1	15
35	URMM		Mid-Rise	3+	3	35
36	MH	**Mobile Homes**		All	1	10

Default Region Inventories

County	Buildings	Transportation	Utilities	Total (Millions)
Adams	16,869.00	2,964.50	1,191.50	**21,025.00**
Alamosa	878.00	665.70	295.80	**1,839.50**
Arapahoe	29,919.00	1,736.00	577.30	**32,232.30**
Archuleta	700.00	791.00	457.70	**1,948.70**
Baca	251.00	1,347.90	232.80	**1,831.70**
Bent	262.00	711.00	108.00	**1,081.00**
Boulder	17,762.00	1,418.40	1,557.00	**20,737.40**
Chaffee	1,011.00	1,002.70	340.40	**2,354.10**
Cheyenne	131.00	1,142.80	177.00	**1,450.80**
Clear Creek	708.00	747.70	177.20	**1,632.90**
Conejos	353.00	650.90	158.50	**1,162.40**
Costilla	174.00	605.20	234.20	**1,013.40**
Crowley	182.00	370.10	114.80	**666.90**
Custer	323.00	420.70	133.90	**877.60**
Delta	1,359.00	1,232.80	249.50	**2,841.30**
Denver	36,233.00	2,247.50	558.90	**39,039.40**
Dolores	120.00	309.90	85.80	**515.70**
Douglas	11,792.00	1,342.70	562.80	**13,697.50**
Eagle	3,003.00	1,581.40	430.50	**5,014.90**
El Paso	28,105.00	2,910.40	1,555.20	**32,570.60**
Elbert	1,029.00	1,106.10	296.50	**2,431.60**
Fremont	1,948.00	1,265.40	546.30	**3,759.70**
Garfield	2,260.00	1,564.10	911.40	**4,735.50**
Gilpin	426.00	210.20	89.10	**725.30**
Grand	1,371.00	1,281.50	479.00	**3,131.50**
Gunnison	1,122.00	1,275.90	283.40	**2,681.30**
Hinsdale	146.00	171.60	29.70	**347.30**
Huerfano	496.00	1,130.20	313.30	**1,939.50**
Jackson	124.00	610.60	215.10	**949.70**
Jefferson	32,456.00	2,033.60	1,339.00	**35,828.60**
Kiowa	83.00	953.40	105.20	**1,141.60**
Kit Carson	399.00	1,588.20	264.80	**2,252.00**
La Plata	2,563.00	950.80	795.60	**4,309.40**
Lake	411.00	456.80	230.90	**1,098.70**
Larimer	15,215.00	2,424.20	1,256.80	**18,896.00**
Las Animas	863.00	2,392.40	450.10	**3,705.50**
Lincoln	290.00	1,329.90	246.50	**1,866.40**
Logan	999.00	1,814.60	243.70	**3,057.30**
Mesa	5,816.00	2,375.30	853.30	**9,044.60**
Mineral	125.00	442.80	99.60	**667.40**
Moffat	631.00	1,570.60	576.40	**2,778.00**
Montezuma	1,148.00	1,405.00	521.20	**3,074.20**
Montrose	1,626.00	1,305.10	842.80	**3,773.90**
Morgan	3,450.00	1,467.40	487.30	**5,404.70**
Otero	1,009.00	1,575.40	351.00	**2,935.40**
Ouray	292.00	237.80	251.90	**781.70**
Park	1,238.00	1,268.60	299.70	**2,806.30**
Phillips	243.00	764.80	143.40	**1,151.20**
Pitkin	1,499.00	313.40	411.90	**2,224.30**
Prowers	669.00	1,327.30	310.10	**2,306.40**
Pueblo	7,100.00	2,448.90	981.20	**10,530.10**

Rio Blanco	379.00	764.40	423.80	**1,567.20**
Rio Grande	666.00	912.40	204.80	**1,783.20**
Routt	1,515.00	1,027.10	571.90	**3,114.00**
Saguache	265.00	992.60	259.50	**1,517.10**
San Juan	82.00	271.40	15.80	**369.20**
San Miguel	646.00	542.00	173.60	**1,361.60**
Sedgwick	162.00	854.10	55.50	**1,071.60**
Summit	2,805.00	746.00	633.10	**4,184.10**
Teller	1,345.00	331.70	275.50	**1,952.20**
Washington	243.00	1,652.20	253.50	**2,148.70**
Weld	7,704.00	4,690.10	1,901.10	**14,295.20**
Yuma	500.00	1,834.20	298.80	**2,633.00**
State	253,527.00	77,869.80	28,492.00	**359,888.80**

Statewide Scenarios

Fault Maps

PGA Maps for all Statewide Scenarios

Statewide Scenarios Ranked by Severity

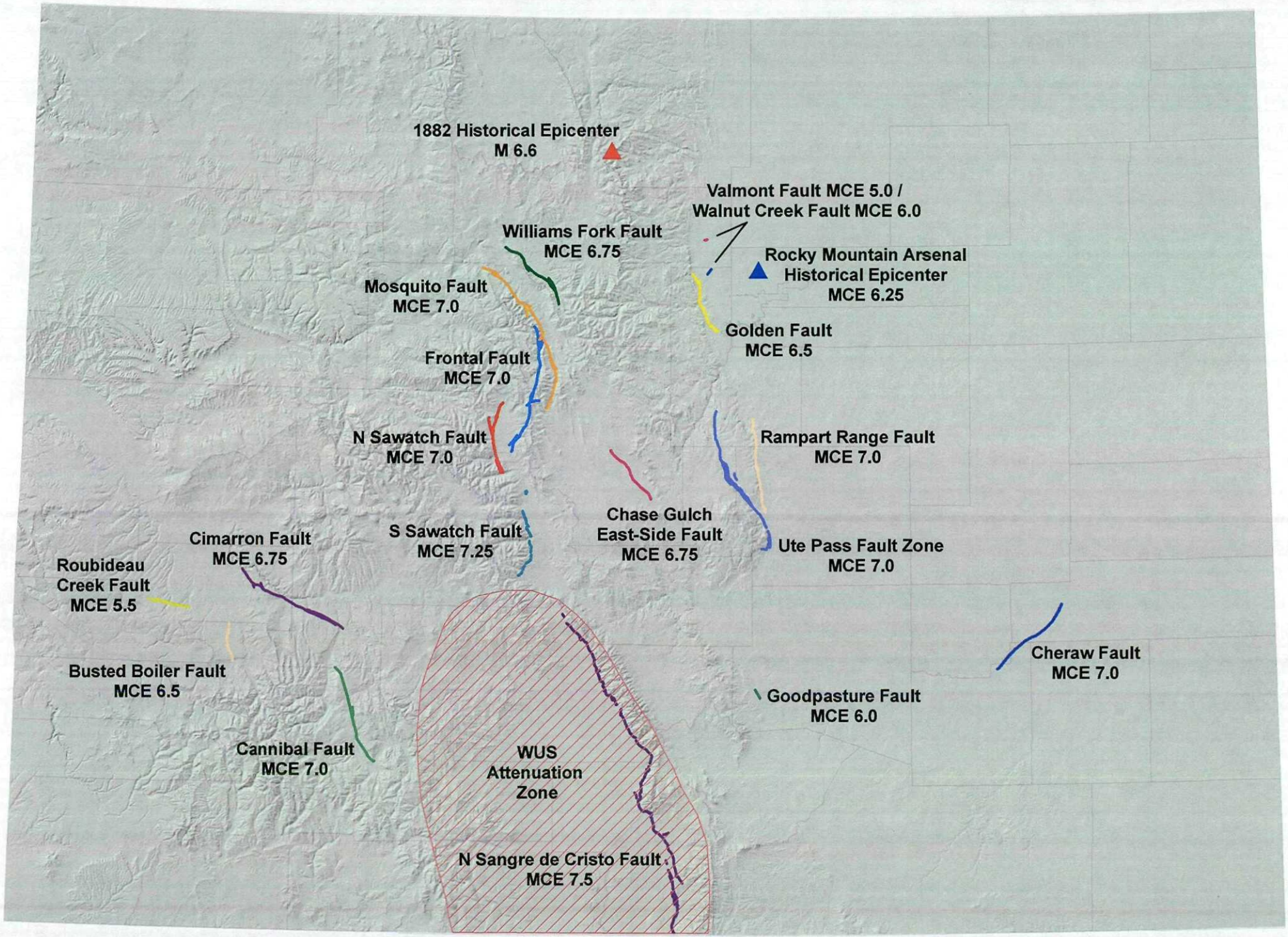
Rank	Fault	Earthquake Magnitude	Economic Loss in State
1	Rampart Range	7	$23.1 Billion
2	Golden	6.5	$21.9 Billion
3	Ute Pass	7	$16.8 Billion
4	Rocky Mountain Arsenal	6.25	$14.9 Billion
5	Anton Scarp (suspect)	7.6	$12.1 Billion
6	Walnut Creek	6	$9.70 Billion
7	N Sangre de Cristo	7.5 CEUS	$8.02 Billion
8	Frontal	7	$6.73 Billion
9	Mosquito	7	$6.19 Billion
10	South Sawatch	7.25	$4.74 Billion
11	Chase Gulch (East-Side)	6.75	$3.76 Billion
12	North Sawatch	7	$3.62 Billion
13	Williams Fork	6.75	$3.48 Billion
14	1882 Rocky Mtn National Park	6.6	$2.76 Billion
15	Cheraw	7	$1.26 Billion
16	Cimarron	6.75	$808 Million
17	N Sangre de Cristo	7.5 WUS	$767 Million
18	Valmont	5	$712 Million
19	Busted Boiler	6.5	$694 Million
20	Cannibal	7	$675 Million
21	Goodpasture	6	$479 Million
22	Roubideau Creek East	5.5	$94.2 Million

CEUS = Central-Eastern U.S. Attenuation Function
WUS = Western U.S. Attenuation Function

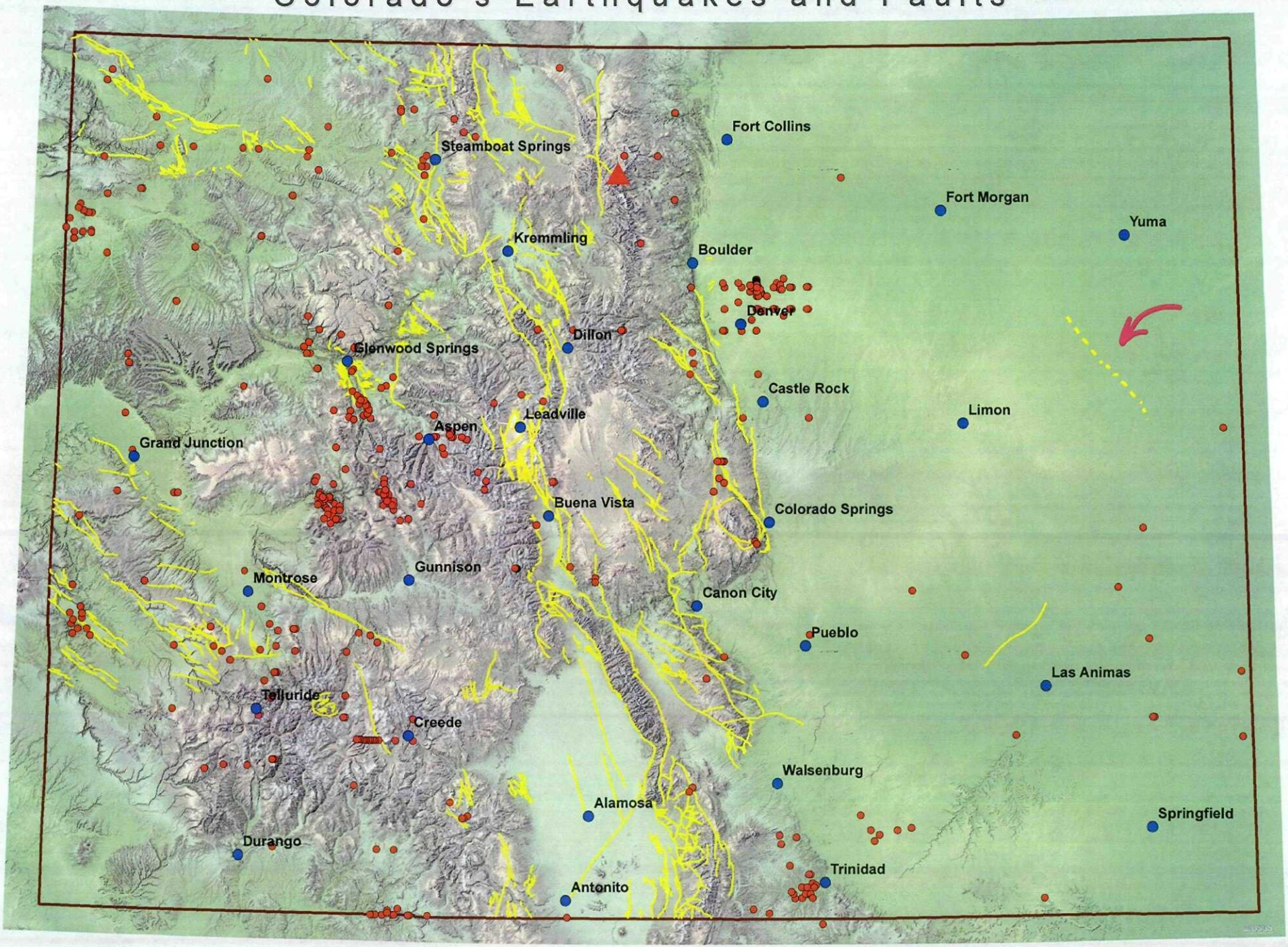
These results show how important attenuation is for accurate ground shaking models. Colorado is in the boundary zone between the two functions, with only the San Luis Valley placed in the WUS zone by the USGS. The rest of Colorado lies in the CEUS zone and was analyzed in HAZUS based on this assumption.

Statewide Scenario Summary

Fault	Earthquake Magnitude	Economic Loss in State ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Anton Scarp	7.6	12,145.18	3.37%	110,531 (8%)	2,617	23,354	5,909	7,434	4,473
Busted Boiler	6.5	694.02	0.19%	8,239 (1%)	107	693	179	12	3,295
Cannibal	7	674.66	0.19%	10,762 (1%)	46	458	117	1	561
Chase Gulch	6.75	3,760.43	1.04%	50,498 (4%)	263	4,373	1,111	304	1,198
Cheraw	7	1,260.53	0.35%	17,472 (1%)	141	1,317	354	3,055	6,291
Cimarron	6.75	807.50	0.22%	10,070 (1%)	142	1,037	262	708	1,863
Frontal	7	6,733.82	1.87%	73,922 (5%)	737	8,765	2,111	1,569	10,100
Golden	6.5	21,890.05	6.08%	213,115 (16%)	4,134	42,952	10,769	6,421	232,559
Goodpasture	6	478.59	0.13%	5,842 (<1%)	16	203	56	0	1,521
Mosquito	7	6,189.80	1.72%	70,083 (5%)	609	7,785	1,901	411	11,782
Rampart Range	7	23,046.35	6.40%	237,595 (17%)	5,058	46,717	11,343	22,364	157,654
Rocky Mountain Arsenal	6.25	14,867.04	4.13%	151,902 (11%)	2,507	28,461	7,416	1,702	112,994
Roubideau Creek East	5.5	94.23	<0.01%	665 (<1%)	1	10	2	0	0
N Sangre de Cristo	7.5 WUS	767.07	0.21%	11,639 (1%)	91	721	190	239	476
N Sangre de Cristo	7.5 CEUS	8,020.95	2.23%	93,178 (7%)	1,655	15,918	4,105	1,397	5,132
North Sawatch	7	3,617.52	1.01%	46,739 (3%)	287	4,086	1,002	695	5,880
South Sawatch	7.25	4,742.32	1.32%	62,251 (5%)	463	6,127	1,551	2,146	7,841
Ute Pass	7	16,774.21	4.66%	179,782 (13%)	3,314	31,676	7,757	19,057	126,754
Valmont	5	711.46	0.20%	1,853 (<1%)	4	77	19	0	0
Walnut Creek	6	9,704.00	2.70%	94,660 (7%)	894	12,483	3,219	0	106,167
Williams Fork	6.75	3,482.99	0.97%	42,225 (3%)	254	3,807	936	125	2,865
1882 Rocky Mtn National Park	6.6	2,761.30	0.77%	35,024 (3%)	193	2,656	658	0	2,844


1882 Historical Epicenter
M 6.6
Valmont Fault MCE 5.0 /
Walnut Creek Fault MCE 6.0
Williams Fork Fault
MCE 6.75
Rocky Mountain Arsenal
Historical Epicenter
MCE 6.25
Mosquito Fault
MCE 7.0
Golden Fault
MCE 6.5
Frontal Fault
MCE 7.0
N Sawatch Fault
MCE 7.0
Rampart Range Fault
MCE 7.0
Chase Gulch
East-Side Fault
MCE 6.75
S Sawatch Fault
MCE 7.25
Cimarron Fault
MCE 6.75
Ute Pass Fault Zone
MCE 7.0
Roubideau
Creek Fault
MCE 5.5
Cheraw Fault
MCE 7.0
Busted Boiler Fault
MCE 6.5
Goodpasture Fault
MCE 6.0
Cannibal Fault
MCE 7.0
WUS
Attenuation
Zone
N Sangre de Cristo Fault
MCE 7.5

Colorado's Earthquakes and Faults

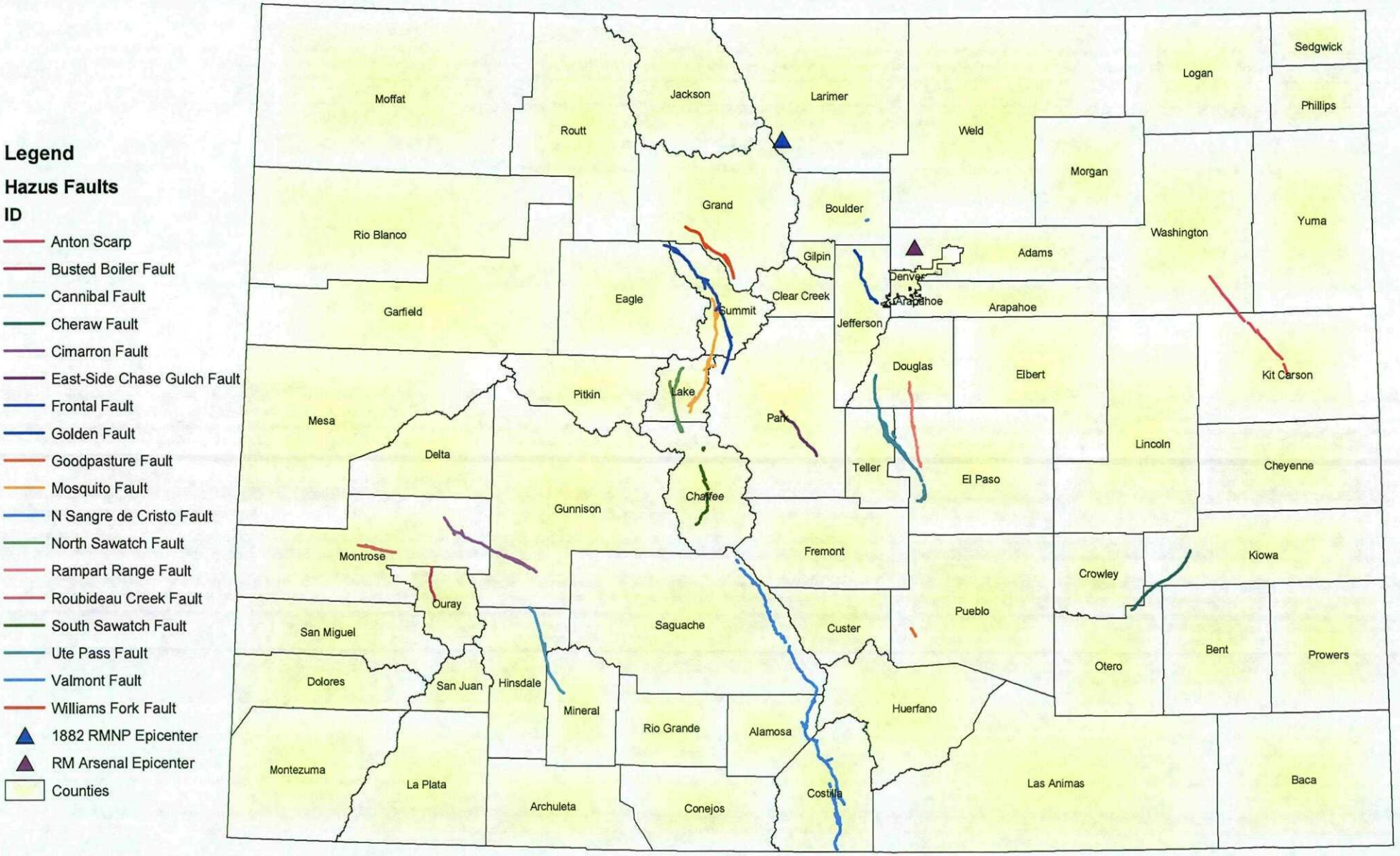


Red Dots = Historical Earthquake Locations

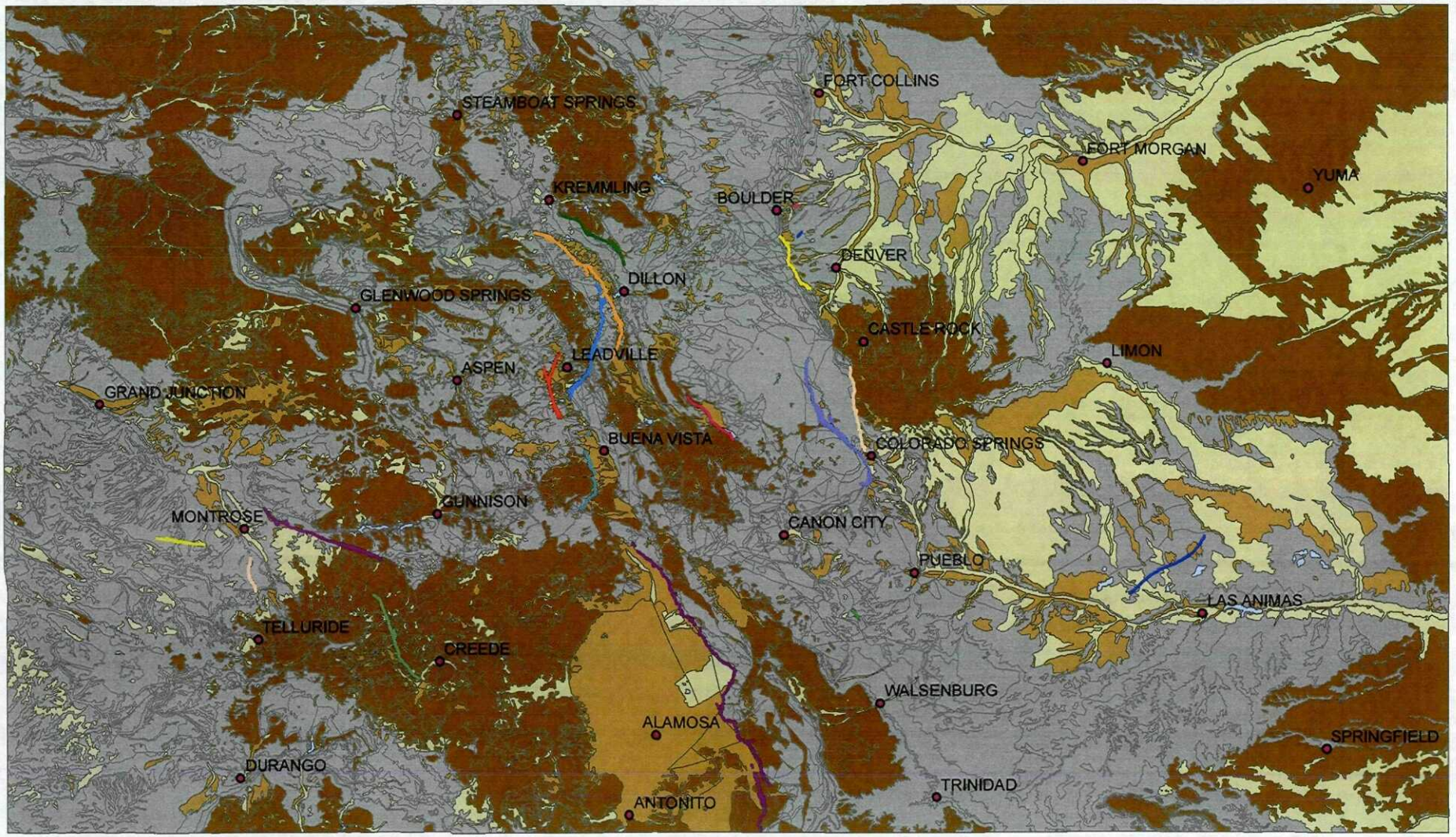
Yellow Lines = Known Faults

Dashed Yellow Line = Anton Suspect Scarp

Selected Faults for Hazus Scenarios



Soil Map Used in Colorado HAZUS Scenarios



Legend

Soil Type

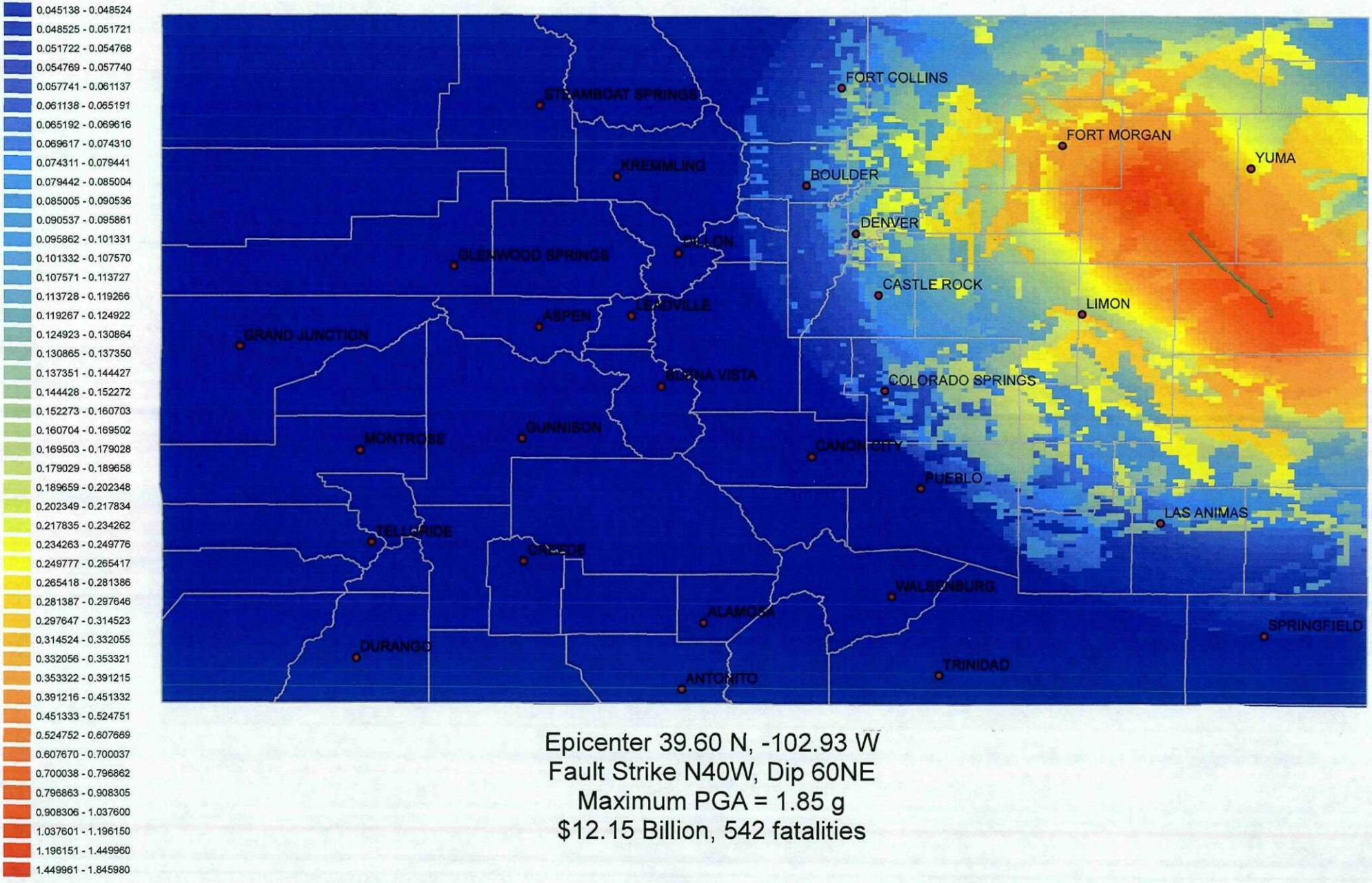
- Water
- Rock
- Soft rock and very dense soil
- Stiff soil
- Soft soil

0 20 40 80 120 160 Miles

N W E S

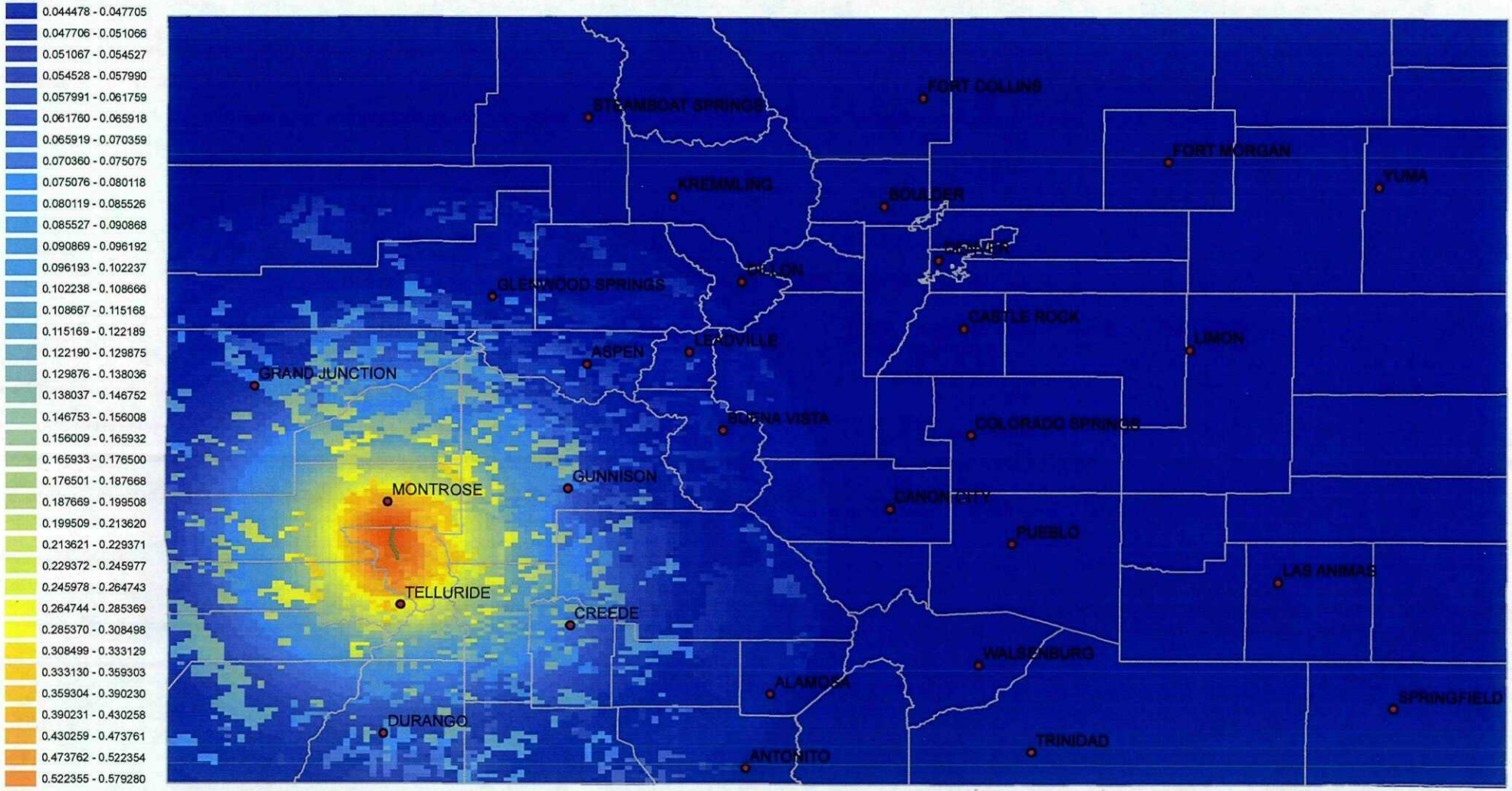
Derived from Geologic Map of Colorado (Tweto, 1979)

Anton Scarp M7.6 Peak Ground Acceleration
CEUS Attenuation Function



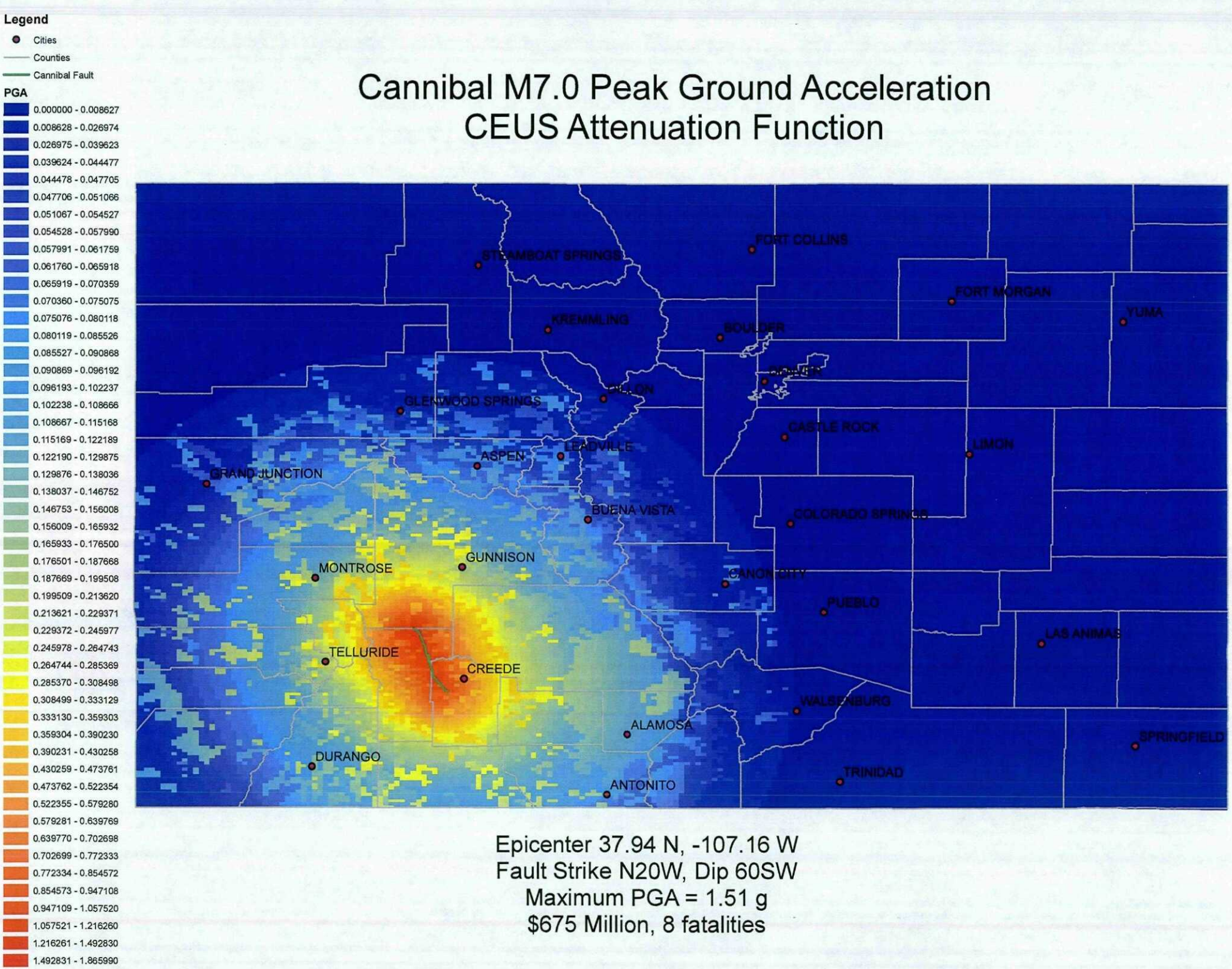
Epicenter 39.60 N, -102.93 W
Fault Strike N40W, Dip 60NE
Maximum PGA = 1.85 g
$12.15 Billion, 542 fatalities

Busted Boiler M6.5 Peak Ground Acceleration
CEUS Attenuation Function



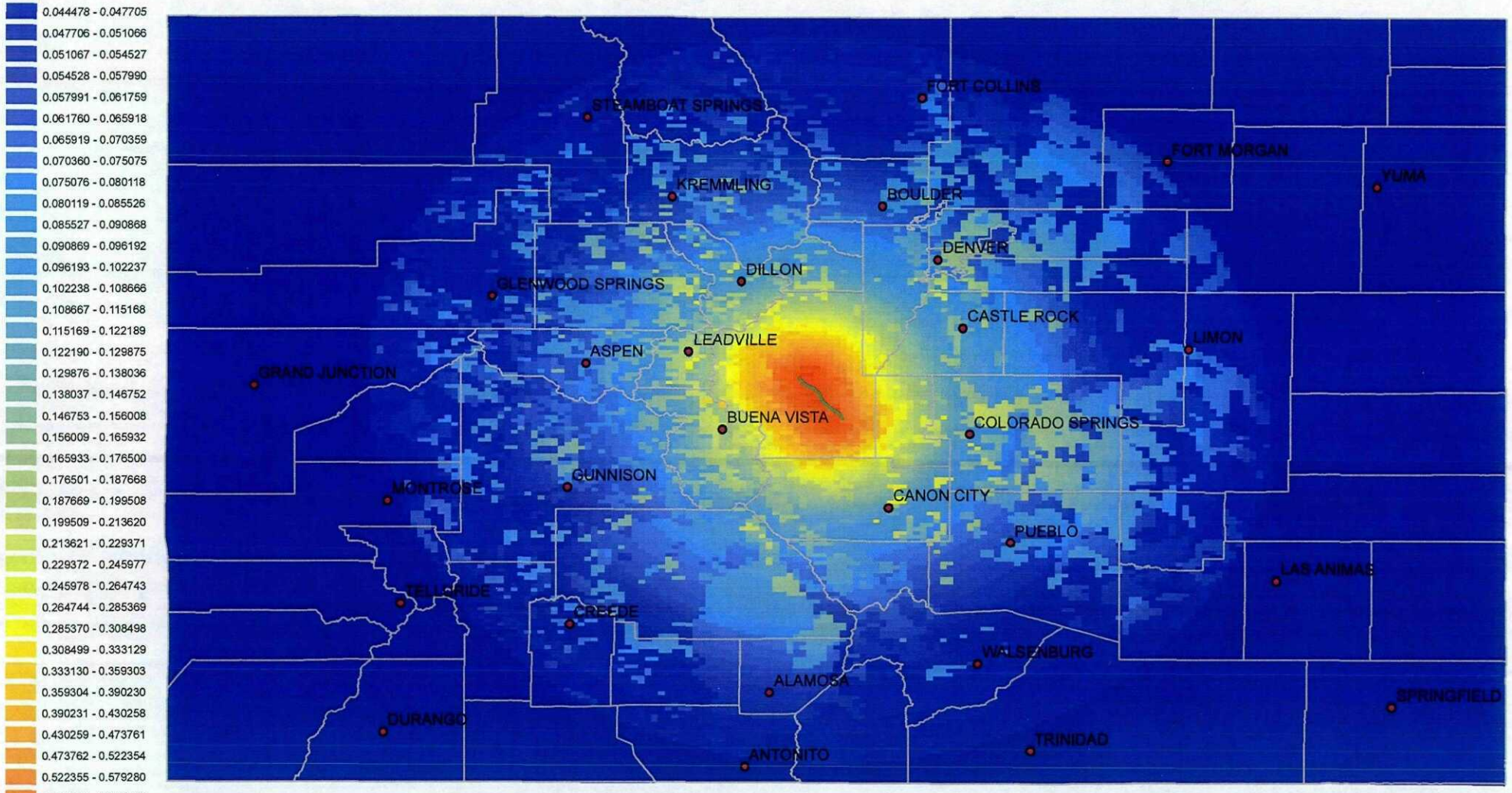
Epicenter 38.24 N, -107.86 W
Fault Strike N5W, Dip 60SW
Maximum PGA = 0.95 g
$694 Million, 22 fatalities

Cannibal M7.0 Peak Ground Acceleration
CEUS Attenuation Function



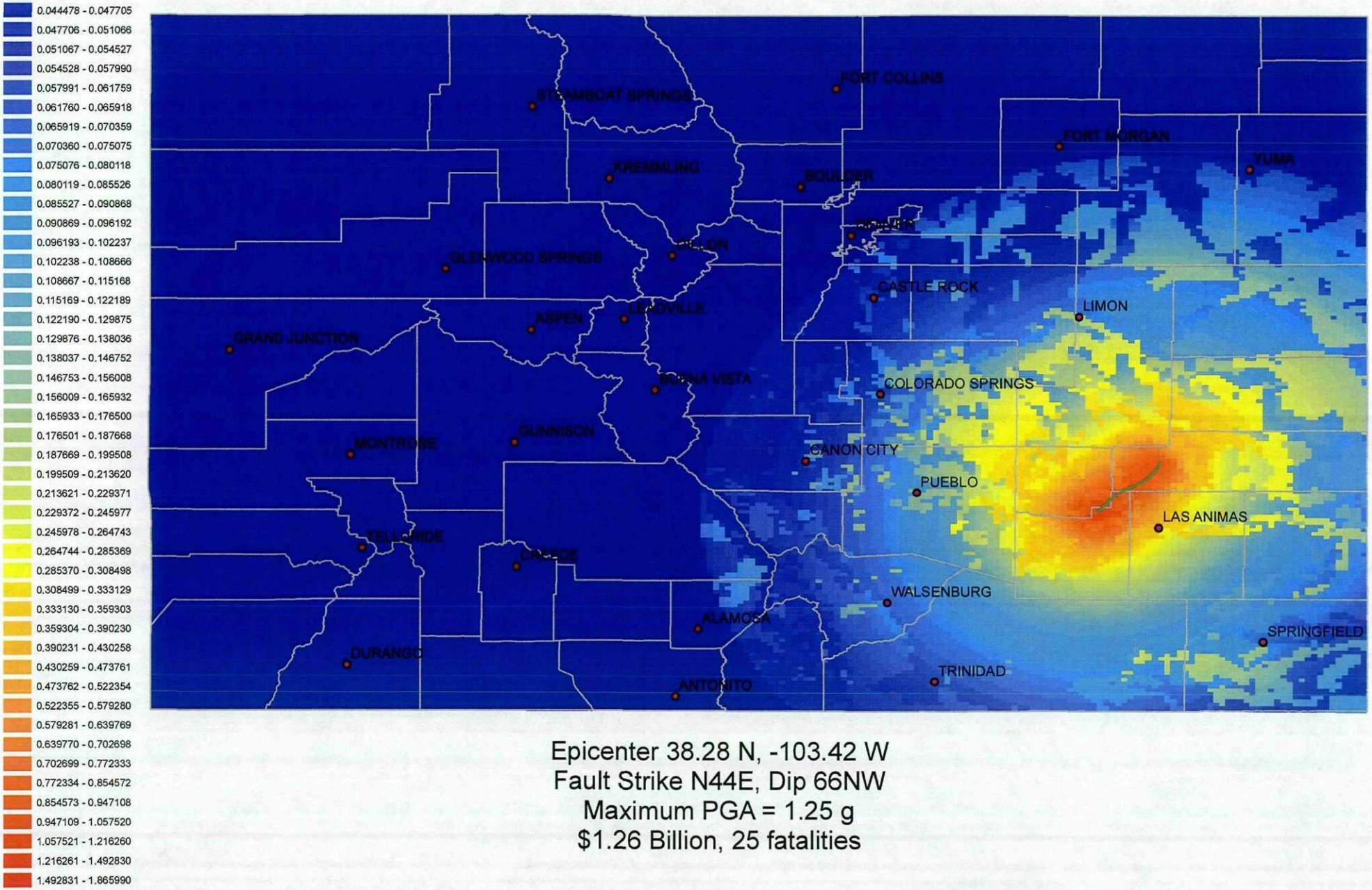
Epicenter 37.94 N, -107.16 W
Fault Strike N20W, Dip 60SW
Maximum PGA = 1.51 g
$675 Million, 8 fatalities

Chase Gulch M6.75 Peak Ground Acceleration
CEUS Attenuation Function



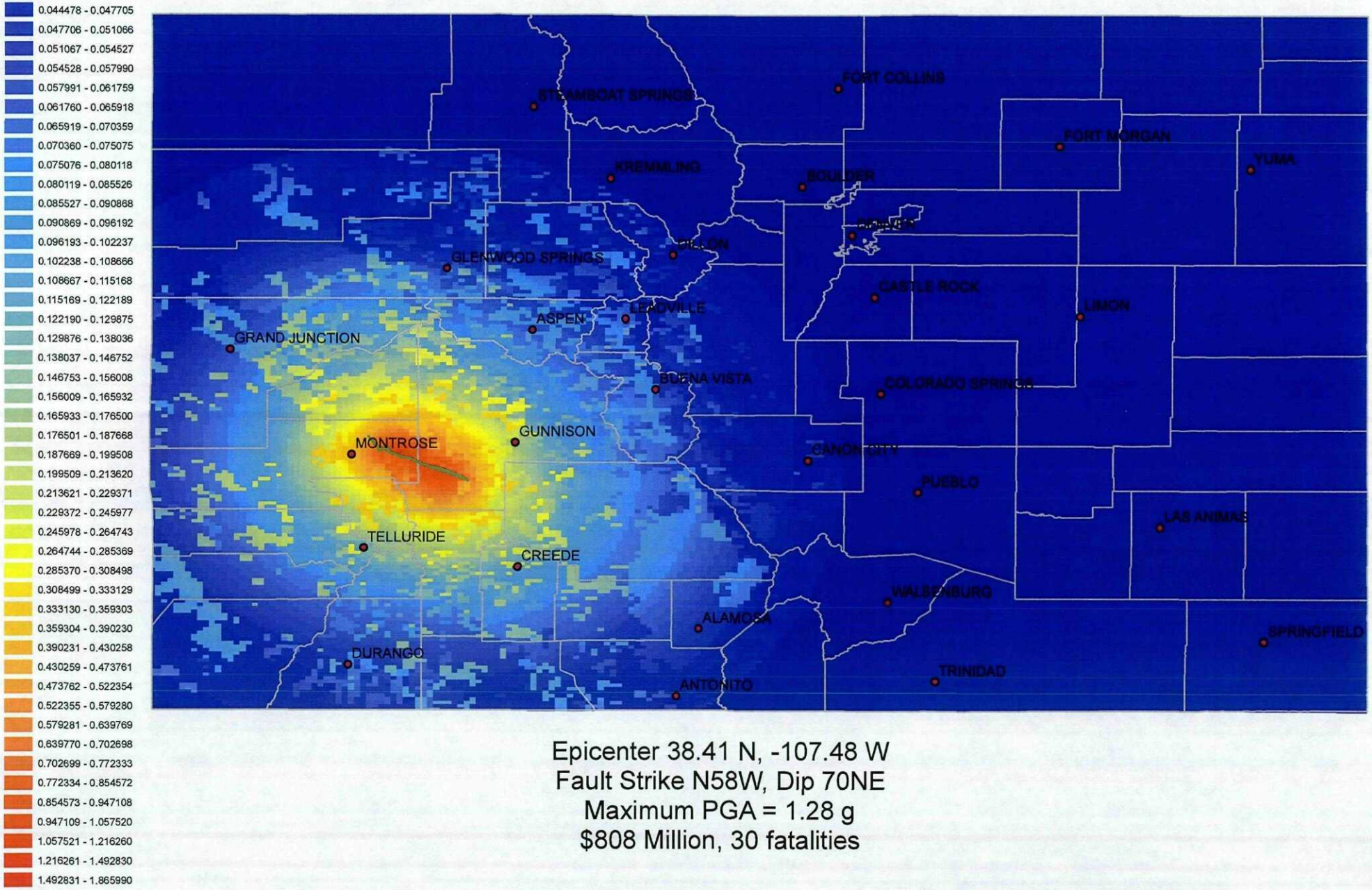
Epicenter 39.00 N, -105.62 W
Fault Strike N23W, Dip 60NE
Maximum PGA = 1.28 g
$3.76 Billion, 40 fatalities

