CHAPTER 15: EARTHQUAKE

2022 PLAN UPDATE

Chapter 15: visual and thematic updates were included throughout the chapter, including updates to fonts, colors, and the addition of a cover page.

Page 15-2: Section 15.2 History, Table 15-2 was updated with two (2) new earthquake events occurring within the previous five year planning period (2017 to 2022). Earthquake data is derived from the Maryland Geological Survey.

Page 15-3: Probable annual average earthquake events was added to Section 15.2. Based on earthquake data from 2000 to 2022, Maryland experiences 0.5 earthquake events annually.

Page 15-3: Section 15.3 County and Municipal Perspective, the 2021 State Hazard Mitigation Plan ranks Somerset County's risk for the earthquake hazard as "Low." The Somerset County HMPC also ranks the earthquake hazard as "Low."

Page 15-4: Section 15.4 Earthquake Risk and Vulnerability, the two figures in this section (Figure 15-1 and 15-2) were updated with the most recent mapping from the USGS – 2018.

Page 15-6: Figure 15-3 Frequency of Damaging Earthquake Shaking Around the U.S. was added to Section 15.5.

Page 15-7: Added Section 15.7 Future Conditions. Somerset County is located in a low-risk zone for earthquakes. It is unlikely that the frequency of earthquakes will increase (or change at all) to any appreciable degree.

Chapter 15: Earthquake

15.1 Hazard Profile

An earthquake is ground shaking caused by a sudden movement of rock in the earth's crust. Such movements occur along faults, which are thin zones of crushed rock separating blocks of crust. When one block suddenly slips and moves relative to the other along a fault, the energy released creates vibrations called seismic waves that radiate up through the crust to the earth's surface, causing the ground to shake.

Earthquakes are measured by their Mercalli magnitude and their intensity. The Modified Mercalli Intensity Scale describes the severity of earthquake effects. It is a ranking based on observed effects that people will experience and find relatable. The lower numbers of the intensity scale generally deal with the way the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above. Table 15-1 describes these measurements.

Table 15-1: Mercalli Intensity Scale Value Descriptions

Intensity	Richter Magnitude	Shaking	Description/Damage	Average Estimated Annual Frequency
I	<2.0 – 2.9	Not Felt	Not felt except by a very few under especially favorable conditions.	Continual/several million per year
II		Weak	Felt only by a few persons at rest, especially on upper floors of buildings.	Over one million per year
III	3.0 – 3.9	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.	Over 100,000 per year
IV		Light	Felt indoors by many, outdoors by a few during the day. At night, some will be awakened. Dishes, windows, and doors disturbed; walls may make cracking sound. Sensation like a heavy truck striking a building. Standing motor cars rocked noticeably.	
V	4.0 – 4.9	Moderate	Felt by nearly everyone; many awakened. Some dishes/windows broken. Unstable objects overturned. Pedulum clocks may stop.	10,000 to 15,000 per year
VI		Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage is slight.	
VII	5.0 – 6.9	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	1,000 to 1,500 per year
VIII		Severe	Damage slight in specially designed structures;	

Table 15-1: Mercalli Intensity Scale Value Descriptions				
Intensity	**Richter Magnitude**	**Shaking**	**Description/Damage**	**Average Estimated Annual Frequency**
			considerable damage in ordinary substantial buildsings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	
IX		Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	100 to 150 per year
X	7.0 – 9.0 and greater	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	One per year
Source: U.S. Geological Survey (USGS).				

15.2 History

In general, earthquakes with an epicenter in Maryland are a rare occurrence, especially events with high intensity and/or magnitude. In most cases, earthquakes that are felt in Maryland occur in adjacent states, such as Virginia or Pennsylvania. Table 15-2, following, details earthquake events within and around Maryland that have occurred in the past 20 years.

Table 15-2: Earthquake Events, 2000 to 2022			
Date	**General Location**	**Intensity**	**Magnitude**
2001/12/18	Columbia near US29-MD32	II	1.5-2.0 (est)
2002/03/22	Columbia near US29-MD32	I	1-2 (est.)
2003/12/09	28 miles west of the Richmond in rural Powhatan County, VA	VI	4.5
2005/02/23	Southeastern Baltimore near Fort McHenry, Dundalk, Glen Burnie, Pasadena, Gambrills	VI	2.0-2.1
2008/12/27	6 miles west of Lancaster, PA.	IV	3.4
2009/07/01	Southwestern New Jersey	III	2.8
2009/09/29	4 miles NNE (15°) from Bel Air North, MD	II	1.6
2010/07/16	Potomac-Shenandoah Region, MD	V	3.4
2011/08/23	5 miles SSW (195°) from Mineral, VA	V-VI	5.8
2017/10/30	Glenelg, Maryland	I	1.52
2017/11/11	0.5 miles ESE of Roxbury, MD	I	1.5
Source: Maryland Geological Survey, 2000 to July 2022.			

The most recent nearby earthquake event struck Roxbury, Maryland on November 11, 2017, with a magnitude of 1.5. The earthquake was approximately 104 miles northwest of the Town of Princess Anne in Somerset County. The most recent earthquake to be felt in Somerset County occurred in Mineral, Virginia on August 23, 2011. The earthquake, which was magnitude 5.8, was felt throughout the County and several structures sustained minor damage.

Based on the data in Table 15-2 from the Maryland Geological Survey (MGS), a total of eleven (11) earthquake events have impacted Maryland since 2000. This means that Maryland and Somerset County potentially experiences approximately 0.5 earthquake events per year, or about one earthquake every two years.

