SEISMIC PROBABILITY IN LEA COUNTY, NM: A BRIEF ANALYSIS

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While seismic activity in southeastern New Mexico is uncommon, one of the most recent major earthquakes (moment magnitude, Md, > 4.5) in New Mexico occurred south of Eunice on 2 January 1992 (Sanford, et.al. 2002). This earthquake had a moment magnitude of 5.0 on the Modified Mercalli - Revised 1931 (Richter, 1958) scale with its epicenter located at 32.3° N 103.2° W (see Figures 1 and 2).

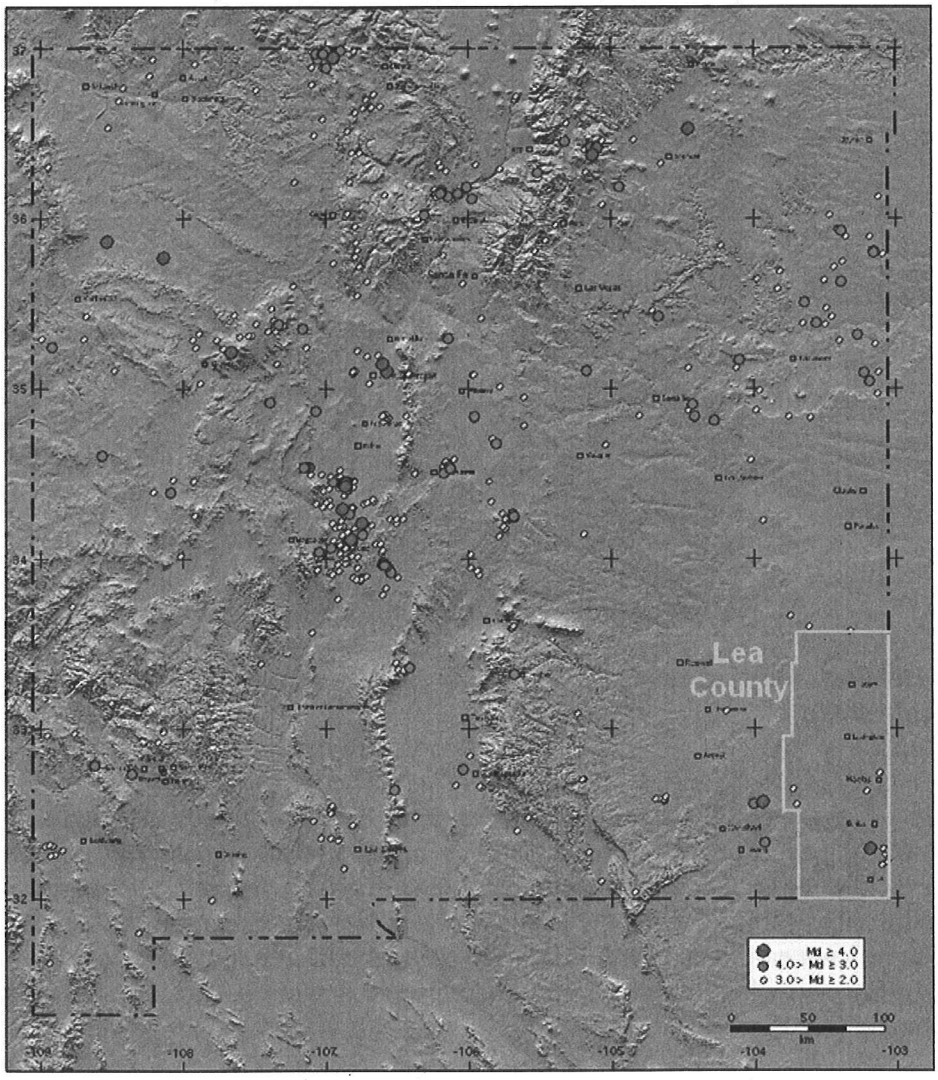

Figure 1. New Mexico earthquakes, 1962-1998, with moment magnitudes, Md, of 2.0 or greater (adapted from Sanford, et.al. 2000).