Cheraw M7.0 Peak Ground Acceleration
CEUS Attenuation Function



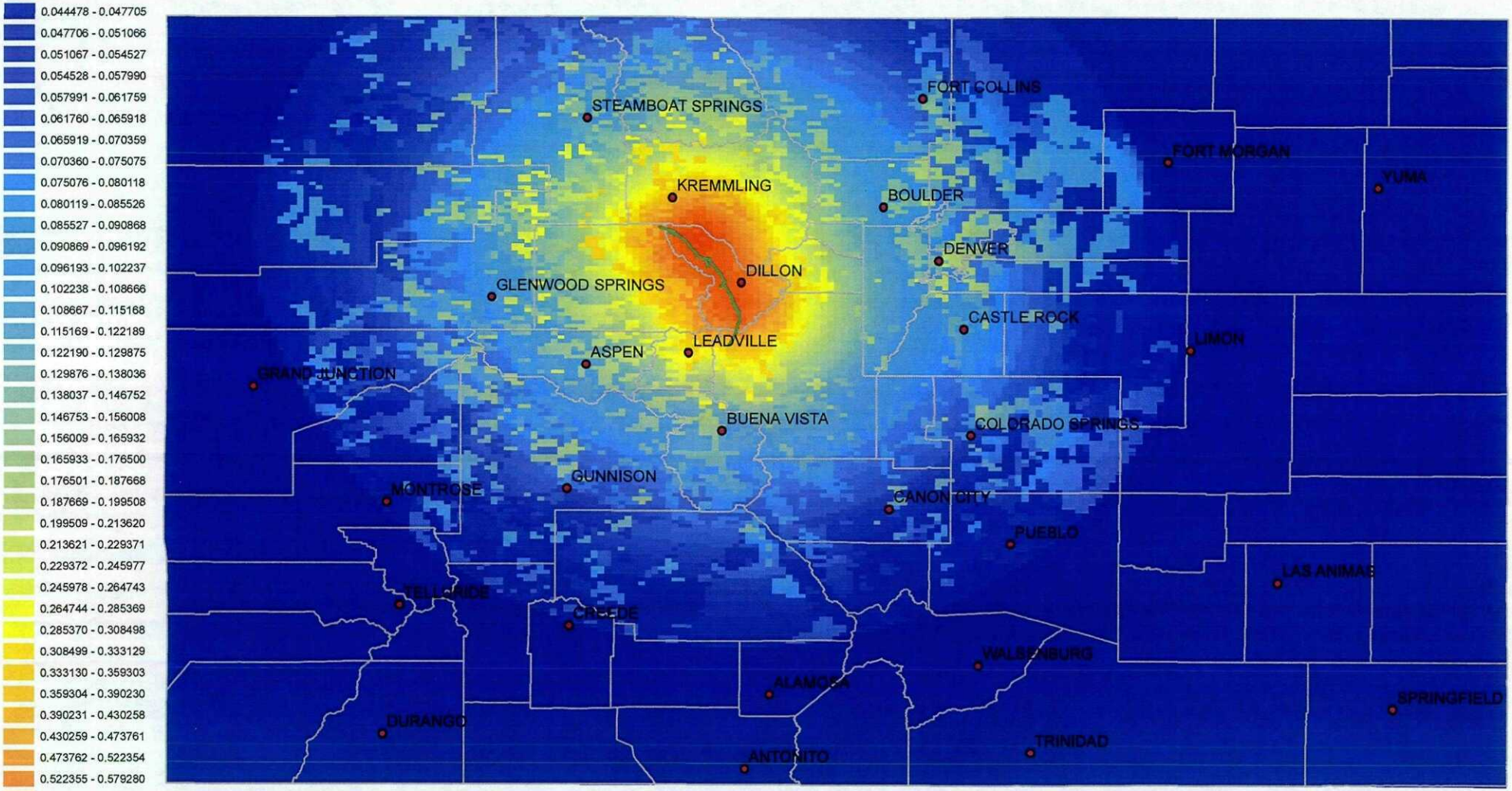
Epicenter 38.28 N, -103.42 W
Fault Strike N44E, Dip 66NW
Maximum PGA = 1.25 g
$1.26 Billion, 25 fatalities

Cimarron M6.75 Peak Ground Acceleration
CEUS Attenuation Function



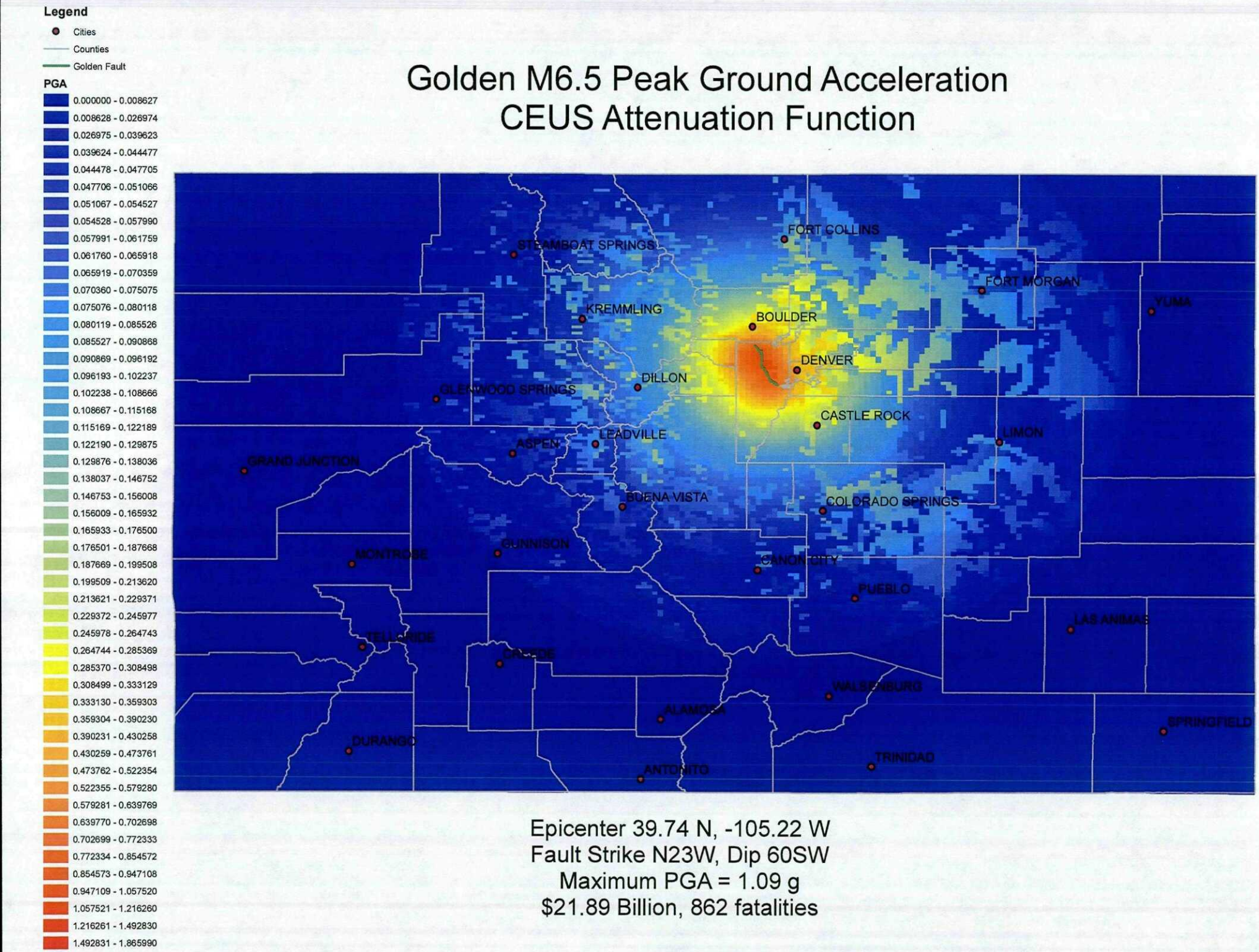
Epicenter 38.41 N, -107.48 W
Fault Strike N58W, Dip 70NE
Maximum PGA = 1.28 g
$808 Million, 30 fatalities

Frontal M7.0 Peak Ground Acceleration
CEUS Attenuation Function



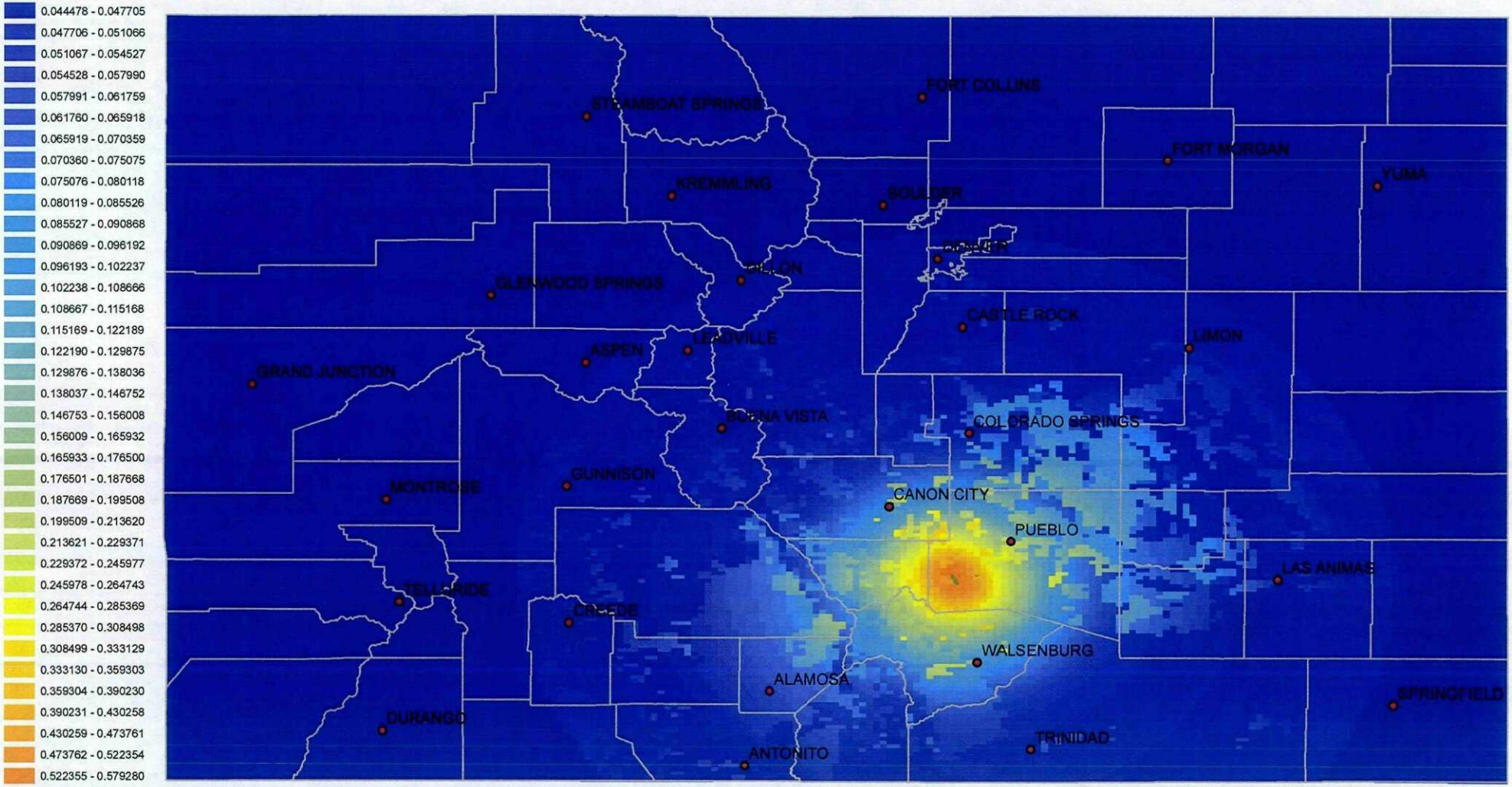
Epicenter 39.68 N, -106.16 W
Fault Strike N24W, Dip 75NE
Maximum PGA = 1.44 g
$6.73 Billion, 137 fatalities

Golden M6.5 Peak Ground Acceleration
CEUS Attenuation Function



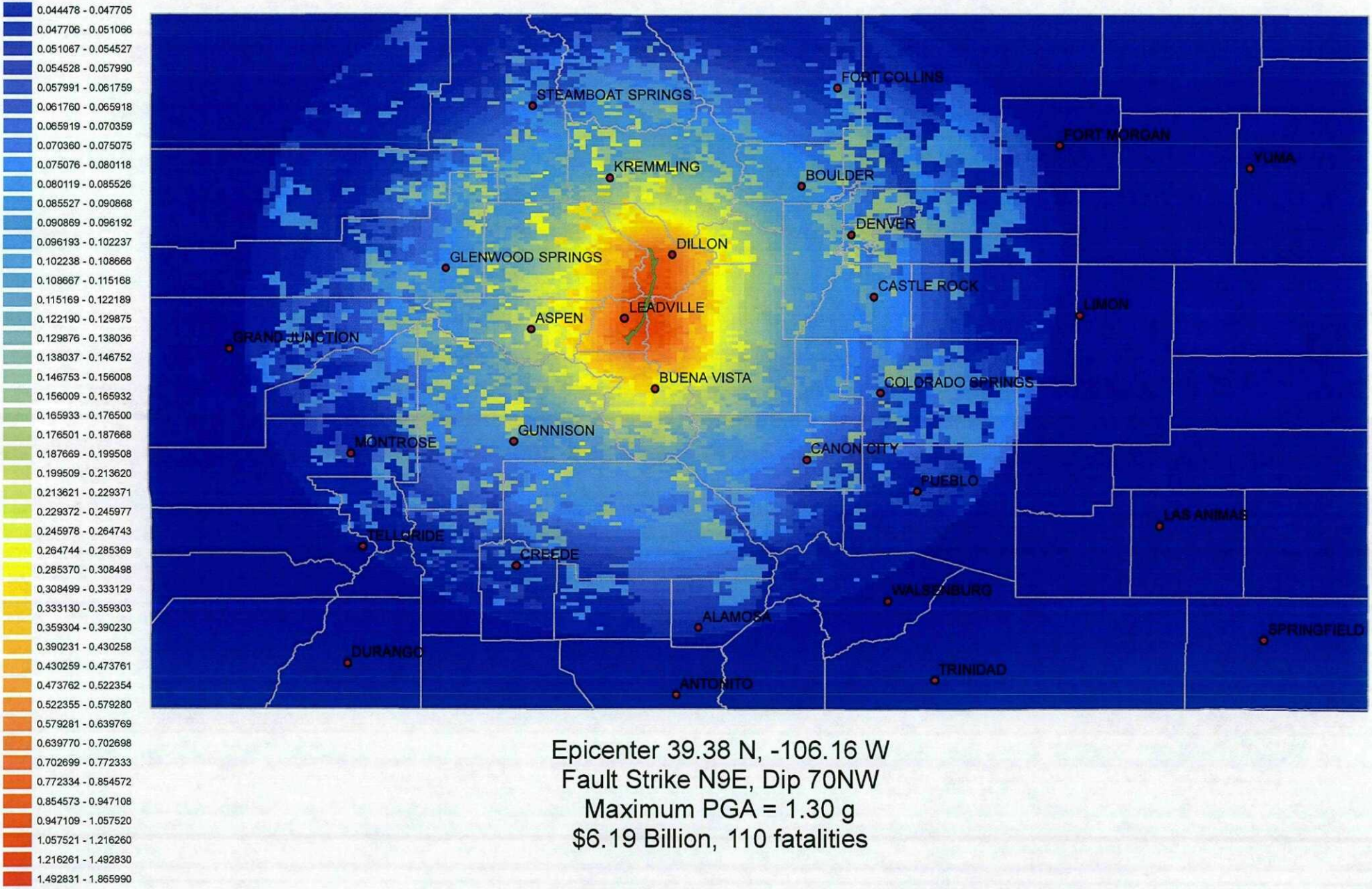
Epicenter 39.74 N, -105.22 W
Fault Strike N23W, Dip 60SW
Maximum PGA = 1.09 g
$21.89 Billion, 862 fatalities

Goodpasture M6.0 Peak Ground Acceleration
CEUS Attenuation Function



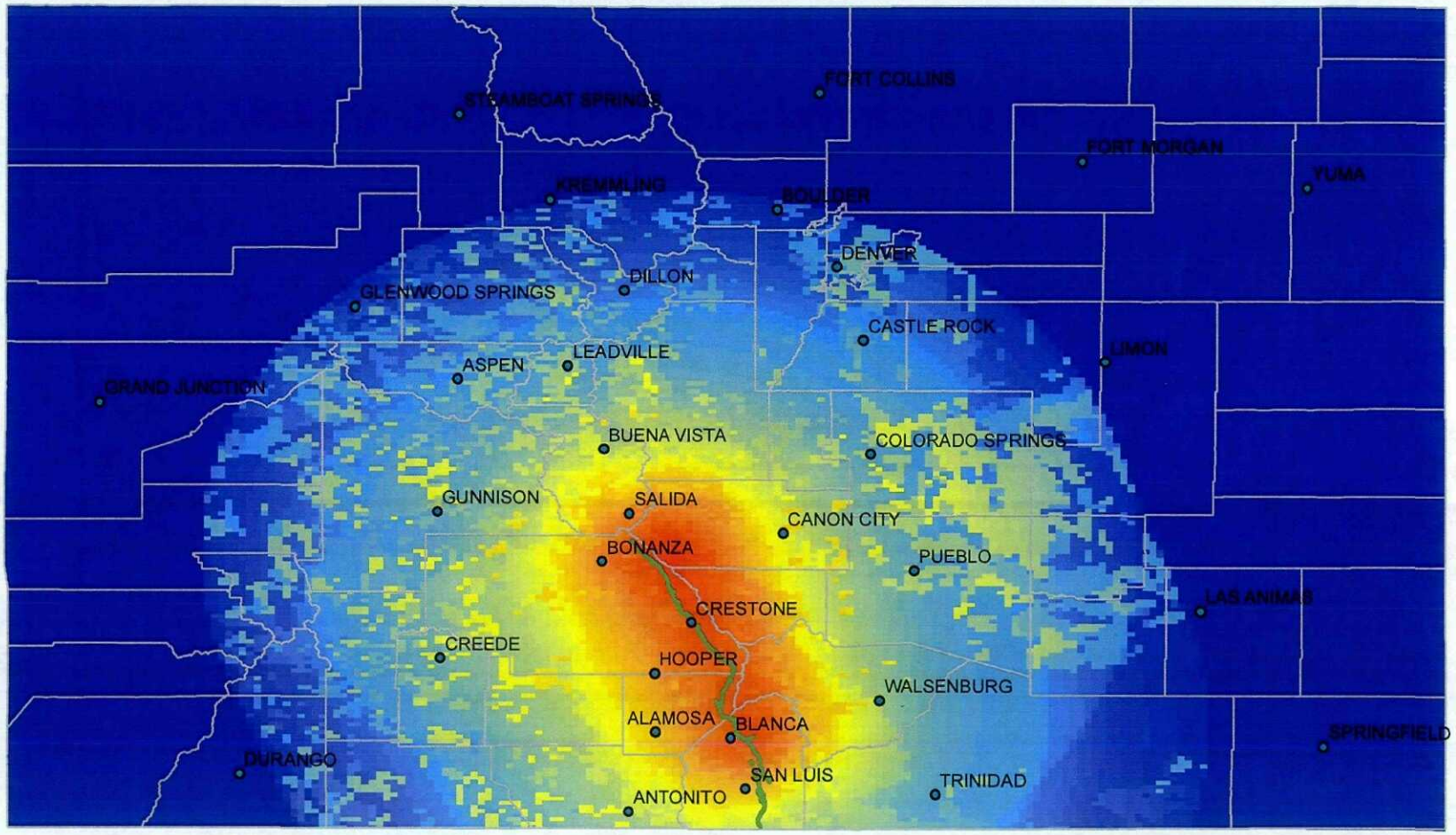
Epicenter 38.05 N, -104.91 W
Fault Strike N32W, Dip 60NE
Maximum PGA = 0.67 g
$479 Million, 2 fatalities

Mosquito M7.0 Peak Ground Acceleration
CEUS Attenuation Function



Epicenter 39.38 N, -106.16 W
Fault Strike N9E, Dip 70NW
Maximum PGA = 1.30 g
$6.19 Billion, 110 fatalities

N Sangre de Cristo M7.5 Peak Ground Acceleration
CEUS Attenuation Function



Legend

county_line

N_Sangre_fault

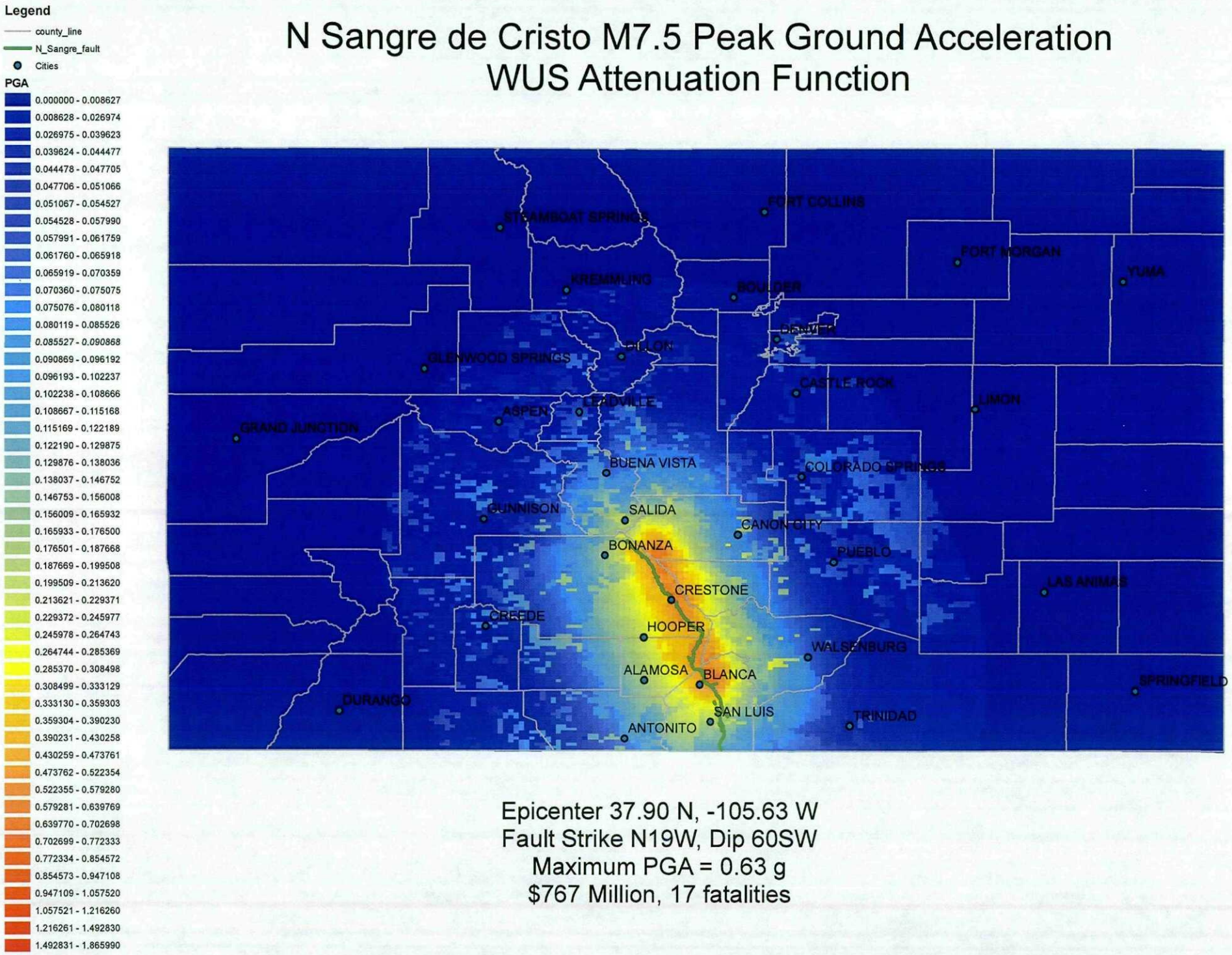
PGA

0.000000 - 0.008627
0.008628 - 0.026974
0.026975 - 0.039623
0.039624 - 0.044477
0.044478 - 0.047705
0.047706 - 0.051066
0.051067 - 0.054527
0.054528 - 0.057990
0.057991 - 0.061759
0.061760 - 0.065918
0.065919 - 0.070359
0.070360 - 0.075075
0.075076 - 0.080118
0.080119 - 0.085526
0.085527 - 0.090868
0.090869 - 0.096192
0.096193 - 0.102237
0.102238 - 0.108666
0.108667 - 0.115168
0.115169 - 0.122189
0.122190 - 0.129875
0.129876 - 0.138036
0.138037 - 0.146752
0.146753 - 0.156008
0.156009 - 0.165932
0.165933 - 0.176500
0.176501 - 0.187668
0.187669 - 0.199508
0.199509 - 0.213620
0.213621 - 0.229371
0.229372 - 0.245977
0.245978 - 0.264743
0.264744 - 0.285369
0.285370 - 0.308498
0.308499 - 0.333129
0.333130 - 0.359303
0.359304 - 0.390230
0.390231 - 0.430258
0.430259 - 0.473761
0.473762 - 0.522354
0.522355 - 0.579280
0.579281 - 0.639769
0.639770 - 0.702698
0.702699 - 0.772333
0.772334 - 0.854572
0.854573 - 0.947108
0.947109 - 1.057520
1.057521 - 1.216260
1.216261 - 1.492830
1.492831 - 1.865990

Cities

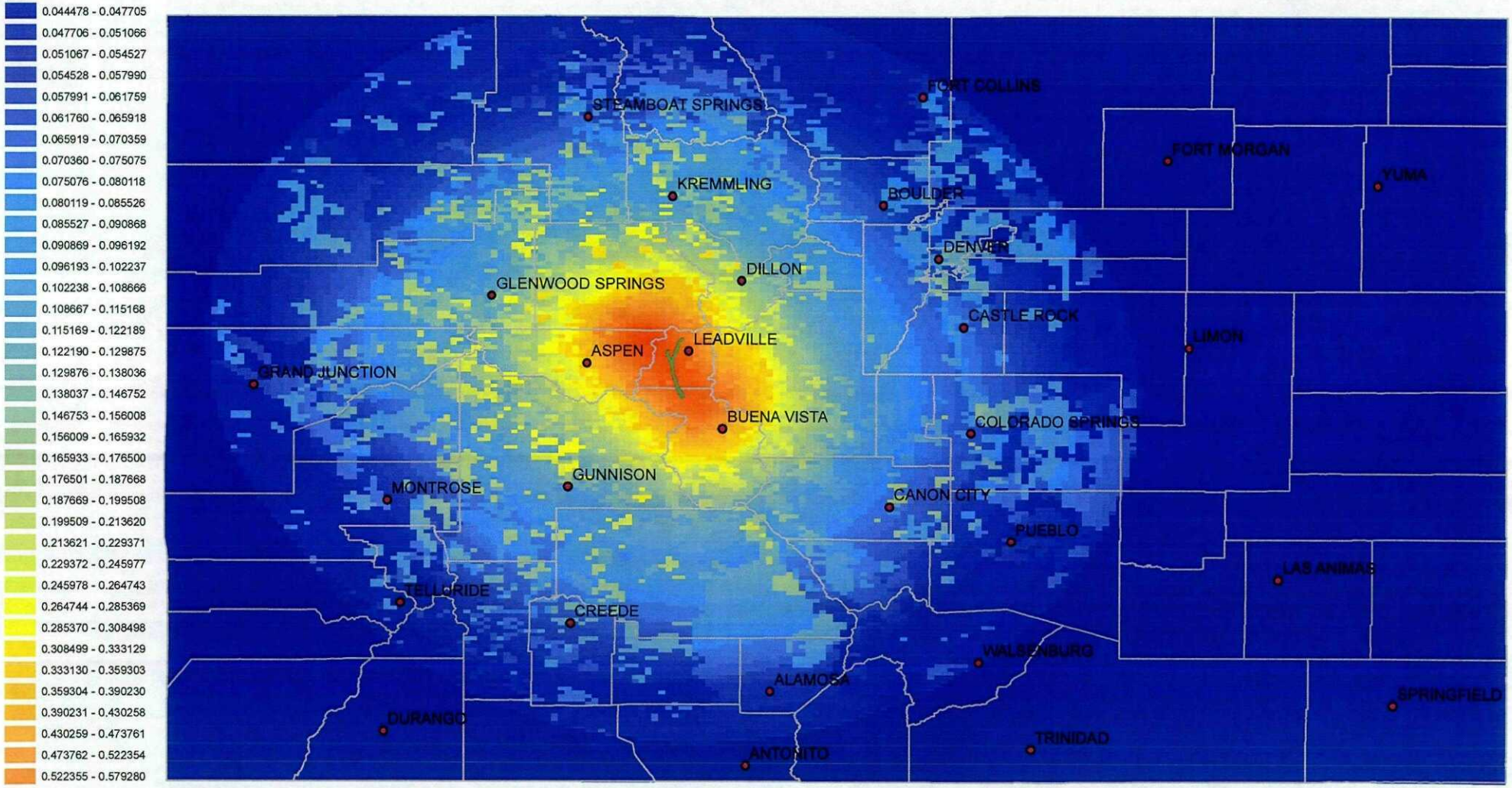
Epicenter 37.90 N, -105.63 W
Fault Strike N19W, Dip 60SW
Maximum PGA = 1.87g
$8.0 Billion, 335 fatalities

N Sangre de Cristo M7.5 Peak Ground Acceleration
WUS Attenuation Function



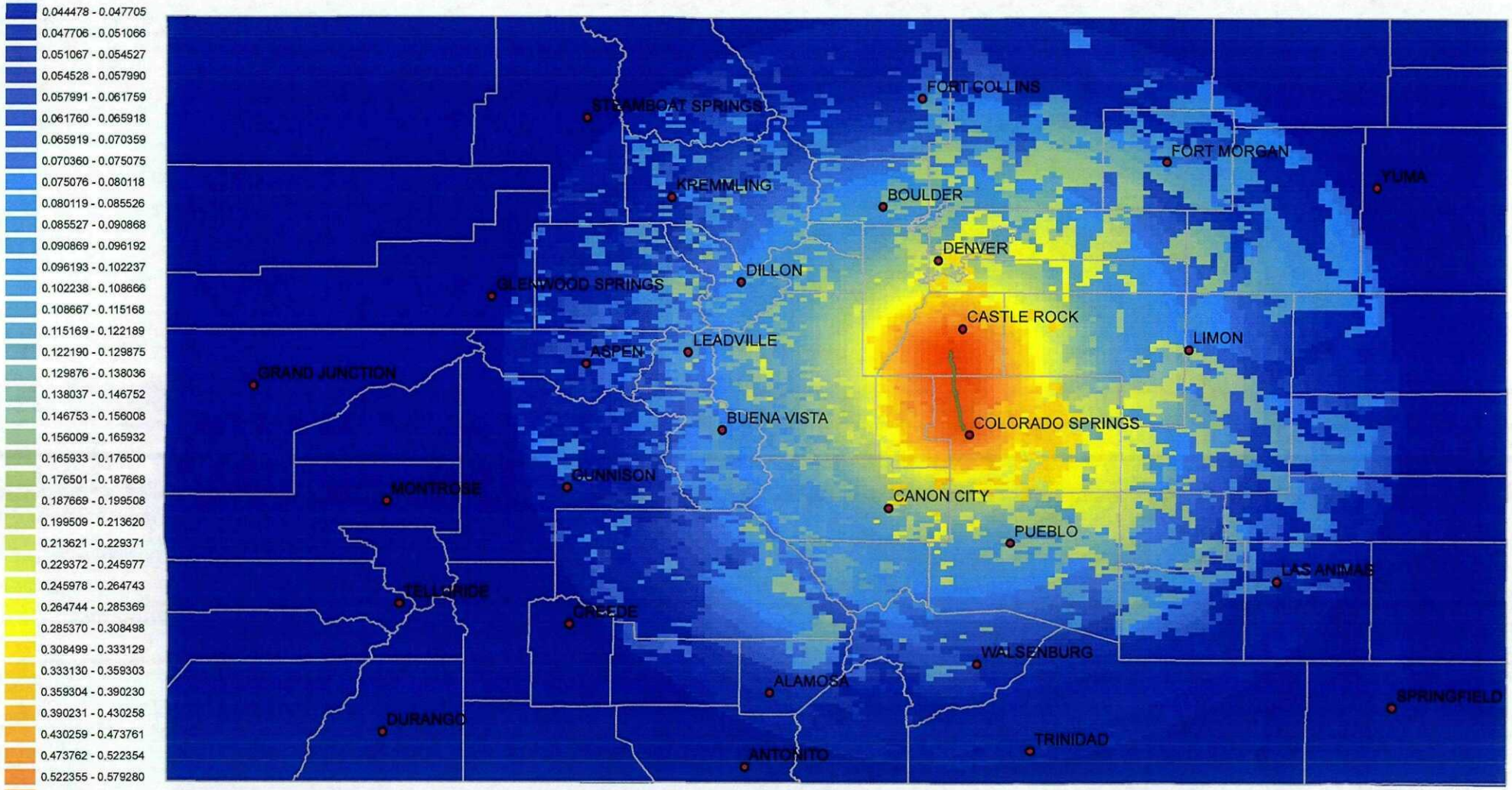
Epicenter 37.90 N, -105.63 W
Fault Strike N19W, Dip 60SW
Maximum PGA = 0.63 g
$767 Million, 17 fatalities

North Sawatch M7.0 Peak Ground Acceleration
CEUS Attenuation Function



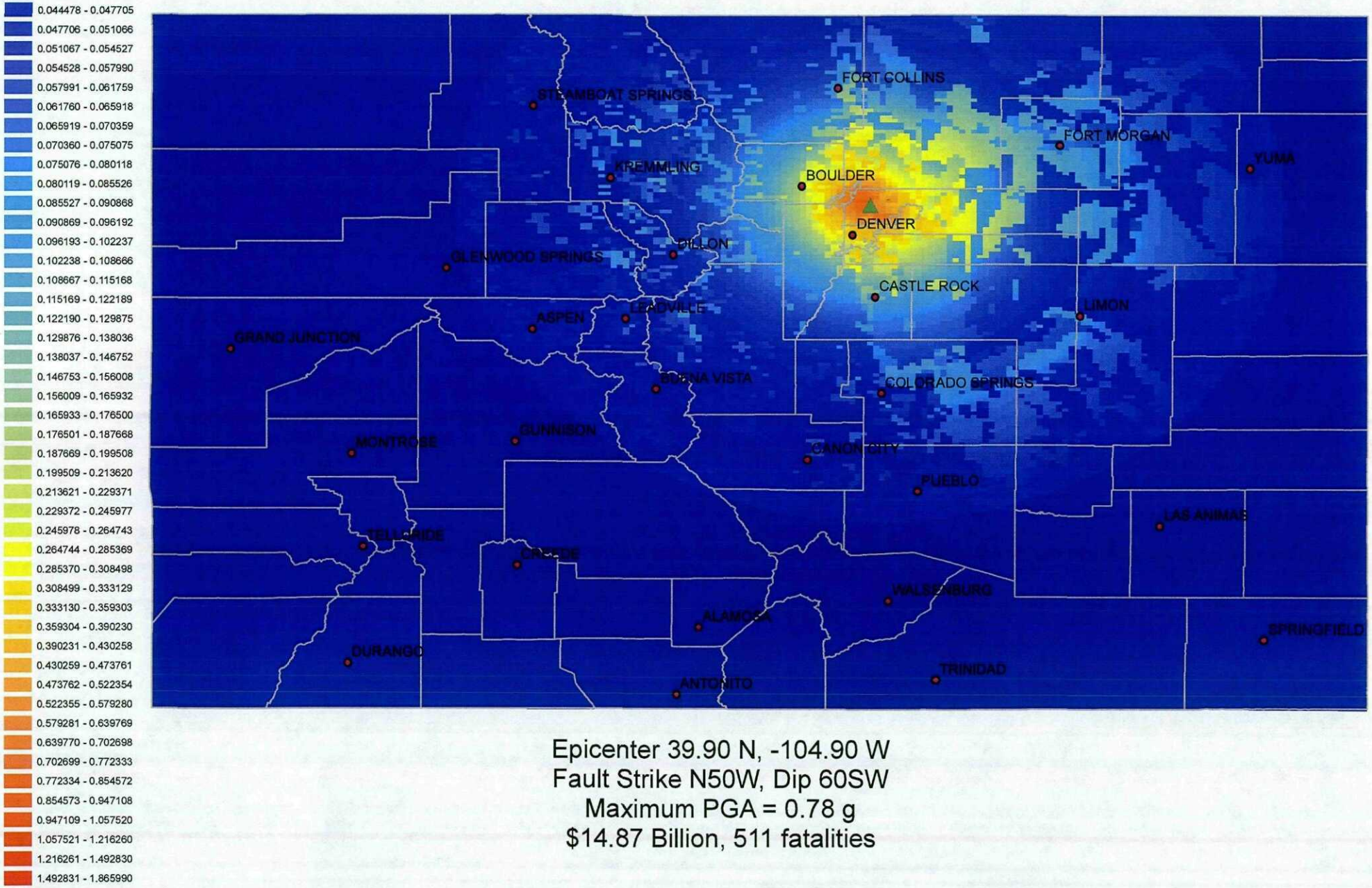
Epicenter 39.15 N, -106.39W
Fault Strike N33W, Dip 72NE
Maximum PGA = 1.45 g
$3.62 Billion, 47 fatalities

Rampart M7.0 Peak Ground Acceleration
CEUS Attenuation Function



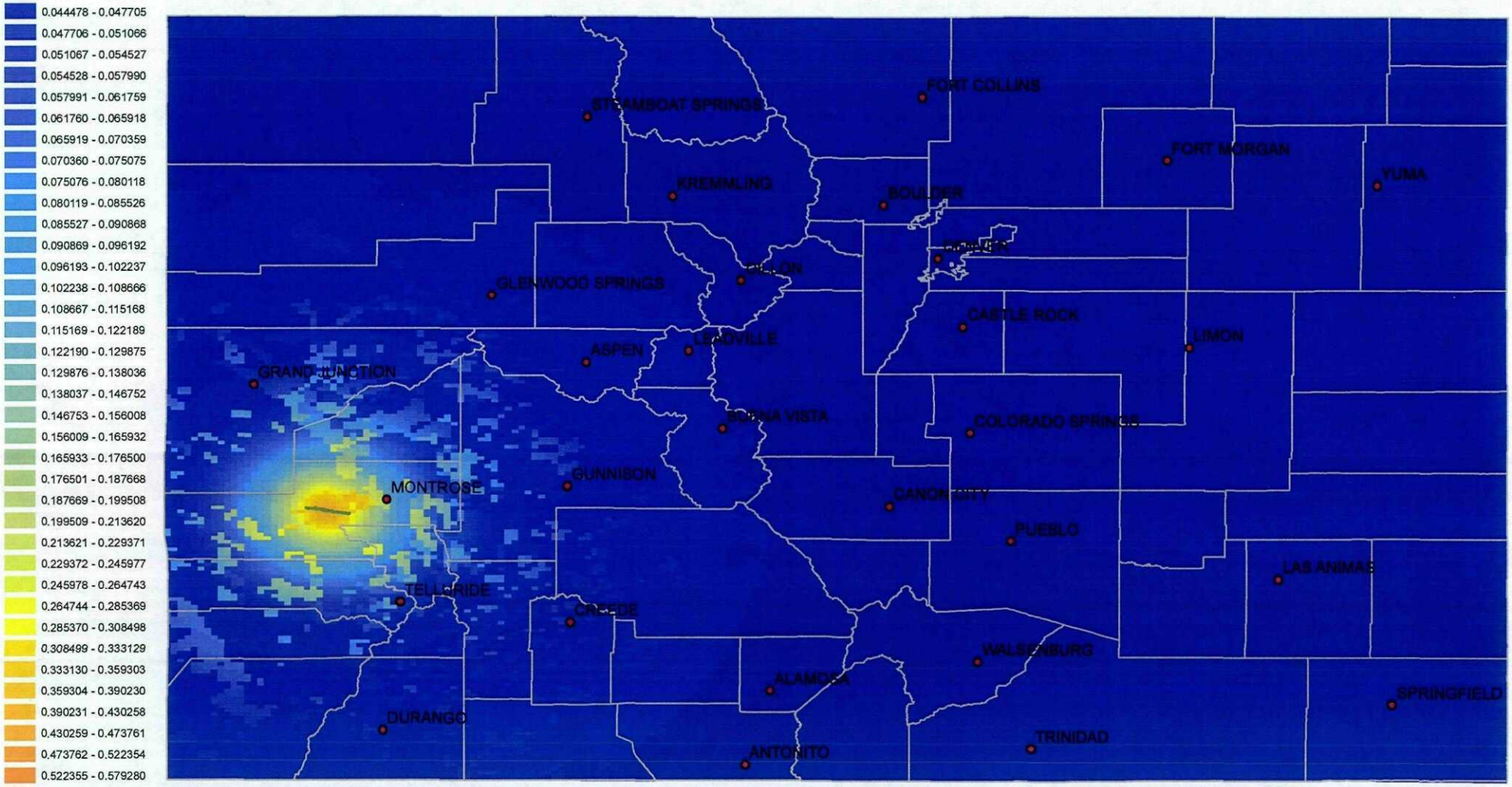
Epicenter 39.06 N, -104.92 W
Fault Strike N9W, Dip 60SW
Maximum PGA = 1.37 g
$23.05 Billion, 1066 fatalities

Rocky Mountain Arsenal M6.25 Peak Ground Acceleration
CEUS Attenuation Function



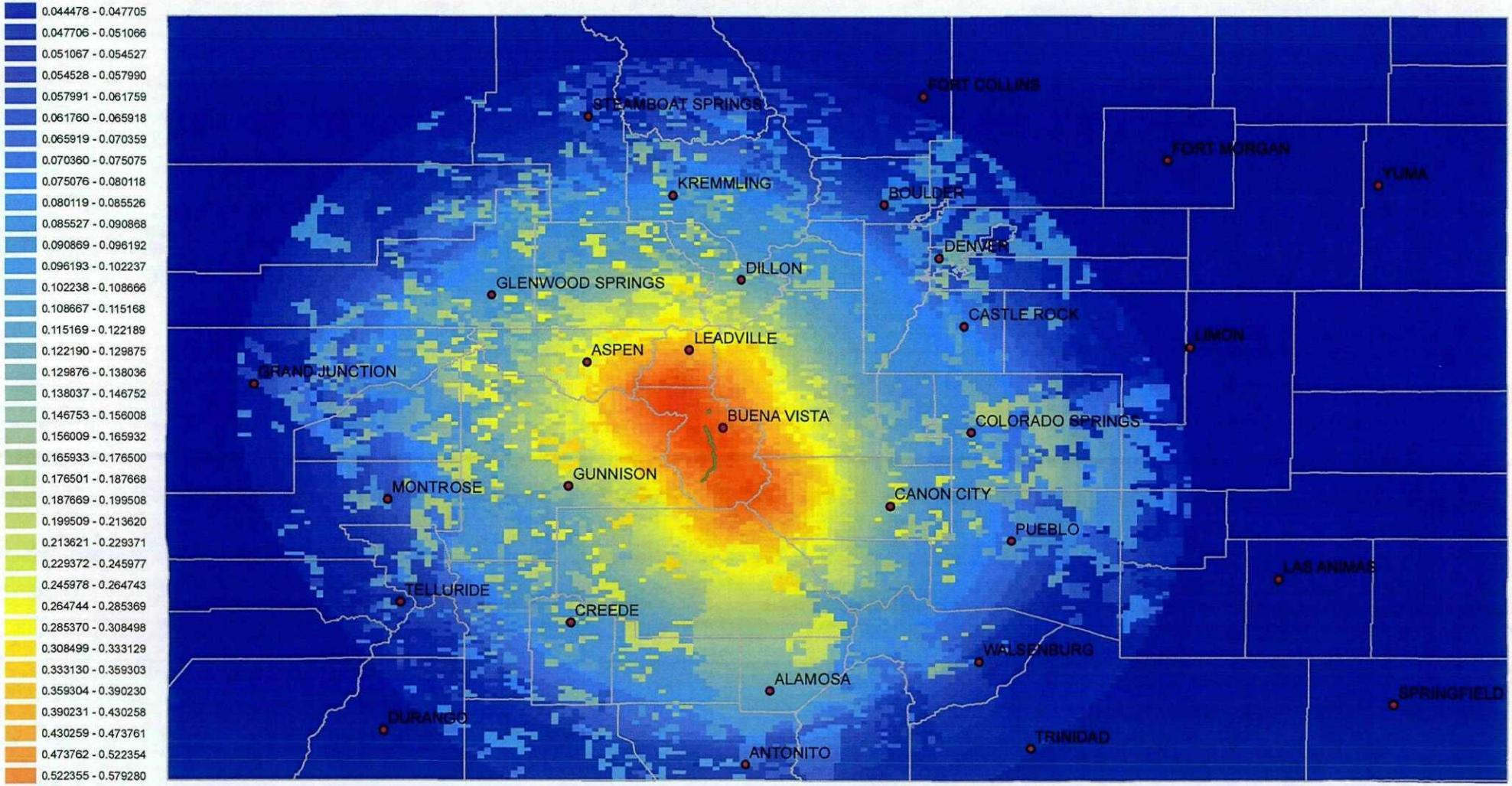
Epicenter 39.90 N, -104.90 W
Fault Strike N50W, Dip 60SW
Maximum PGA = 0.78 g
$14.87 Billion, 511 fatalities

Roubideau Creek M5.5 Peak Ground Acceleration
CEUS Attenuation Function



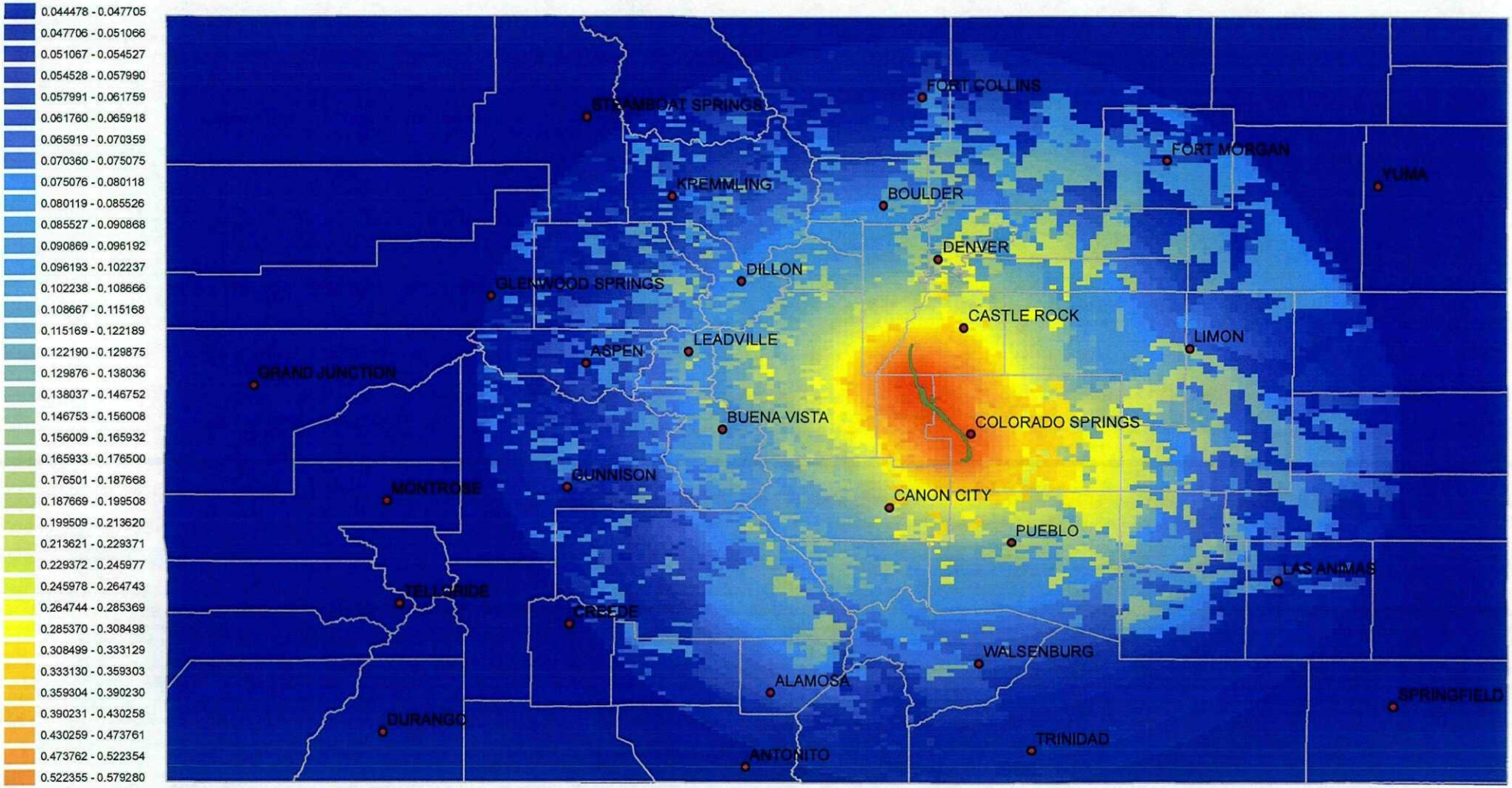
Epicenter 38.41 N, -108.19 W
Fault Strike N74W, Dip 65NE
Maximum PGA = 0.46 g
$94.2 Million, 0 fatalities