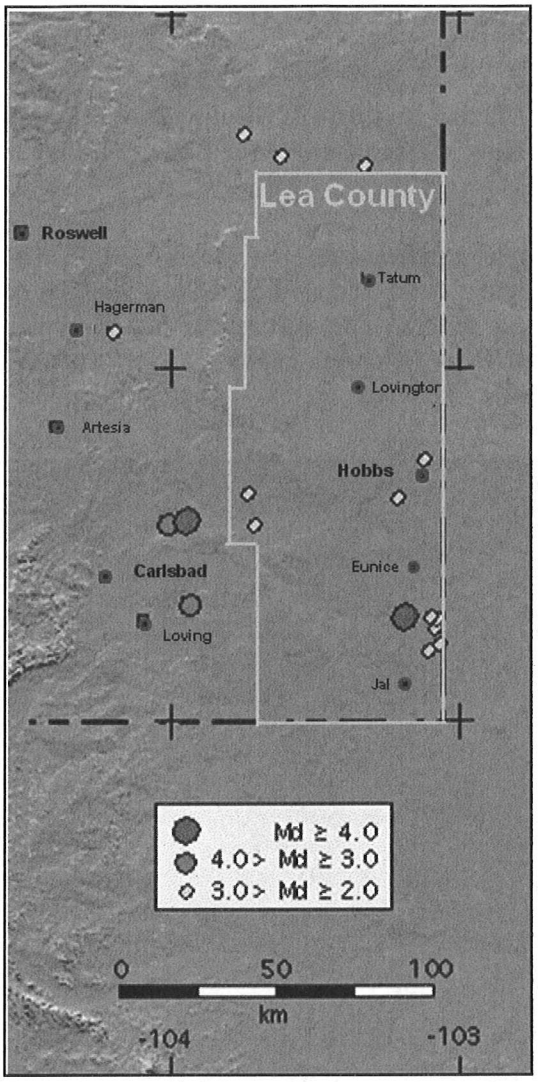

Figure 2. Detailed map showing Lea County earthquakes, 1962-1998 (adapted from Sanford, et.al. 2000).

Table 1 lists the strongest earthquakes that have occurred in New Mexico between 1860 and 1998, including the Eunice earthquake. Only one major earthquake has occurred in New Mexico since 1998 – a moment magnitude 4.9 earthquake located approximately 60 km northwest of the city of Raton, along the Colorado-New Mexico border, on 10 August 2005. The majority of significant earthquakes have occurred along the Rio Grande Rift Zone, particularly in the vicinity of Socorro where exists a large underground magma pocket, known as the Socorro Seismic Anomaly (see Figure 3).

Table 1. Strongest Earthquakes in New Mexico - 1860 through May 1998 (adapted from Sanford, et.al. 2000).

No.	Date			Time		Approximate Location		Maximum intensity	Estimated M_d	Nearby City
	Mon	Day	Year			Lat (N)	Long (W)	(Modified Mercalli)		
1.			1869			34.1	106.9	VII	5.2	Socorro
2.	Sep.	07,	1893			34.7	106.6	VII	5.2	Belen
3.	Oct.	31,	1895	1200		34.1	106.9	VI	4.5	Socorro
4.			1897			34.1	106.9	VI	4.5	Socorro
5.	Sep	10,	1904			34.1	106.9	VI	4.5	Socorro
6.	Jul.	02,	1906	1015		34.1	106.9	VI	4.5	Socorro
7.	Jul.	12,	1906	1215		34.1	106.9	VII to VIII	5.5	Socorro
8.	Jul.	16,	1906	1900		34.1	106.9	VIII	5.8	Socorro
9.	Nov.	15,	1906	1215		34.1	106.9	VIII	5.8	Socorro
10.	Dec.	19,	1906	1200		34.1	106.9	VI	4.5	Socorro
11.	May	28,	1918	1130		35.5	106.1	VII to VIII	5.5	Cerrillos
12.	Feb.	05,	1931	0448		35.0	106.5	VI	4.5	Albuquerque
13.	Feb.	21,	1935	0125		34.5	106.8	VI	4.5	Bernardo
14.	Dec.	22,	1935	0156		34.7	106.8	VI	4.5	Belen
15.	Sep.	17,	1938	1720		33.3	108.5	VI	4.5	Glenwood
16.	Sep.	20,	1938	0539		33.3	108.5	VI	4.5	Glenwood
17.	Sep.	29,	1938	2335		33.3	108.5	VI	4.5	Glenwood
18.	Nov.	02,	1938	1600		33.3	108.5	VI	4.5	Glenwood
19.	Jan.	20,	1939	1217		33.3	108.5	VI	4.5	Glenwood
20.	Jun.	04,	1939	0119		33.3	108.5	VI	4.5	Glenwood
21.	Nov.	06,	1947	1650		35.0	106.4	VI	4.5	Albuquerque
22.	May	23,	1949	0722		34.6	105.2	VI	4.5	Vaughn
23.	Aug.	03,	1955	0639	42	37.0	107.3	VI	4.5	Dulce
24.	Jul.	23,	1960	1416		34.4	106.9	VI	4.5	Bernardo
25.	Jul.	03,	1961	0706		34.2	106.9	VI	4.5	Socorro
26.	Jan.	23,	1966	0156	39	37.0	107.0		4.8	Dulce
27.	Jan.	05,	1976	0623	29	35.9	108.5		4.7	Gallup
28.	Nov.	29,	1989	0654	39	34.5	106.9		4.7	Bernardo
29.	Jan.	29,	1990	1316	11	34.5	106.9		4.6	Bernardo
30.	Jan.	02,	1992	1145	35	32.3	108.2		5.0	Eunice