South Sawatch M7.25 Peak Ground Acceleration
CEUS Attenuation Function



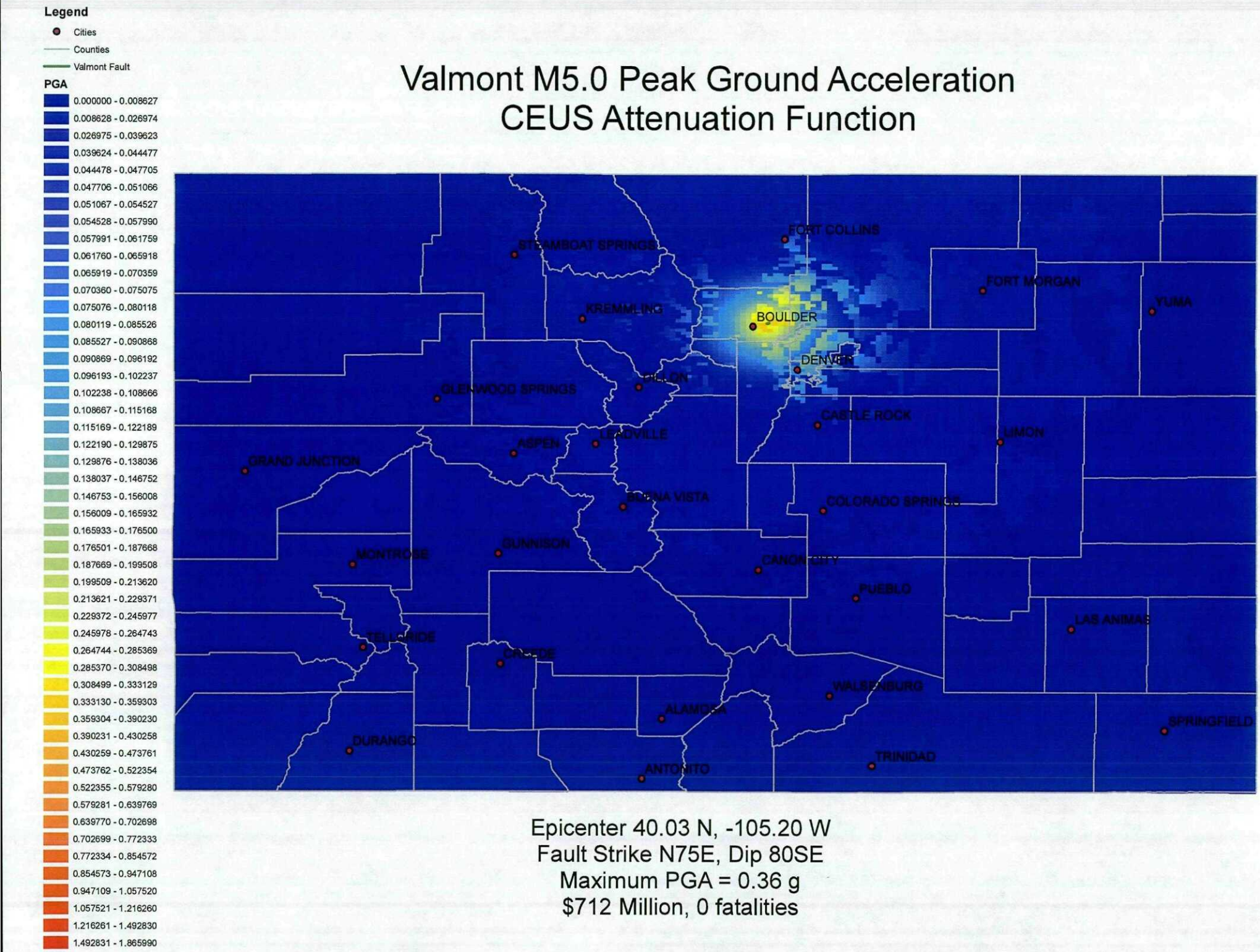
Epicenter 38.75 N, -106.18 W
Fault Strike N32W, Dip 70NE
Maximum PGA = 1.44 g
$4.74 Billion, 81 fatalities

Ute Pass M7.0 Peak Ground Acceleration
CEUS Attenuation Function



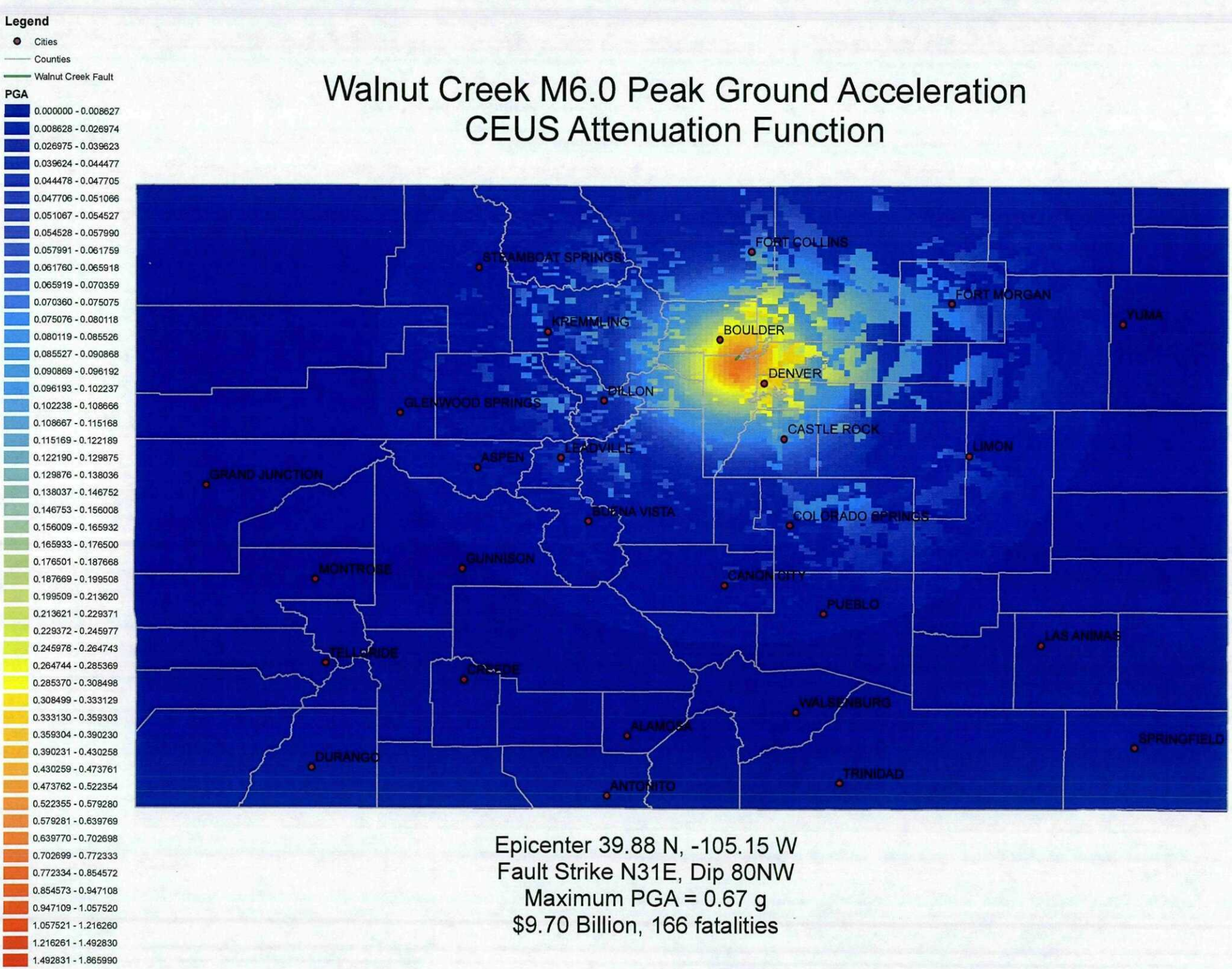
Epicenter 38.92 N, -105.00 W
Fault Strike N28W, Dip 50SW
Maximum PGA = 1.27 g
$16.77 Billion, 690 fatalities

Valmont M5.0 Peak Ground Acceleration
CEUS Attenuation Function



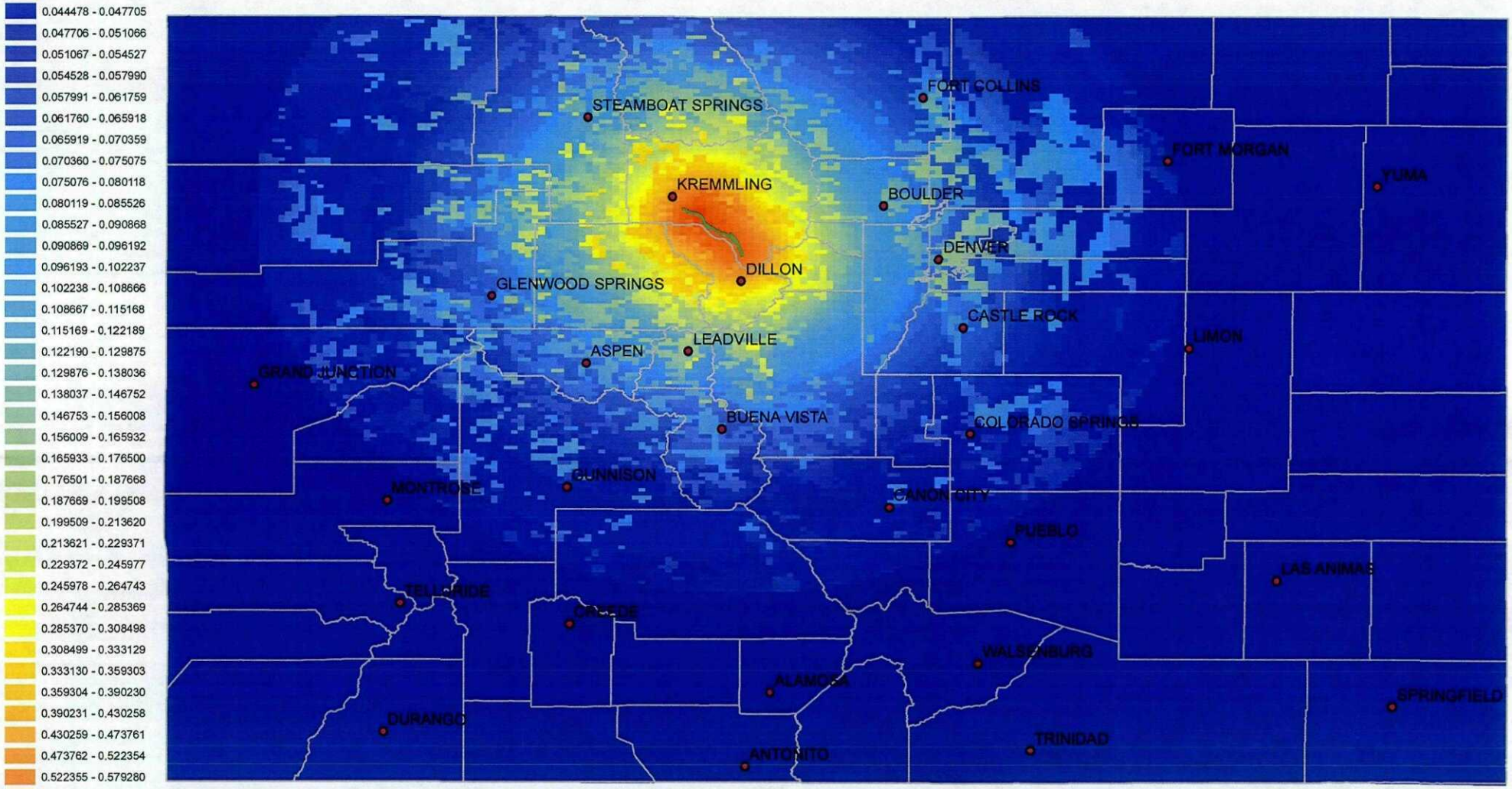
Epicenter 40.03 N, -105.20 W
Fault Strike N75E, Dip 80SE
Maximum PGA = 0.36 g
$712 Million, 0 fatalities

Walnut Creek M6.0 Peak Ground Acceleration
CEUS Attenuation Function



Epicenter 39.88 N, -105.15 W
Fault Strike N31E, Dip 80NW
Maximum PGA = 0.67 g
$9.70 Billion, 166 fatalities

Williams Fork M6.75 Peak Ground Acceleration
CEUS Attenuation Function



Epicenter 39.87 N, -106.15 W
Fault Strike N40W, Dip 60NE
Maximum PGA = 1.28 g
$3.48 Billion, 41 fatalities

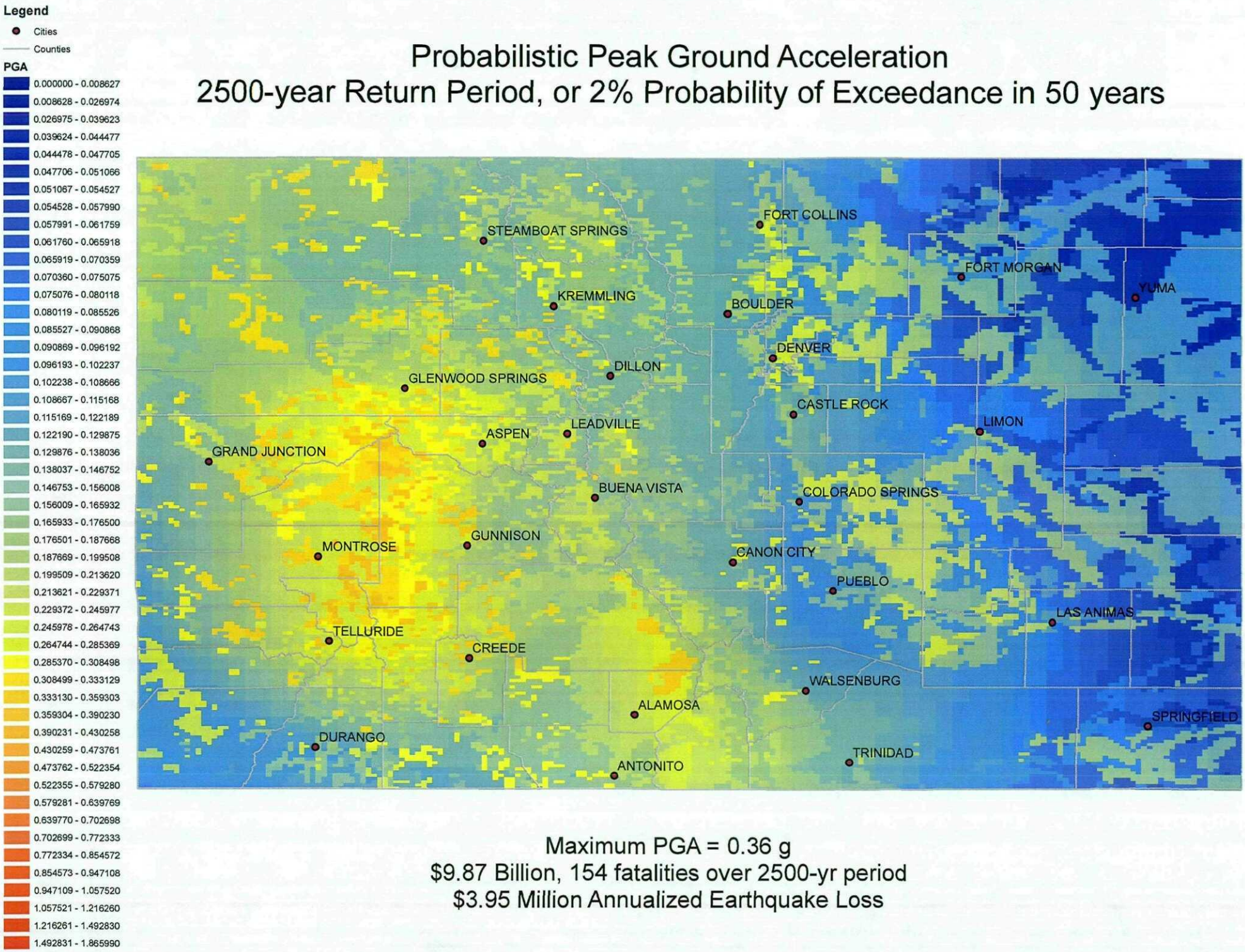
Probabilistic Scenarios

PGA Maps for Probabilistic Scenarios
USGS Hazard Maps for Colorado

Probabilistic

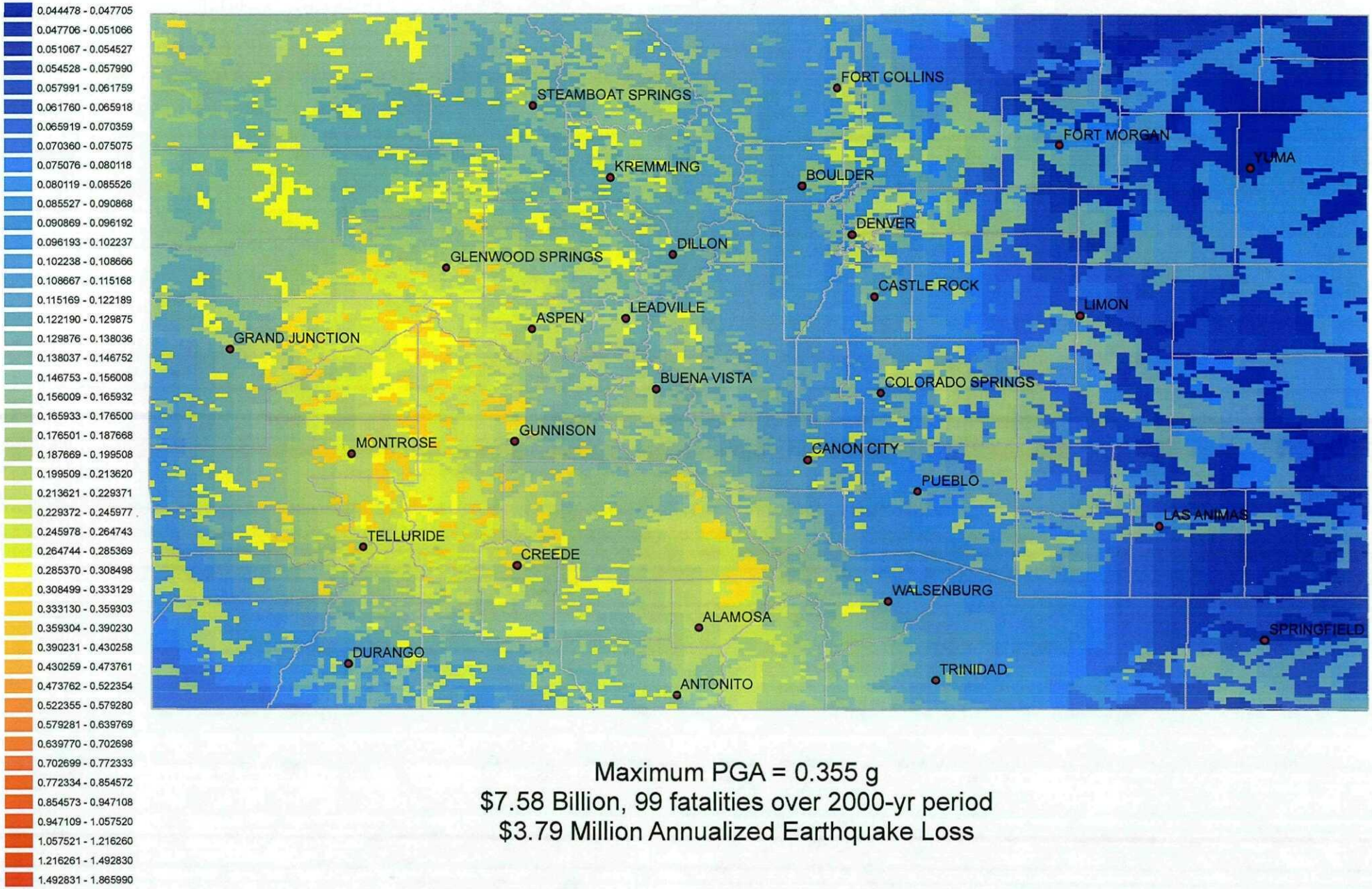
Date Run	Return Period (yrs)	Prob. Exc. In 50yrs	Region	Driving Magnitude	Casualties	Total Damage ($M)	AEL ($M)
24-Apr-06	2500	2%	State	6.50	3305, 641, 94, 154	$9,870	$3.95
28-Apr-06	2000	2.50%	State	6.50	2450, 443, 60, 99	$7,580	$3.79
1-May-06	1500	3.30%	State	6.50	1633, 268, 31, 53	$5,374	$3.56
2-May-06	1000	5%	State	6.50	893, 128, 12, 21	$3,054	$3.05
4-May-06	750	6.60%	State	6.50	597, 80, 6, 12	$2,043	$2.72
8-May-06	500	10%	State	6.50	310, 38, 3, 5	$1,030	$2.06
17-May-06	250	20%	State	6.50	109, 12, 1, 1	$295	$1.18
18-May-06	100	50%	State	6.50	16, 2, 0, 0	$34	$0.34

Probabilistic Peak Ground Acceleration
2500-year Return Period, or 2% Probability of Exceedance in 50 years



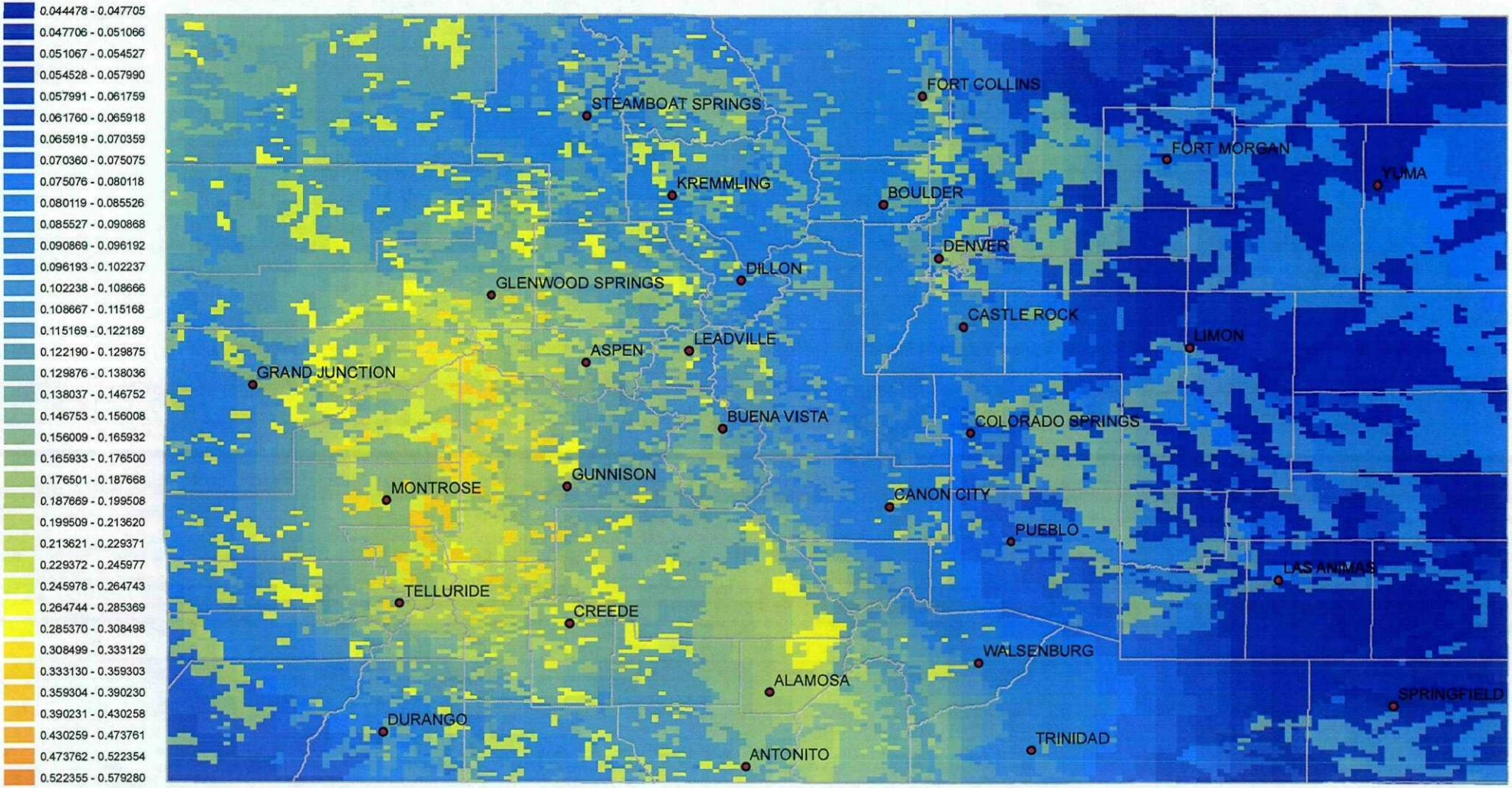
Maximum PGA = 0.36 g
$9.87 Billion, 154 fatalities over 2500-yr period
$3.95 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
2000-year Return Period, or 2.5% Probability of Exceedance in 50 years



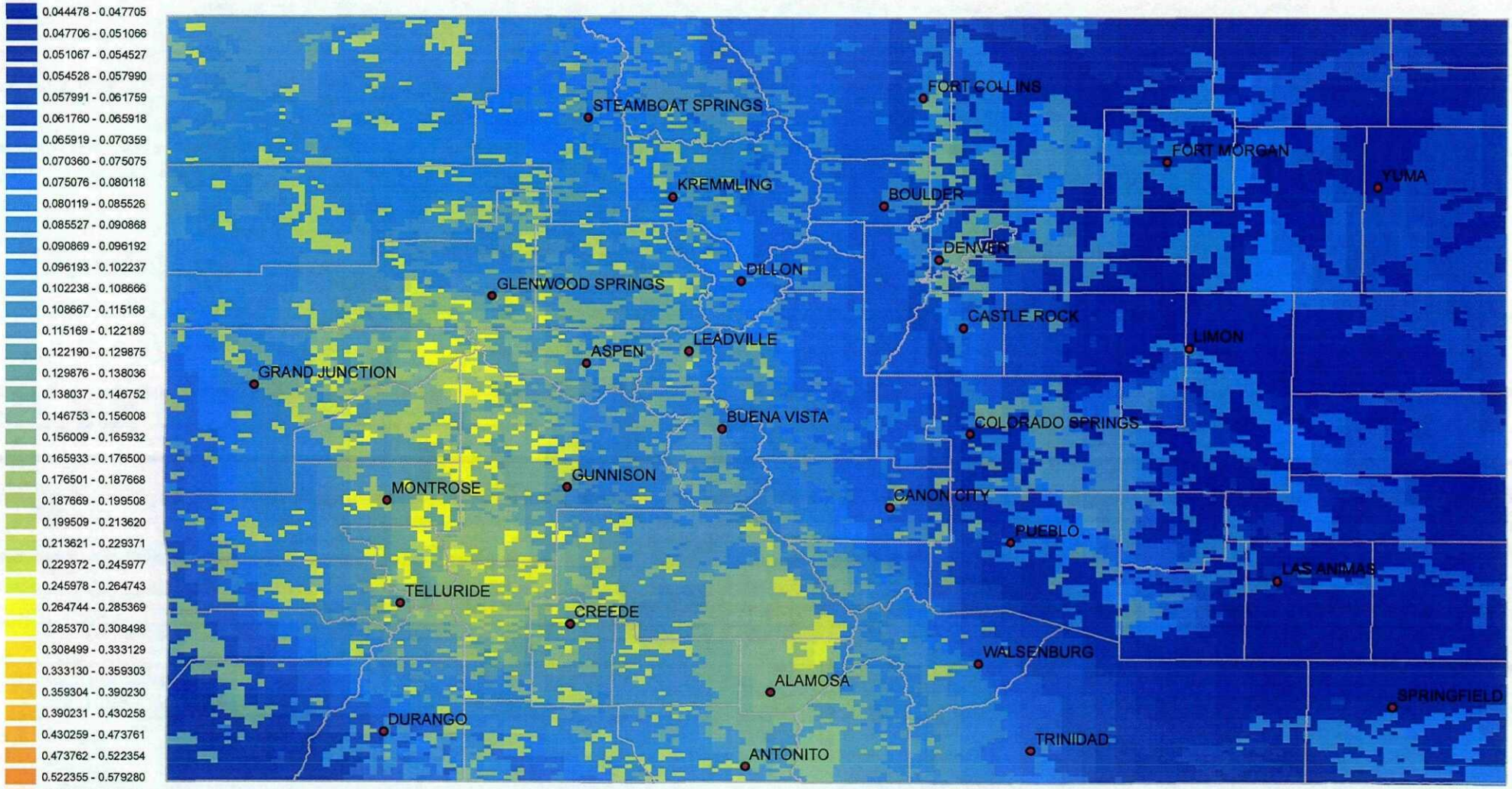
Maximum PGA = 0.355 g
$7.58 Billion, 99 fatalities over 2000-yr period
$3.79 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
1500-year Return Period, or 3.3% Probability of Exceedance in 50 years



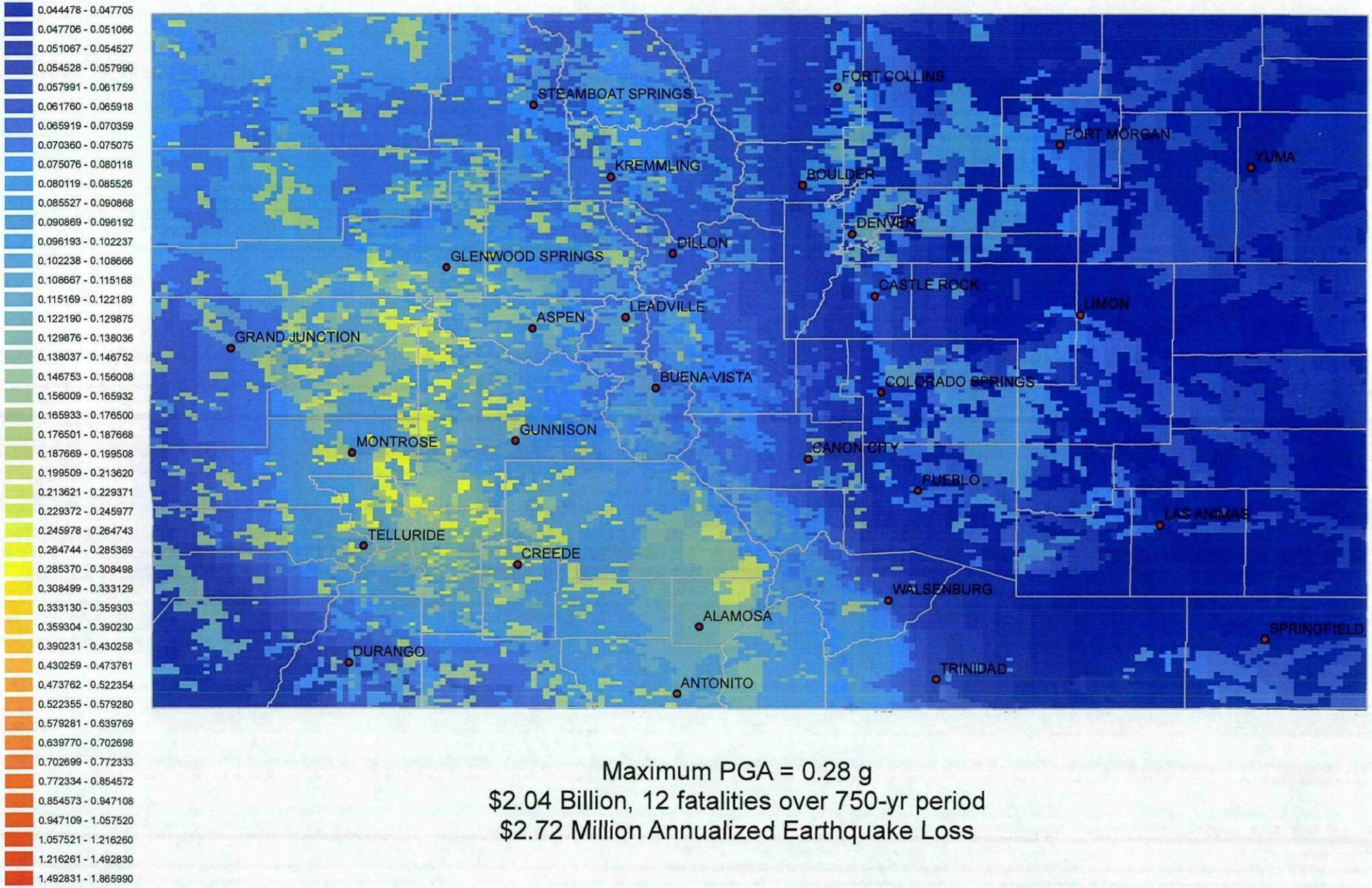
Maximum PGA = 0.34 g
$5.34 Billion, 53 fatalities over 1500-yr period
$3.56 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
1000-year Return Period, or 5% Probability of Exceedance in 50 years



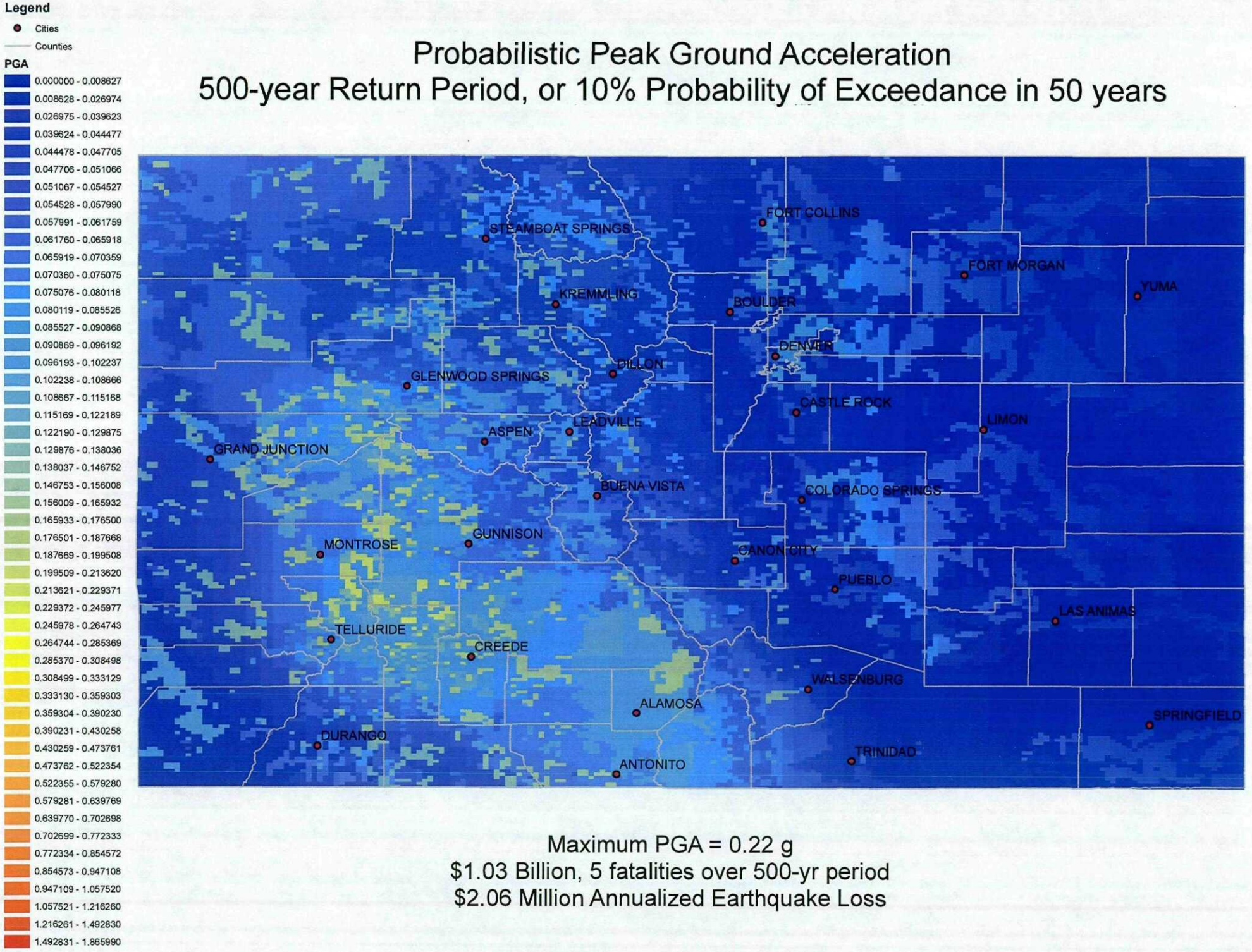
Maximum PGA = 0.307 g
$3.05 Billion, 21 fatalities over 1000-yr period
$3.05 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
750-year Return Period, or 6.7% Probability of Exceedance in 50 years



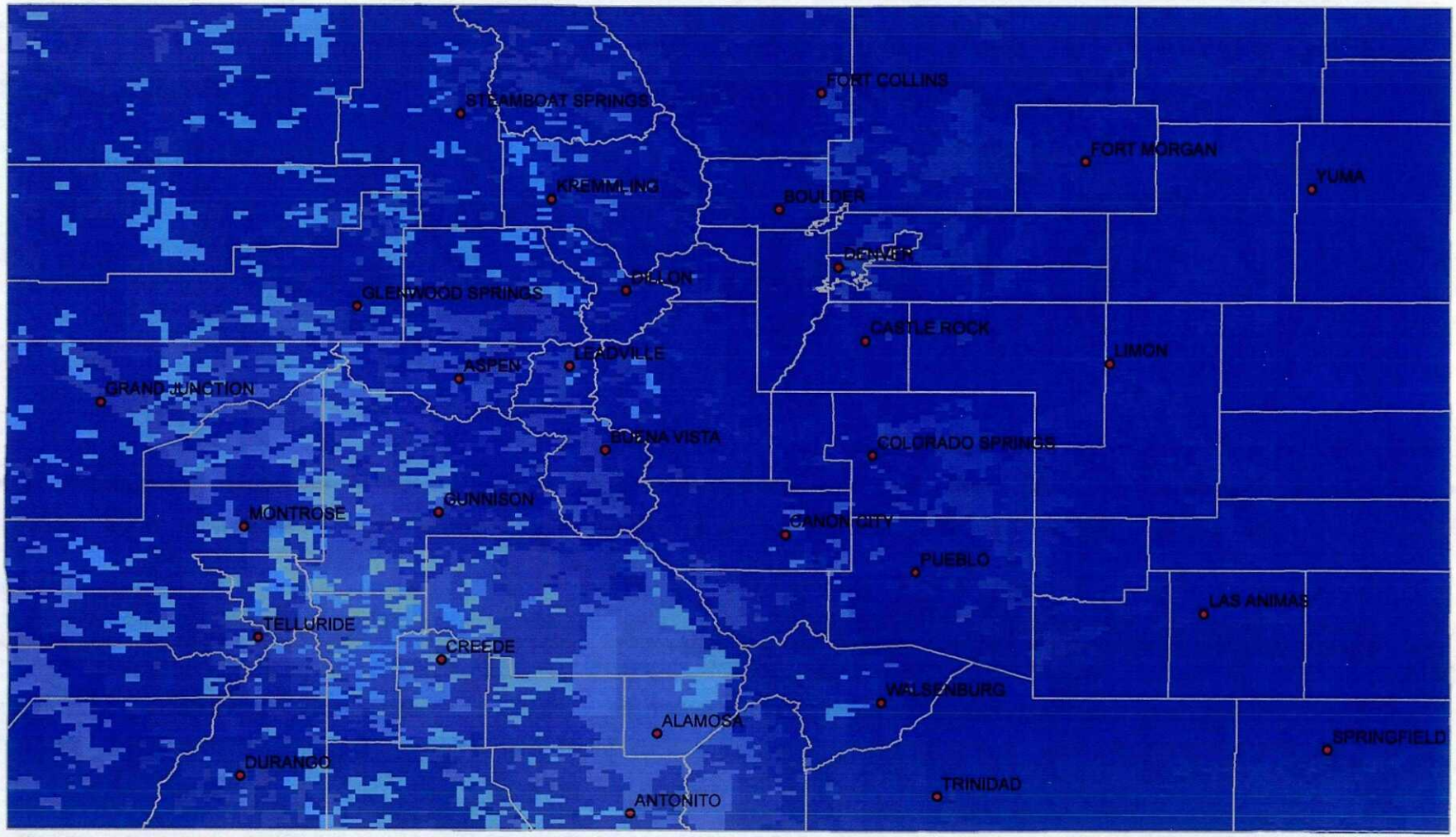
Maximum PGA = 0.28 g
$2.04 Billion, 12 fatalities over 750-yr period
$2.72 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
500-year Return Period, or 10% Probability of Exceedance in 50 years



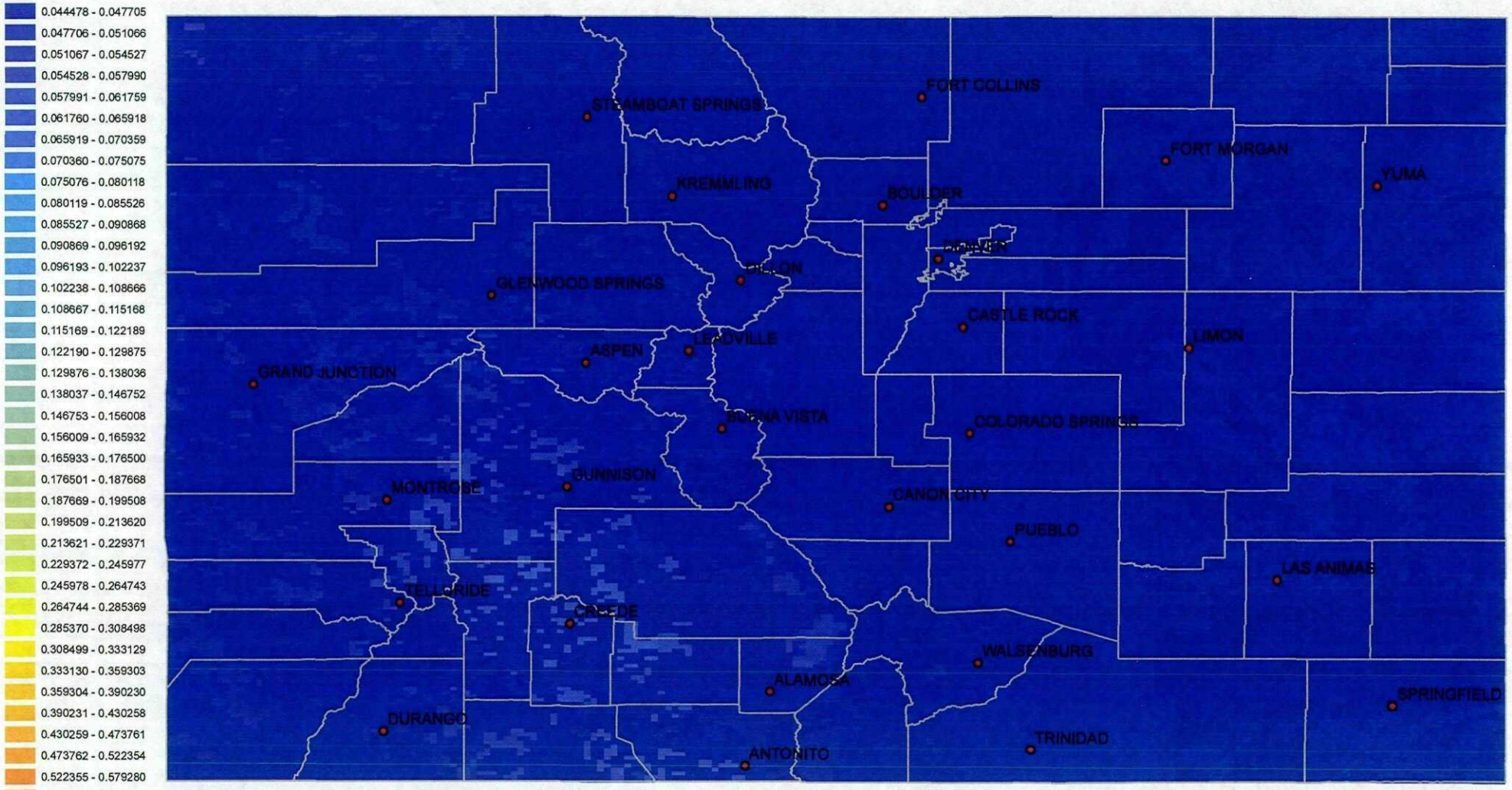
Maximum PGA = 0.22 g
$1.03 Billion, 5 fatalities over 500-yr period
$2.06 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
250-year Return Period, or 20% Probability of Exceedance in 50 years



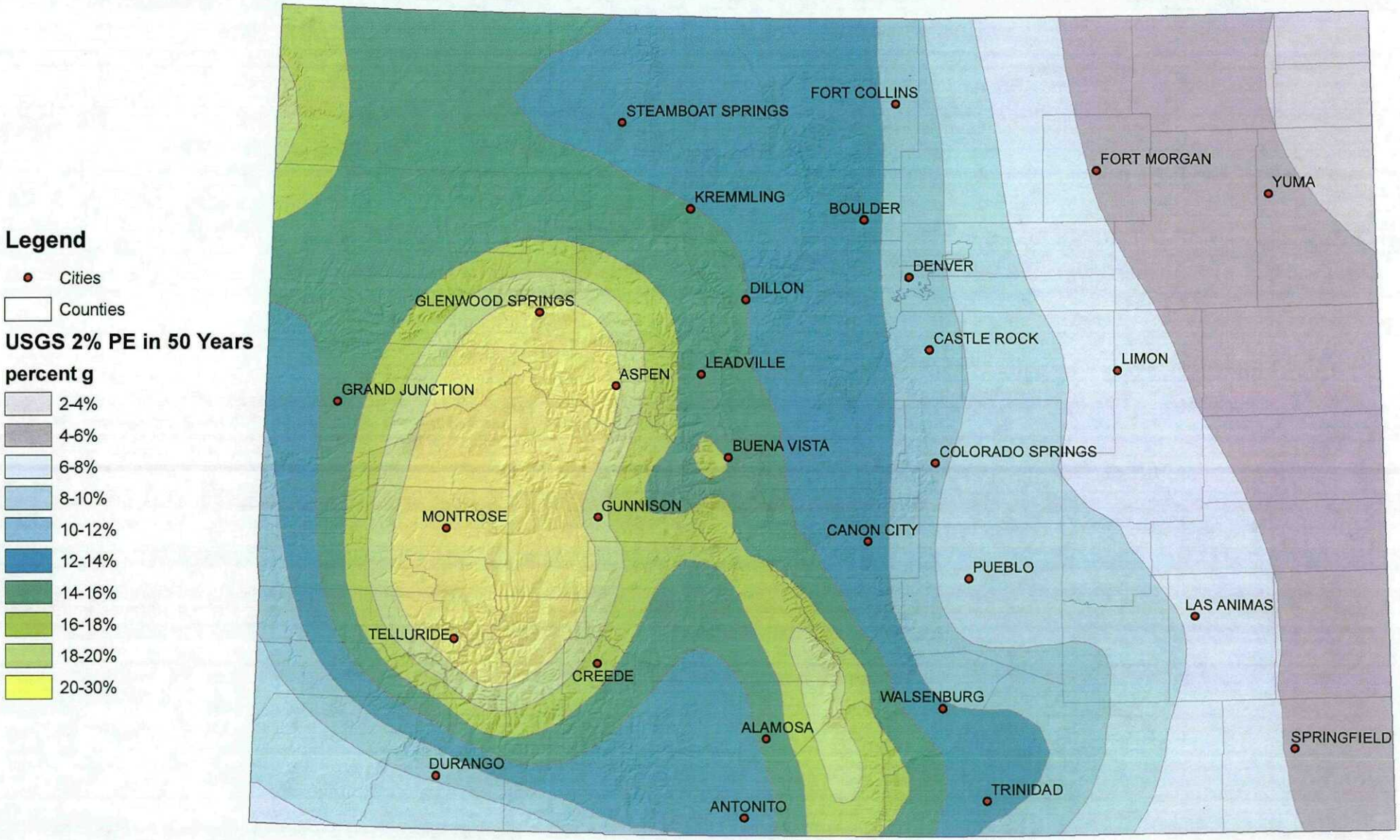
Maximum PGA = 0.13 g
$295 Million, 1 fatality over 250-yr period
$1.18 Million Annualized Earthquake Loss

Probabilistic Peak Ground Acceleration
100-year Return Period, or 50% Probability of Exceedance in 50 years



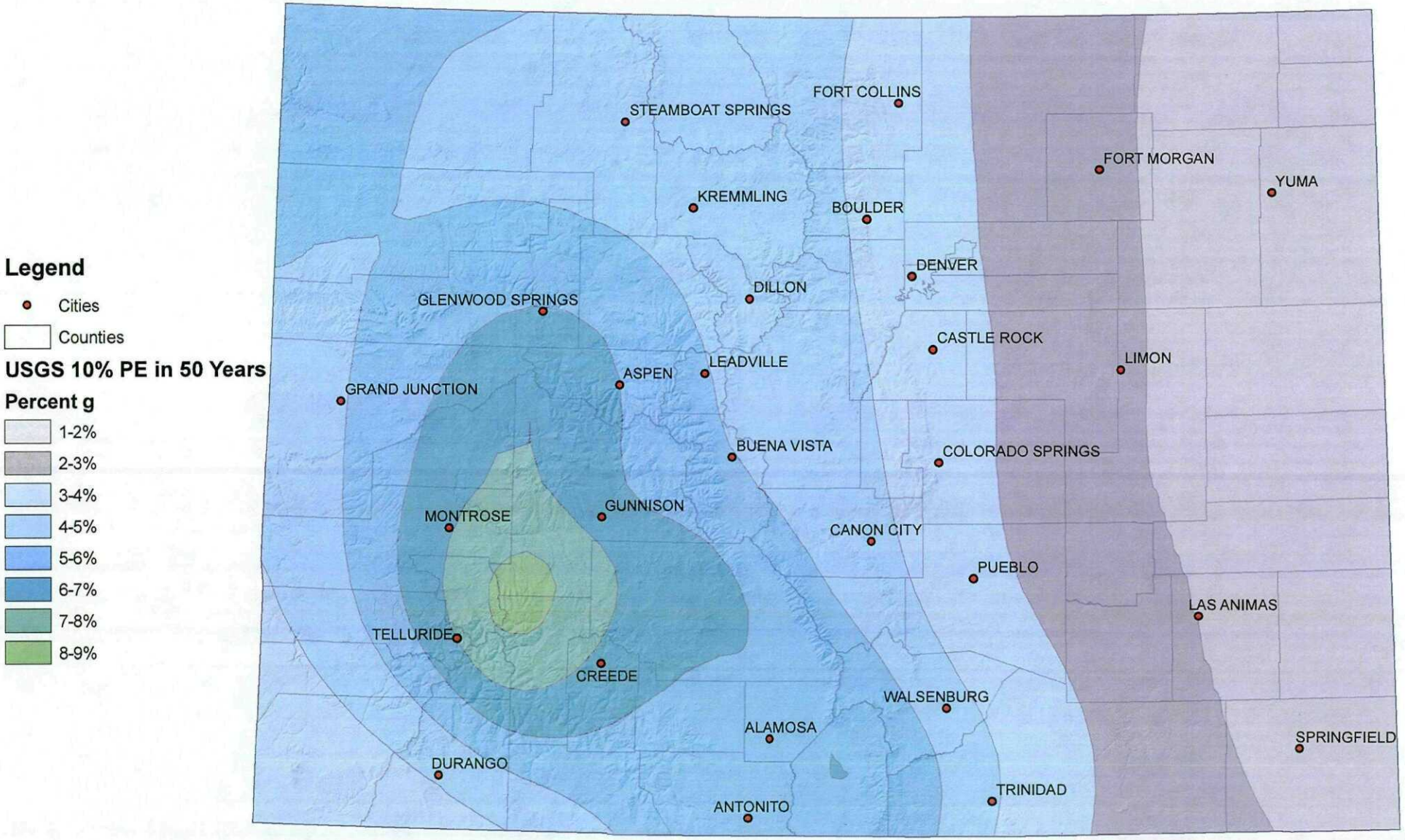
Maximum PGA = 0.06 g
$33.6 Million, 0 fatalities over 100-yr period
$0.34 Million Annualized Earthquake Loss

Seismic Hazard Map of Colorado
Peak Horizontal Acceleration (%g) with 2% Probability of Exceedance in 50 Years



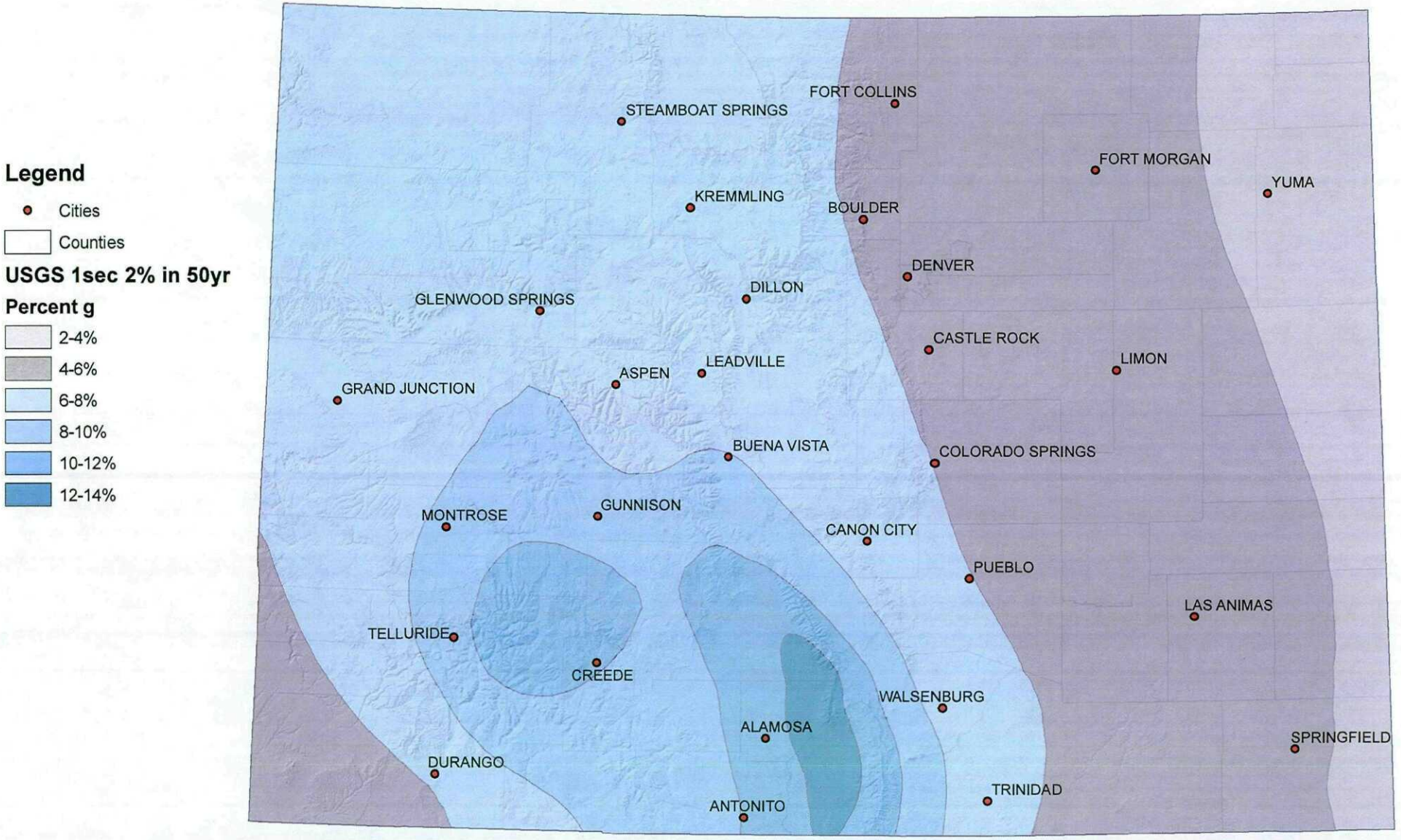
Derived from USGS National Seismic Hazard Interactive Map, 2002

Seismic Hazard Map of Colorado
Peak Horizontal Acceleration (%g) with 10% Probability of Exceedance in 50 Years



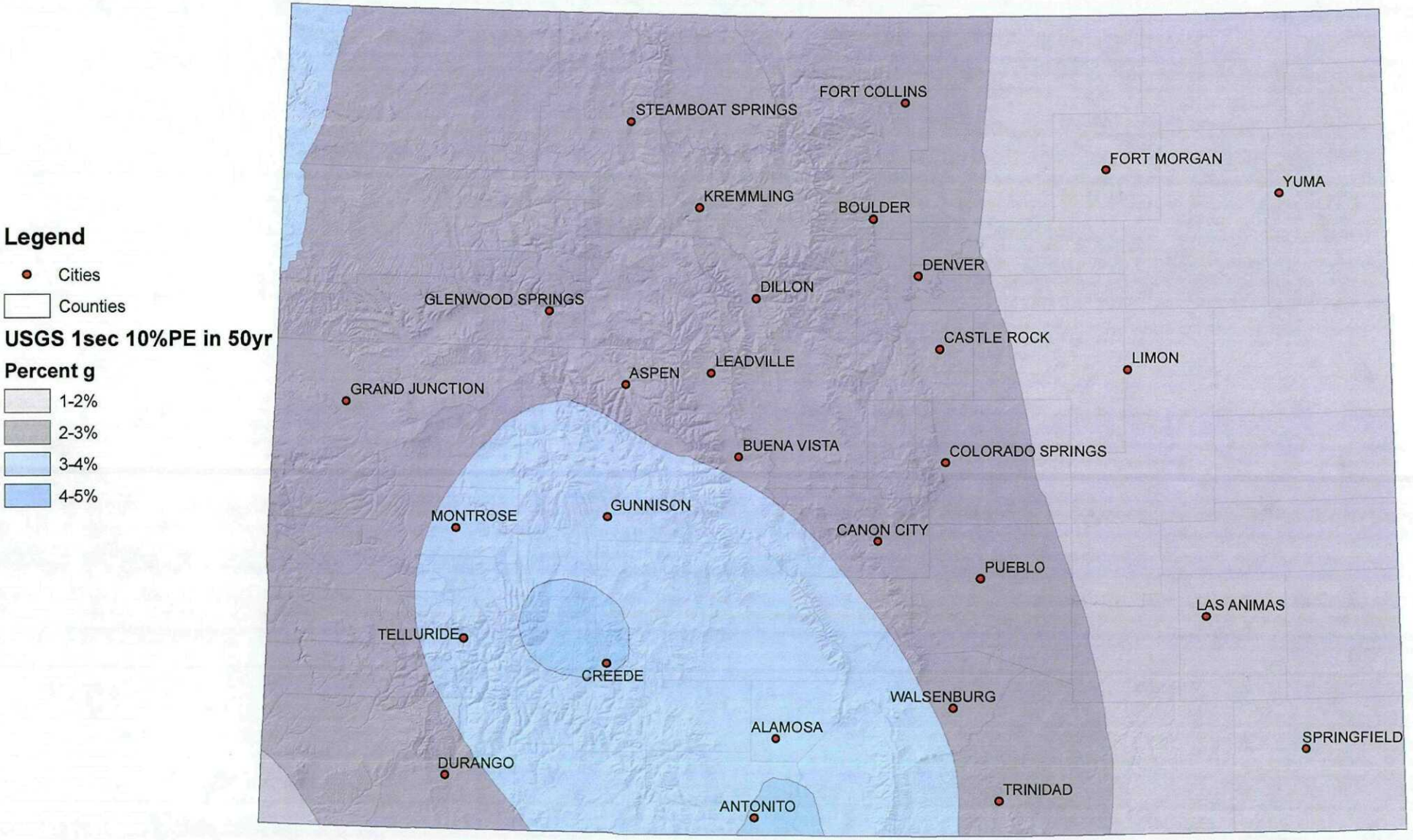
Derived from USGS National Seismic Hazard Interactive Map, 2002

Seismic Hazard Map of Colorado
1 Second Horizontal Acceleration (%g) with 2% Probability of Exceedance in 50 Years



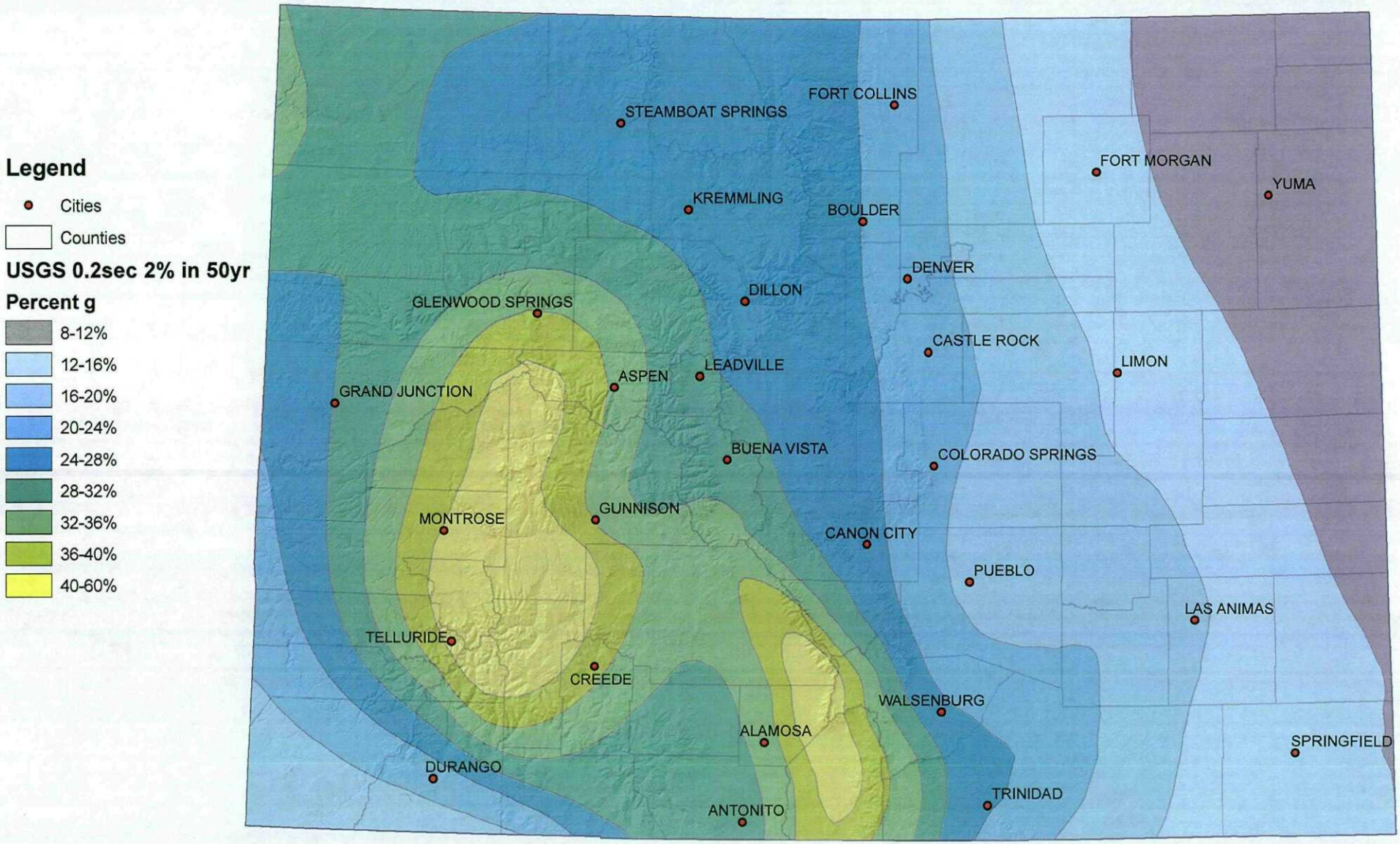
Derived from USGS National Seismic Hazard Interactive Map, 2002

Seismic Hazard Map of Colorado
1 Second Horizontal Acceleration (%g) with 10% Probability of Exceedance in 50 Years



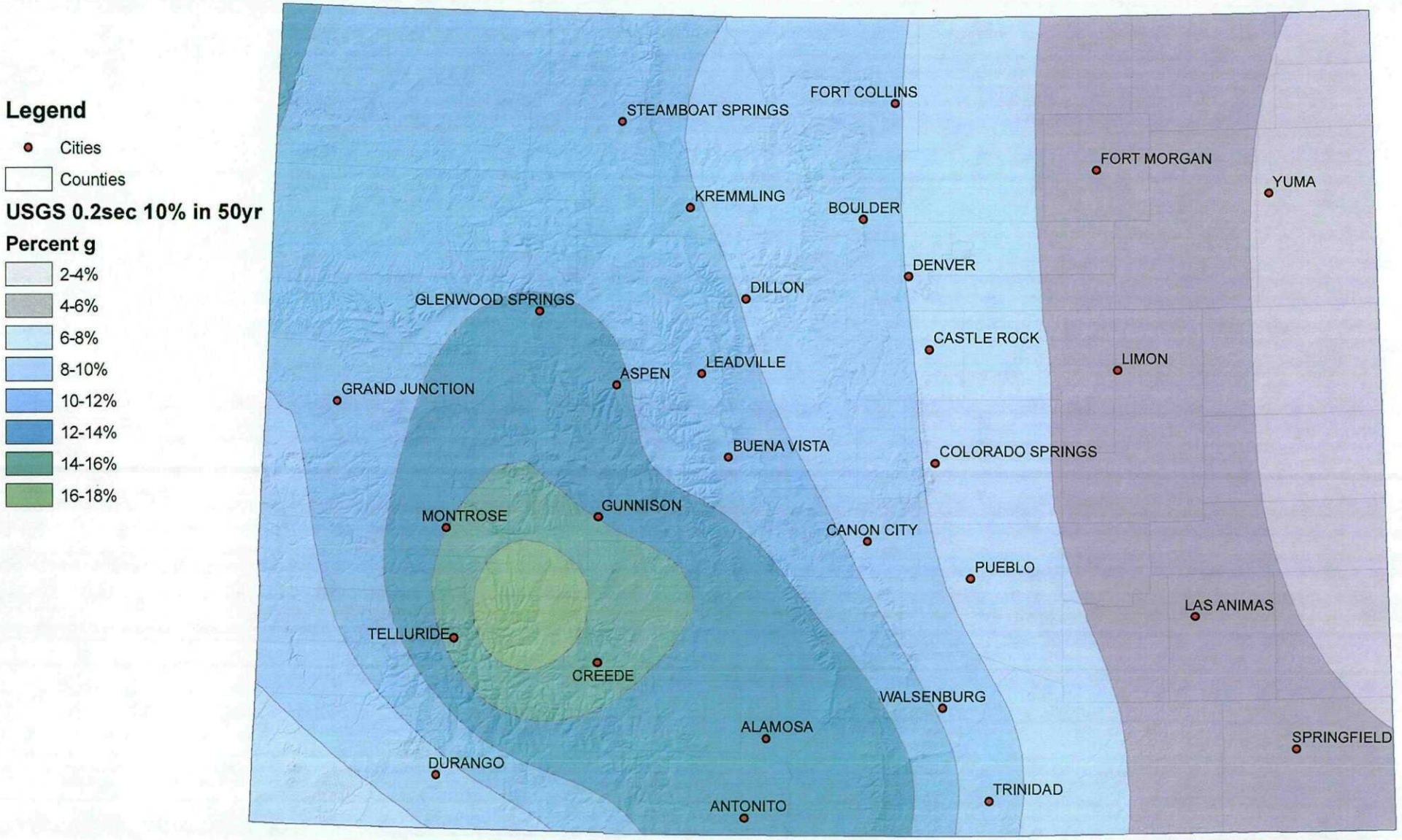
Derived from USGS National Seismic Hazard Interactive Map, 2002

Seismic Hazard Map of Colorado
0.2 Second Horizontal Acceleration (%g) with 2% Probability of Exceedance in 50 Years



Derived from USGS National Seismic Hazard Interactive Map, 2002

Seismic Hazard Map of Colorado
0.2 Second Horizontal Acceleration (%g) with 10% Probability of Exceedance in 50 Years

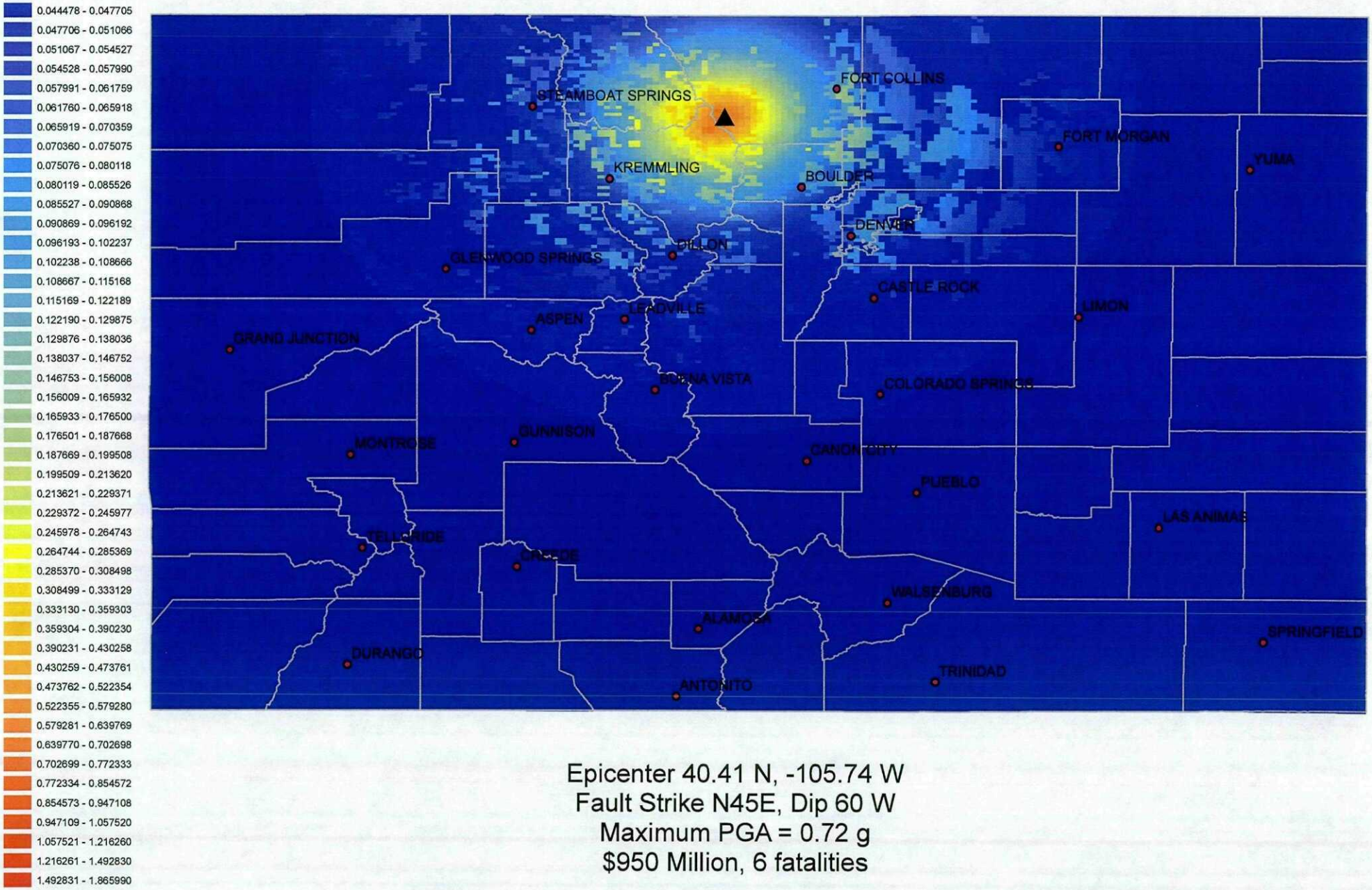


Derived from USGS National Seismic Hazard Interactive Map, 2002

1882 Earthquake Scenarios

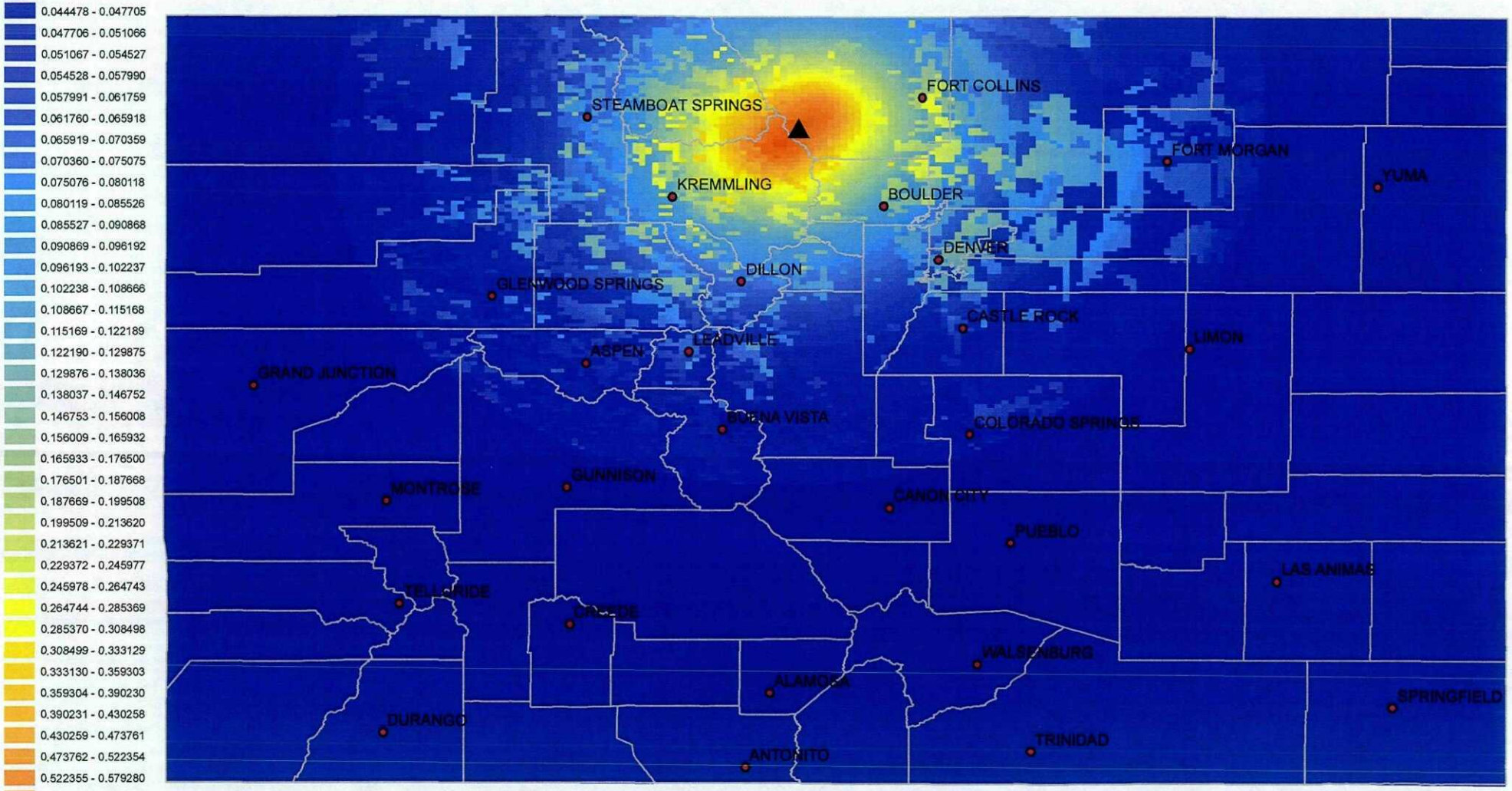
PGA Maps
Intensity Maps derived from PGA

1882 Earthquake, Rocky Mountain National Park Epicenter
M 6.0, CEUS Attenuation



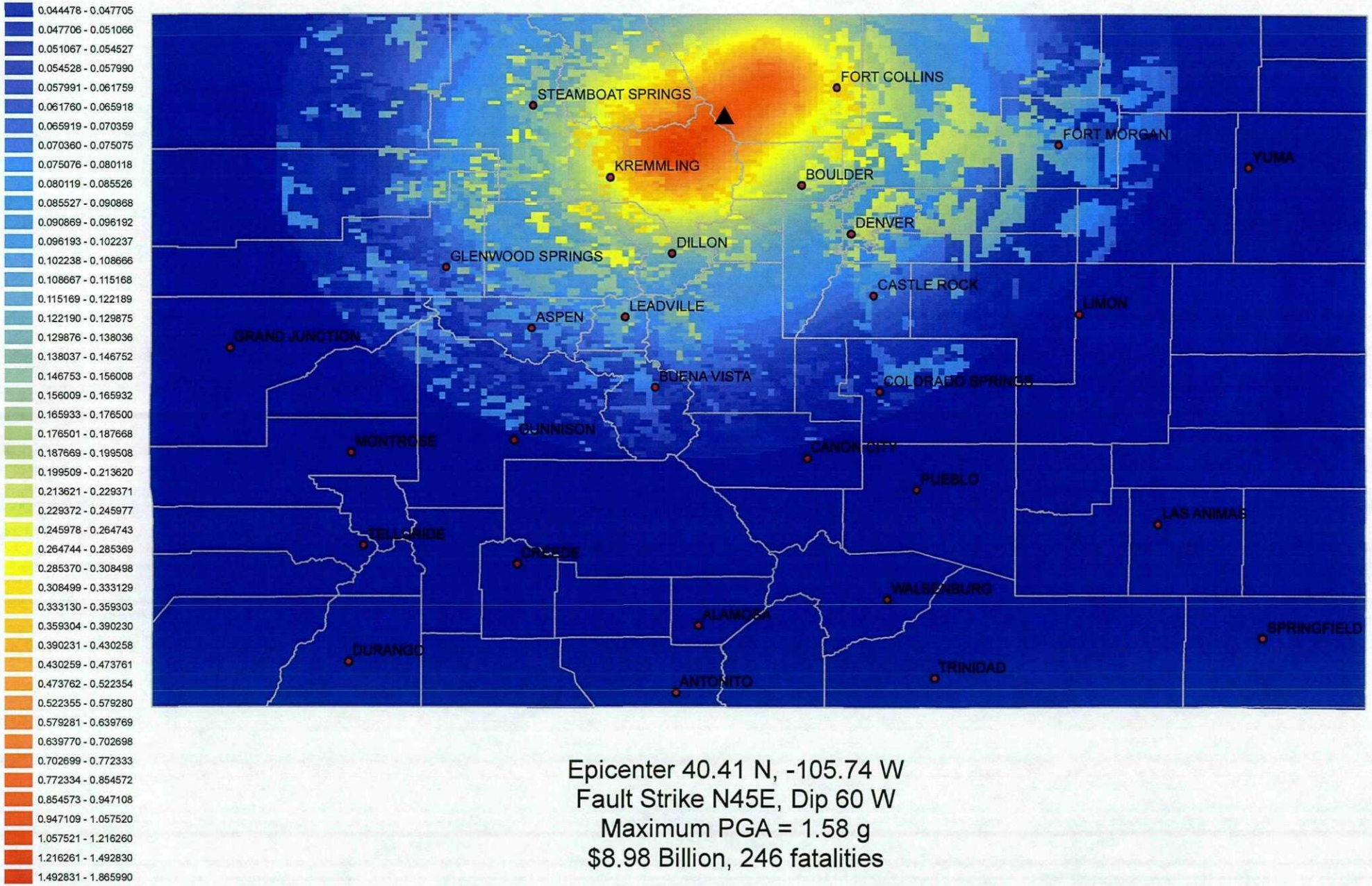
Epicenter 40.41 N, -105.74 W
Fault Strike N45E, Dip 60 W
Maximum PGA = 0.72 g
$950 Million, 6 fatalities

1882 Earthquake, Rocky Mountain National Park Epicenter
M 6.6, CEUS Attenuation



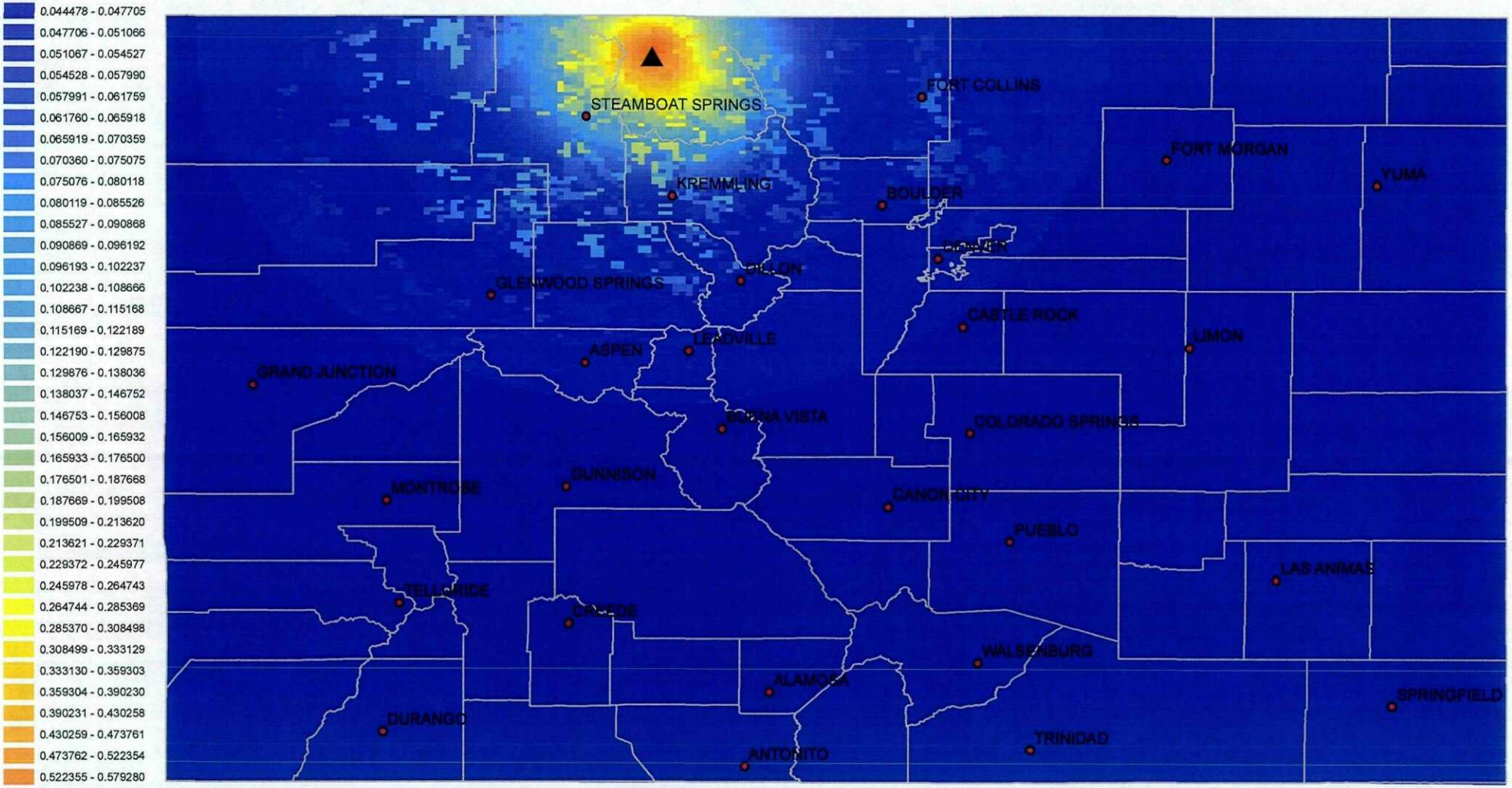
Epicenter 40.41 N, -105.74 W
Fault Strike N45E, Dip 60 W
Maximum PGA = 1.15 g
$2.76 Billion, 31 fatalities

1882 Earthquake, Rocky Mountain National Park Epicenter
M 7.2, CEUS Attenuation



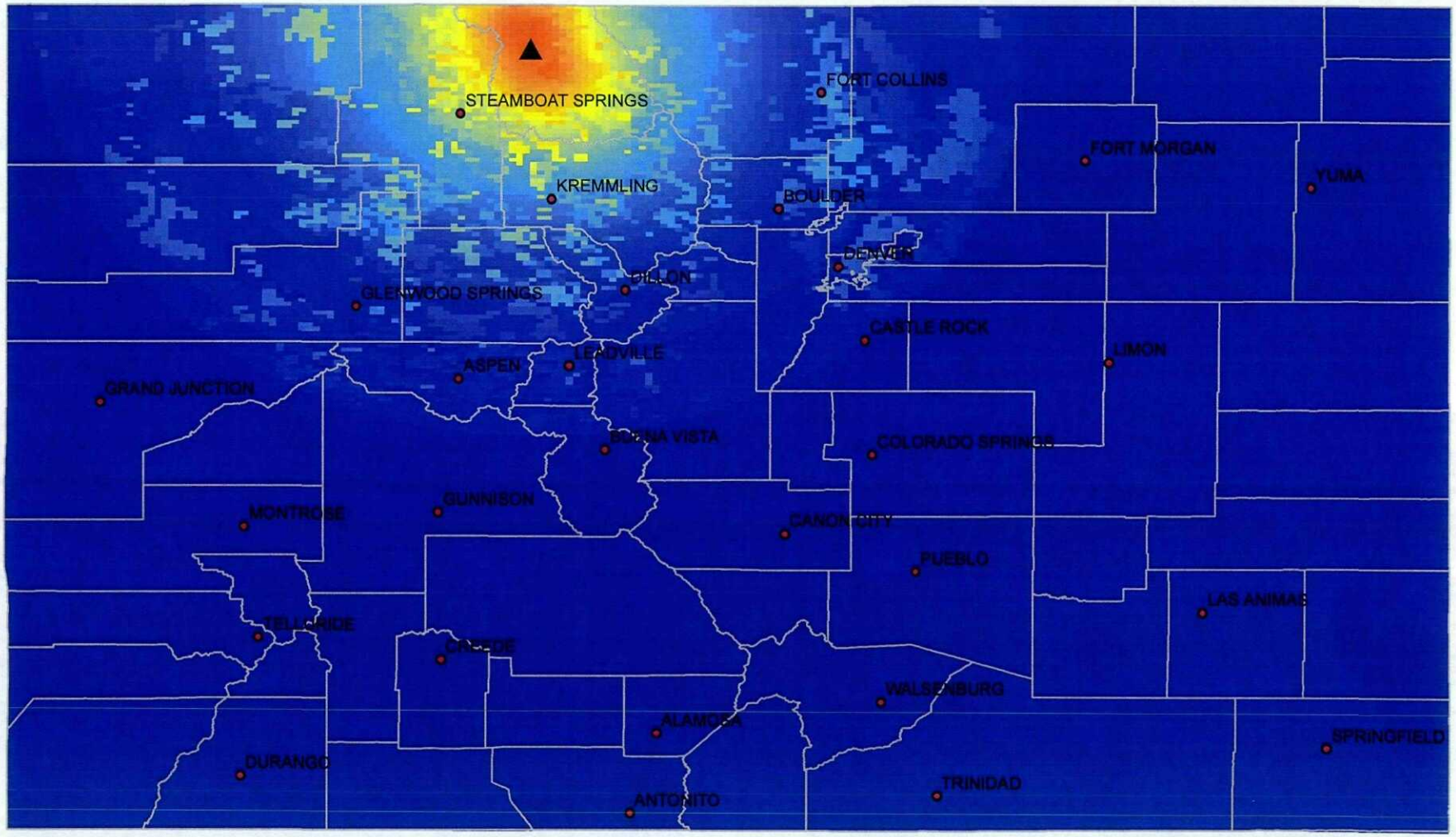
Epicenter 40.41 N, -105.74 W
Fault Strike N45E, Dip 60 W
Maximum PGA = 1.58 g
$8.98 Billion, 246 fatalities

1882 Earthquake, North Park Epicenter
M 6.0, CEUS Attenuation, 10 km Hypocenter Depth



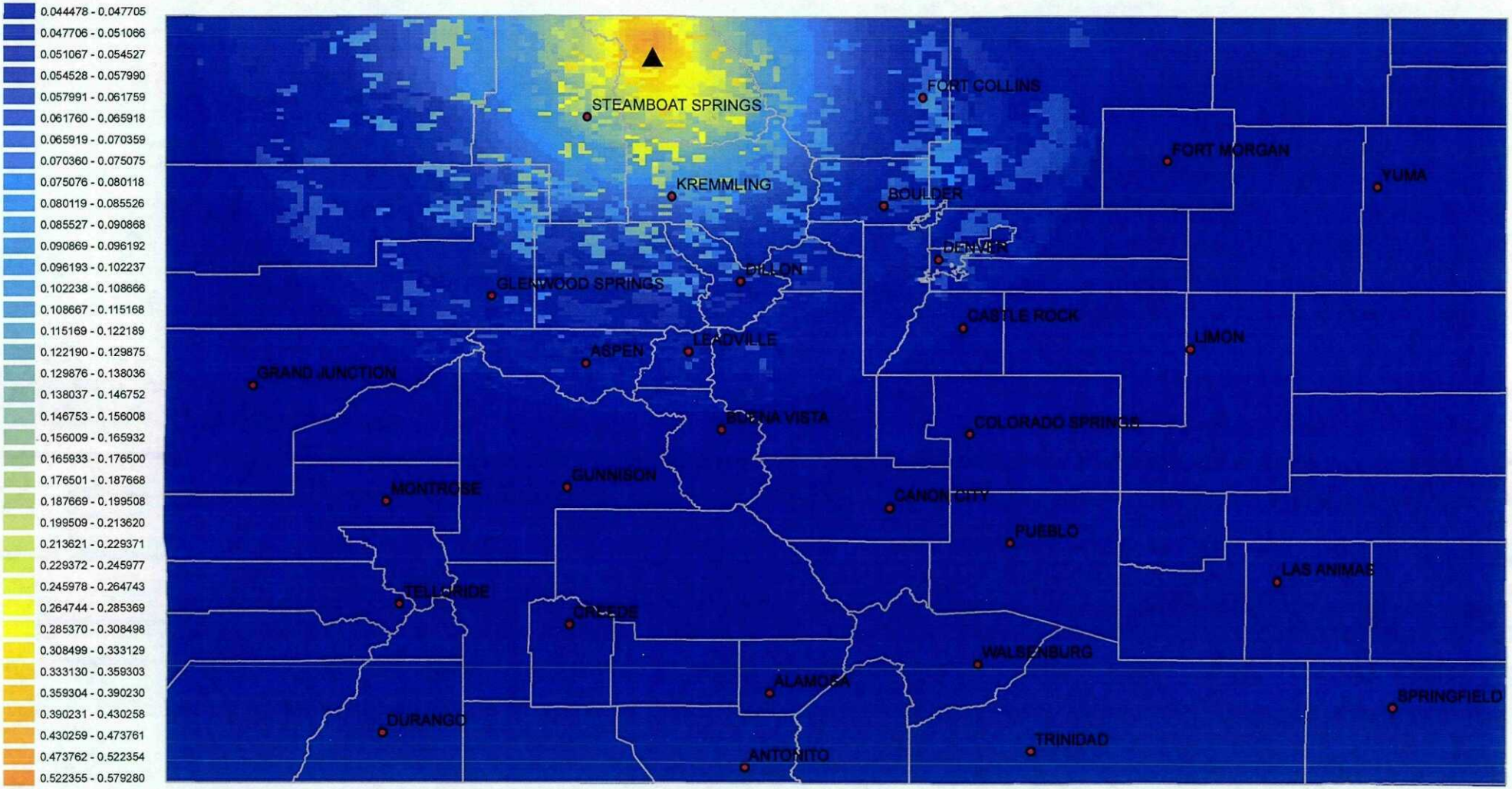
Epicenter 40.79 N, -106.5 W
Fault Strike N19W, Dip 60 E
Maximum PGA = 0.79 g
$149 Million, 1 fatality

1882 Earthquake, North Park Epicenter
M 6.6, CEUS Attenuation, 10 km Hypocenter Depth



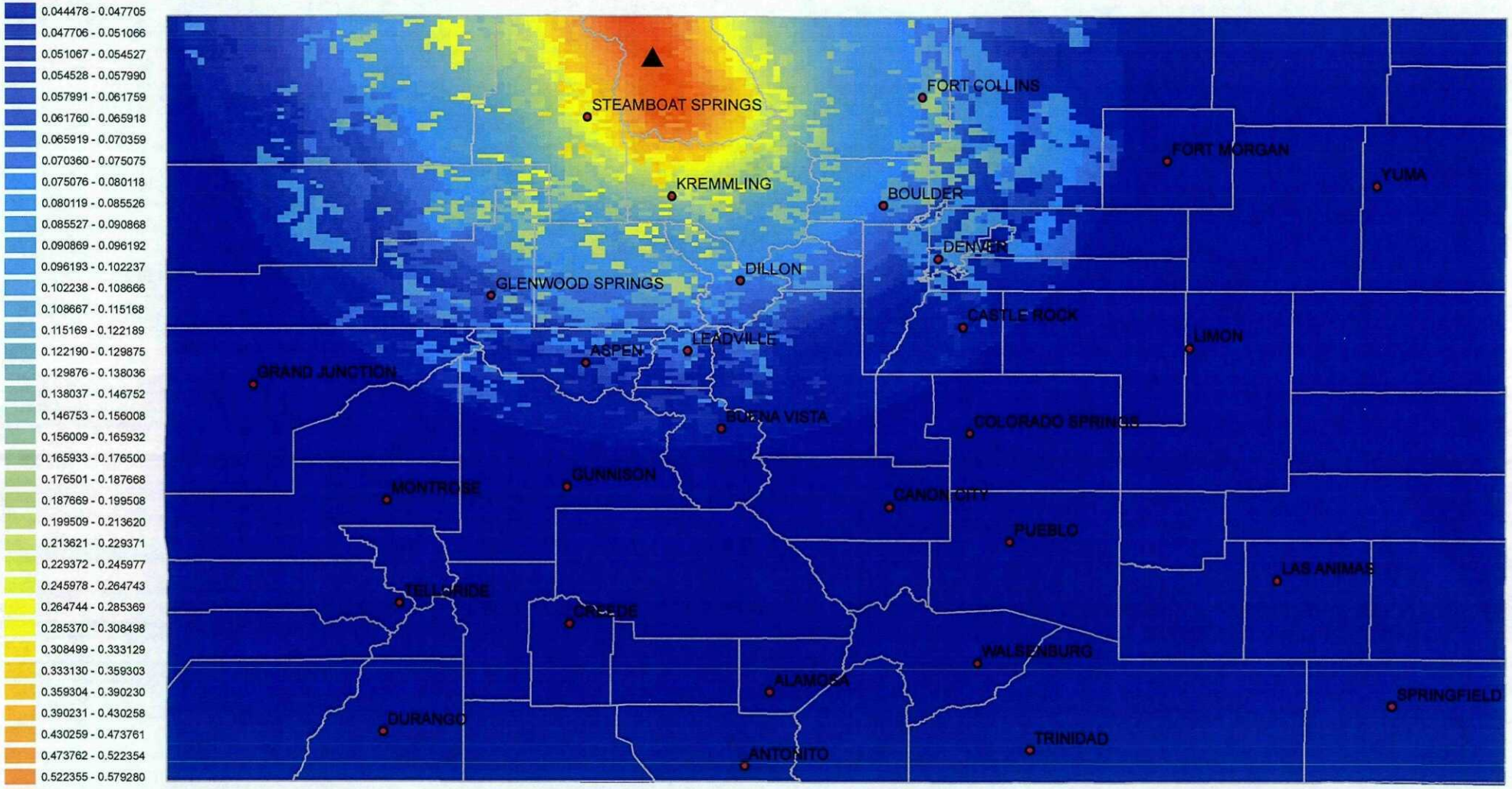
Epicenter 40.79 N, -106.5 W
Fault Strike N19W, Dip 60 E
Maximum PGA = 1.05 g
$553 Million, 3 fatalities