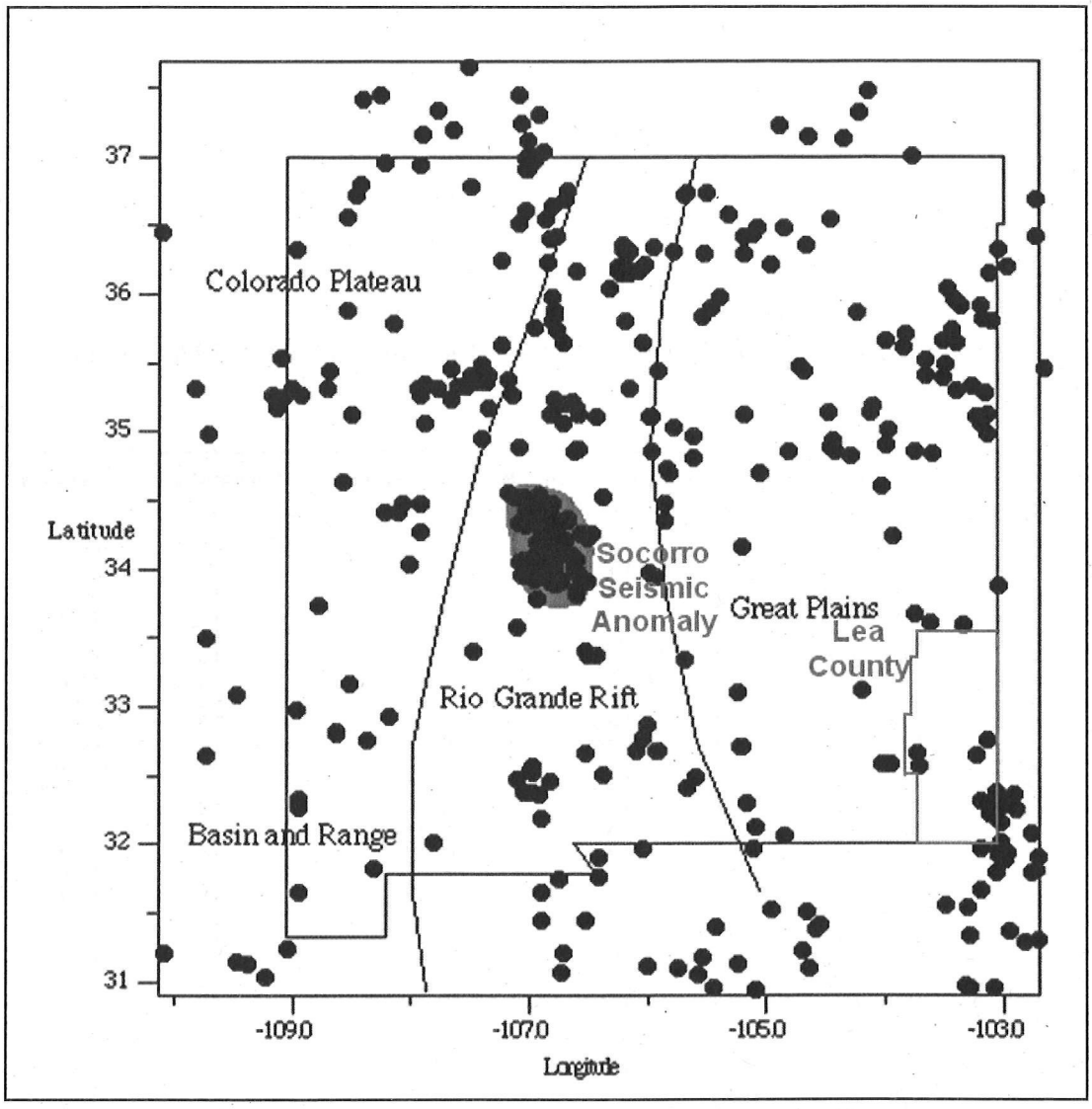

Figure 3. Geographical distribution of earthquakes from 1962 to 1995, having moment magnitudes, Md, ≥ 2 (adapted from Lin, et.al. 1997)