1882 Earthquake, North Park Epicenter
M 6.6, CEUS Attenuation, 30 km Hypocenter Depth



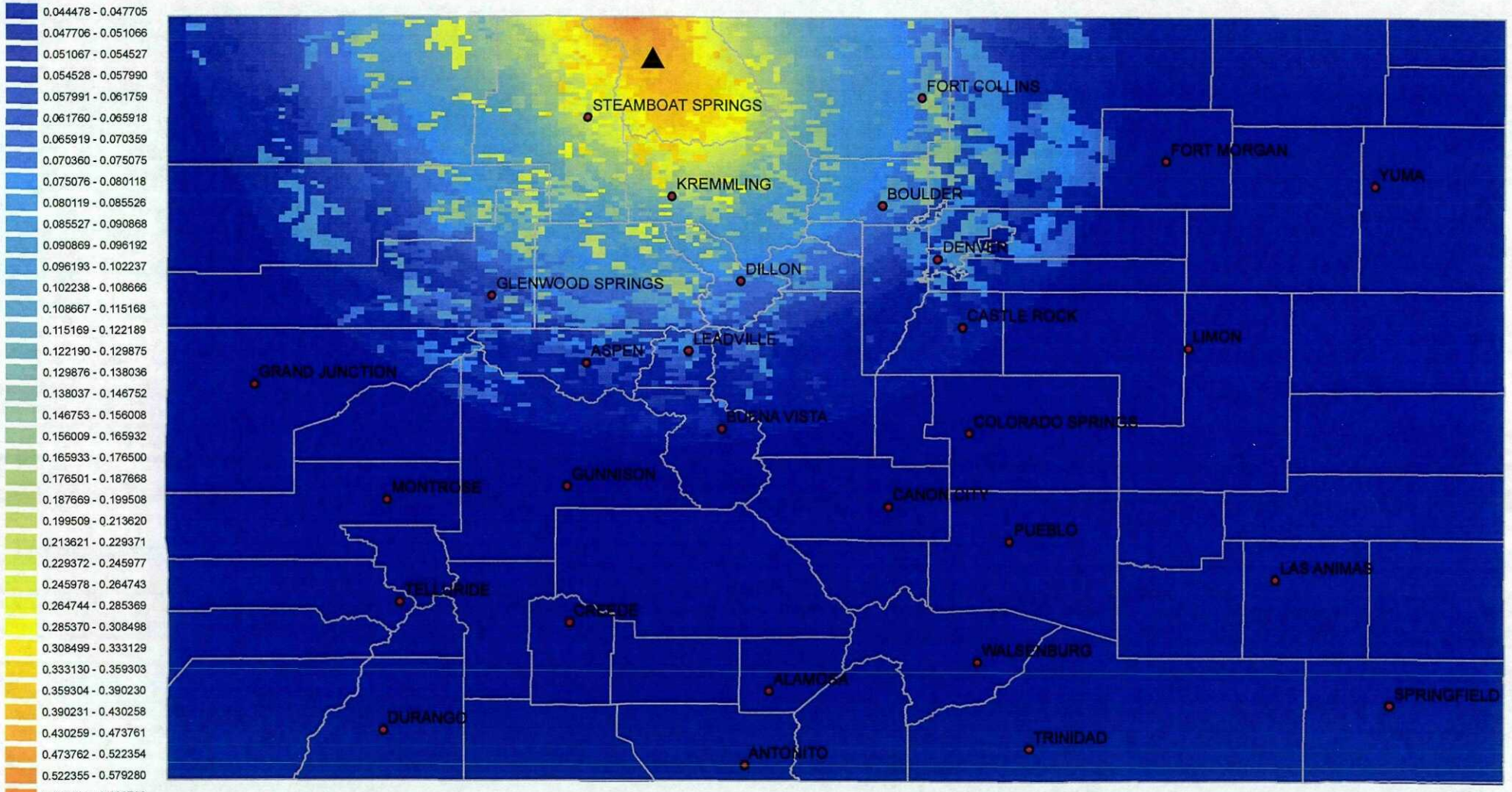
Epicenter 40.79 N, -106.5 W
Fault Strike N19W, Dip 60 E
Maximum PGA = 0.51 g
$470 Million, 3 fatalities

1882 Earthquake, North Park Epicenter
M 7.2, CEUS Attenuation, 10 km Hypocenter Depth



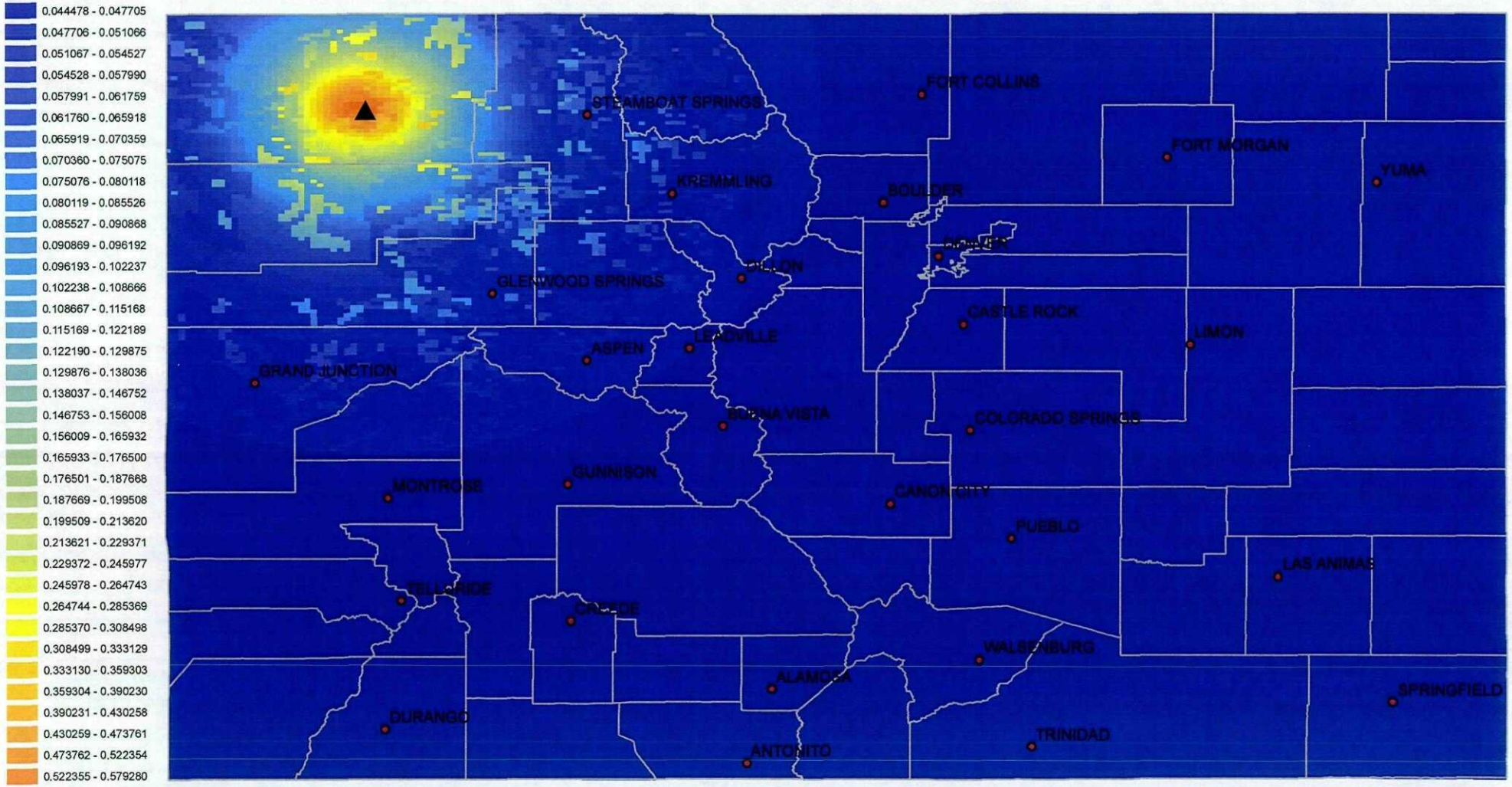
Epicenter 40.79 N, -106.5 W
Fault Strike N19W, Dip 60 E
Maximum PGA = 1.47 g
$2.17 Billion, 26 fatalities

1882 Earthquake, North Park Epicenter
M 7.2, CEUS Attenuation, 30 km Hypocenter Depth



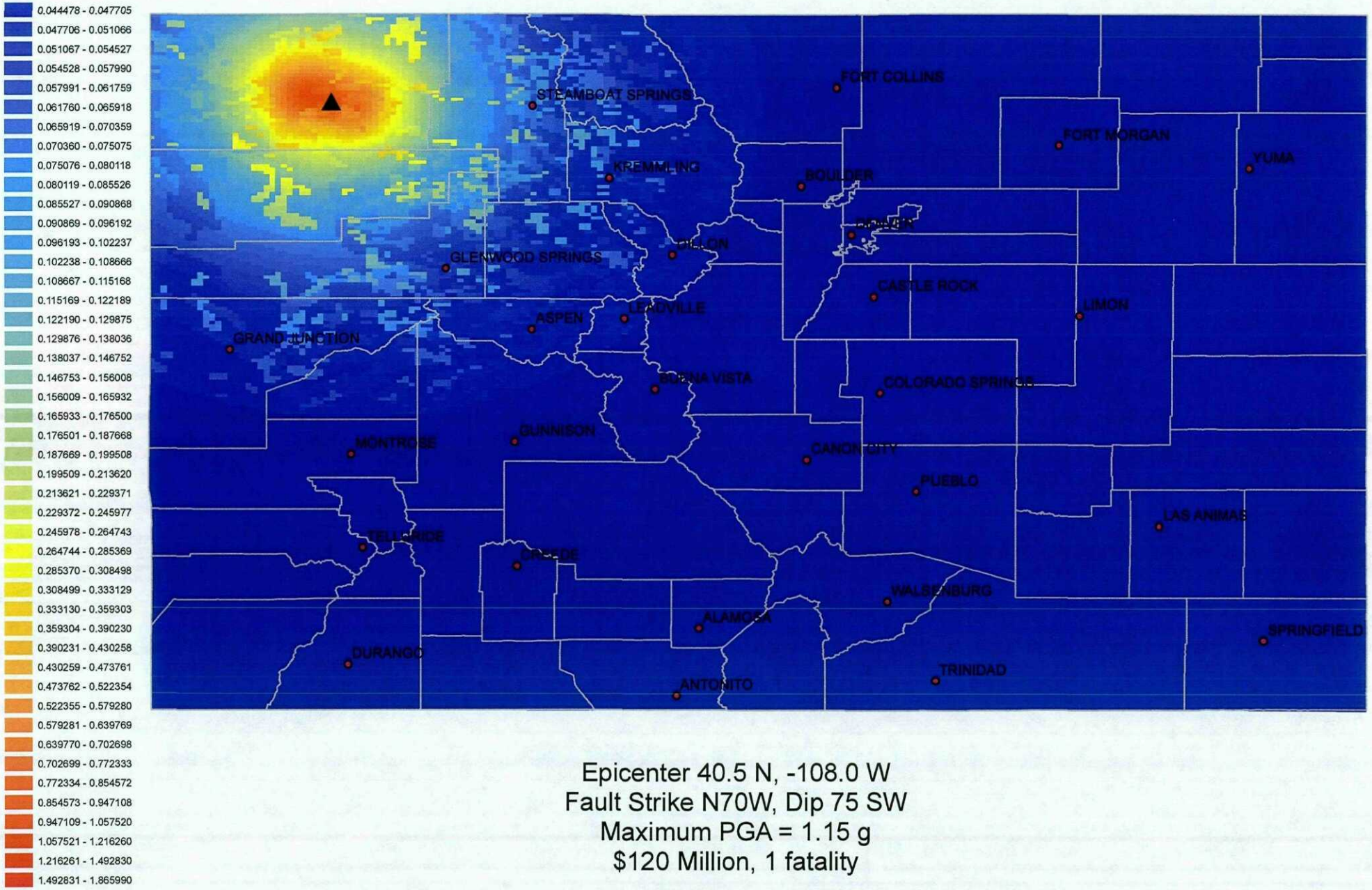
Epicenter 40.79 N, -106.5 W
Fault Strike N19W, Dip 60 E
Maximum PGA = 0.78 g
$1.95 Billion, 21 fatalities

1882 Earthquake, Piceance Basin Epicenter
M 6.0, CEUS Attenuation



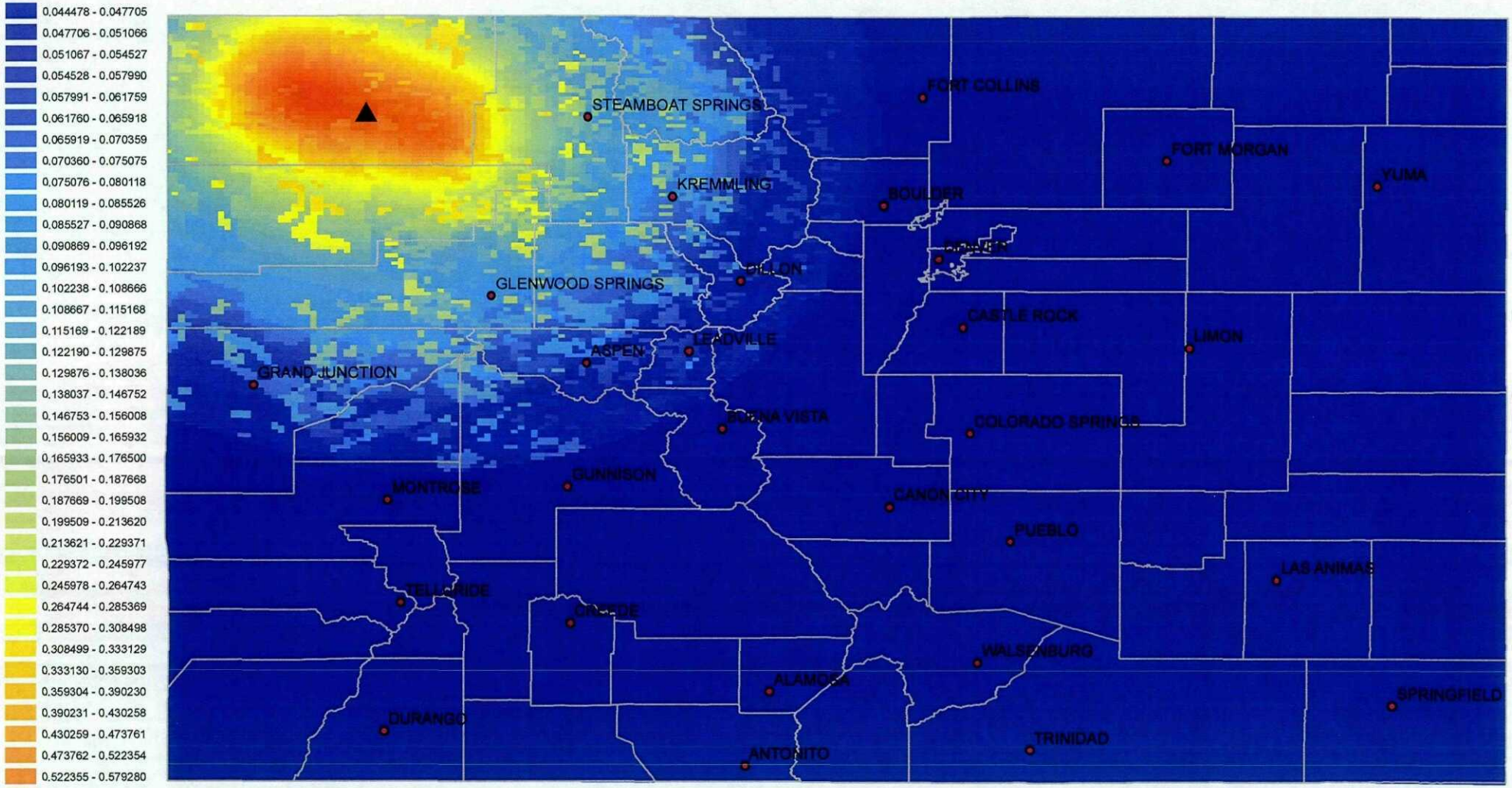
Epicenter 40.5 N, -108.0 W
Fault Strike N70W, Dip 75 SW
Maximum PGA = 0.81 g
$42.2 Million, 0 fatalities

1882 Earthquake, Piceance Basin Epicenter
M 6.6, CEUS Attenuation



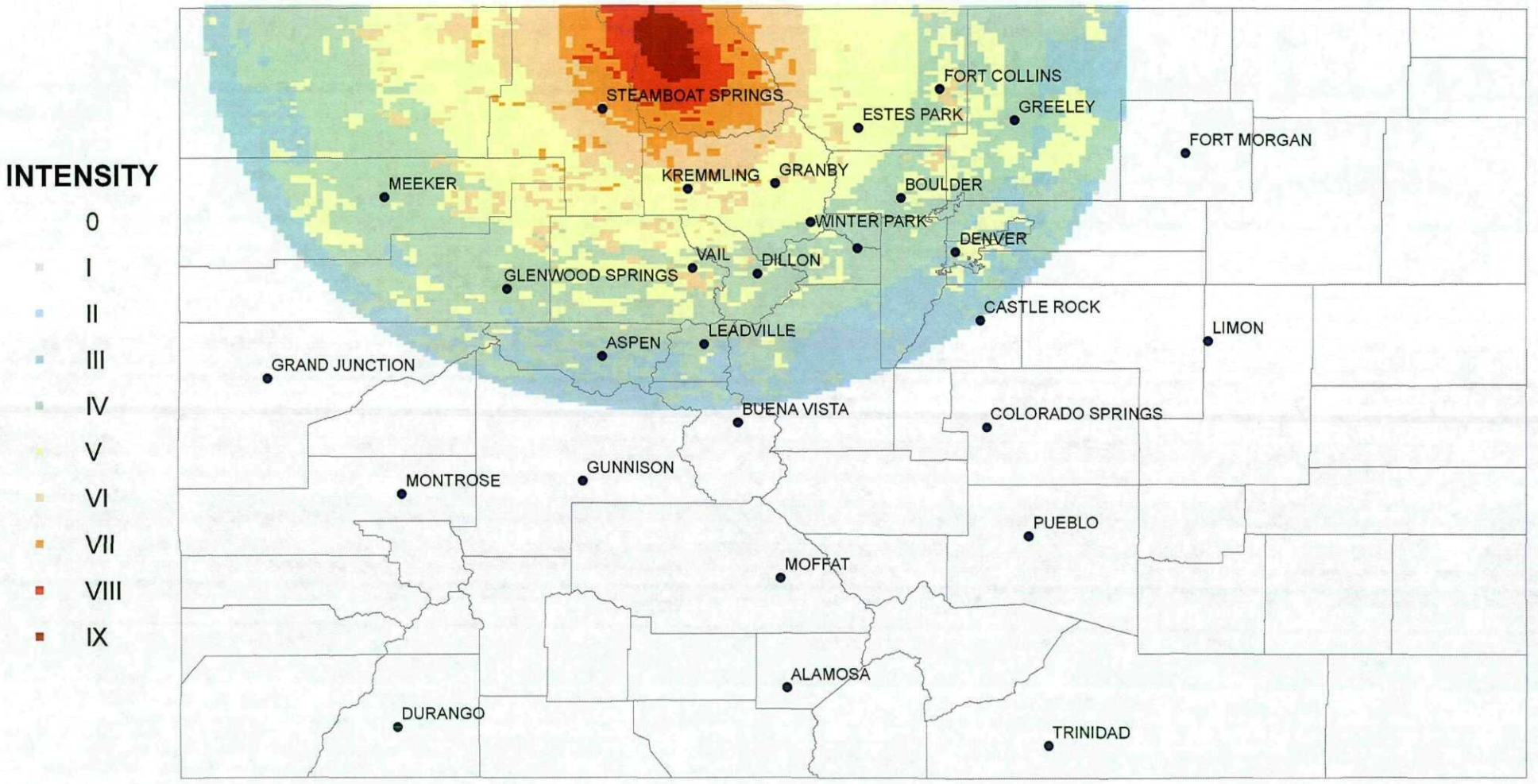
Epicenter 40.5 N, -108.0 W
Fault Strike N70W, Dip 75 SW
Maximum PGA = 1.15 g
$120 Million, 1 fatality

1882 Earthquake, Piceance Basin Epicenter
M 7.2, CEUS Attenuation

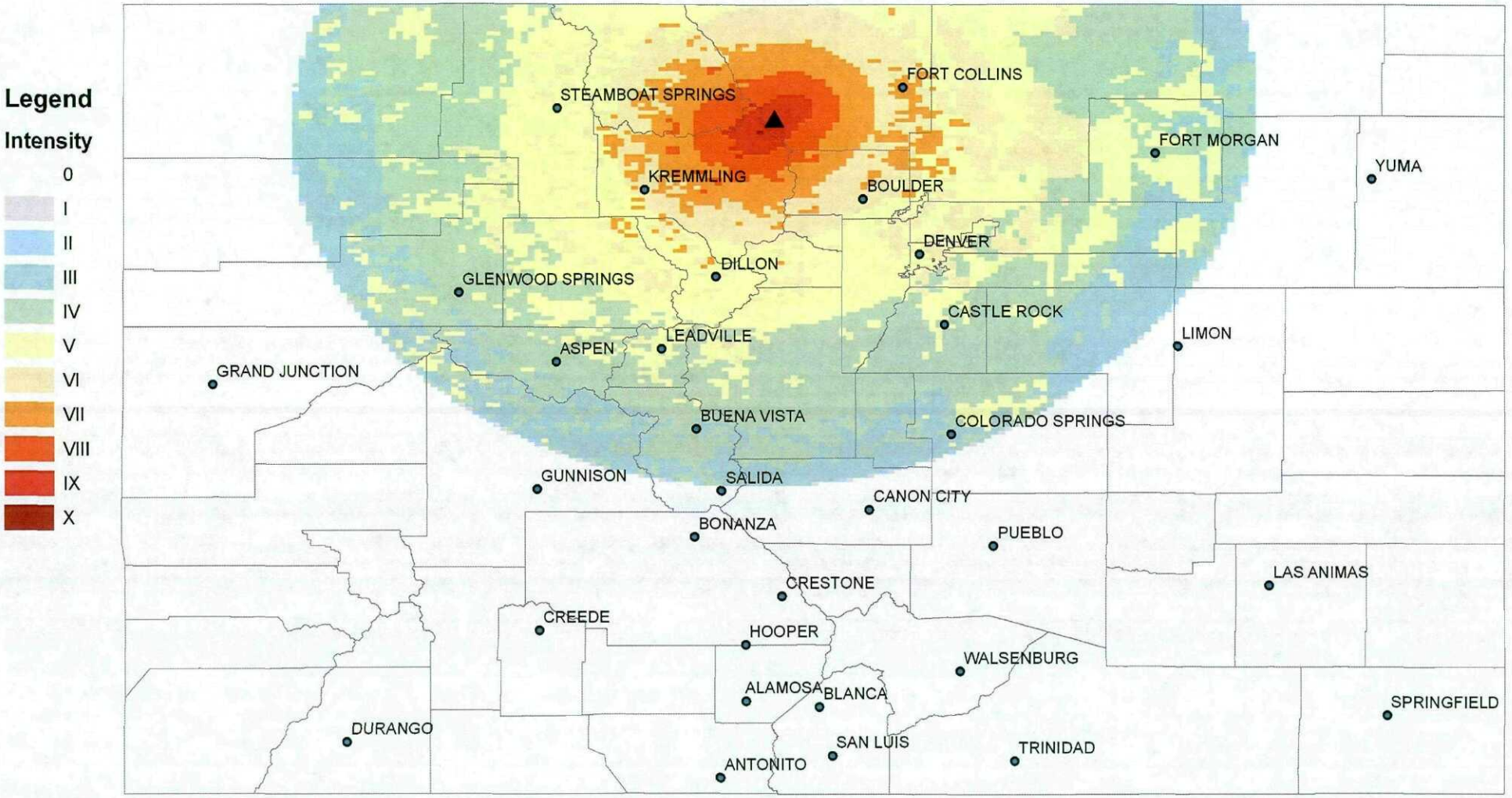


Epicenter 40.5 N, -108.0 W
Fault Strike N70W, Dip 75 SW
Maximum PGA = 1.58 g
$464 Million, 6 fatalities

Modified Mercalli Intensity Map Derived from Hazus PGA Values
1882 M6.6 North Park Epicenter

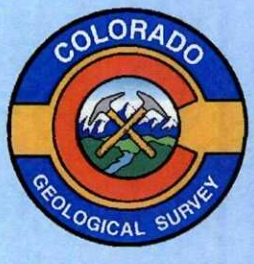


Modified Mercalli Intensity Map Derived from Hazus PGA Values
1882 M6.6 Rocky Mountain National Park Epicenter



County Scenarios

Worst-Case Results
Random EQ Results
Spreadsheet of all Scenarios



County Worst-Case Scenarios Ranked by Loss Ratio

Rank	County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)
1	Summit	Frontal	7.00	1,345.36	32.15%
2	Chaffee	S Sawatch	7.25	665.16	28.26%
3	El Paso	Rampart	7.00	9,013.76	27.67%
4	Lake	N Sawatch	7.00	302.50	27.53%
5	Lake	Mosquito	7.00	298.86	27.20%
6	Teller	Ute Pass	7.00	523.85	26.83%
7	Summit	Mosquito	7.00	1,056.71	25.26%
8	El Paso	Ute Pass	7.00	8,216.92	25.23%
9	Alamosa	N Sangre de Cristo	7.5 CEUS	433.09	23.54%
10	Denver	Golden	6.50	7,510.48	19.24%
11	Chaffee	N Sangre de Cristo	7.5 CEUS	425.76	18.09%
12	Jefferson	Golden	6.50	5,881.32	16.42%
13	Custer	N Sangre de Cristo	7.5 CEUS	138.38	15.77%
14	Adams	Rocky Mtn Arsenal	6.25	3,148.06	14.97%
15	Denver	Rocky Mtn Arsenal	6.25	5,557.58	14.24%
16	Otero	Cheraw	7.00	415.54	14.16%
17	Douglas	Rampart	7.00	1,848.03	13.49%
18	Ouray	Busted Boiler	6.50	104.19	13.33%
19	Montrose	Cimarron	6.75	497.40	13.18%
20	Arapahoe	Golden	6.50	3,900.99	12.10%
21	Denver	Rampart	7.00	4,652.06	11.92%
22	Arapahoe	Rampart	7.00	3,835.78	11.90%
23	Eagle	Frontal	7.00	571.47	11.40%
24	Fremont	N Sangre de Cristo	7.5 CEUS	393.64	10.47%
25	Hinsdale	Cannibal	7.00	35.15	10.12%

Loss Ratio = Scenario Economic Loss / Region's Total Inventory x 100

Loss Ratio presents a more *relative* view of a disaster's impact upon a community than dollar amounts alone. $500 Million loss in Denver County is a very different situation than $500 Million loss in Ouray County…

EQ SUMMARY FOR REPORT

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Adams	Random	6.50	853.52	4.06%	12,185 (12%)	105	931	246	1,013	923
Adams	Golden	6.50	1,589.25	7.56%	21,656 (21%)	257	2,194	597	0	5,691
Adams	Rocky Mtn Arsenal	6.25	3,148.06	14.97%	34,723 (34%)	623	4,764	1,231	811	80,388
Alamosa	Random	6.5 WUS	152.22	8.28%	1,628 (35%)	15	144	40	316	0
Alamosa	N Sangre de Cristo	7.5 WUS	142.06	7.72%	1,342 (29%)	19	137	37	51	0
Arapahoe	Random	6.50	2,350.41	7.29%	28,526 (19%)	317	4,927	1,197	0	1,126
Arapahoe	Golden	6.50	3,900.99	12.10%	42,239 (28%)	885	9,835	2,373	190	4,752
Arapahoe	Rampart	7.00	3,835.78	11.90%	42,105 (28%)	892	9,250	2,191	374	0
Archuleta	Random	6.50	341.25	17.51%	2,110 (44%)	16	129	30	11	2,723
Archuleta	Cannibal	7.00	42.09	2.16%	461 (10%)	1	10	2	0	0
Baca	Random	6.50	119.80	6.54%	1,011 (53%)	8	68	14	112	1,725
Baca	Cheraw	7.00	2.14	0.12%	42 (2%)	0	0	0	0	0
Bent	Random	6.50	72.32	6.69%	826 (44%)	7	49	12	0	1,787
Bent	Cheraw	7.00	18.08	1.67%	192 (10%)	0	3	0	0	0
Boulder	Random	6.50	3,282.58	15.83%	28,018 (30%)	434	5,290	1,267	315	55,571
Boulder	Golden	6.50	1,489.54	7.18%	15,073 (16%)	136	1,880	445	0	7,554
Chaffee	Random	6.50	288.32	12.25%	2,770 (39%)	17	132	32	2	3,302
Chaffee	S Sawatch	7.25	665.16	28.26%	5,321 (76%)	121	919	233	1,953	6,057
Chaffee	N Sangre de Cristo	7.50	425.76	18.09%	3,935 (56%)	134	759	195	2,207	2,061
Cheyenne	Random	6.50	51.12	3.52%	427 (45%)	2	15	2	0	786
Cheyenne	Cheraw	7.00	8.57	0.59%	35 (4%)	0	0	0	0	0
Clear Creek	Random	6.50	175.44	10.74%	1,483 (33%)	11	64	13	0	3,337
Clear Creek	Golden	6.50	42.88	2.63%	342 (8%)	1	6	1	0	0
Conejos	Random	6.5 WUS	26.37	2.27%	656 (21%)	1	10	2	0	0
Conejos	N Sangre de Cristo	7.5 WUS	9.88	0.85%	451 (15%)	2	5	1	0	0
Costilla	Random	6.5 WUS	20.66	2.04%	482 (33%)	2	16	5	2	0
Costilla	N Sangre de Cristo	7.5 WUS	51.60	5.10%	714 (48%)	13	101	24	188	476
Crowley	Random	6.50	91.11	13.66%	966 (74%)	28	143	37	200	1,211
Crowley	Cheraw	7.00	55.19	8.28%	693 (53%)	12	54	14	5	881
Custer	Random	6.50	148.28	16.90%	1,489 (60%)	10	83	17	78	1,363
Custer	N Sangre de Cristo	7.50	138.38	15.77%	1,572 (63%)	19	128	27	31	1,085
Delta	Random	6.50	287.66	10.12%	3,453 (33%)	23	194	49	0	5,515
Delta	Cimarron	6.75	53.14	1.87%	861 (8%)	1	9	2	0	0
Denver	Random	6.50	14,227.75	36.44%	73,314 (51%)	5,841	37,053	9,900	94,819	182,596
Denver	Golden	6.50	7,510.48	19.24%	56,664 (39%)	1,959	20,014	5,360	5,511	60,801
Denver	Rampart	7.00	4,652.06	11.92%	38,815 (27%)	993	12,255	3,229	287	0
Denver	Rocky Mtn Arsenal	6.25	5,557.58	14.24%	45,403 (32%)	1,257	13,992	3,809	909	6,803
Denver	Walnut Creek	6.00	3,152.92	8.08%	26,336 (18%)	395	5,779	1,599	0	290
Dolores	Random	6.50	26.18	5.08%	474 (45%)	1	11	2	0	694
Dolores	Cannibal	7.00	0.90	0.17%	28 (3%)	0	0	0	0	0

EQ SUMMARY FOR REPORT

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Douglas	Random	6.50	2,036.54	14.87%	23,914 (36%)	326	1,716	312	324	38,419
Douglas	Rampart	7.00	1,848.03	13.49%	22,731 (34%)	493	1,785	327	3,183	18,030
Eagle	Random	6.50	599.67	11.96%	5,120 (36%)	70	832	168	755	7,002
Eagle	Frontal	7.00	571.47	11.40%	3,880 (27%)	120	812	163	50	1,469
El Paso	Random	6.50	4,254.96	13.06%	48,244 (31%)	903	8,292	1,968	1,173	51,038
El Paso	Rampart	7.00	9,013.76	27.67%	80,644 (52%)	2,496	19,660	4,657	18,538	135,366
El Paso	Ute Pass	7.00	8,216.92	25.23%	76,253 (50%)	2,193	17,892	4,290	18,970	118,308
Elbert	Random	6.50	72.84	3.00%	823 (12%)	6	14	2	0	549
Elbert	Rampart	7.00	98.88	4.07%	1,320 (19%)	21	36	6	0	0
Fremont	Random	6.50	299.14	7.96%	3,468 (24%)	31	293	80	0	1,783
Fremont	N Sangre de Cristo	7.50	393.64	10.47%	4,901 (34%)	89	629	170	13	790
Garfield	Random	6.50	252.92	5.34%	2,492 (18%)	27	237	53	0	3,316
Garfield	N Sawatch	7.00	76.57	1.62%	977 (7%)	4	47	10	0	0
Gilpin	Random	6.50	133.28	18.38%	1,067 (40%)	9	46	9	0	1,826
Gilpin	Golden	6.50	40.11	5.53%	323 (12%)	1	5	0	0	0
Grand	Random	6.50	194.88	6.22%	1,615 (21%)	11	86	17	44	913
Grand	Williams Fork	6.75	184.15	5.88%	1,389 (18%)	12	94	18	125	929
Gunnison	Random	6.50	164.33	6.13%	1,494 (23%)	24	306	83	0	239
Gunnison	N Sangre de Cristo	7.50	100.28	3.74%	1,001 (15%)	19	217	59	0	0
Hinsdale	Random	6.50	45.10	12.99%	627 (58%)	3	19	3	0	330
Hinsdale	Cannibal	7.00	35.15	10.12%	576 (53%)	2	15	2	0	294
Huerfano	Random	6.50	146.52	7.55%	1,193 (33%)	5	36	9	3	2,245
Huerfano	N Sangre de Cristo	7.50	83.97	4.33%	874 (25%)	5	28	7	0	0
Jackson	Random	6.50	88.91	9.36%	610 (62%)	5	35	7	67	609
Jackson	1882 RMNP	6.60	3.66	0.39%	49 (5%)	0	0	0	0	0
Jefferson	Random	6.50	5,111.00	14.27%	50,103 (29%)	603	6,403	1,403	345	113,457
Jefferson	Golden	6.50	5,881.32	16.42%	54,824 (32%)	828	8,306	1,839	927	153,809
Kiowa	Random	6.50	45.31	3.97%	483 (72%)	7	59	10	117	584
Kiowa	Cheraw	7.00	11.36	1.00%	182 (27%)	1	4	0	0	0
Kit Carson	Random	6.50	100.24	4.45%	1,192 (43%)	10	83	18	33	519
Kit Carson	Cheraw	7.00	11.25	0.50%	179 (6%)	0	3	0	0	0
La Plata	Random	6.50	640.28	14.86%	5,520 (32%)	64	632	162	0	8,925
La Plata	Cannibal	7.00	53.12	1.23%	916 (5%)	1	18	4	0	0
Lake	Random	6.50	274.37	24.97%	1,983 (68%)	39	344	86	48	2,610
Lake	Mosquito	7.00	298.86	27.20%	2,213 (75%)	54	479	120	320	2,616
Lake	N Sawatch	7.00	302.50	27.53%	2,185 (74%)	55	458	114	693	2,573
Larimer	Random	6.50	1,357.50	7.18%	17,869 (21%)	171	1,663	407	21	1,198
Larimer	1882 RMNP	6.60	887.27	4.70%	10,171 (12%)	93	831	189	0	2,844
Las Animas	Random	6.50	33.82	0.91%	345 (6%)	1	5	1	0	0

EQ SUMMARY FOR REPORT

County	Fault	Earthquake Magnitude	Economic Loss in County ($ Million)	Economic Loss Ratio (% total inventory)	Buildings with at least Moderate Damage (# and % total)	Casualties Requiring Hospitalization	Displaced Households	People Seeking Public Shelter	Households without Water	Households without Electric Power
Las Animas	N Sangre de Cristo	7.50	31.63	0.85%	576 (10%)	1	20	6	0	0
Lincoln	Random	6.50	118.13	6.33%	818 (41%)	19	136	28	1,268	672
Lincoln	Cheraw	7.00	22.48	1.20%	371 (19%)	1	9	2	0	0
Logan	Random	6.50	346.75	11.34%	3,838 (58%)	91	629	166	372	2,095
Logan	Rocky Mtn Arsenal	6.25	2.12	0.00%	63 (1%)	0	0	0	0	0
Mesa	Random	6.50	2,122.40	23.47%	20,611 (54%)	545	4,152	1,145	18	35,626
Mesa	Random	7.00	2,960.92	32.74%	26,101 (68%)	913	6,811	1,838	1,259	38,793
Mesa	Cimarron	6.75	55.36	0.61%	1,265 (3%)	2	30	8	0	0
Mineral	Random	6.50	74.41	11.15%	688 (71%)	5	36	6	34	336
Mineral	Cannibal	7.00	43.13	6.46%	546 (56%)	3	19	3	1	267
Moffat	Random	6.50	36.09	1.30%	348 (8%)	1	6	1	12	251
Moffat	Frontal	7.00	5.11	0.18%	77 (2%)	0	0	0	0	0
Montezuma	Random	6.50	259.84	8.45%	2,903 (33%)	17	122	33	0	5,304
Montezuma	Cannibal	7.00	9.80	0.32%	234 (3%)	0	1	0	0	0
Montrose	Random	6.50	256.99	6.81%	3,361 (28%)	24	183	49	0	0
Montrose	Cimarron	6.75	497.40	13.18%	4,969 (41%)	130	856	213	708	1,863
Morgan	Random	6.50	1,384.96	25.63%	5,359 (62%)	132	921	244	1,316	6,410
Morgan	Rocky Mtn Arsenal	6.25	21.84	0.40%	272 (3%)	0	2	0	0	0
Otero	Random	6.50	334.00	11.38%	2,945 (44%)	39	329	88	2,804	4,935
Otero	Cheraw	7.00	415.54	14.16%	3,676 (55%)	78	588	166	3,050	5,410
Ouray	Random	6.50	147.27	18.84%	746 (40%)	6	30	6	0	1,390
Ouray	Busted Boiler	6.50	104.19	13.33%	598 (32%)	4	18	3	0	1,305
Park	Random	6.50	152.72	5.44%	2,356 (25%)	7	53	7	116	575
Park	Chase Gulch	6.75	165.45	5.90%	2,784 (29%)	8	76	14	304	1,198
Park	Mosquito	7.00	169.29	6.03%	2,308 (24%)	15	144	26	22	714
Phillips	Random	6.50	74.10	6.44%	800 (47%)	7	50	9	5	1,520
Phillips	Rocky Mtn Arsenal	6.25	0.00	0.00%	0 (0%)	0	0	0	0	0
Pitkin	Random	6.50	375.02	16.86%	1,567 (24%)	20	204	41	0	4,611
Pitkin	N Sawatch	7.00	168.78	7.59%	1,060 (16%)	14	100	20	0	616
Prowers	Random	6.50	209.69	9.09%	2,383 (51%)	42	296	82	109	1,788
Prowers	Cheraw	7.00	60.89	2.64%	777 (16%)	5	31	9	0	0
Pueblo	Random	6.50	2,315.75	21.99%	21,293 (47%)	515	4,079	1,255	410	43,103
Pueblo	N Sangre de Cristo	7.50	483.70	4.59%	6,793 (15%)	124	739	224	0	0
Pueblo	Ute Pass	7.00	288.21	2.74%	4,327 (10%)	29	248	75	0	0
Rio Blanco	Random	6.50	51.43	3.28%	647 (27%)	4	31	7	0	0
Rio Blanco	Frontal	7.00	6.69	0.43%	132 (5%)	0	2	0	0	0
Rio Grande	Random	6.5 WUS	88.75	4.98%	1,556 (33%)	18	145	41	0	0
Rio Grande	Cannibal	7.0 CEUS	36.60	2.05%	629 (13%)	2	18	5	0	0
Routt	Random	6.50	461.55	14.82%	2,665 (34%)	70	347	69	0	3,934

EQ SUMMARY FOR REPORT

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Routt	Frontal	7.00	55.99	1.80%	626 (8%)	4	32	6	0	0
Saguache	Random	6.5 WUS	53.11	3.50%	1,145 (48%)	8	65	17	139	625
Saguache	N Sangre de Cristo	7.5 WUS	25.23	1.66%	421 (18%)	2	12	3	0	0
San Juan	Random	6.50	20.06	5.43%	214 (42%)	1	6	1	0	241
San Juan	Cannibal	7.00	2.36	0.64%	38 (7%)	0	0	0	0	0
San Miguel	Random	6.50	32.62	2.40%	324 (10%)	1	10	2	0	466
San Miguel	Busted Boiler	6.50	36.15	2.65%	201 (6%)	1	13	2	0	0
Sedgwick	Random	6.50	62.77	5.86%	659 (59%)	7	79	17	48	1,075
Sedgwick	Rocky Mtn Arsenal	6.25	0.00	0.00%	0 (0%)	0	0	0	0	0
Summit	Random	6.50	829.99	19.84%	4,028 (37%)	67	602	116	0	7,071
Summit	Frontal	7.00	1,345.36	32.15%	6,602 (60%)	179	1,379	267	1,491	7,862
Summit	Mosquito	7.00	1,056.71	25.26%	5,177 (47%)	117	849	162	69	6,861
Teller	Random	6.50	255.40	13.08%	2,849 (30%)	13	90	18	0	6,043
Teller	Ute Pass	7.00	523.85	26.83%	5,099 (54%)	65	514	104	87	6,384
Washington	Random	6.50	71.76	3.34%	784 (42%)	7	49	7	85	819
Washington	Rocky Mtn Arsenal	6.25	1.09	0.00%	5 (0%)	0	0	0	0	0
Weld	Random	6.50	944.83	6.61%	13,382 (25%)	125	1,414	393	0	887
Weld	Rocky Mtn Arsenal	6.25	501.92	3.51%	6,871 (13%)	42	322	80	0	1,610
Yuma	Random	6.50	201.22	7.64%	2,069 (60%)	40	325	68	1,261	1,161
Yuma	Cheraw	7.00	3.29	0.13%	84 (2%)	0	0	0	0	0

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage	Loss Ratio %
28-Jun-05	712	Anton M7.6 Denver	7.6	Denver County	CEUS Event	0h6m	2219, 569, 88, 172	3,045.36	7.8
11-Jul-05	754	Anton M7.6 State	7.6	State	CEUS Event	1h17m	6914, 1796, 279, 542	12,145.18	3.37
24-Jan-06	800	Anton M7.6 Cheyenne	7.6	Cheyenne Co	CEUS Event	0h1m	3, 1, 0, 0	27.06	1.87
27-Jan-06	905	Anton M7.6 Kit Carson	7.6	Kit Carson Co	CEUS Event	0h2m	189, 56, 10, 17	285.07	12.66
30-Jan-06	925	Anton M7.6 Lincoln	7.6	Lincoln County	CEUS Event	0h2m	27, 6, 1, 2	59.21	3.17
30-Jan-06	927	Anton M7.6 Logan	7.6	Logan County	CEUS Event	0h2m	203, 62, 11, 20	300.21	9.82
31-Jan-06	939	Anton M7.6 Morgan	7.6	Morgan	CEUS Event	0h2m	463, 147, 27, 48	2441.92	45.18
31-Jan-06	956	Anton M7.6 Phillips	7.6	Phillips	CEUS Event	0h1m	3, 0, 0, 0	17.63	1.53
1-Feb-06	989	Anton M7.6 Sedgwick	7.6	Sedgwick	CEUS Event	0h1m	1, 0, 0, 0	4.01	0.37
1-Feb-06	1001	Anton M7.6 Washington	7.6	Washington	CEUS Event	0h1m	126, 36, 7, 10	227.65	10.59
1-Feb-06	1006	Anton M7.6 Yuma	7.6	Yuma	CEUS Event	0h1m	131, 38, 8, 12	214.1	8.13
Every HAZUS scenario run with the latest version, MR1, is recorded in these tables.									
Scenario result spreadsheets are alphabetized by fault or epicenter. Results are listed in chronological order of when scenario was run.									
Casualties are ordered by severity, from level 1 to 4.									
The loss ratio is the total damage divided by the total region inventory, multiplied by 100. Loss ratios are highlighted if greater than 5%.									

Busted Boiler

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($M)	Loss Ratio (%)
11-Jul-05	752	Busted Boiler M6.5 State	6.50	State	CEUS Event	1h15m	273, 73, 14, 22	694.02	0.19
25-Jan-06	832	Busted Boiler M6.5 Dolores	6.50	Dolores Co	CEUS Event	0h1m	0, 0, 0, 0	0.85	0.16
26-Jan-06	872	Busted Boiler M6.5 Gunnison	6.50	Gunnison	CEUS Event	0h1m	3, 0, 0, 0	13.13	0.49
26-Jan-06	881	Busted Boiler M6.5 Hinsdale	6.50	Hinsdale	CEUS Event	0h1m	0, 0, 0, 0	1.14	0.33
27-Jan-06	906	Busted Boiler M6.5 La Plata	6.50	La Plata	CEUS Event	0h2m	3, 0, 0, 0	14.42	0.33
31-Jan-06	935	Busted Boiler M6.5 Montrose	6.50	Montrose	CEUS Event	0h2m	233, 67, 13, 21	432.16	11.45
31-Jan-06	942	Busted Boiler M6.5 Ouray	6.50	Ouray	CEUS Event	0h1m	11, 2, 1, 1	104.19	13.33
1-Feb-06	984	Busted Boiler M6.5 San Juan	6.50	San Juan	CEUS Event	0h1m	0, 0, 0, 0	0.89	0.24
1-Feb-06	986	Busted Boiler M6.5 San Miguel	6.50	San Miguel	CEUS Event	0h1m	4, 1, 0, 0	36.15	2.65

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($M)	Loss Ratio (%)
11-Jul-05	753	Cannibal M7.0 State	7.0	State	CEUS Event	1h14m	178, 33, 6, 8	674.66	0.19
24-Jan-06	783	Cannibal M7.0 Archuleta	7.0	Archuleta	CEUS Event	0h1m	6, 1, 0, 0	42.09	2.16
25-Jan-06	833	Cannibal M7.0 Dolores	7.0	Dolores	CEUS Event	0h1m	0, 0, 0, 0	0.90	0.17
26-Jan-06	873	Cannibal M7.0 Gunnison	7.0	Gunnison	CEUS Event	0h1m	26, 6, 1, 2	70.09	2.61
26-Jan-06	882	Cannibal M7.0 Hinsdale	7.0	Hinsdale	CEUS Event	0h1m	6, 2, 0, 0	35.15	10.12
27-Jan-06	907	Cannibal M7.0 La Plata	7.0	La Plata	CEUS Event	0h2m	11, 1, 0, 0	53.12	1.23
30-Jan-06	930	Cannibal M7.0 Mineral	7.0	Mineral	CEUS Event	0h1m	7, 2, 0, 1	43.13	6.46
30-Jan-06	933	Cannibal M7.0 Montezuma	7.0	Montezuma	CEUS Event	0h2m	2, 0, 0, 0	9.80	0.32
31-Jan-06	936	Cannibal M7.0 Montrose	7.0	Montrose	CEUS Event	0h2m	66, 15, 3, 4	174.27	4.62
31-Jan-06	943	Cannibal M7.0 Ouray	7.0	Ouray	CEUS Event	0h1m	2, 0, 0, 0	36.48	4.67
31-Jan-06	971	Cannibal M7.0 Rio Grande	7.0	Rio Grande	CEUS Event	0h2m	10, 2, 0, 0	36.60	2.05
1-Feb-06	979	Cannibal M7.0 Saguache	7.0	Saguache	CEUS Event	0h1m	8, 1, 0, 0	16.31	1.08
1-Feb-06	985	Cannibal M7.0 San Juan	7.0	San Juan	CEUS Event	0h1m	0, 0, 0, 0	2.36	0.64

Chase Gulch E

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage (Mil)	Loss Ratio (%)
11-Jul-05	755	Chase Gulch M6.75 State	6.75	State	CEUS Event	1h17m	1249, 202, 23, 40	3,760.43	1.04
24-Jan-06	781	Chase Gulch M6.75 Arapahoe	6.75	Arapahoe	CEUS Event	0h5m	267, 45, 6, 9	678.30	2.10
24-Jan-06	793	Chase Gulch M6.75 Chaffee	6.75	Chaffee	CEUS Event	0h2m	5, 1, 0, 0	33.91	1.44
24-Jan-06	801	Chase Gulch M6.75 Clear Cr	6.75	Cl Creek	CEUS Event	0h1m	1, 0, 0, 0	9.71	0.60
25-Jan-06	819	Chase Gulch M6.75 Denver	6.75	Denver	CEUS Event	0h7m	407, 67, 7, 13	1,008.01	2.58
25-Jan-06	834	Chase Gulch M6.75 Douglas	6.75	Douglas	CEUS Event	0h3m	29, 4, 1, 1	117.42	0.86
25-Jan-06	840	Chase Gulch M6.75 Eagle	6.75	Eagle	CEUS Event	0h1m	9, 1, 0, 0	33.91	0.68
25-Jan-06	845	Chase Gulch M6.75 El Paso	6.75	El Paso	CEUS Event	0h5m	209, 36, 5, 8	636.41	1.95
26-Jan-06	856	Chase Gulch M6.75 Fremont	6.75	Fremont	CEUS Event	0h3m	16, 3, 0, 1	79.48	2.11
26-Jan-06	891	Chase Gulch M6.75 Jefferson	6.75	Jefferson	CEUS Event	0h5m	83, 12, 1, 2	306.98	0.86
27-Jan-06	909	Chase Gulch M6.75 Lake	6.75	Lake	CEUS Event	0h2m	5, 1, 0, 0	27.31	2.49
31-Jan-06	946	Chase Gulch M6.75 Park	6.75	Park	CEUS Event	0h1m	30, 6, 1, 1	165.45	5.90
31-Jan-06	957	Chase Gulch M6.75 Pitkin	6.75	Pitkin	CEUS Event	0h1m	2, 0, 0, 0	10.86	0.49
1-Feb-06	990	Chase Gulch M6.75 Summit	6.75	Summit	CEUS Event	0h1m	11, 2, 0, 0	73.31	1.75
1-Feb-06	997	Chase Gulch M6.75 Teller	6.75	Teller	CEUS Event	0h1m	8, 1, 0, 0	50.02	2.56

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Damage (Mil)	Loss Ratio (%)
11-Jul-05	756	Cheraw M7.0 State	7.0	State	CEUS Event	1h15m	451, 93, 24, 25	1,260.53	0.35
24-Jan-06	782	Cheraw M7.0 Arapahoe	7.0	Arapahoe	CEUS Event	0h4m	23, 3, 0, 0	57.94	0.18
24-Jan-06	784	Cheraw M7.0 Baca	7.0	Baca	CEUS Event	0h1m	0, 0, 0, 0	2.14	0.12
24-Jan-06	785	Cheraw M7.0 Bent	7.0	Bent	CEUS Event	0h1m	3, 0, 0, 0	18.08	1.67
24-Jan-06	799	Cheraw M7.0 Cheyenne	7.0	Cheyenne	CEUS Event	0h1m	0, 0, 0, 0	8.57	0.59
25-Jan-06	813	Cheraw M7.0 Crowley	7.0	Crowley	CEUS Event	0h1m	39, 9, 2, 2	55.19	8.28
25-Jan-06	820	Cheraw M7.0 Denver	7.0	Denver	CEUS Event	0h6m	3, 0, 0, 0	8.02	0.00
25-Jan-06	835	Cheraw M7.0 Douglas	7.0	Douglas	CEUS Event	0h3m	6, 1, 0, 0	19.20	0.14
25-Jan-06	846	Cheraw M7.0 El Paso	7.0	El Paso	CEUS Event	0h5m	128, 20, 5, 4	353.22	1.08
26-Jan-06	853	Cheraw M7.0 Elbert	7.0	Elbert	CEUS Event	0h2m	1, 0, 0, 0	5.29	0.22
26-Jan-06	884	Cheraw M7.0 Huerfano	7.0	Huerfano	CEUS Event	0h2m	1, 0, 0, 0	4.62	0.24
27-Jan-06	904	Cheraw M7.0 Kiowa	7.0	Kiowa	CEUS Event	0h2m	3, 1, 0, 0	11.36	1.00
30-Jan-06	922	Cheraw M7.0 Las Animas	7.0	Las Animas	CEUS Event	0h3m	1, 0, 0, 0	3.97	0.11
30-Jan-06	926	Cheraw M7.0 Lincoln	7.0	Lincoln	CEUS Event	0h2m	7, 1, 0, 0	22.48	1.20
31-Jan-06	941	Cheraw M7.0 Otero	7.0	Otero	CEUS Event	0h3m	173, 48, 15, 15	415.54	14.16
31-Jan-06	964	Cheraw M7.0 Prowers	7.0	Prowers	CEUS Event	0h2m	17, 4, 0, 1	60.89	2.64
31-Jan-06	965	Cheraw M7.0 Pueblo	7.0	Pueblo	CEUS Event	0h5m	59, 11, 1, 2	170.75	1.62
17-Mar-06	1076	Cheraw M7.0 Kit Carson	7.0	Kit Carson	CEUS Event	0h2m	3, 0, 0, 0	11.25	0.50
17-Mar-06	1082	Cheraw M7.0 Yuma	7.0	Yuma	CEUS Event	0h2m	1, 0, 0, 0	3.29	0.13

Cimarron

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Damage (Mil)	Loss Ratio (%)
12-Jul-05	758	Cimarron M6.75 State	6.75	State	CEUS Event	1h14m	354, 97, 20, 30	807.50	0.22
25-Jan-06	817	Cimarron M6.75 Delta	6.75	Delta	CEUS Event	0h2m	10, 1, 0, 0	53.14	1.87
26-Jan-06	874	Cimarron M6.75 Gunnison	6.75	Gunnison	CEUS Event	0h1m	21, 4, 1, 1	67.62	2.52
26-Jan-06	883	Cimarron M6.75 Hinsdale	6.75	Hinsdale	CEUS Event	0h1m	0, 0, 0, 0	1.90	0.55
27-Jan-06	908	Cimarron M6.75 La Plata	6.75	La Plata	CEUS Event	0h2m	3, 0, 0, 0	12.27	0.29
30-Jan-06	928	Cimarron M6.75 Mesa	6.75	Mesa	CEUS Event	0h3m	17, 2, 0, 0	55.36	0.61
30-Jan-06	931	Cimarron M6.75 Mineral	6.75	Mineral	CEUS Event	0h1m	0, 0, 0, 0	2.75	0.41
31-Jan-06	937	Cimarron M6.75 Montrose	6.75	Montrose	CEUS Event	0h2m	291, 87, 19, 28	497.40	13.18
31-Jan-06	944	Cimarron M6.75 Ouray	6.75	Ouray	CEUS Event	0h1m	2, 0, 0, 0	32.65	4.18
31-Jan-06	958	Cimarron M6.75 Pitkin	6.75	Pitkin	CEUS Event	0h1m	2, 0, 0, 0	12.58	0.57
1-Feb-06	987	Cimarron M6.75 San Miguel	6.75	San Miguel	CEUS Event	0h1m	1, 0, 0, 0	7.53	0.55

Frontal

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage (Mil)	Loss Ratio (%)
12-Jul-05	759	Frontal M7.0 State	7.00	State	CEUS Event	1h15m	2523, 529, 86, 137	6,733.82	1.87
24-Jan-06	786	Frontal M7.0 Boulder	7.00	Boulder	CEUS Event	0h4m	93, 15, 3, 3	330.08	1.59
24-Jan-06	794	Frontal M7.0 Chaffee	7.00	Chaffee	CEUS Event	0h1m	3, 0, 0, 0	17.51	0.74
24-Jan-06	802	Frontal M7.0 Clear Cr	7.00	Cl Creek	CEUS Event	0h1m	5, 1, 1, 0	38.02	2.33
25-Jan-06	821	Frontal M7.0 Denver	7.00	Denver	CEUS Event	0h6m	681, 128, 15, 30	1,479.89	3.79
25-Jan-06	836	Frontal M7.0 Douglas	7.00	Douglas	CEUS Event	0h3m	30, 4, 1, 1	113.62	0.83
25-Jan-06	841	Frontal M7.0 Eagle	7.00	Eagle	CEUS Event	0h1m	285, 81, 13, 26	571.47	11.40
26-Jan-06	862	Frontal M7.0 Garfield	7.00	Garfield	CEUS Event	0h2m	8, 1, 0, 0	35.28	0.75
26-Jan-06	865	Frontal M7.0 Gilpin	7.00	Gilpin	CEUS Event	0h1m	2, 0, 0, 0	10.82	1.49
26-Jan-06	868	Frontal M7.0 Grand	7.00	Grand	CEUS Event	0h2m	27, 6, 2, 2	157.11	5.02
26-Jan-06	888	Frontal M7.0 Jackson	7.00	Jackson	CEUS Event	0h1m	0, 0, 0, 0	2.98	0.31
26-Jan-06	892	Frontal M7.0 Jefferson	7.00	Jefferson	CEUS Event	0h5m	143, 24, 4, 5	460.39	1.28
27-Jan-06	910	Frontal M7.0 Lake	7.00	Lake	CEUS Event	0h1m	18, 4, 1, 1	69.45	6.32
30-Jan-06	933	Frontal M7.0 Moffat	7.00	Moffat	CEUS Event	0h2m	1, 0, 0, 0	5.11	0.18
31-Jan-06	947	Frontal M7.0 Park	7.00	Park	CEUS Event	0h1m	15, 3, 0, 1	75.85	2.70
31-Jan-06	959	Frontal M7.0 Pitkin	7.00	Pitkin	CEUS Event	0h1m	5, 1, 0, 0	32.48	1.46
31-Jan-06	970	Frontal M7.0 Rio Blanco	7.00	Rio Blanco	CEUS Event	0h1m	2, 0, 0, 0	6.69	0.43
1-Feb-06	975	Frontal M7.0 Routt	7.00	Routt	CEUS Event	0h2m	17, 3, 1, 1	55.99	1.80
1-Feb-06	991	Frontal M7.0 Summit	7.00	Summit	CEUS Event	0h1m	395, 120, 29, 39	1,345.36	32.15

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage	Loss Ratio (%)
28-Jun-05	717	Golden M6.5 Jefferson	6.50	Jefferson County	CEUS Event	0h5m	2067, 563, 127, 174	5,881.32	16.42
28-Jun-05	718	Golden M6.5 Boulder	6.50	Boulder County	CEUS Event	0h4m	418, 90, 24, 24	1,489.54	7.18
28-Jun-05	719	Golden M6.5 Denver	6.50	Denver County	CEUS Event	0h6m	4786, 1330, 213, 416	7,510.48	19.24
28-Jun-05	720	Golden M6.5 Adams	6.50	Adams County	CEUS Event	0h5m	738, 179, 38, 51	1,589.25	7.56
28-Jun-05	721	Golden M6.5 Arapahoe	6.50	Arapahoe County	CEUS Event	0h4m	2241, 604, 117, 185	3,900.99	12.10
12-Jul-05	760	Golden M6.5 State	6.50	State	CEUS Event	1h16m	10627, 2827, 529, 862	21,890.05	6.08
24-Jan-06	803	Golden M6.5 Clear Cr	6.50	Clear Creek	CEUS Event	0h1m	4, 1, 0, 0	42.88	2.63
25-Jan-06	837	Golden M6.5 Douglas	6.50	Douglas County	CEUS Event	0h3m	155, 28, 5, 7	577.72	4.22
26-Jan-06	854	Golden M6.5 Elbert	6.50	Elbert County	CEUS Event	0h1m	2, 0, 0, 0	15.62	0.64
26-Jan-06	866	Golden M6.5 Gilpin	6.50	Gilpin County	CEUS Event	0h1m	4, 1, 0, 0	40.11	5.53
26-Jan-06	893	Golden M5.5 Jefferson	5.50	Jefferson County	CEUS Event	0h5m	113, 17, 2, 3	1,025.06	2.86
30-Jan-06	918	Golden M6.5 Larimer	6.50	Larimer County	CEUS Event	0h5m	92, 15, 1, 3	236.73	1.25
31-Jan-06	948	Golden M6.5 Park	6.50	Park County	CEUS Event	0h1m	2, 0, 0, 0	13.01	0.46
1-Feb-06	992	Golden M6.5 Summit	6.50	Summit County	CEUS Event	0h1m	4, 1, 0, 0	27.05	0.65
1-Feb-06	1002	Golden M6.5 Weld	6.50	Weld County	CEUS Event	0h5m	89, 15, 3, 3	298.85	2.09

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($M)	Loss Ratio (%)
12-Jul-05	761	Goodpasture M6.0 State	6.0	State	CEUS Event	1h14m	100, 13, 1, 2	478.59	0.13
25-Jan-06	814	Goodpasture M6.0 Custer	6.0	Custer	CEUS Event	0h1m	1, 0, 0, 0	6.22	0.71
25-Jan-06	847	Goodpasture M6.0 El Paso	6.0	El Paso	CEUS Event	0h5m	30, 3, 0, 0	102.64	0.32
26-Jan-06	857	Goodpasture M6.0 Fremont	6.0	Fremont	CEUS Event	0h3m	6, 1, 0, 0	56.07	1.49
26-Jan-06	885	Goodpasture M6.0 Huerfano	6.0	Huerfano	CEUS Event	0h2m	0, 0, 0, 0	10.07	0.52
31-Jan-06	966	Goodpasture M6.0 Pueblo	6.0	Pueblo	CEUS Event	0h5m	42, 7, 1, 1	242.57	2.30

Mosquito

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage (Mil)	Loss Ratio (%)
12-Jul-05	762	Mosquito M7.0 State	7.00	State	CEUS Event	1h16m	2207, 442, 72, 110	6,189.80	1.72
24-Jan-06	787	Mosquito M7.0 Boulder	7.00	Boulder	CEUS Event	0h4m	70, 10, 2, 2	251.96	1.22
24-Jan-06	795	Mosquito M7.0 Chaffee	7.00	Chaffee	CEUS Event	0h1m	12, 2, 0, 0	65.82	2.80
24-Jan-06	804	Mosquito M7.0 Cl Creek	7.00	Cl Creek	CEUS Event	0h1m	4, 1, 1, 0	31.83	1.95
25-Jan-06	822	Mosquito M7.0 Denver	7.00	Denver	CEUS Event	0h6m	604, 110, 13, 25	1,318.61	3.38
25-Jan-06	838	Mosquito M7.0 Douglas	7.00	Douglas	CEUS Event	0h3m	30, 4, 1, 1	110.96	0.81
25-Jan-06	842	Mosquito M7.0 Eagle	7.00	Eagle	CEUS Event	0h1m	191, 50, 8, 15	416.76	8.31
26-Jan-06	863	Mosquito M7.0 Garfield	7.00	Garfield	CEUS Event	0h2m	8, 1, 0, 0	35.25	0.74
26-Jan-06	869	Mosquito M7.0 Grand	7.00	Grand	CEUS Event	0h2m	5, 1, 0, 0	47.21	1.51
26-Jan-06	875	Mosquito M7.0 Gunnison	7.00	Gunnison	CEUS Event	0h1m	10, 2, 0, 0,	32.43	1.21
26-Jan-06	894	Mosquito M7.0 Jefferson	7.00	Jefferson	CEUS Event	0h5m	124, 20, 3, 4	401.79	1.12
27-Jan-06	911	Mosquito M7.0 Lake	7.00	Lake	CEUS Event	0h1m	118, 33, 11, 10	298.86	27.20
31-Jan-06	949	Mosquito M7.0 Park	7.00	Park	CEUS Event	0h1m	42, 10, 2, 3	169.29	6.03
31-Jan-06	960	Mosquito M7.0 Pitkin	7.00	Pitkin	CEUS Event	0h1m	12, 2, 0, 0	61.43	2.76
1-Feb-06	976	Mosquito M7.0 Routt	7.00	Routt	CEUS Event	0h2m	7, 1, 0, 0	23.17	0.74
1-Feb-06	993	Mosquito M7.0 Summit	7.00	Summit	CEUS Event	0h1m	272, 79, 17, 25	1,056.71	25.26

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Damage (Millions)	Loss Ratio (%)
28-Jun-05	713	Rampart M7 El Paso	7.0	El Paso County	CEUS Event	0h5m	5498, 1668, 403, 545	9,013.76	27.67
28-Jun-05	714	Rampart M7 Douglas	7.0	Douglas County	CEUS Event	0h3m	797, 263, 151, 79	1,848.03	13.49
28-Jun-05	715	Rampart M7 Denver	7.0	Denver County	CEUS Event	0h6m	2704, 686, 104, 203	4,652.06	11.92
28-Jun-05	716	Rampart M7 Arapahoe	7.0	Arapahoe County	CEUS Event	0h5m	2292, 610, 121, 186	3,835.78	11.90
12-Jul-05	763	Rampart M7 State	7.0	State	CEUS Event	1h15m	12557, 3440, 835, 1066	23,046.35	6.40
24-Jan-06	778	Rampart M7 Adams	7.0	Adams County	CEUS Event	0h5m	419, 95, 17, 26	773.82	3.68
25-Jan-06	848	Rampart M6 El Paso	6.0	El Paso County	CEUS Event	0h5m	445, 82, 12, 20	1,669.57	5.13
26-Jan-06	855	Rampart M7 Elbert	7.0	Elbert County	CEUS Event	0h1m	27, 9, 9, 3	98.88	4.07
26-Jan-06	858	Rampart M7 Fremont	7.0	Fremont County	CEUS Event	0h3m	33, 6, 1, 2	127.02	3.38
26-Jan-06	895	Rampart M7 Jefferson	7.0	Jefferson County	CEUS Event	0h5m	437, 94, 19, 25	1,297.64	3.62
31-Jan-06	950	Rampart M7 Park	7.0	Park County	CEUS Event	0h1m	5, 1, 0, 0	25.94	0.92
31-Jan-06	967	Rampart M7 Pueblo	7.0	Pueblo County	CEUS Event	0h4m	68, 13, 1, 3	202.87	1.93
1-Feb-06	998	Rampart M7 Teller	7.0	Teller County	CEUS Event	0h1m	60, 15, 3, 4	260.05	13.32

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($ Mil)	Loss Ratio %
28-Jun-05	722	RMA M6.25 Adams CEUS Event	6.25	Adams County	CEUS Event	0h5m	1552, 425, 104, 130	3,148.06	14.97
28-Jun-05	723	RMA M6.25 Denver CEUS Event	6.25	Denver County	CEUS Event	0h6m	3249, 861, 157, 262	5,557.58	14.24
28-Jun-05	724	RMA M6.25 Arapahoe CEUS Event	6.25	Arapahoe County	CEUS Event	0h4m	1118, 266, 44, 74	2,626.60	8.15
15-Jul-05	765	RMA M6.25 State	6.25	State	CEUS Event	1h15m	6821, 1732, 338, 511	14,867.04	4.13
18-Jul-05	773	RMA M6.0 State	6.00	State	CEUS Event	1h15m	3861, 888, 157, 244	10,179.43	2.83
19-Jul-05	776	RMA M6.0 Denver	6.00	Denver County	CEUS Event	0h6m	1858, 445, 75, 126	3,887.85	1.08
24-Jan-06	792	RMA M6.25 Boulder	6.25	Boulder County	CEUS Event	0h4m	247, 47, 10, 11	1,099.49	5.30
25-Jan-06	823	RMA M5.5 Denver	5.50	Denver County	CEUS Event	0h6m	311, 51, 5, 10	1,412.63	3.62
25-Jan-06	824	RMA M5.0 Denver	5.00	Denver County	CEUS Event	0h6m	54, 6, 0, 1	543.70	1.39
26-Jan-06	896	RMA M6.25 Jefferson	6.25	Jefferson County	CEUS Event	0h5m	394, 86, 16, 23	1,416.08	3.95
31-Jan-06	940	RMA M6.25 Morgan	6.25	Morgan County	CEUS Event	0h2m	4, 0, 0, 0	21.84	0.40
1-Feb-06	1003	RMA M6.25 Weld	6.25	Weld County	CEUS Event	0h5m	153, 29, 6, 7	501.92	3.51
17-Mar-06	1077	RMA M6.25 Logan	6.25	Logan County	CEUS Event	0h2m	1, 0, 0, 0	2.12	0.00
17-Mar-06	1078	RMA M6.25 Phillips	6.25	Phillips County	CEUS Event	0h1m	0, 0, 0, 0	0.00	0.00
17-Mar-06	1079	RMA M6.25 Sedgwick	6.25	Sedgwick Co	CEUS Event	0h1m	0, 0, 0, 0	0.00	0.00
17-Mar-06	1080	RMA M6.25 Washington	6.25	Washington Co	CEUS Event	0h1m	0, 0, 0, 0	1.09	0.00
17-Mar-06	1081	RMA M6.25 Yuma	6.25	Yuma County	CEUS Event	0h1m	0, 0, 0, 0	0.37	0.00

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage (%M)	Loss Ratio (%)
15-Jul-05	766	Roubideau M5.5 State	5.50	State	CEUS Event	1h13m	9, 1, 0, 0	94.23	0.00
25-Jan-06	818	Roubideau M5.5 Delta	5.50	Delta County	CEUS Event	0h2m	0, 0, 0, 0	5.93	0.21
26-Jan-06	876	Roubideau M5.5 Gunnison	5.50	Gunnison	CEUS Event	0h1m	0, 0, 0, 0	0.54	0.00
30-Jan-06	929	Roubideau M5.5 Mesa	5.50	Mesa	CEUS Event	0h3m	1, 0, 0, 0	4.71	0.00
31-Jan-06	938	Roubideau M5.5 Montrose	5.50	Montrose	CEUS Event	0h2m	7, 1, 0, 0	78.24	2.07
31-Jan-06	945	Roubideau M5.5 Ouray	5.50	Ouray	CEUS Event	0h1m	0, 0, 0, 0	2.80	0.36
1-Feb-06	988	Roubideau M5.5 San Miguel	5.50	San Miguel	CEUS Event	0h1m	0, 0, 0, 0	0.81	0.00

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Damage ($ Mil)	Loss Ratio (%)	CEUS-WUS Mean ($M)
30-Jun-05	745	N Sangre M7.5 Saguache	7.5	Saguache County	WUS Shallow - Ext.	0h1m	9, 2, 0, 0	25.23	1.66	
30-Jun-05	746	N Sangre M7.5 Alamosa	7.5	Alamosa County	WUS Shallow - Ext.	0h2m	54, 13, 2, 4	142.06	7.72	
30-Jun-05	748	N Sangre M7.5 Chaffee WUS	7.5	Chaffee County	WUS Shallow - Ext.	0h1m	95, 28, 5, 9	133.36	5.67	Chaffee County:
30-Jun-05	749	N Sangre M7.5 Chaffee CEUS	7.5	Chaffee County	CEUS Event	0h1m	287, 90, 15, 29	425.76	18.09	279.56
15-Jul-05	765	N Sangre M7.5 State WUS	7.5	State	WUS Shallow - Ext.	4h28m	306, 65, 12, 17	767.07	0.21	State:
18-Jul-05	772	N Sangre M7.5 State CEUS	7.5	State	CEUS Event	1h15m	4615, 1147, 186, 335	8,020.95	2.23	4394.01
25-Jan-06	808	N Sangre M7.5 Conejos CEUS	7.5	Conejos County	CEUS Event	0h1m	48, 11, 1, 3	56.31	4.84	Conejos County:
25-Jan-06	809	N Sangre M7.5 Conejos WUS	7.5	Conejos County	WUS - Ext.	0h1m	9, 2, 0, 0	9.88	0.85	33.1
25-Jan-06	810	N Sangre M7.5 Costilla CEUS	7.5	Costilla County	CEUS Event	0h1m	57, 15, 2, 4	85.15	8.40	Costilla County:
25-Jan-06	811	N Sangre M7.5 Costilla WUS	7.5	Costilla County	WUS - Ext.	0h1m	37, 10, 1, 2	51.60	5.10	68.38
25-Jan-06	812	N Sangre M7.5 Alamosa CEUS	7.5	Alamosa County	CEUS Event	0h2m	193, 55, 9, 18	433.09	23.54	Alamosa: 287.58
25-Jan-06	815	N Sangre M7.5 Custer WUS Ext	7.5	Custer County	WUS - Ext.	0h1m	9, 2, 1, 1	28.50	3.25	
25-Jan-06	816	N Sangre M7.5 Custer WUS Sh	7.5	Custer County	WUS Shallow - Ext.	0h1m	9, 2, 1, 1	28.50	3.25	
25-Jan-06	825	N Sangre M7.5 Denver CEUS	7.5	Denver County	CEUS Event	0h6m	895, 188, 25, 48	1,474.46	3.78	Denver County:
25-Jan-06	826	N Sangre M7.5 Denver WUS	7.5	Denver County	WUS - Ext.	0h6m	30, 3, 0, 0	69.87	0.18	772.17
25-Jan-06	849	N Sangre M7.5 El Paso CEUS	7.5	El Paso County	CEUS Event	0h5m	1459, 400, 78, 125	2,115.97	6.50	El Paso County:
25-Jan-06	850	N Sangre M7.5 El Paso WUS	7.5	El Paso County	WUS - Ext.	0h5m	33, 5, 2, 1	90.76	0.28	1103.37
26-Jan-06	859	N Sangre M7.5 Fremont CEUS	7.5	Fremont County	CEUS Event	0h3m	204, 60, 13, 19	393.64	10.47	Fremont County:
26-Jan-06	860	N Sangre M7.5 Fremont WUS	7.5	Fremont County	WUS - Ext.	0h3m	42, 11, 2, 3	89.58	2.38	241.61
26-Jan-06	877	N Sangre M7.5 Gunnison CEUS	7.5	Gunnison Co	CEUS Event	0h1m	50, 13, 2, 4	100.28	3.74	Gunnison County:
26-Jan-06	878	N Sangre M7.5 Gunnison WUS	7.5	Gunnison Co	WUS - Ext.	0h1m	1, 0, 0, 0	4.17	0.16	52.23
26-Jan-06	886	N Sangre M7.5 Huerfano CEUS	7.5	Huerfano Co	CEUS Event	0h2m	14, 3, 1, 1	83.97	4.33	Huerfano County:
26-Jan-06	887	N Sangre M7.5 Huerfano WUS	7.5	Huerfano Co	WUS - Ext.	0h2m	2, 0, 0, 0	18.96	0.98	51.47
26-Jan-06	897	N Sangre M7.5 Jefferson CEUS	7.5	Jefferson Co	CEUS Event	0h5m	125, 23, 3, 5	285.25	0.80	Jefferson County:
26-Jan-06	898	N Sangre M7.5 Jefferson WUS	7.5	Jefferson Co	WUS - Ext.	0h5m	6, 1, 0, 0	15.55	0.00	150.4
27-Jan-06	915	N Sangre M7.5 Archuleta CEUS	7.5	Archuleta Co	CEUS Event	0h2m	10, 2, 1, 1	28.10	1.44	Archuleta County:
27-Jan-06	916	N Sangre M7.5 Archuleta WUS	7.5	Archuleta Co	WUS - Ext.	0h2m	0, 0, 0, 0	1.04	0.00	14.57
27-Jan-06	917	N Sangre M7.5 Custer CEUS	7.5	Custer County	CEUS Event	0h1m	42, 13, 2, 4	138.38	15.77	
30-Jan-06	923	N Sangre M7.5 Las Animas CEUS	7.5	Las Animas Co	CEUS Event	0h2m	8, 1, 0, 0	31.63	0.85	Las Animas County:
30-Jan-06	924	N Sangre M7.5 Las Animas WUS	7.5	Las Animas Co	WUS - Ext.	0h2m	1, 0, 0, 0	3.40	0.00	17.52
30-Jan-06	932	N Sangre M7.5 Mineral CEUS	7.5	Mineral Co	CEUS Event	0h1m	1, 0, 0, 0	9.52	1.43	
31-Jan-06	951	N Sangre M7.5 Park WUS	7.5	Park County	WUS Shallow - Ext.	0h1m	1, 0, 0, 0	4.17	0.15	
31-Jan-06	968	N Sangre M7.5 Pueblo CEUS	7.5	Pueblo County	CEUS Event	0h4m	321, 85, 13, 26	483.70	4.59	Pueblo County:
31-Jan-06	969	N Sangre M7.5 Pueblo WUS	7.5	Pueblo County	WUS - Ext.	0h4m	9, 1, 0, 0	25.57	0.24	254.64
31-Jan-06	972	N Sangre M7.5 Rio Grande CEUS	7.5	Rio Grande Co	CEUS Event	0h2m	78, 21, 4, 7	124.26	7.00	Rio Grande County:
31-Jan-06	973	N Sangre M7.5 Rio Grande WUS	7.5	Rio Grande Co	WUS - Ext.	0h2m	8, 1, 0, 0	16.28	0.91	70.27
1-Feb-06	980	N Sangre M7.5 Saguache CEUS	7.5	Saguache County	CEUS Event	0h1m	66, 17, 2, 4	104.00	6.86	
1-Feb-06	981	N Crestone M7.28 Saguache WUS	7.3	Saguache County	WUS Shallow - Ext.	0h1m	4, 1, 0, 0	21.19	1.40	
1-Feb-06	999	N Sangre M7.5 Teller WUS	7.5	Teller County	WUS - Ext.	0h1m	1, 0, 0, 0	2.44	0.13	

N Sawatch

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage (Mil)	Loss Ratio (%)
15-Jul-05	767	N Sawatch M7.0 State	7.0	State	CEUS Event	1h15m	1211, 215, 35, 47	3,617.52	1.01
24-Jan-06	796	N Sawatch M7.0 Chaffee	7.0	Chaffee	CEUS Event	0h1m	34, 7, 1, 2	152.75	6.49
24-Jan-06	805	N Sawatch M7.0 Clear Creek	7.0	Cl Creek	CEUS Event	0h1m	1, 0, 0, 0	8.96	5.49
25-Jan-06	827	N Sawatch M7.0 Denver	7.0	Denver	CEUS Event	0h6m	269, 41, 4, 7	651.85	1.67
25-Jan-06	839	N Sawatch M7.0 Douglas	7.0	Douglas	CEUS Event	0h3m	18, 2, 0, 0	64.11	0.47
25-Jan-06	843	N Sawatch M7.0 Eagle	7.0	Eagle	CEUS Event	0h1m	148, 34, 5, 9	386.86	7.71
26-Jan-06	864	N Sawatch M7.0 Garfield	7.0	Garfield	CEUS Event	0h2m	18, 3, 0, 1	76.57	1.62
26-Jan-06	870	N Sawatch M7.0 Grand	7.0	Grand	CEUS Event	0h2m	3, 0, 0, 0	24.12	0.77
26-Jan-06	879	N Sawatch M7.0 Gunnison	7.0	Gunnison	CEUS Event	0h1m	15, 3, 0, 1	46.15	1.72
26-Jan-06	899	N Sawatch M7.0 Jefferson	7.0	Jefferson	CEUS Event	0h5m	64, 9, 1, 1	205.49	0.57
27-Jan-06	912	N Sawatch M7.0 Lake	7.0	Lake	CEUS Event	0h1m	112, 33, 12, 10	302.50	27.53
31-Jan-06	952	N Sawatch M7.0 Park	7.0	Park	CEUS Event	0h1m	13, 3, 0, 1	66.92	2.38
31-Jan-06	961	N Sawatch M7.0 Pitkin	7.0	Pitkin	CEUS Event	0h1m	42, 10, 1, 3	168.78	7.59
1-Feb-06	994	N Sawatch M7.0 Summit	7.0	Summit	CEUS Event	0h1m	54, 13, 2, 3	217.41	5.20

S Sawatch

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Damage (Mil)	Loss Ratio (%)
15-Jul-05	768	S Sawatch M7.25 State	7.25	State	CEUS Event	1h16m	1764, 340, 56, 81	4742.32	1.32
24-Jan-06	797	S Sawatch M7.25 Chaffee CEUS	7.25	Chaffee	CEUS Event	0h1m	271, 82, 13, 26	665.16	28.26
24-Jan-06	798	S Sawatch M7.25 Chaffee WUS	7.25	Chaffee	WUS Shallow Ext	0h1m	223, 67, 11, 21	425.99	18.10
25-Jan-06	828	S Sawatch M7.25 Denver	7.25	Denver	CEUS Event	0h9m	384, 63, 6, 12	866.07	2.22
25-Jan-06	844	S Sawatch M7.25 Eagle	7.25	Eagle	CEUS Event	0h1m	48, 9, 1, 2	145.56	2.90
25-Jan-06	851	S Sawatch M7.25 El Paso	7.25	El Paso	CEUS Event	0h5m	267, 50, 10, 11	658.81	2.02
26-Jan-06	861	S Sawatch M7.25 Fremont	7.25	Fremont	CEUS Event	0h3m	31, 6, 1, 2	120.48	3.21
26-Jan-06	880	S Sawatch M7.25 Gunnison	7.25	Gunnison	CEUS Event	0h1m	33, 7, 1, 2	88.33	3.29
26-Jan-06	900	S Sawatch M7.25 Jefferson	7.25	Jefferson	CEUS Event	0h5m	81, 12, 2, 2	253.29	0.71
27-Jan-06	913	S Sawatch M7.25 Lake	7.25	Lake	CEUS Event	0h1m	64, 20, 8, 6	182.95	16.65
31-Jan-06	953	S Sawatch M7.25 Park	7.25	Park	CEUS Event	0h1m	14, 3, 0, 1	72.20	2.57
31-Jan-06	962	S Sawatch M7.25 Pitkin	7.25	Pitkin	CEUS Event	0h1m	31, 7, 1, 2	114.85	5.16
1-Feb-06	982	S Sawatch M7.25 Saguache WUS	7.25	Saguache	WUS Shallow Ext	0h1m	2, 0, 0, 0	7.30	0.48
1-Feb-06	983	S Sawatch M7.25 Saguache CEUS	7.25	Saguache	CEUS Event	0h1m	10, 2, 0, 0	28.57	1.88
1-Feb-06	995	S Sawatch M7.25 Summit	7.25	Summit	CEUS Event	0h1m	33, 7, 1, 2	140.74	3.36
1-Feb-06	1000	S Sawatch M7.25 Teller	7.25	Teller	CEUS Event	0h1m	4, 1, 0, 0	17.96	0.92

Ute Pass

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Damage ($Mil)	Loss Ratio (%)
30-Jun-05	727	Ute Pass M7.0 El Paso	7.0	El Paso County	CEUS Event	0h5m	4889, 1468, 390, 477	8,216.92	25.23
30-Jun-05	728	Ute Pass M7.0 Douglas	7.0	Douglas County	CEUS Event	0h4m	211, 54, 29, 15	652.44	4.76
30-Jun-05	729	Ute Pass M7.0 Teller	7.0	Teller County	CEUS Event	0h1m	155, 44, 11, 14	523.85	26.83
30-Jun-05	730	Ute Pass M7.0 Denver	7.0	Denver County	CEUS Event	0h6m	1394, 310, 43, 84	2,749.25	7.04
30-Jun-05	731	Ute Pass M7.0 Pueblo	7.0	Pueblo County	CEUS Event	0h4m	105, 21, 3, 5	288.21	2.74
30-Jun-05	732	Ute Pass M7.0 Fremont	7.0	Fremont County	CEUS Event	0h2m	56, 12, 2, 3	183.77	4.89
30-Jun-05	733	Ute Pass M7.0 Elbert	7.0	Elbert County	CEUS Event	0h1m	9, 3, 4, 1	44.25	1.82
30-Jun-05	734	Ute Pass M7.0 Arapahoe	7.0	Arapahoe County	CEUS Event	0h5m	1046, 242, 43, 67	2,106.05	6.53
30-Jun-05	735	Ute Pass M7.0 Jefferson	7.0	Jefferson County	CEUS Event	0h5m	240, 45, 9, 11	769.60	2.15
30-Jun-05	736	Ute Pass M7.0 Adams	7.0	Adams County	CEUS Event	0h5m	246, 50, 8, 12	495.75	2.36
18-Jul-05	769	Ute Pass M7.0 State	7.0	State	CEUS Event	1h15m	8542, 2266, 545, 690	16,774.21	4.66
24-Jan-06	788	Ute Pass M7.0 Boulder	7.0	Boulder County	CEUS Event	0h4m	70, 10, 2, 2	245.00	1.18
24-Jan-06	806	Ute Pass M7.0 Cl Creek	7.0	Clear Creek Co	CEUS Event	0h1m	2, 0, 0, 0	10.57	0.65
25-Jan-06	852	Ute Pass M6.0 El Paso	6.0	El Paso County	CEUS Event	0h5m	522, 108, 15, 27	1,908.61	5.86
31-Jan-06	954	Ute Pass M6.0 Park	7.0	Park County	CEUS Event	0h1m	6, 1, 0, 0	34.50	1.23
1-Feb-06	996	Ute Pass M6.0 Summit	7.0	Summit County	CEUS Event	0h1m	8, 1, 0, 0	42.72	1.02

Valmont

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($Mil)	Loss Ratio (%)
18-Jul-05	770	Valmont M5.0 State	5.0	State	CEUS Event	1h15m	40, 4, 0, 0	711.46	0.20
24-Jan-06	779	Valmont M5.0 Adams	5.0	Adams	CEUS Event	0h5m	4, 0, 0, 0	64.14	0.31
24-Jan-06	789	Valmont M5.0 Boulder	5.0	Boulder	CEUS Event	0h4m	14, 2, 0, 0	410.72	1.98
25-Jan-06	829	Valmont M5.0 Denver	5.0	Denver	CEUS Event	0h6m	12, 1, 0, 0	98.40	0.25
26-Jan-06	901	Valmont M5.0 Jefferson	5.0	Jefferson	CEUS Event	0h5m	3, 0, 0, 0	50.44	0.14
30-Jan-06	919	Valmont M5.0 Larimer	5.0	Larimer	CEUS Event	0h4m	1, 0, 0, 0	11.43	0.00
1-Feb-06	1004	Valmont M5.0 Weld	5.0	Weld	CEUS Event	0h5m	1, 0, 0, 0	40.15	0.28

Walnut Creek

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($Mil)	Loss Ratio (%)
30-Jun-05	737	Walnut Creek M6.0 Jefferson	6.0	Jefferson County	CEUS Event	0h5m	631, 151, 33, 43	2,307.28	6.44
30-Jun-05	738	Walnut Creek M6.0 Boulder	6.0	Boulder County	CEUS Event	0h4m	225, 43, 10, 10	1,211.73	5.84
30-Jun-05	739	Walnut Creek M6.0 Denver	6.0	Denver County	CEUS Event	0h6m	1291, 282, 38, 75	3,152.92	8.08
30-Jun-05	740	Walnut Creek M6.0 Adams	6.0	Adams County	CEUS Event	0h5m	377, 78, 13, 20	1,276.87	6.07
30-Jun-05	741	Walnut Creek M6.0 Arapahoe	6.0	Arapahoe County	CEUS Event	0h4m	387, 73, 9, 17	1,245.01	3.86
18-Jul-05	771	Walnut Creek M6.5 State	6.5	State	CEUS Event	1h15m	10737, 2840, 559, 862	22,410.30	6.23
1-Feb-06	1005	Walnut Creek M6.5 Weld	6.0	Weld County	CEUS Event	0h5m	47, 7, 1, 1	212.07	1.48
2-Feb-06	1007	Walnut Creek M6.0 State	6.0	State	CEUS Event	4h46m	3020, 642, 101, 166	9,704.00	2.70

Date Run	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage ($M)	Loss Ratio (%)
30-Jun-05	742	Williams Fork M6.75 Grand	6.75	Grand County	CEUS Event	0h2m	35, 8, 2, 2	184.15	5.88
30-Jun-05	743	Williams Fork M6.75 Summit	6.75	Summit County	CEUS Event	0h1m	109, 30, 8, 9	436.15	10.42
30-Jun-05	744	Williams Fork M6.75 Eagle	6.75	Eagle County	CEUS Event	0h2m	74, 17, 2, 5	206.95	4.13
18-Jul-05	773	Williams Fork M6.75 State	6.75	State	CEUS Event	1h15m	1129, 192, 26, 41	3,482.99	0.97
24-Jan-06	790	Williams Fork M6.75 Boulder	6.75	Boulder	CEUS Event	0h4m	58, 8, 1, 1	232.76	1.12
24-Jan-06	807	Williams Fork M6.75 Cl Creek	6.75	Clear Creek	CEUS Event	0h1m	4, 1, 1, 0	31.93	1.96
25-Jan-06	830	Williams Fork M6.75 Denver	6.75	Denver	CEUS Event	0h6m	339, 53, 5, 10	849.99	2.18
26-Jan-06	867	Williams Fork M6.75 Gilpin	6.75	Gilpin	CEUS Event	0h1m	1, 0, 0, 0	9.96	1.37
26-Jan-06	889	Williams Fork M6.75 Jackson	6.75	Jackson	CEUS Event	0h1m	0, 0, 0, 0	2.25	0.24
26-Jan-06	902	Williams Fork M6.75 Jefferson	6.75	Jefferson	CEUS Event	0h5m	78, 11, 1, 2	273.83	0.76
27-Jan-06	914	Williams Fork M6.75 Lake	6.75	Lake	CEUS Event	0h1m	3, 0, 0, 0	17.20	1.57
30-Jan-06	920	Williams Fork M6.75 Larimer	6.75	Larimer	CEUS Event	0h4m	69, 10, 1, 2	177.66	0.94
31-Jan-06	955	Williams Fork M6.75 Park	6.75	Park	CEUS Event	0h1m	3, 0, 0, 0	18.52	0.66
31-Jan-06	963	Williams Fork M6.75 Pitkin	6.75	Pitkin	CEUS Event	0h1m	2, 0, 0, 0	13.21	0.59
1-Feb-06	977	Williams Fork M6.75 Routt	6.75	Routt	CEUS Event	0h2m	11, 2, 0, 0	40.36	1.30

1882 EQ

Run Date	#	Scenario Name	Mag.	Region	Q Function	RunTime	Casualties	Total Damage	Loss Ratio (%)
21-Jun-05	710	1882 M6.6 State RMNP epicenter	6.6	State	CEUS Event	1h20m	865, 146, 16, 31	2,761.30	0.77
21-Jun-05	711	1882 M6.0 State RMNP epicenter	6.0	State	CEUS Event	4h22m	243, 35, 3, 6	950.43	0.26
28-Jun-05	725	1882 M7.2 State RMNP epicenter	7.2	State	CEUS Event	4h41m	3981, 898, 149, 246	8,976.99	2.49
29-Jun-05	726	1882 M7.2 State Piceance epicenter	7.2	State	CEUS Event	overnight	112, 23, 9, 6	464.05	0.13
30-Jun-05	750	1882 M7.2 State Npark epicenter	7.2	State	CEUS Event	4h41m	796, 130, 16, 26	2,166.66	0.60
8-Jul-05	751	1882 M6.0 State Npark epicenter	6.0	State	CEUS Event	4h19m	48, 5, 0, 1	148.45	0.00
12-Jul-05	757	1882 M6.0 State Piceance epicenter	6.0	State	CEUS Event	4h46m	5, 1, 0, 0	42.20	0.00
19-Jul-05	775	1882 M6.6 State Piceance epicenter	6.6	State	CEUS Event	1h13m	21, 3, 1, 1	120.00	0.00
19-Jul-05	777	1882 M6.6 State Npark epicenter	6.6	State	CEUS Event	1h15m	181, 24, 2, 3	553.20	0.15
24-Jan-06	780	1882 M6.6 RMNP Adams	6.6	Adams	CEUS Event	0h5m	53, 7, 1, 1	149.77	0.71
24-Jan-06	791	1882 M6.6 RMNP Boulder	6.6	Boulder	CEUS Event	0h4m	76, 11, 2, 2	328.24	1.58
25-Jan-06	831	1882 M6.6 RMNP Denver	6.6	Denver	CEUS Event	0h6m	200, 28, 2, 5	527.25	1.35
26-Jan-06	871	1882 M6.6 RMNP Grand	6.6	Grand	CEUS Event	0h2m	9, 2, 0, 0	110.19	3.52
26-Jan-06	890	1882 M6.6 RMNP Jackson	6.6	Jackson	CEUS Event	0h1m	0, 0, 0, 0	3.66	0.39
30-Jan-06	921	1882 M6.6 RMNP Larimer	6.6	Larimer	CEUS Event	0h4m	297, 66, 9, 18	887.27	4.70
1-Feb-06	978	1882 M6.6 RMNP Routt	6.6	Routt	CEUS Event	0h2m	4, 1, 0, 0	16.48	0.53
15-May-06		1882 M6.6 State Npark 30km Depth	6.6	State	CEUS Event	4h20m	164, 20, 1, 3	470.35	0.13
19-May-06		1882 M7.2 State Npark 30km Depth	7.2	State	CEUS Event	4h24m	725, 113, 13, 21	1,948.92	0.54

Random EQ

Run Date	#	Scenario Name	Mag.	Q Function	Casualties	Total Damage ($M)	Loss Ratio (%)	Inventory ($M)
7-Feb-06	1008	Adams County Random EQ	6.5	CEUS Event	343, 75, 16, 20	853.52	4.06	21,025.00
7-Feb-06	1009	Alamosa County Random EQ WUS	6.5	WUS - Ext.	50, 11, 2, 3	152.22	8.28	1,839.50
7-Feb-06	1010	Alamosa County Random EQ CEUS	6.5	CEUS Event	101, 24, 4, 6	327.84	17.82	1,839.50
7-Feb-06	1011	Arapahoe County Random EQ	6.5	CEUS Event	978, 224, 47, 61	2,350.41	7.29	32,232.30
7-Feb-06	1012	Archuleta County Random EQ	6.5	CEUS Event	45, 11, 2, 3	341.25	17.51	1,948.70
7-Feb-06	1013	Baca County Random EQ	6.5	CEUS Event	26, 6, 1, 1	119.80	6.54	1,831.70
7-Feb-06	1014	Bent County Random EQ	6.5	CEUS Event	23, 5, 1, 1	72.32	6.69	1,081.00
7-Feb-06	1015	Boulder County Random EQ	6.5	CEUS Event	1143, 298, 84, 89	3,282.58	15.83	20,737.40
7-Feb-06	1016	Chaffee County Random EQ	6.5	CEUS Event	55, 12, 2, 3	288.32	12.25	2,354.10
7-Feb-06	1017	Cheyenne County Random EQ	6.5	CEUS Event	9, 2, 0, 0	51.12	3.52	1,450.80
7-Feb-06	1018	Clear Creek County Random EQ	6.5	CEUS Event	23, 6, 3, 2	175.44	10.74	1,632.90
7-Feb-06	1019	Conejos County Random EQ WUS	6.5	WUS - Ext.	8, 1, 0, 0	26.37	2.27	1,162.40
7-Feb-06	1020	Conejos County Random EQ CEUS	6.5	CEUS Event	28, 6, 1, 1	76.42	6.57	1,162.40
7-Feb-06	1021	Costilla County Random EQ WUS	6.5	WUS - Ext.	9, 2, 0, 0	20.66	2.04	1,013.40
7-Feb-06	1022	Costilla County Random EQ CEUS	6.5	CEUS Event	18, 4, 1, 1	46.92	4.63	1,013.40
7-Feb-06	1023	Crowley County Random EQ	6.5	CEUS Event	76, 20, 3, 5	91.11	13.66	666.90
8-Feb-06	1024	Custer County Random EQ	6.5	CEUS Event	28, 7, 1, 2	148.28	16.90	877.60
8-Feb-06	1025	Delta County Random EQ	6.5	CEUS Event	77, 16, 4, 4	287.66	10.12	2,841.30
8-Feb-06	1026	Denver County Random EQ	6.5	CEUS Event	12284, 3873, 749, 1302	14,227.75	36.44	39,039.40
8-Feb-06	1027	Dolores County Random EQ	6.5	CEUS Event	7, 1, 0, 0	26.18	5.08	515.70
8-Feb-06	1028	Douglas County Random EQ	6.5	CEUS Event	629, 183, 90, 53	2,036.54	14.87	13,697.50
8-Feb-06	1029	Eagle County Random EQ	6.5	CEUS Event	185, 48, 11, 14	599.67	11.96	5,014.90
8-Feb-06	1030	El Paso County Random EQ	6.5	CEUS Event	2193, 612, 155, 191	4,254.96	13.06	32,570.60
8-Feb-06	1031	Elbert County Random EQ	6.5	CEUS Event	14, 3, 2, 1	72.84	3.00	2,431.60
8-Feb-06	1032	Fremont County Random EQ	6.5	CEUS Event	86, 22, 4, 6	299.14	7.96	3,759.70
8-Feb-06	1033	Garfield County Random EQ	6.5	CEUS Event	67, 15, 8, 4	252.92	5.34	4,735.50
8-Feb-06	1034	Gilpin County Random EQ	6.5	CEUS Event	24, 6, 1, 2	133.28	18.38	725.30
8-Feb-06	1035	Grand County Random EQ	6.5	CEUS Event	32, 7, 2, 2	194.88	6.22	3,131.50
8-Feb-06	1036	Gunnison County Random EQ	6.5	CEUS Event	61, 16, 3, 5	164.33	6.13	2,681.30
8-Feb-06	1037	Hinsdale County Random EQ	6.5	CEUS Event	7, 2, 0, 1	45.10	12.99	347.30
8-Feb-06	1038	Huerfano County Random EQ	6.5	CEUS Event	17, 3, 1, 1	146.52	7.55	1,939.50
8-Feb-06	1039	Jackson County Random EQ	6.5	CEUS Event	13, 3, 1, 1	88.91	9.36	949.70
8-Feb-06	1040	Jefferson County Random EQ	6.5	CEUS Event	1589, 414, 92, 124	5,111.00	14.27	35,828.60
8-Feb-06	1041	Kiowa County Random EQ	6.5	CEUS Event	20, 5, 1, 1	45.31	3.97	1,141.60
8-Feb-06	1042	Kit Carson County Random EQ	6.5	CEUS Event	34, 7, 1, 2	100.24	4.45	2,252.00
8-Feb-06	1043	La Plata County Random EQ	6.5	CEUS Event	163, 42, 10, 12	640.28	14.86	4,309.40
9-Feb-06	1044	Lake County Random EQ	6.5	CEUS Event	85, 24, 8, 7	274.37	24.97	1,098.70
9-Feb-06	1045	Larimer County Random EQ	6.5	CEUS Event	534, 121, 18, 33	1,357.50	7.18	18,896.00
9-Feb-06	1046	Las Animas County Random EQ	6.5	CEUS Event	4, 1, 0, 0	33.82	0.91	3,705.50
9-Feb-06	1047	Lincoln County Random EQ	6.5	CEUS Event	46, 13, 2, 4	118.13	6.33	1,866.40