No Quaternary faults or folds - thought to be associated with most earthquakes of moment magnitude 6 or greater over the last 1.6 million years - exist in the southeast New Mexico/west Texas region (http://earthquake.usgs.gov/hazards/qfaults/). Seismic activity in the region appears to be primarily associated with the Central Basin Platform which underlies the oil-rich Permian Basin region. The Central Basin Platform is a long, approximately north-south oriented ridge that divides the Permian Basin into the Delaware Basin to the west and the Midland Basin to the east and has its northern end under Hobbs, NM. Figures 4 is a contour elevation map of the Wolfcamp Formation layer of the Permian Basin and clearly shows the Central Basin Platform. Figure 5 is an east-west geologic cross-section of the Permian Basin.

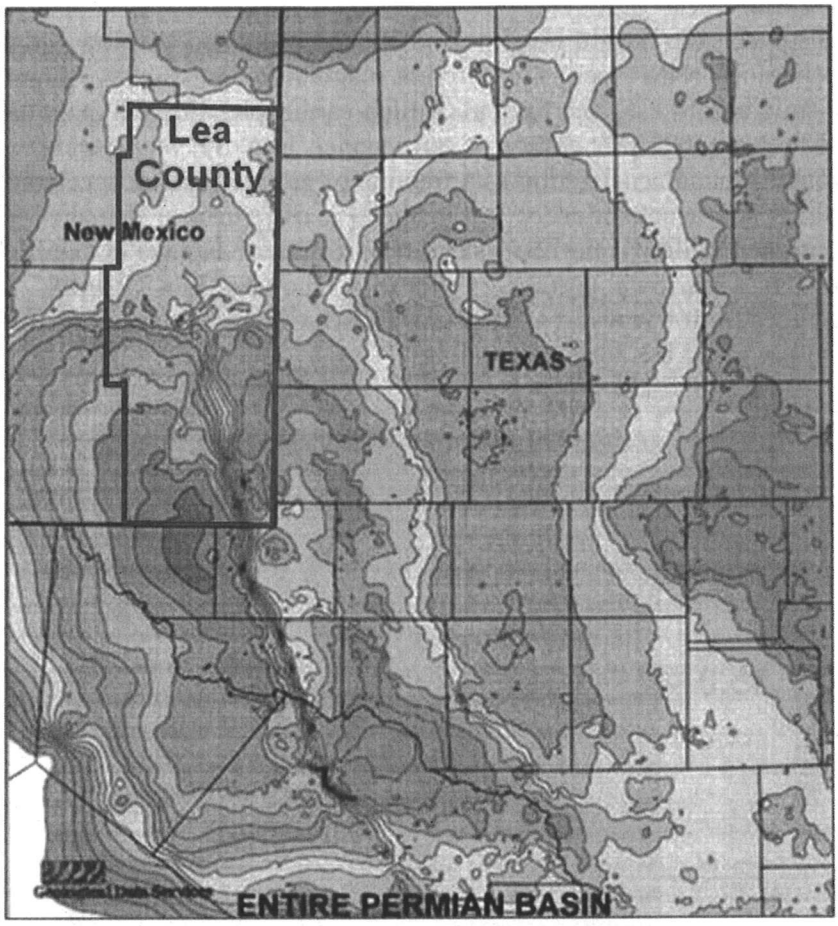

Figure 4. Elevation contour map of Wolfcamp Formation layer underlying the Permian Basin with Lea County, NM, outlined (adapted from http://ceed.utpb.edu; original map generated by Geological Data Services [now IHS, Inc.]).