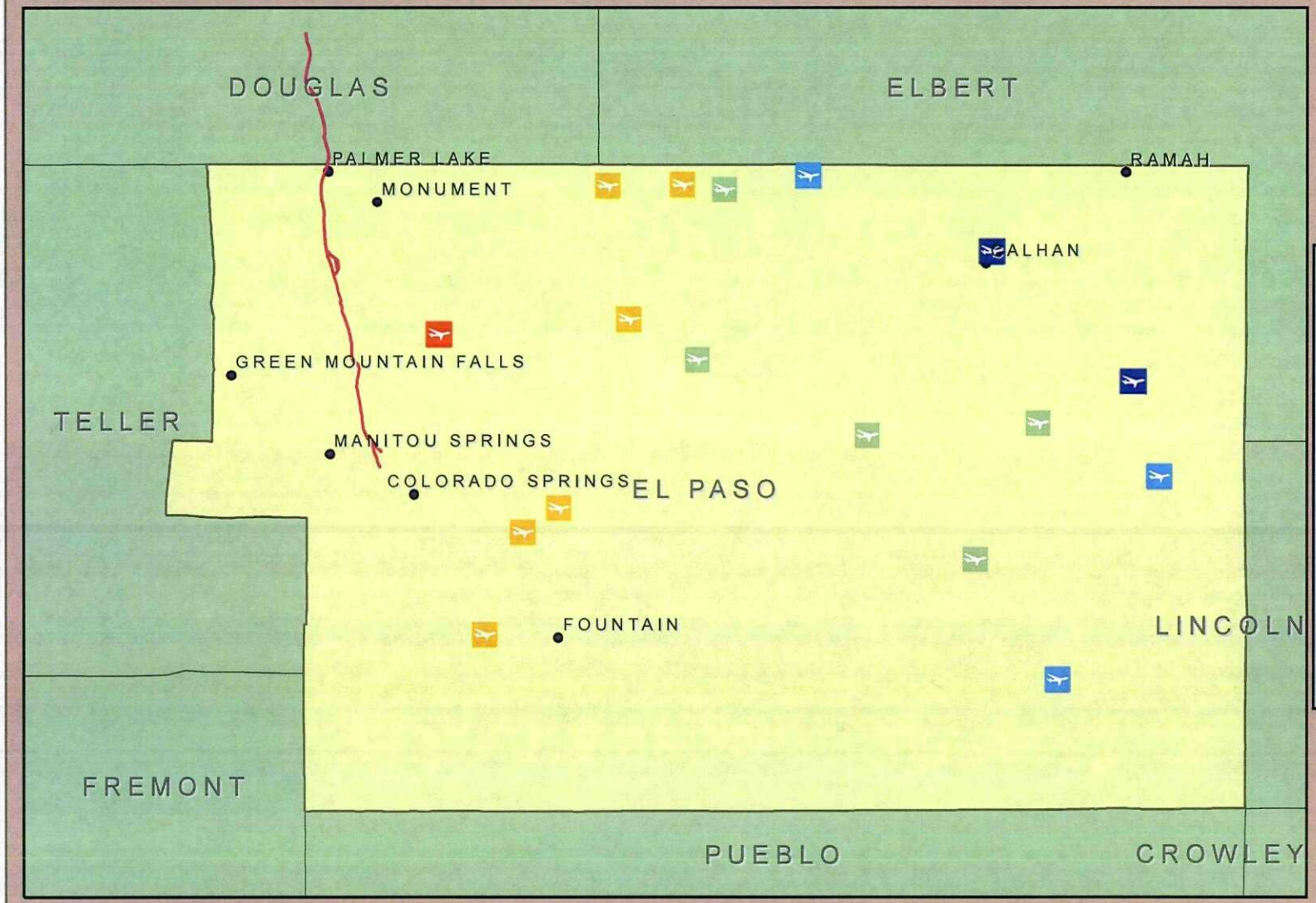
9-Feb-06	1048	Logan County Random EQ	6.5	CEUS Event	202, 61, 12, 20	346.75	11.34	3,057.30
9-Feb-06	1049	Mesa County Random EQ	6.5	CEUS Event	1241, 367, 80, 117	2,122.40	23.47	9,044.60
2-May-06		Mesa County Random M7.0 EQ	7	CEUS Event	1914, 590, 131, 192	2,960.92	32.74	9,044.60
9-Feb-06	1050	Mineral County Random EQ	6.5	CEUS Event	11, 3, 1, 1	74.41	11.15	667.40
9-Feb-06	1051	Moffat County Random EQ	6.5	CEUS Event	5, 1, 0, 0	36.09	1.30	2,778.00
10-Feb-06	1052	Montezuma County Random EQ	6.5	CEUS Event	57, 12, 3, 3	259.84	8.45	3,074.20
10-Feb-06	1053	Montrose County Random EQ	6.5	CEUS Event	74, 17, 3, 5	256.99	6.81	3,773.90
10-Feb-06	1054	Morgan County Random EQ	6.5	CEUS Event	297, 89, 20, 28	1,384.96	25.63	5,404.70
10-Feb-06	1055	Otero County Random EQ	6.5	CEUS Event	107, 26, 7, 7	334.00	11.38	2,935.40
10-Feb-06	1056	Ouray County Random EQ	6.5	CEUS Event	16, 4, 1, 1	147.27	18.84	781.70
10-Feb-06	1057	Park County Random EQ	6.5	CEUS Event	24, 5, 1, 1	152.72	5.44	2,806.30
10-Feb-06	1058	Phillips County Random EQ	6.5	CEUS Event	21, 5, 1, 1	74.10	6.44	1,151.20
10-Feb-06	1059	Pitkin County Random EQ	6.5	CEUS Event	63, 14, 3, 4	375.02	16.86	2,224.30
10-Feb-06	1060	Prowers County Random EQ	6.5	CEUS Event	100, 28, 5, 9	209.69	9.09	2,306.40
10-Feb-06	1061	Pueblo County Random EQ	6.5	CEUS Event	1165, 346, 68, 111	2,315.75	21.99	10,530.10
10-Feb-06	1062	Rio Blanco County Random EQ	6.5	CEUS Event	12, 3, 1, 1	51.43	3.28	1,567.20
10-Feb-06	1063	Rio Grande County Random EQ	6.5	CEUS Event	89, 22, 5, 6	199.08	11.16	1,783.20
10-Feb-06	1067	Rio Grande County Random EQ WUS	6.5	WUS - Ext.	54, 13, 3, 4	88.75	4.98	1,783.20
10-Feb-06	1064	Routt County Random EQ	6.5	CEUS Event	164, 47, 9, 15	461.55	14.82	3,114.00
10-Feb-06	1065	Saguache County Random EQ WUS	6.5	WUS - Ext.	27, 6, 1, 1	53.11	3.50	1,517.10
10-Feb-06	1066	Saguache County Random EQ CEUS	6.5	CEUS Event	42, 9, 1, 2	94.02	6.20	1,517.10
10-Feb-06	1068	San Juan County Random EQ	6.5	CEUS Event	3, 1, 0, 0	20.06	5.43	369.20
10-Feb-06	1069	San Miguel County Random EQ	6.5	CEUS Event	4, 1, 0, 0	32.62	2.40	1,361.60
10-Feb-06	1070	Sedgwick County Random EQ	6.5	CEUS Event	21, 5, 1, 1	62.77	5.86	1,071.60
10-Feb-06	1071	Summit County Random EQ	6.5	CEUS Event	167, 46, 10, 14	829.99	19.84	4,184.10
10-Feb-06	1072	Teller County Random EQ	6.5	CEUS Event	44, 9, 2, 2	255.40	13.08	1,952.20
10-Feb-06	1073	Washington County Random EQ	6.5	CEUS Event	21, 5, 1, 1	71.76	3.34	2,148.70
10-Feb-06	1074	Weld County Random EQ	6.5	CEUS Event	389, 88, 18, 24	944.83	6.61	14,295.20
10-Feb-06	1075	Yuma County Random EQ	6.5	CEUS Event	104, 28, 5, 8	201.22	7.64	2,633.00

County Results Maps

El Paso County Rampart M7.0
Mesa County Random M7.0 - Schools

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Airports

Probability Damage > Extensive

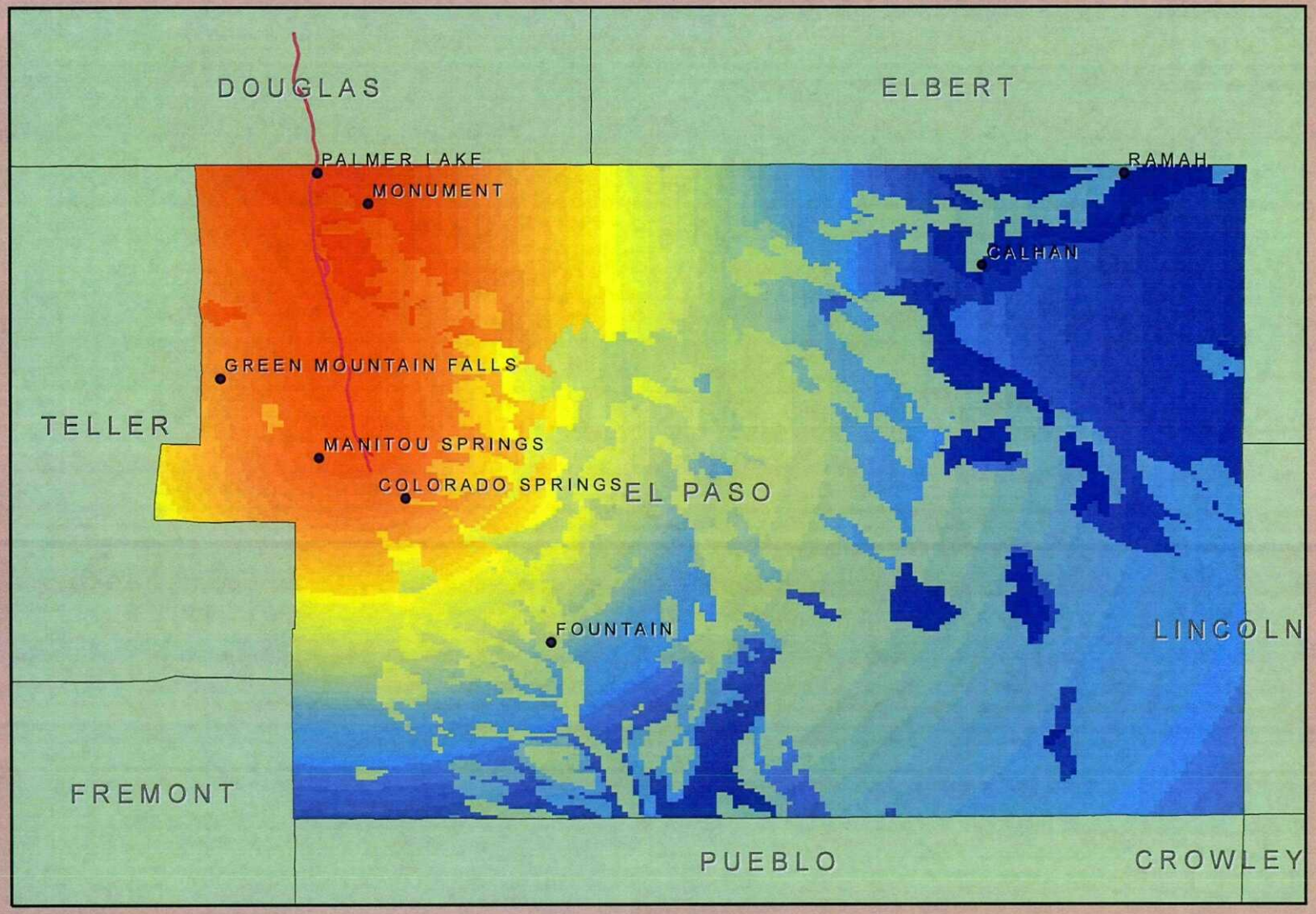
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20
Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

PGA

- 0.107710 - 0.126493
- 0.126494 - 0.145560
- 0.145561 - 0.162846
- 0.162847 - 0.174912
- 0.174913 - 0.183662
- 0.183663 - 0.192506
- 0.192507 - 0.201716
- 0.201717 - 0.210993
- 0.210994 - 0.220232
- 0.220233 - 0.229848
- 0.229849 - 0.239296
- 0.239297 - 0.248137
- 0.248138 - 0.255835
- 0.255836 - 0.262487
- 0.262488 - 0.268981
- 0.268982 - 0.275752
- 0.275753 - 0.282625
- 0.282626 - 0.289498
- 0.289499 - 0.296711
- 0.296712 - 0.304287
- 0.304288 - 0.311957
- 0.311958 - 0.319810
- 0.319811 - 0.327898
- 0.327899 - 0.335594
- 0.335595 - 0.344049
- 0.344050 - 0.353788
- 0.353789 - 0.362007
- 0.362008 - 0.374461
- 0.374462 - 0.392168
- 0.392169 - 0.410797
- 0.410798 - 0.431693
- 0.431694 - 0.454024
- 0.454025 - 0.478556
- 0.478557 - 0.505394
- 0.505395 - 0.533173
- 0.533174 - 0.562210
- 0.562211 - 0.592943
- 0.592944 - 0.626741
- 0.626742 - 0.664488
- 0.664489 - 0.704354
- 0.704355 - 0.743936
- 0.743937 - 0.781981
- 0.781982 - 0.819004
- 0.819005 - 0.856134
- 0.856135 - 0.893283
- 0.893284 - 0.934954
- 0.934955 - 0.986975
- 0.986976 - 1.064990
- 1.064991 - 1.149390
- 1.149391 - 1.243890
- Cities
- Rampart Fault
- Study Region Boundary
- Counties

COLORADO GEOLOGICAL SURVEY

N
W E
S

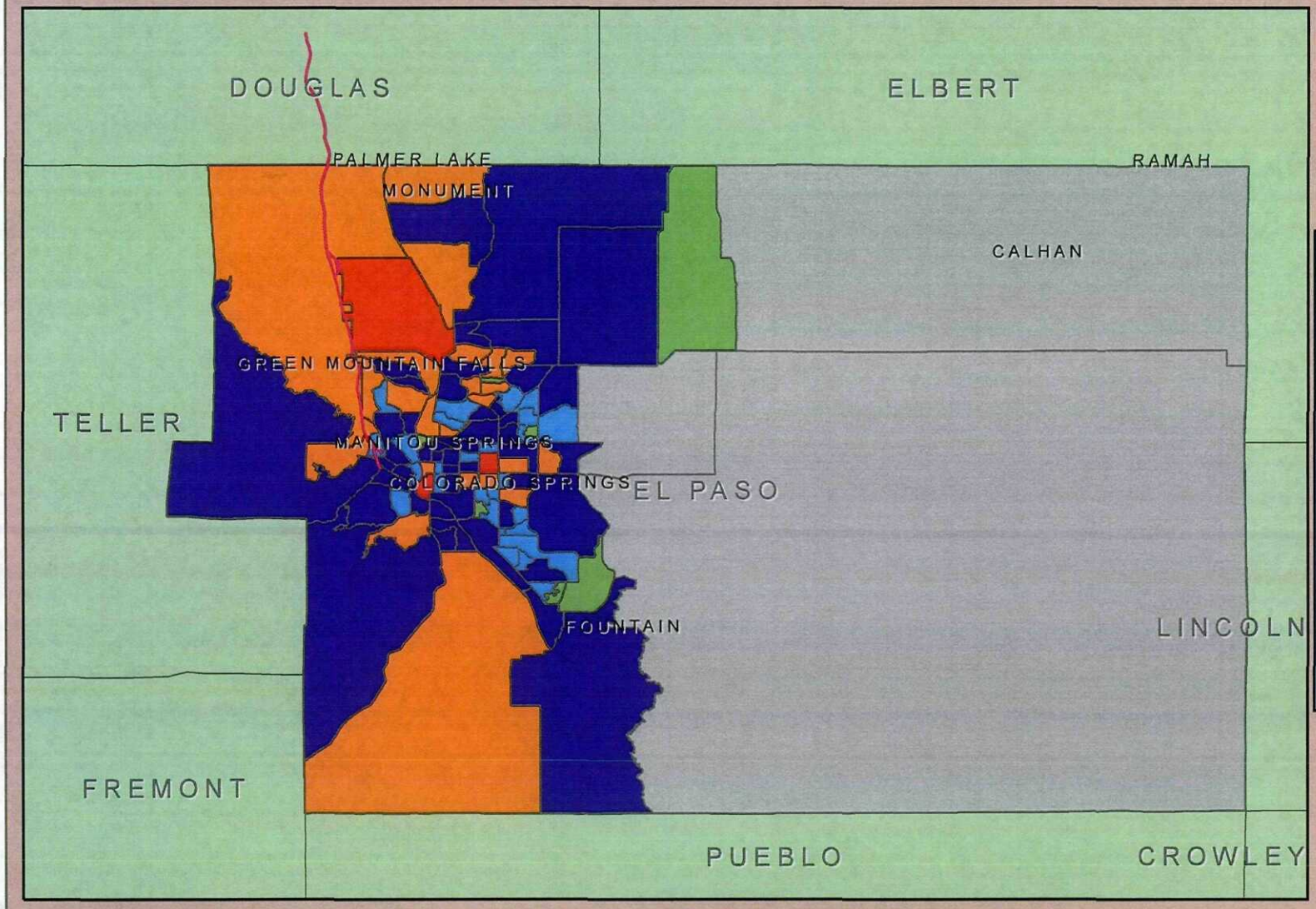
0 5 10 20
Miles

HAZUS-MH

"At least" moderate includes moderate, extensive, & complete.

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Building Economic Loss in Thousands of Dollars

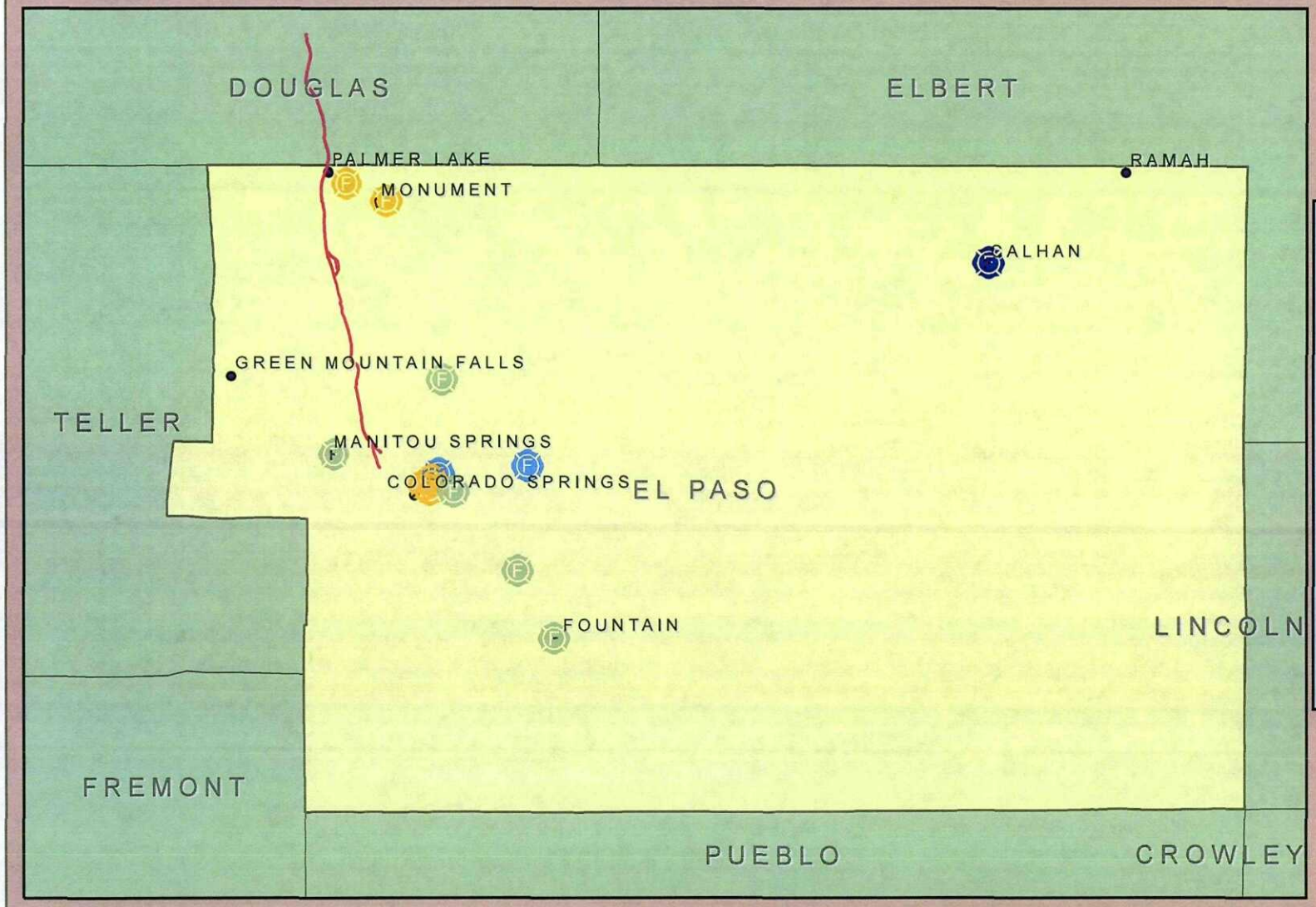
- 3421 - 10390
- 10400 - 25150
- 25160 - 50080
- 50090 - 100600
- 100700 - 200300
- 200400 - 315500
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20
Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Fire Station

Probability Damage > Extensive

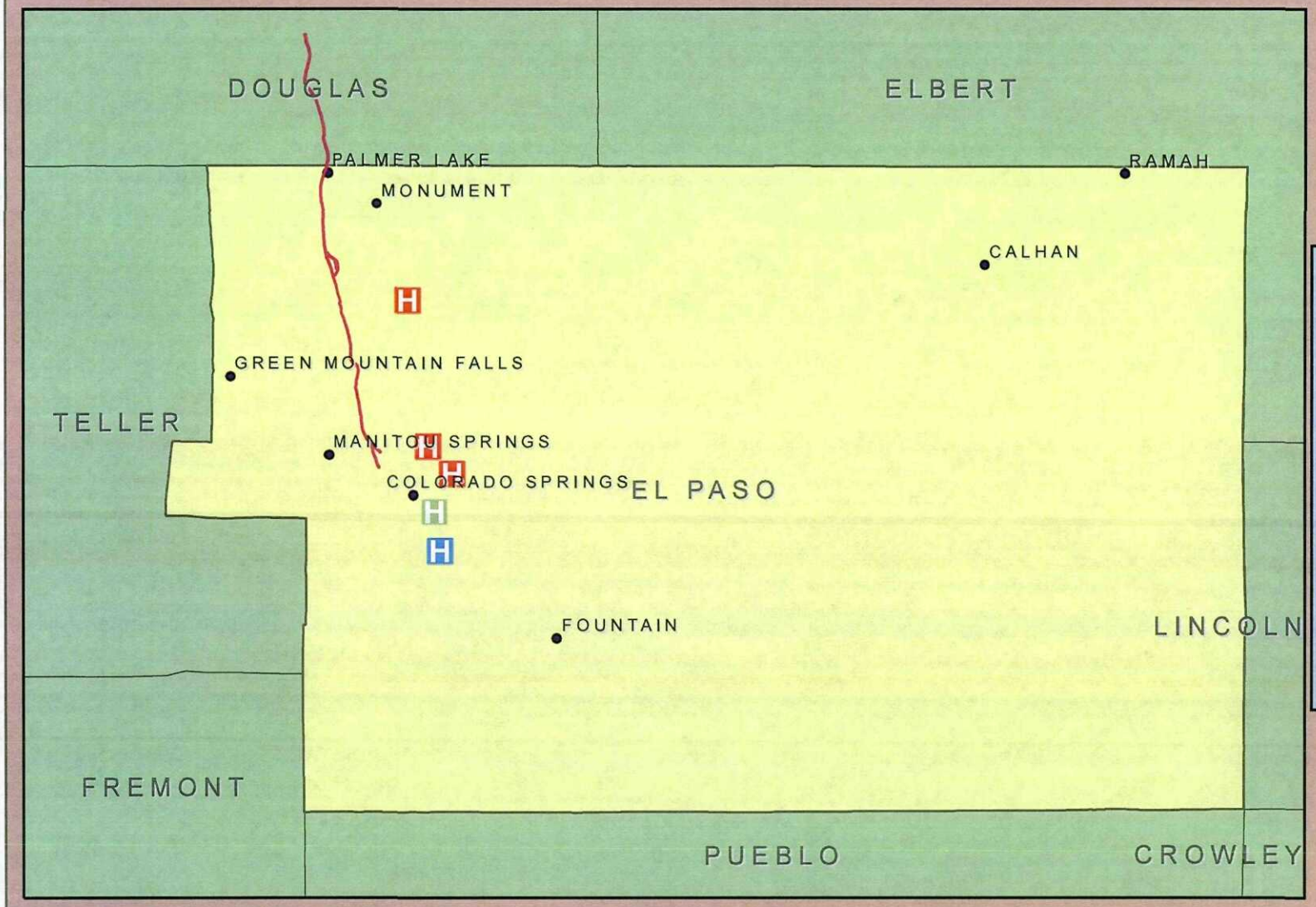
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20
Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Medical Care Facilities

Probability Damage > Extensive

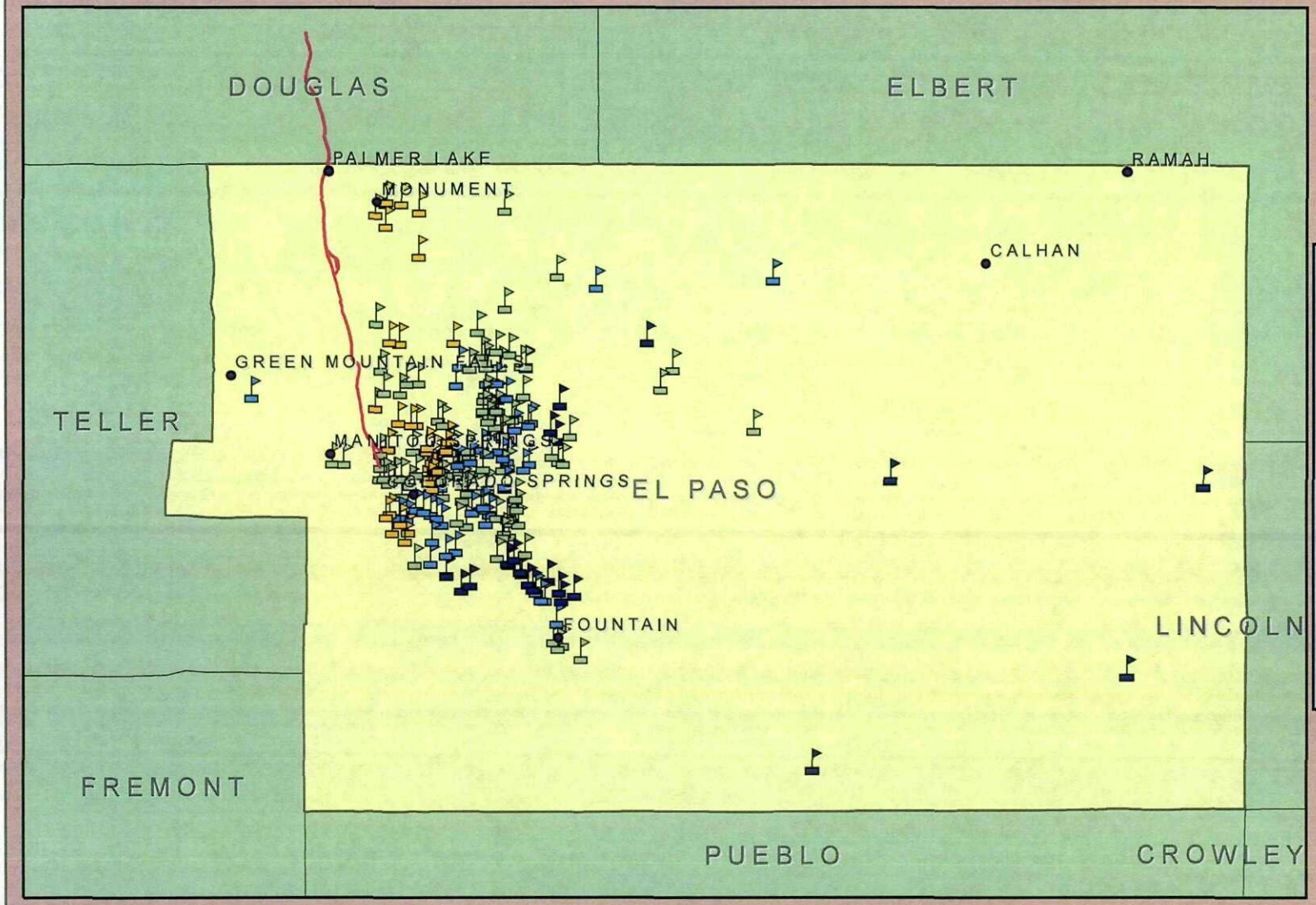
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N W E S

0 5 10 20 Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Schools

Probability Damage > Extensive

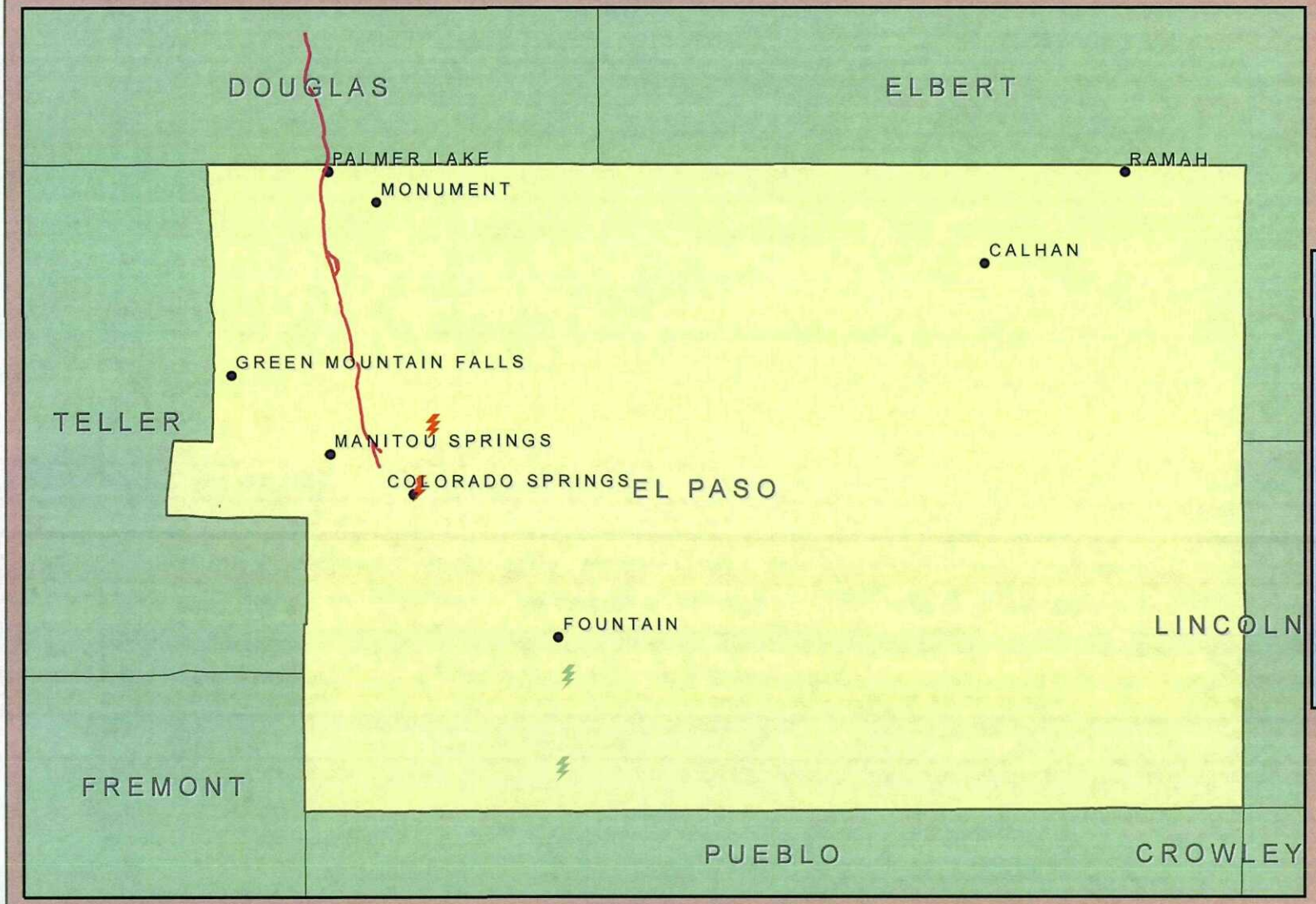
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Cities
- Rampart Fault
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20
Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Electrical Facilities

Probability Damage > Extensive

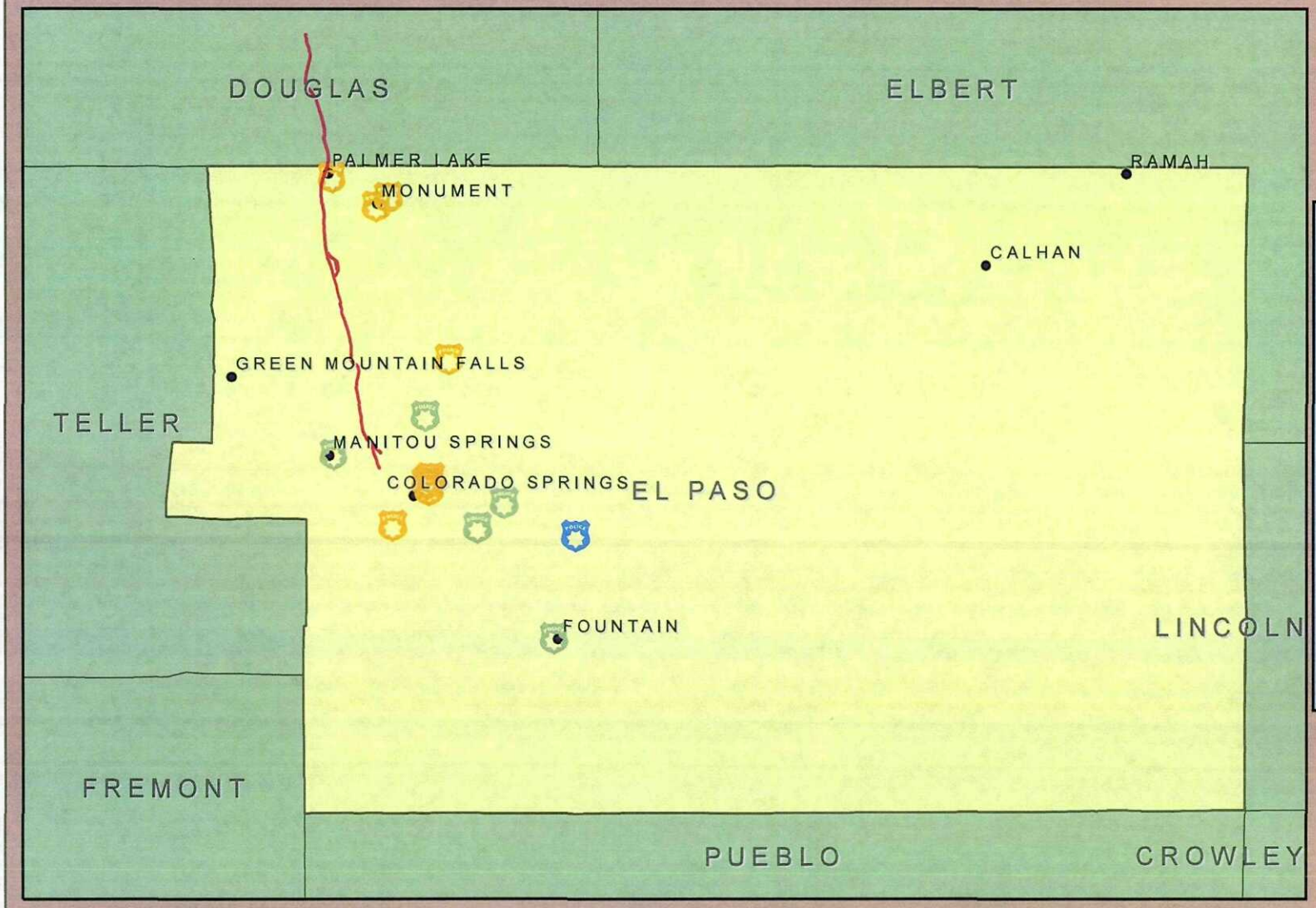
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20
Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Police Stations

Probability Damage > Extensive

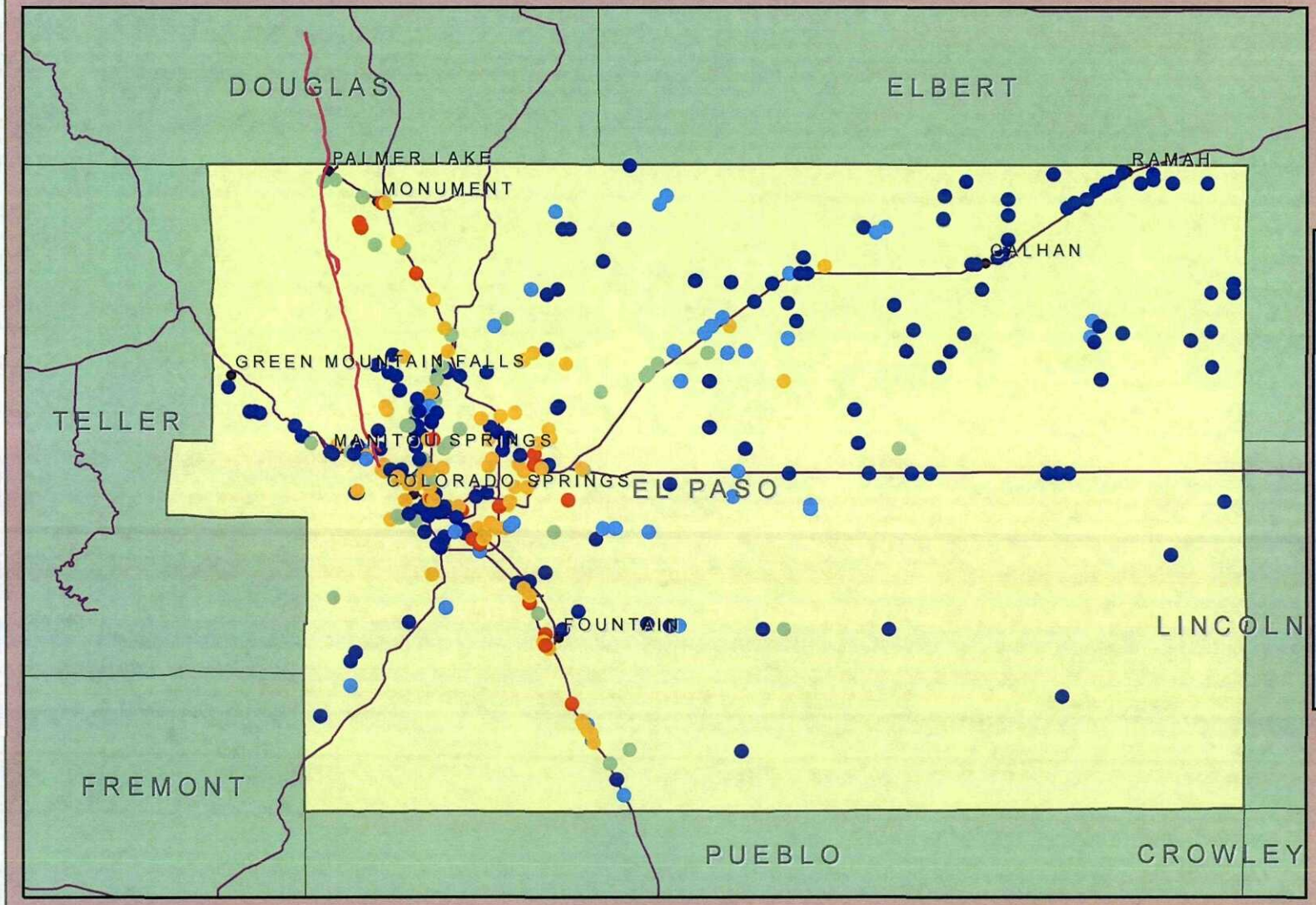
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N W E S

0 5 10 20 Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Bridge Damage

Probability Damage > Extensive

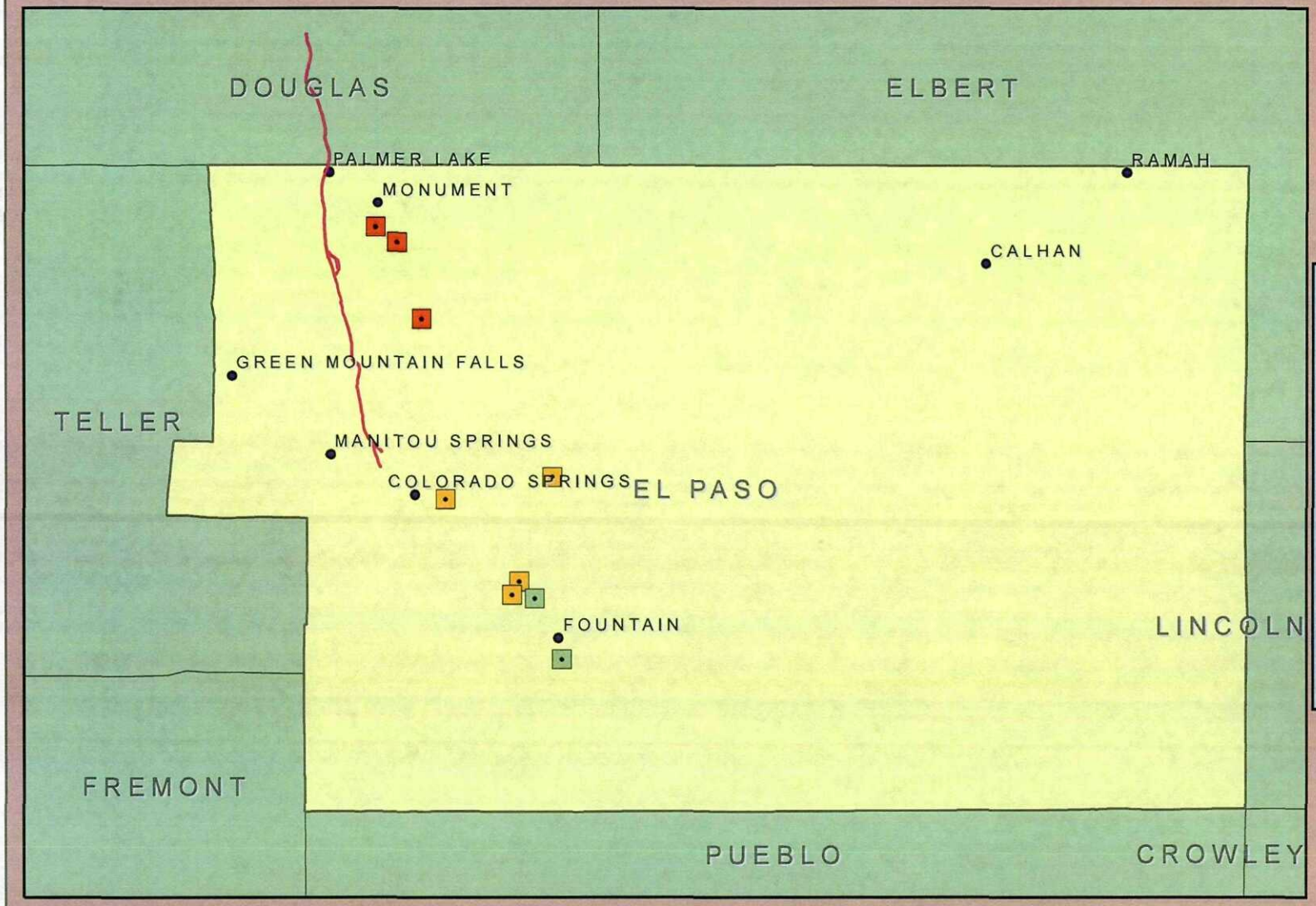
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Highways
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20 Miles

Study Region: El Paso County

Hazard Scenario: Rampart M7.0 CEUS



Legend

Waste Water Facilities

Probability Damage > Extensive

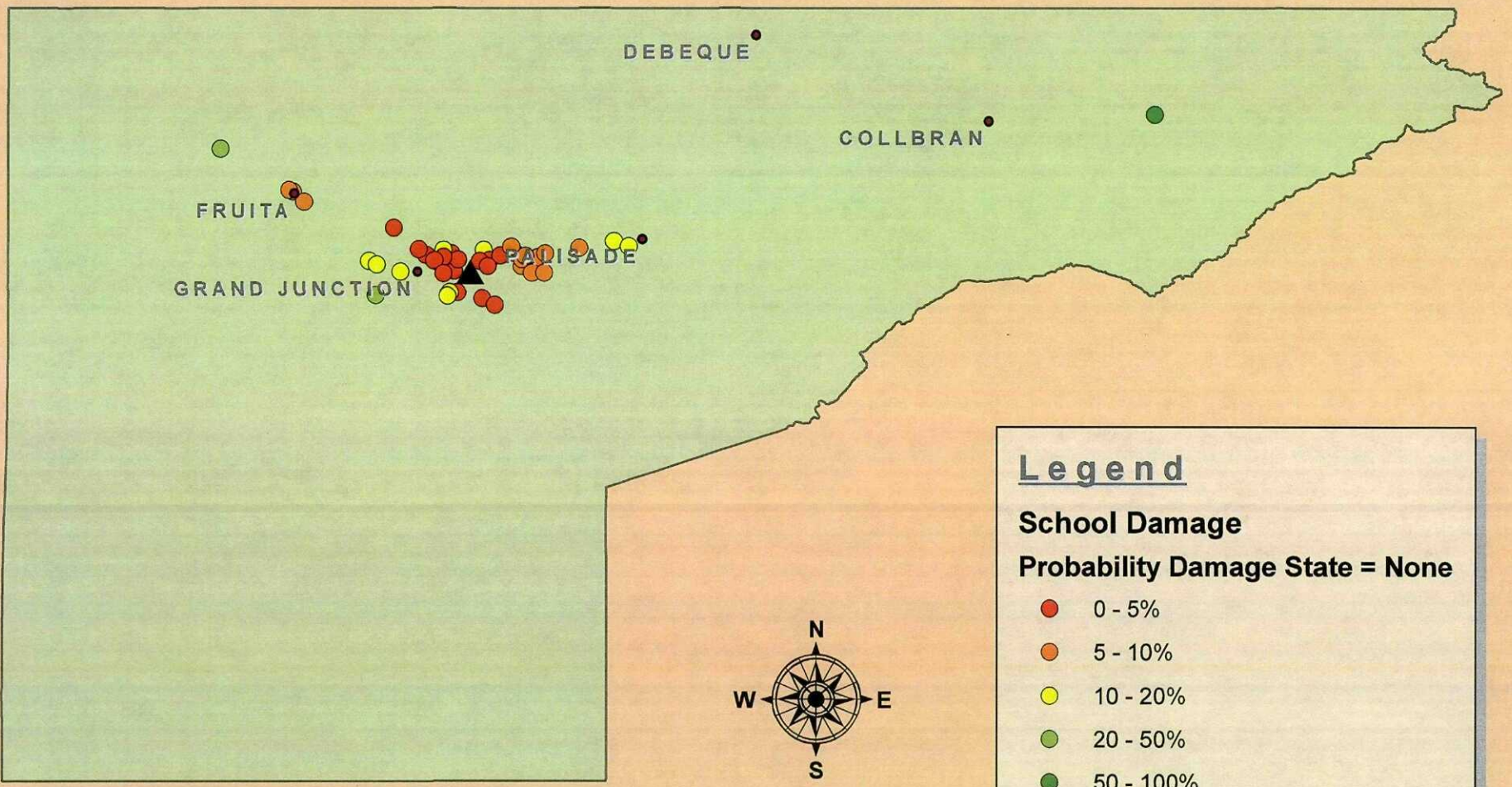
- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Rampart Fault
- Cities
- Study Region Boundary
- Counties