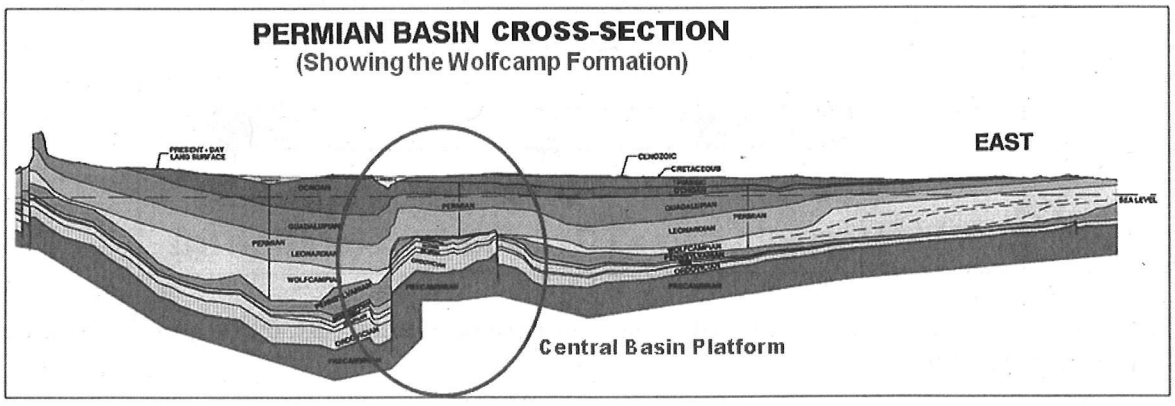

Figure 5. Cross-section of Permian Basin, showing underlying Wolfcamp Formation layer and Central Basin Platform (adapted from http://ceed.utpb.edu).

Probabilistic seismic hazard estimates have been generated by New Mexico Institute of Mining and Technology (NM Tech) for different magnitude earthquakes. Figure 6 shows the probabilistic seismic hazard estimate for a maximum earthquake moment magnitude of 6 for the State of New Mexico (10% probability of exceedance in a 50 year period). The contours represent horizontal ground acceleration as a fraction of *g*, gravitational acceleration. Note that, for a horizontal ground acceleration of 0.2 *g*, the risk of structural damage is minimal for a modern, well-designed building; but the risk of non-structural damage is significant (Lin, et.al. 1996). Figure 7 is a close-up portion of Figure 6, showing Lea County. Seismic hazard increases as one goes from northwest to southeast in Lea County with the exception of a slightly increased probability along the north county line.