N
W E
S

0 5 10 20
Miles

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

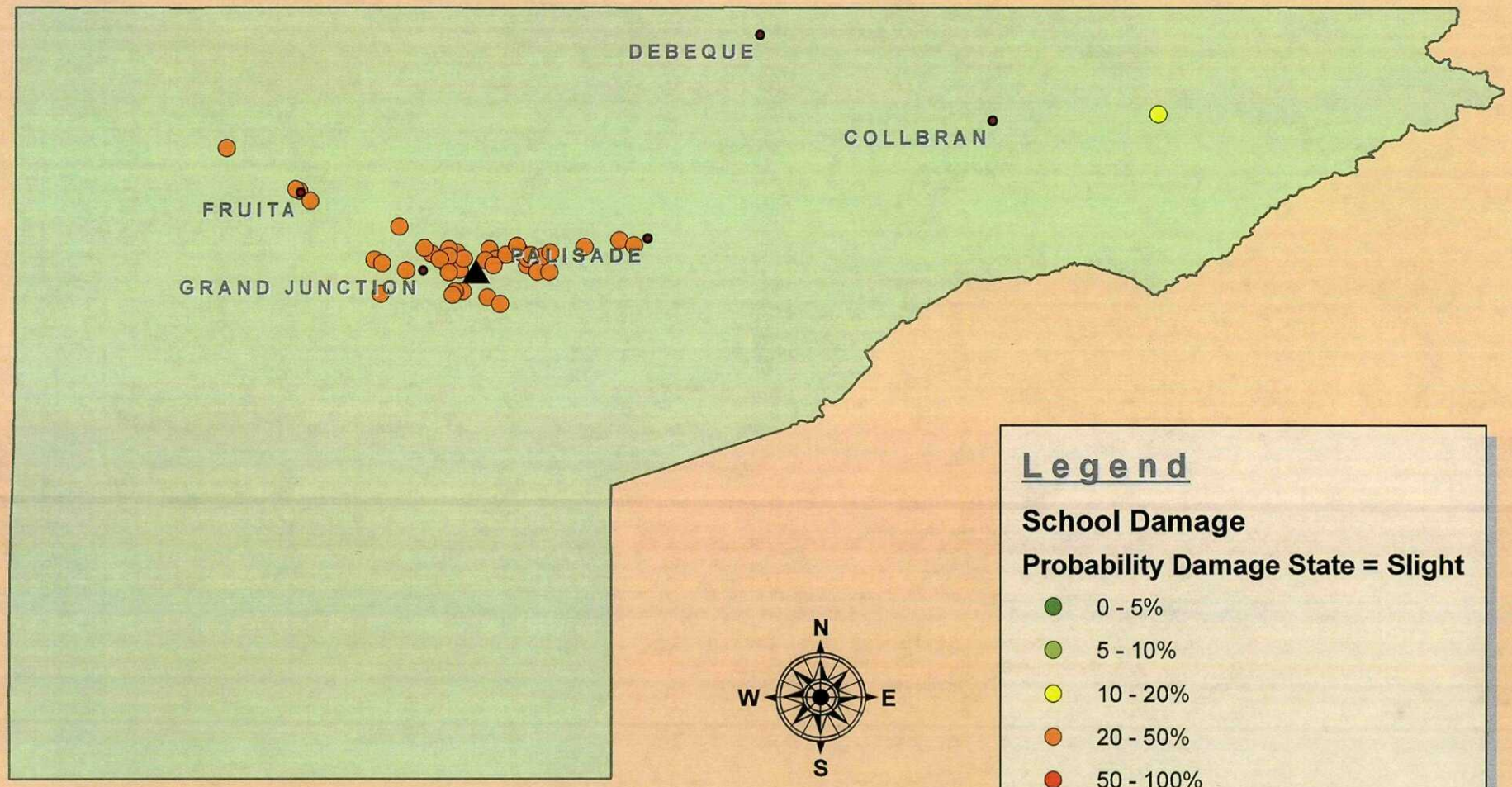
School Damage

Probability Damage State = None

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

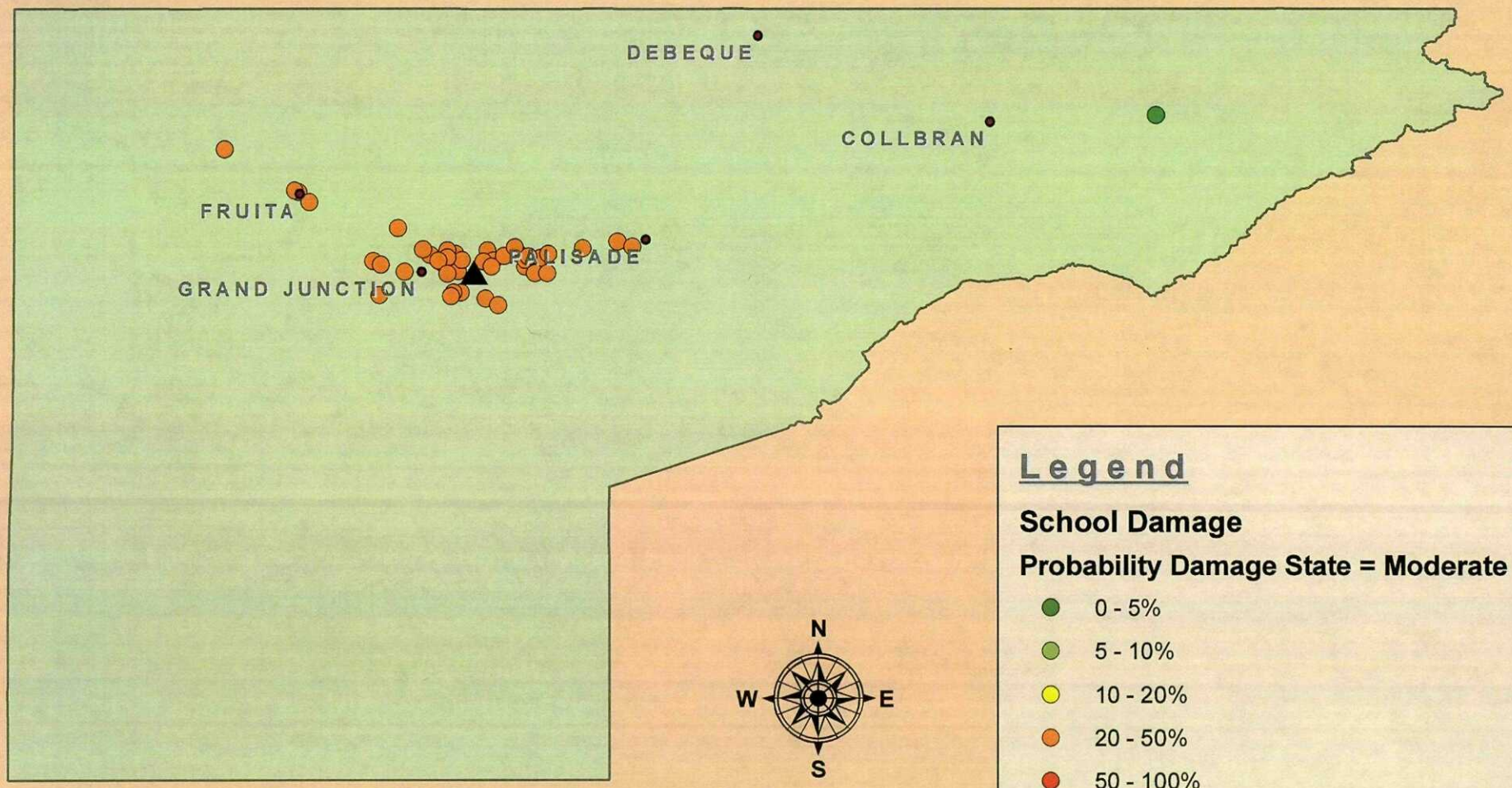
School Damage

Probability Damage State = Slight

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



N
W
E
S

0 5 10 20 30 40
Miles

Legend

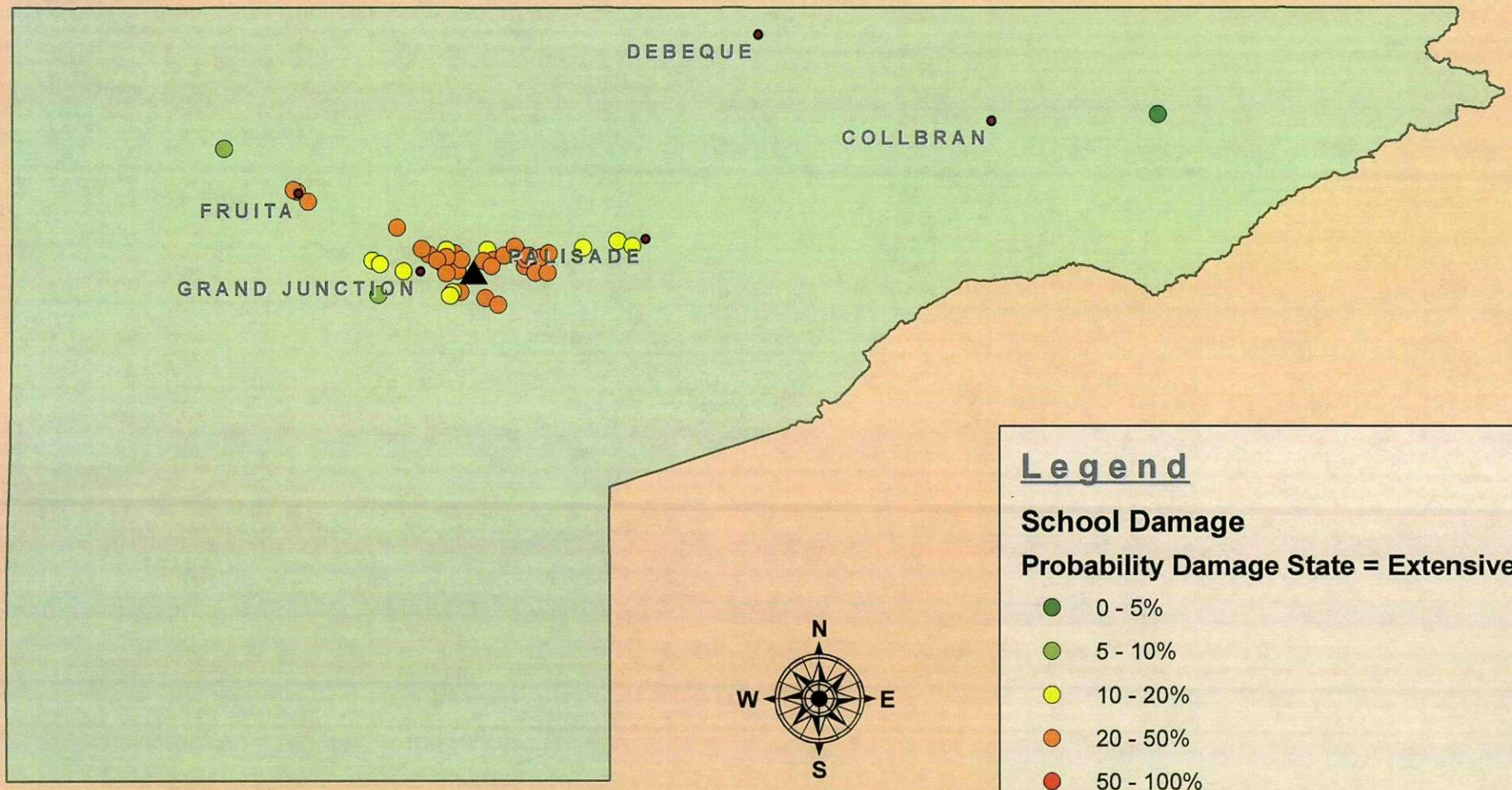
School Damage

Probability Damage State = Moderate

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

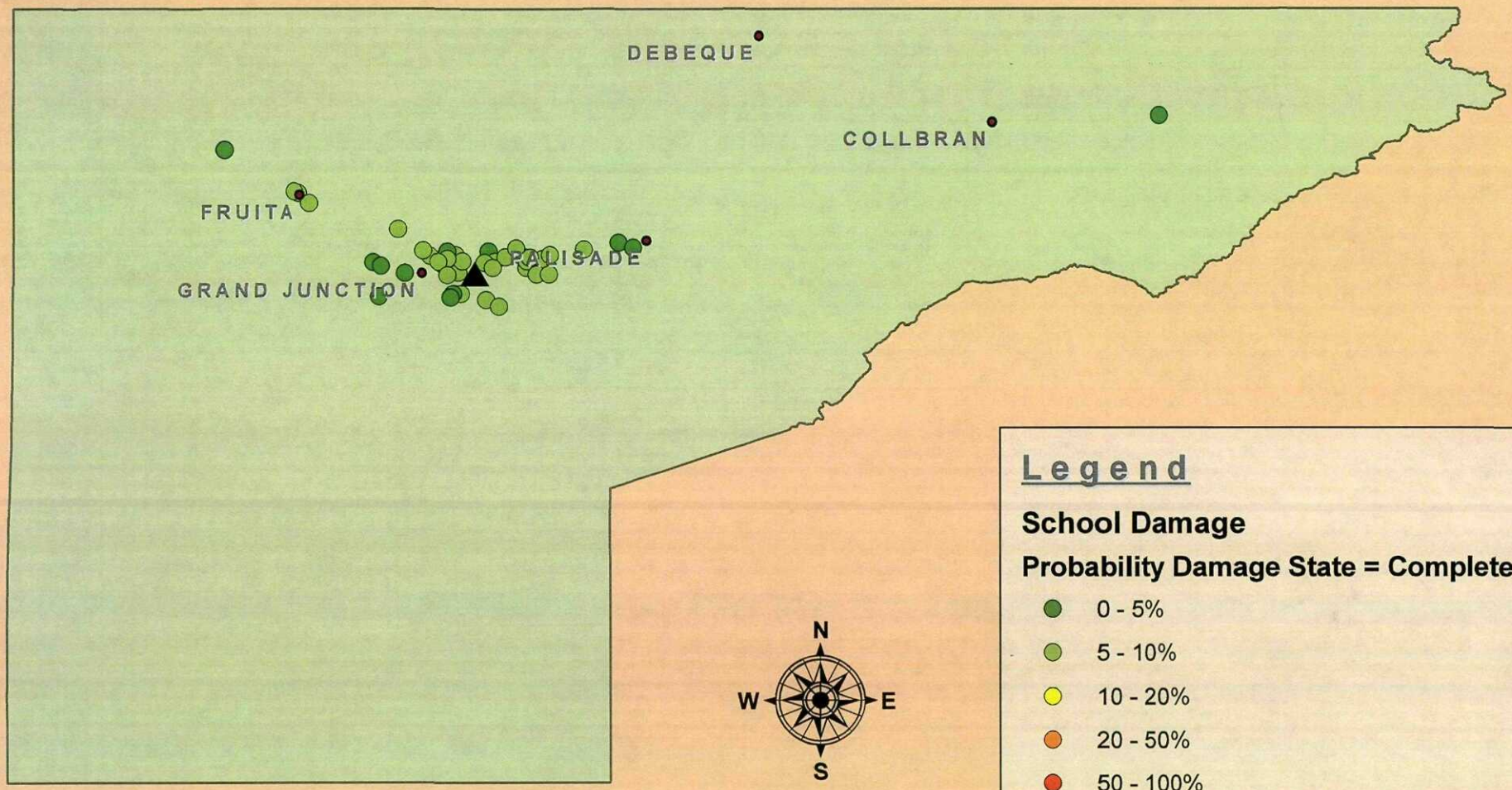
School Damage

Probability Damage State = Extensive

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

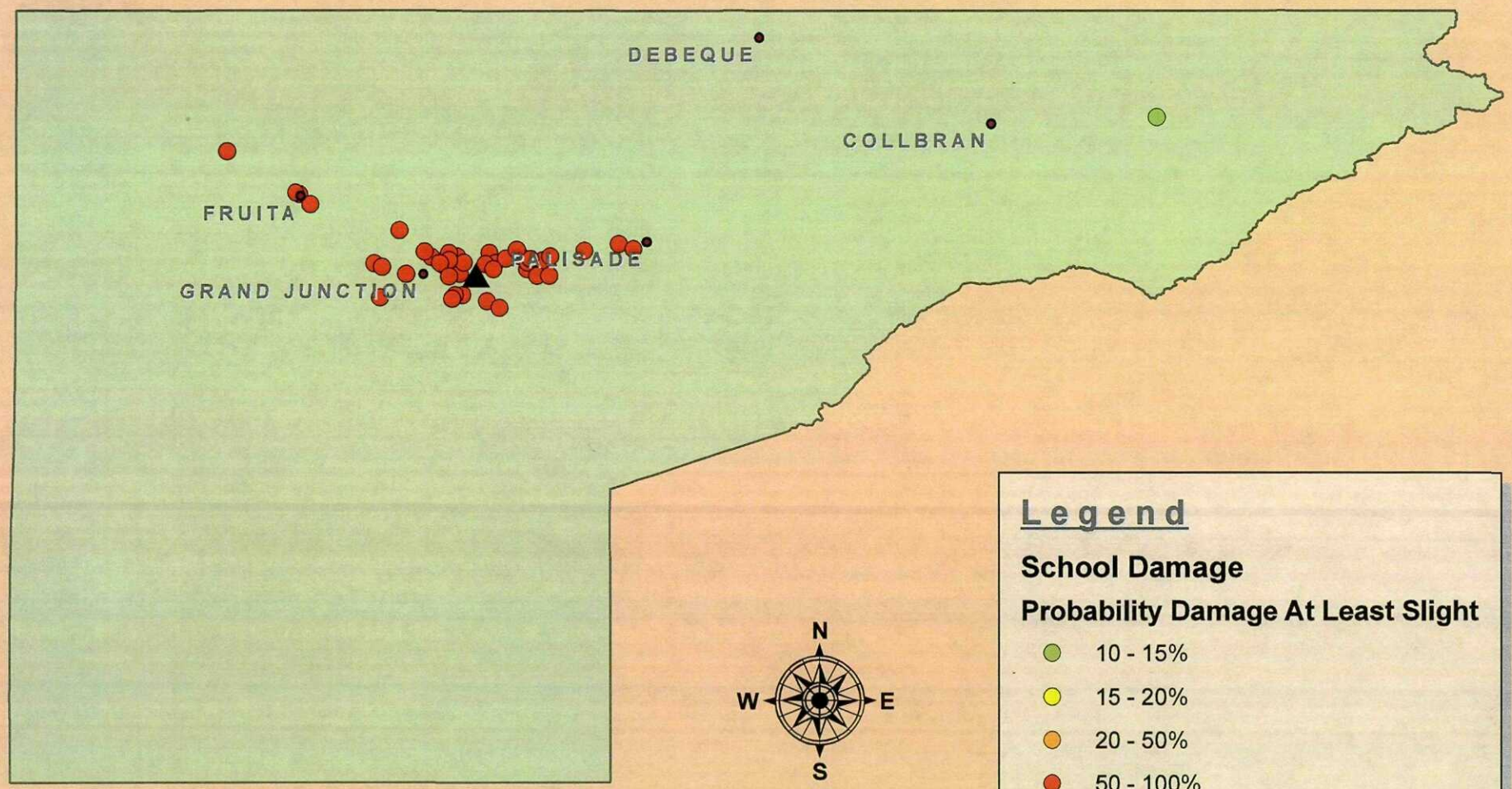
School Damage

Probability Damage State = Complete

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

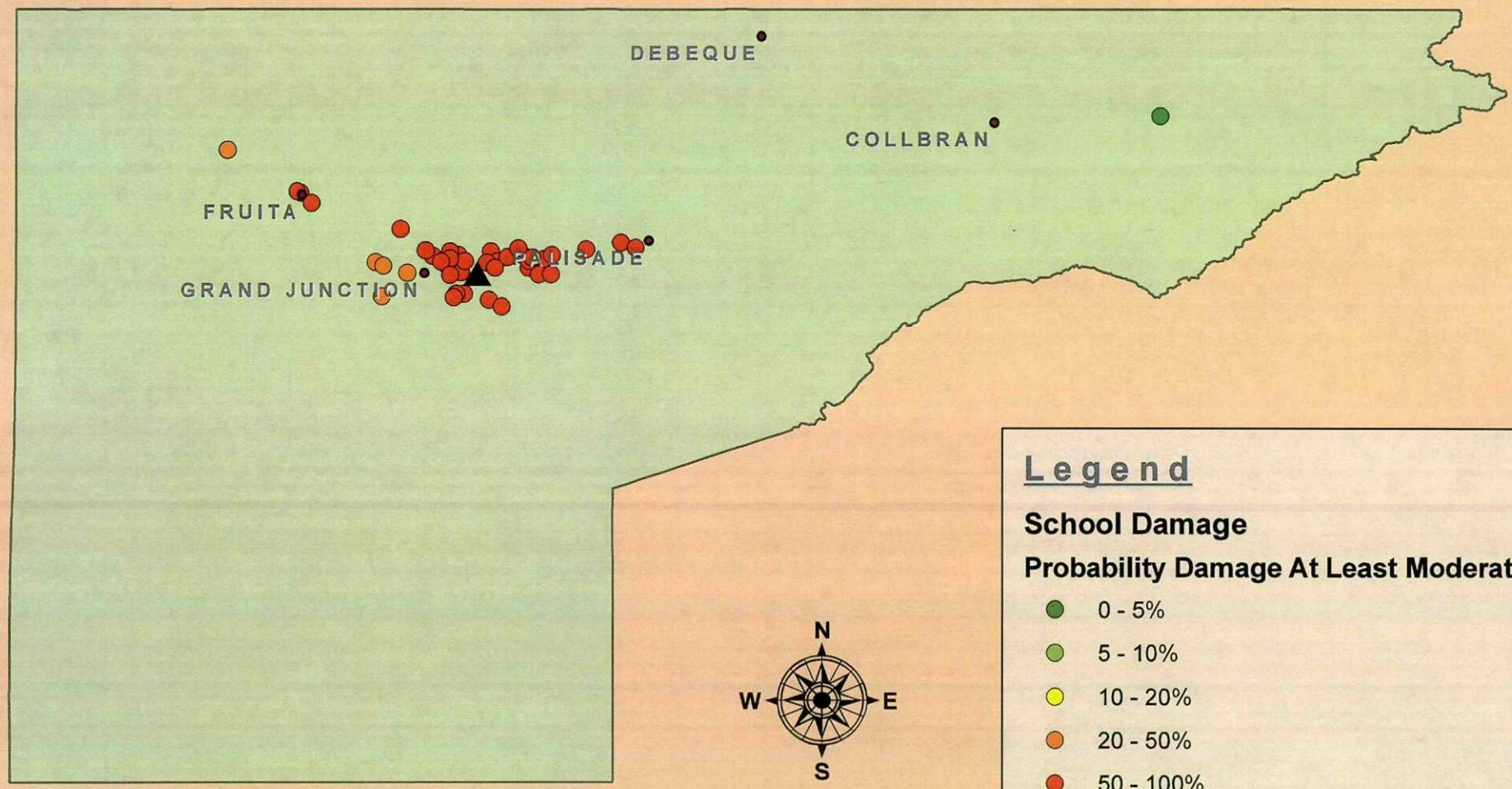
School Damage

Probability Damage At Least Slight

- 10 - 15%
- 15 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

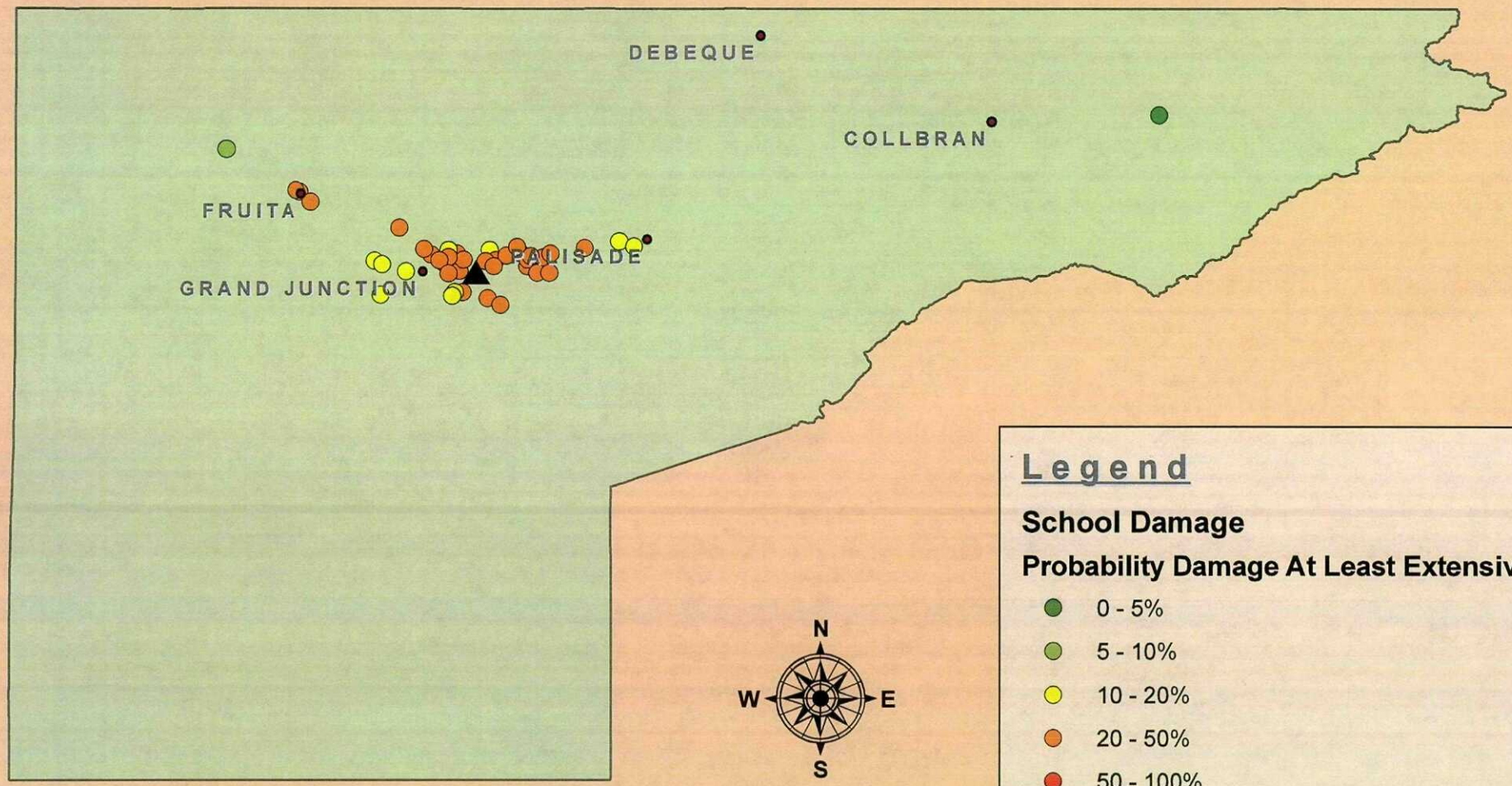
School Damage

Probability Damage At Least Moderate

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

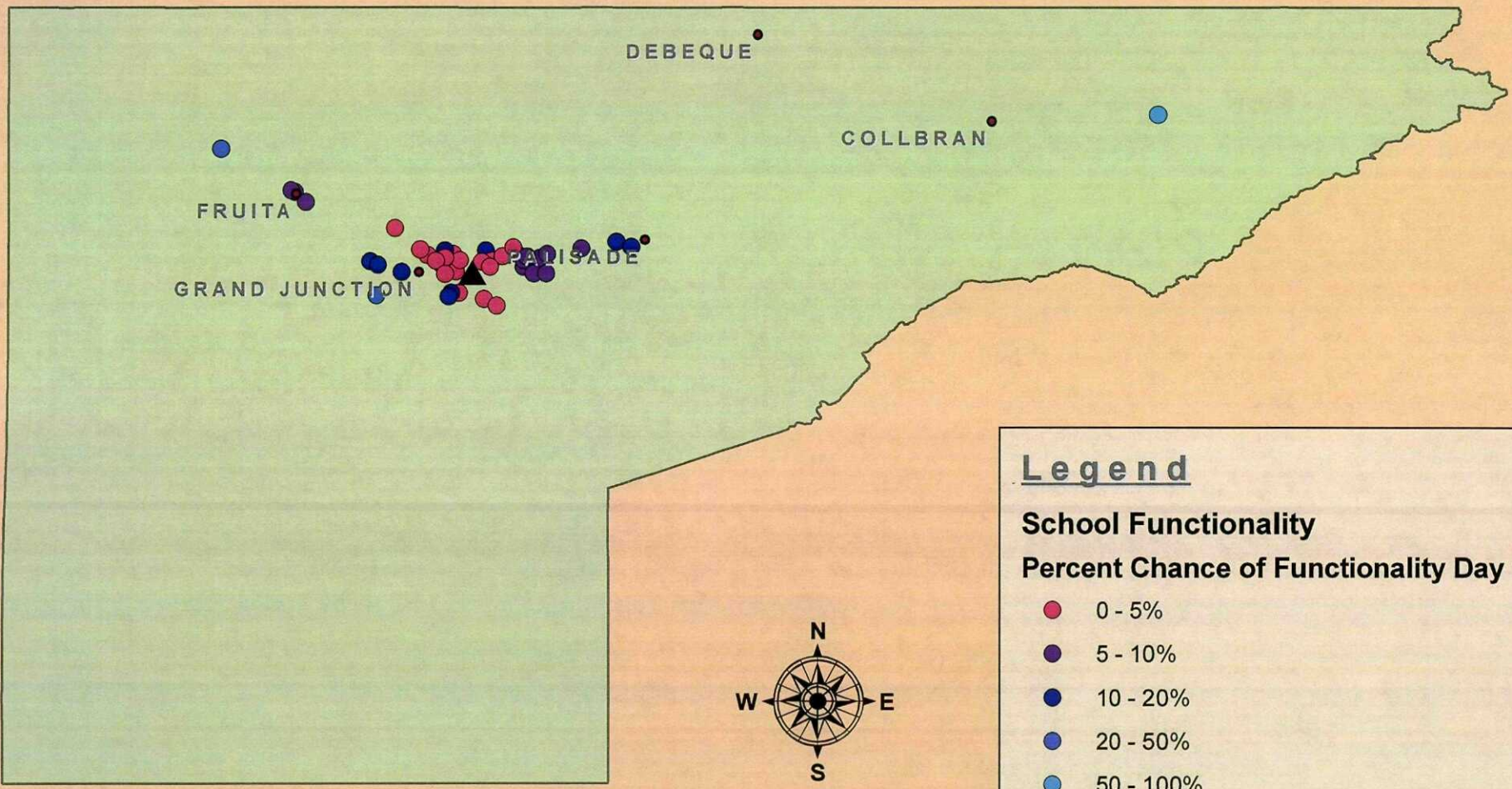
School Damage

Probability Damage At Least Extensive

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



N
W E
S

0 5 10 20 30 40
Miles

Legend

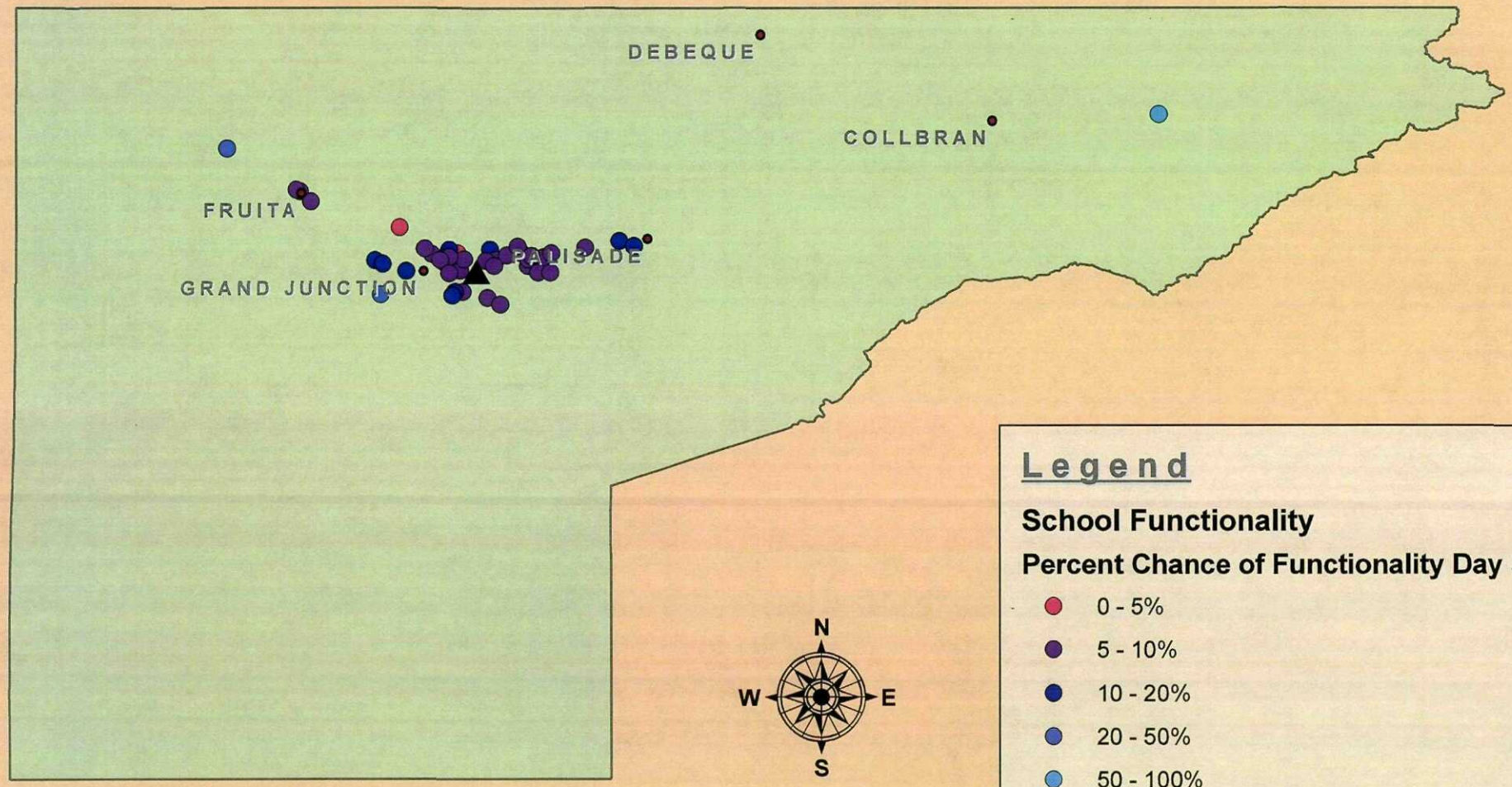
School Functionality

Percent Chance of Functionality Day 1

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

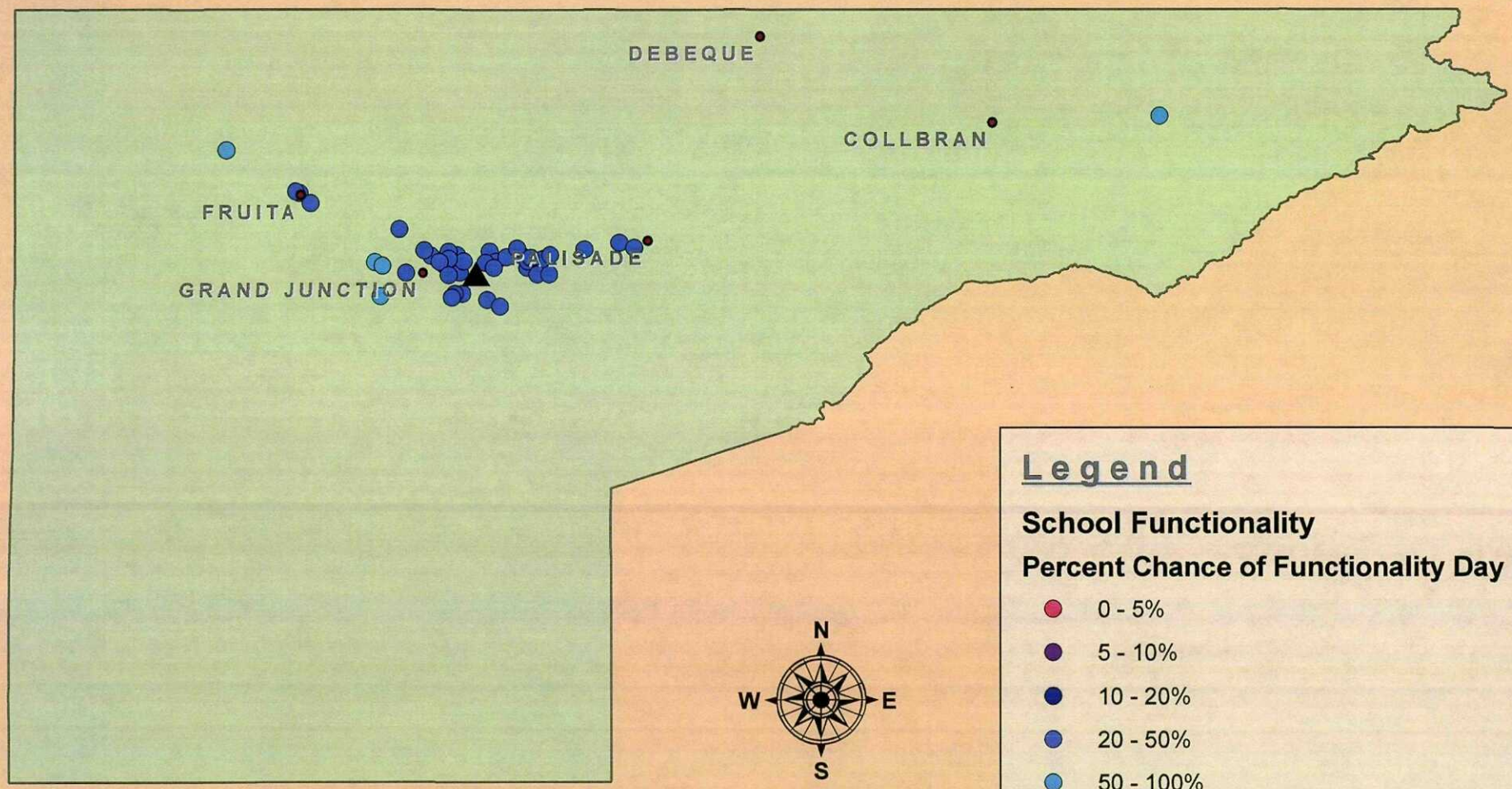
School Functionality

Percent Chance of Functionality Day 3

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

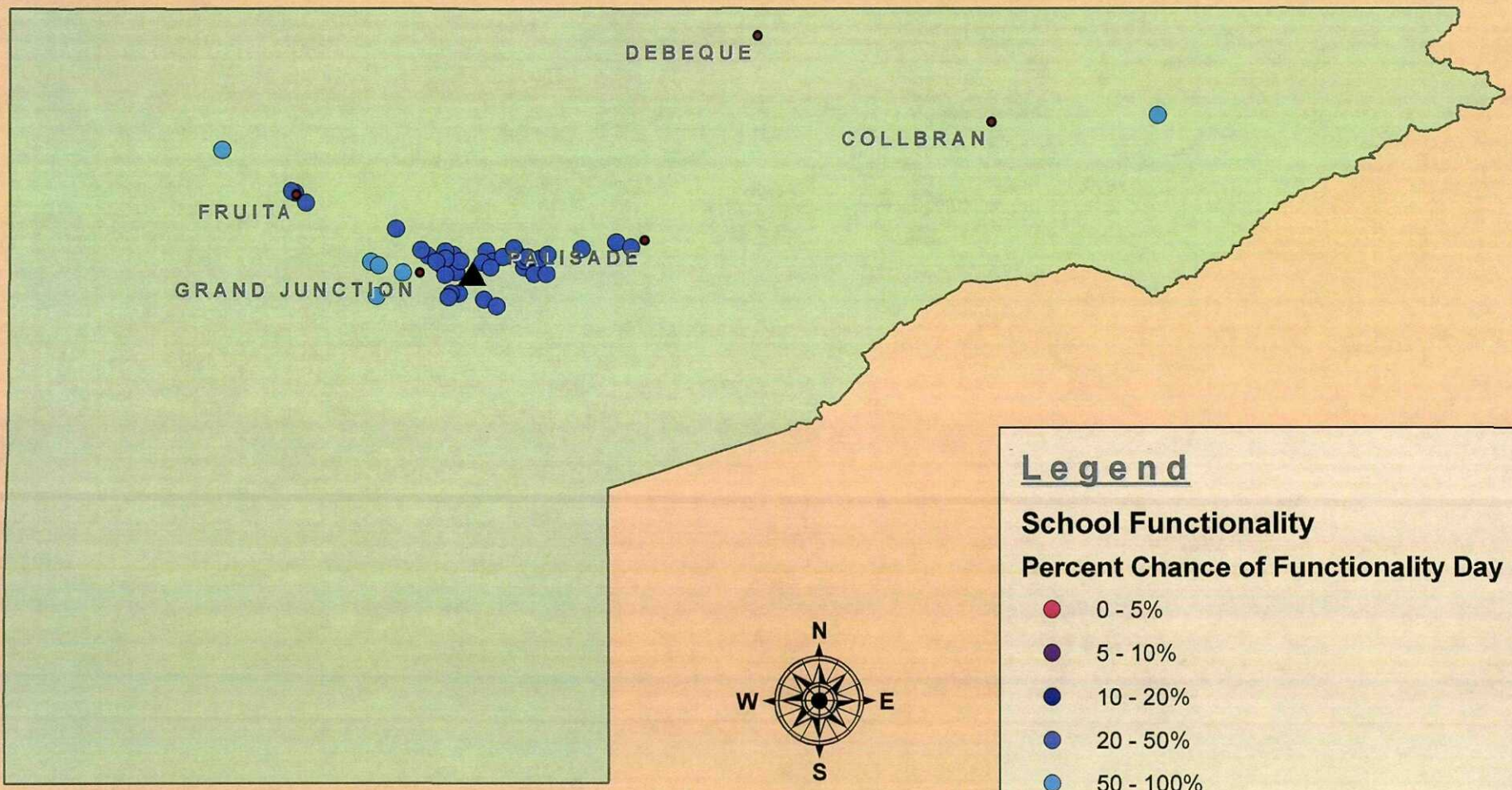
School Functionality

Percent Chance of Functionality Day 7

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

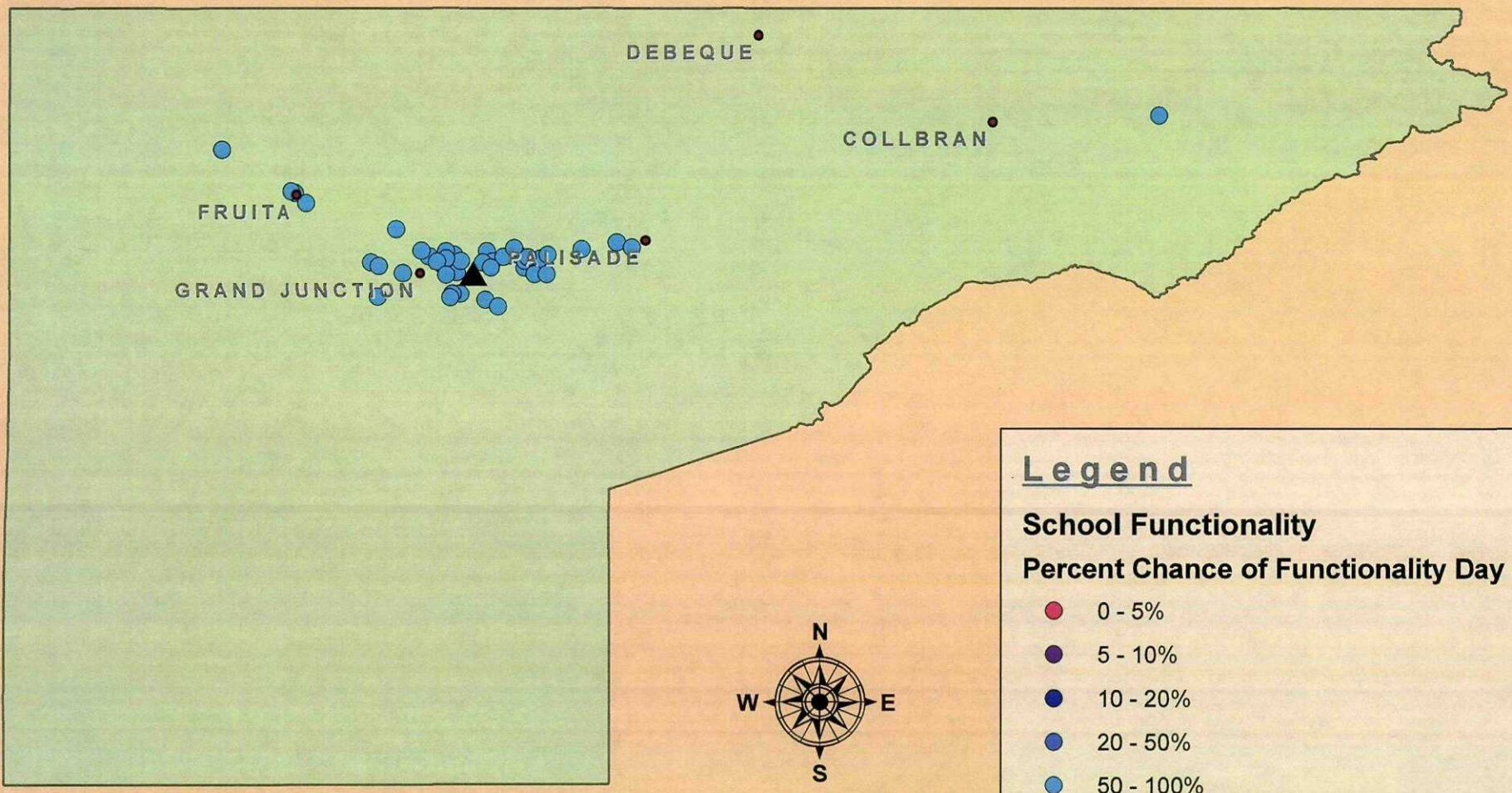
School Functionality

Percent Chance of Functionality Day 14

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



N
W E
S

0 5 10 20 30 40
Miles

Legend

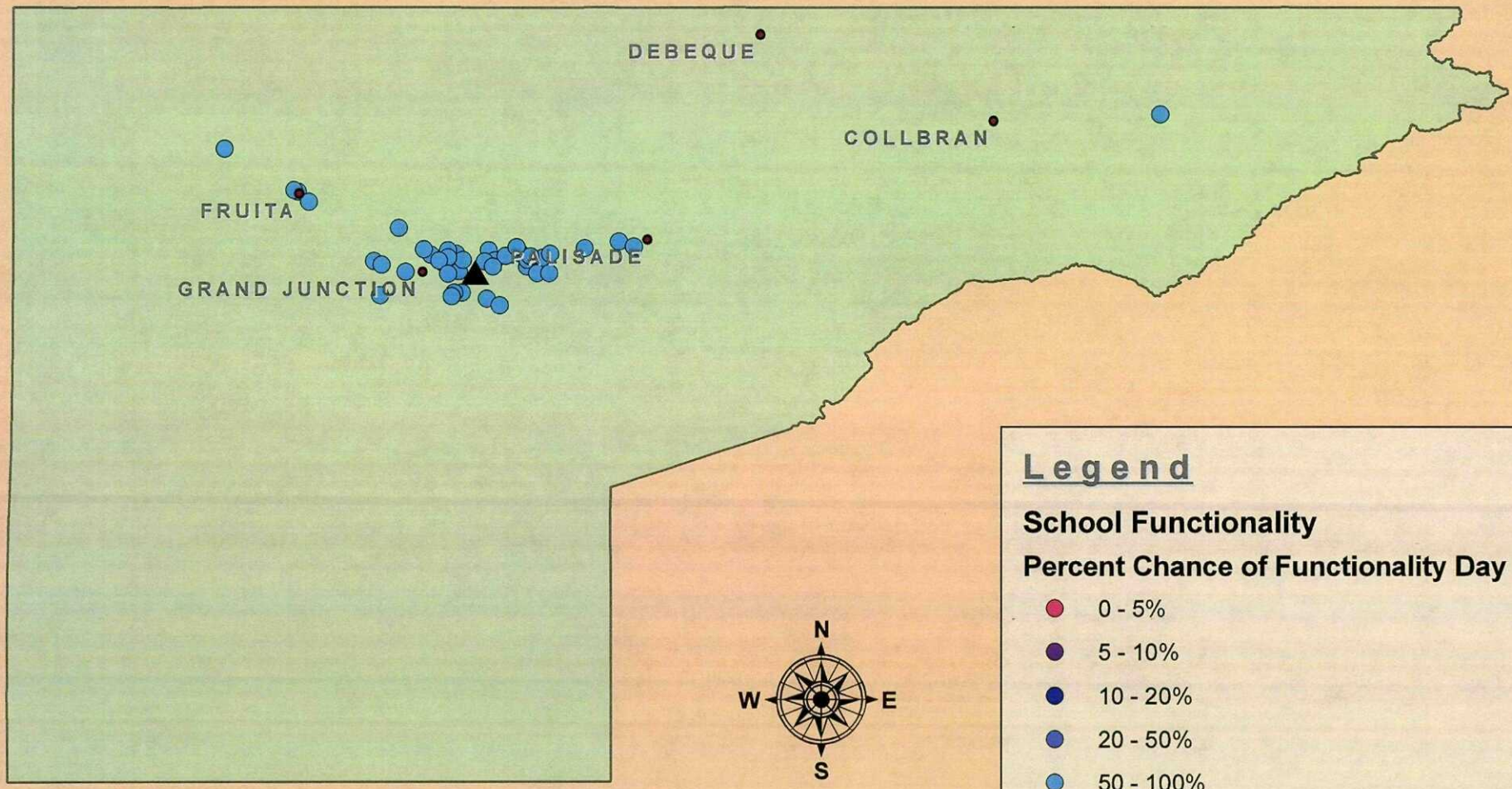
School Functionality

Percent Chance of Functionality Day 30

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

MESA COUNTY HAZUS SCENARIOS

Random Earthquake M 7.0



Legend

School Functionality

Percent Chance of Functionality Day 90

- 0 - 5%
- 5 - 10%
- 10 - 20%
- 20 - 50%
- 50 - 100%
- Background Epicenter
- Cities
- Study Region Boundary

Data CDs

HAZUS MR1 Release
All Regions and Shapefiles
All Results, Reports, and Maps

6 DISCS IN NOTEBOOK

NOT SCANNED

- HAZUS MULTI HAZARD LOSS ESTIMATION SOFTWARE
- HAZUS GIS & MISCELLANOUS EARTHQUAKE FILES
- HAZUS RESULTS 2006
- C01 - BOUNDARY FILES FOR MR1 RELEASE
- HAZUS FINAL REPORT MAY 2006
- HAZUS PRESENTATIONS MAY 2006