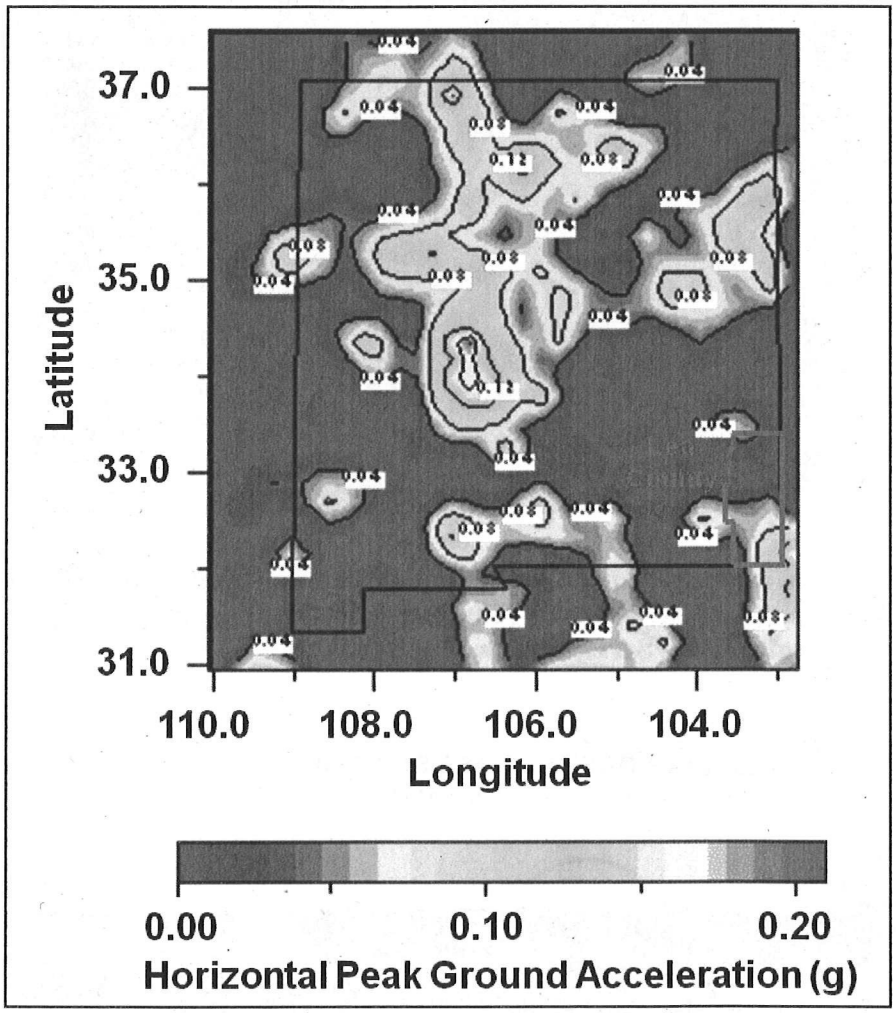

Figure 6. New Mexico seismic hazard for a moment magnitude, Md, 6 earthquake (adapted from Lin, et.al. 1998).

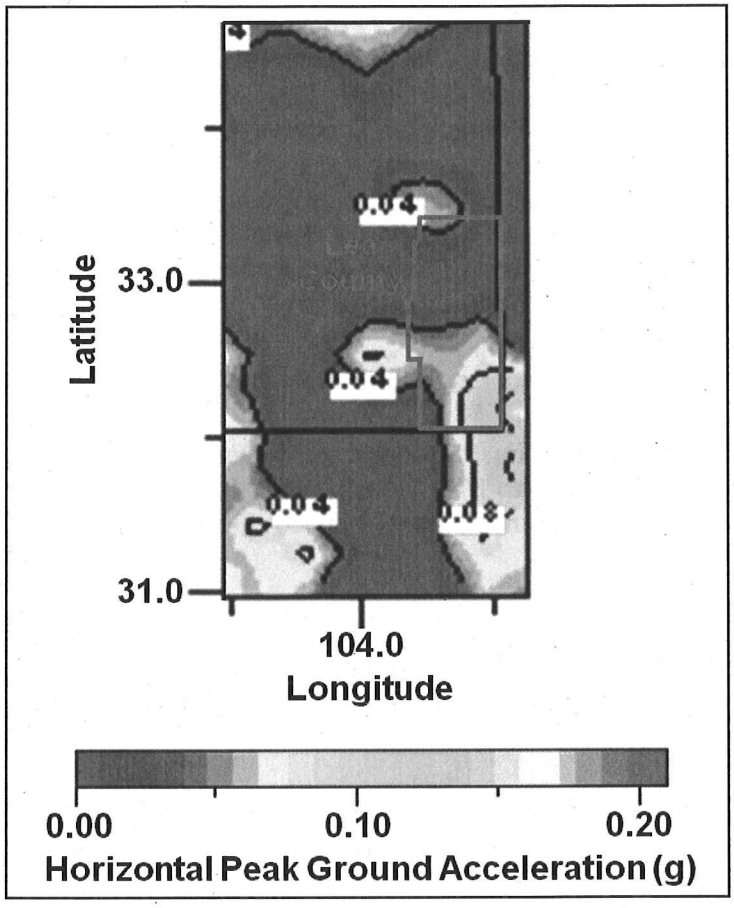

Figure 7. Detailed map showing Lea County seismic hazard for a moment magnitude, Md, 6 earthquake (adapted from Lin, et.al. 1998).

Figures 6 and 7 indicate that the apparent risk of earthquake damage in Lea County is minimal, although the probability of a significant earthquake increases towards the southeastern corner of the County. The average time interval between earthquakes having a moment magnitude of 4.5 or greater in New Mexico is six to seven years (Sanford, et.al. 1998). The expected number of moment magnitude 2.0 or greater earthquakes in New Mexico is 19.1 per year (Sanford, et.al. 2002).

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8. U. S. Geological Survey, Earthquake Hazards Program, Quaternary Fault and Fold Database of the United States web page: http://earthquake.usgs.gov/hazards/qfaults/

9. The University of Texas of the Permian Basin (UTPB), Center for Energy and Economic Diversification (CEED), West Texas Geology, West Texas Structure web page: http://ceed.utpb.edu/geology-resources/west-texas-geology/west-texas-structure/

CAUTION

While the information provided herein may be useful in performing a preliminary seismic risk evaluation of a location within Lea County, NM; it does not purport to predict the future occurrence or magnitude of any earthquake in the region. No liability is assumed by the author or New Mexico Tech for damages that might result from any earthquake in the region.