15.3 County and Municipal Perspective

The 2021 State Hazard Mitigation Plan ranks Somerset County's risk for the earthquake hazard as "Low." The Somerset County HMPC ranks the earthquake hazard as "Low" risk as well.

Earthquake impacts would be experienced county-wide upon occurrence, including both municipalities and all communities. As shown on figures presented in this chapter, Somerset County is in a low-risk earthquake zone; furthermore, were an earthquake to occur, Somerset County is located within a low shake impact area. That being stated, enforcement of building codes and proper construction techniques would assist in mitigating potential earthquake impacts.

The following list provides potential impacts from a community perspective due to earthquakes:

Health & Safety of the Public
- Looting
- Bodily Harm
- Evacuation of Vulnerable Population
- Risk of Fire

Health & Safety of the First Responders
- Falling Debris
- Biohazard
- Inability to go where they are needed
- Risk of Fire

Continuity of Operations (including Delivery Services)
- Structural damage to Police/Fire equipment
- Transportation Network Damage (i.e., roads)
- Cell Towers/Radio Operations

Property, Facilities, & Infrastructure
- Structural Damage
- Cell Phone Infrastructure
- Water Treatment Plant Damage

Environment
- Pipe Ruptures/Gas Lines/Water Mains

Economic Conditions
- Cost of rebuilding structures & infrastructure
- Looting
- Loss of Commercial Industry

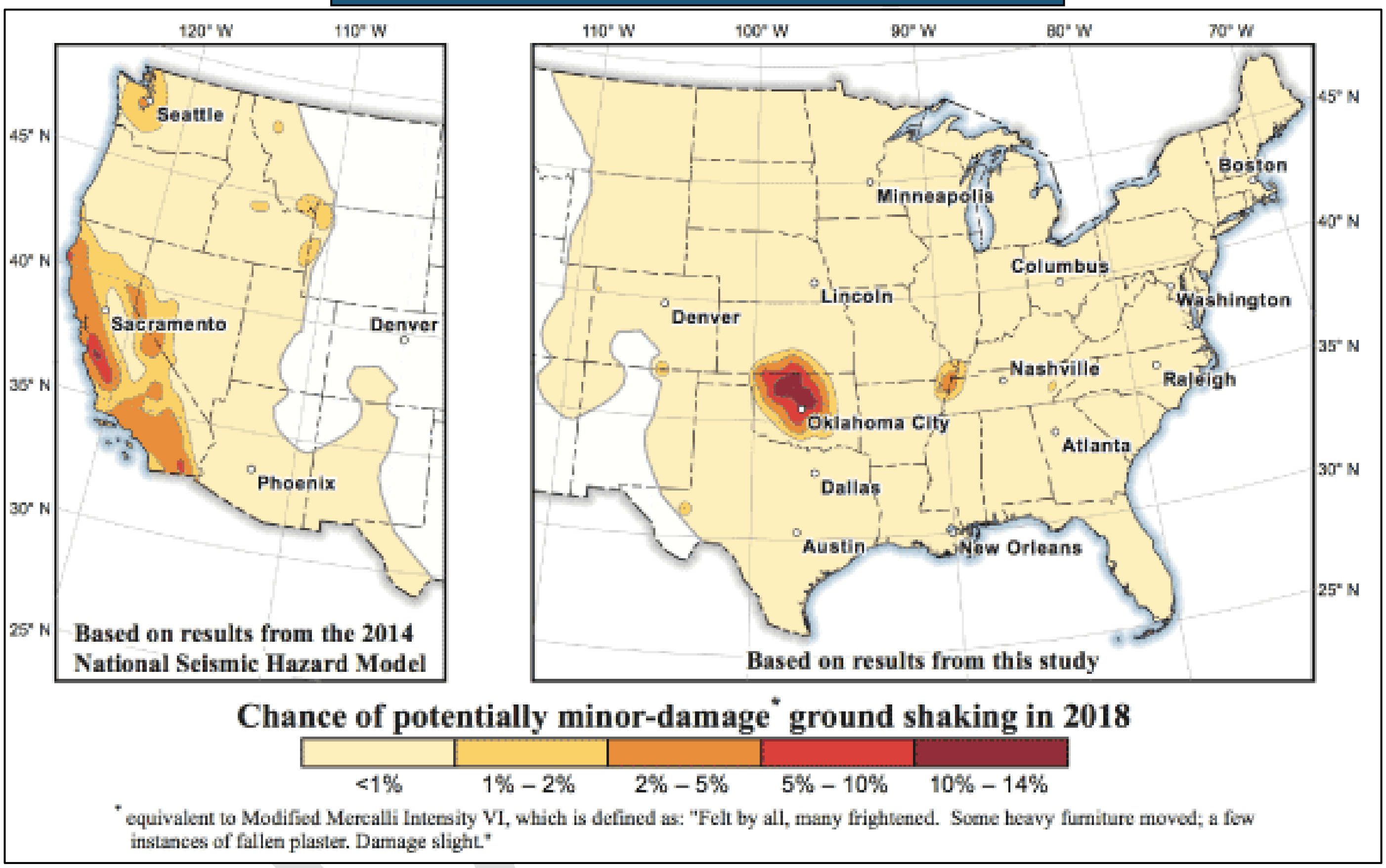
Public Confidence in Government
- Communication to Public

15.4 Earthquake Risk and Vulnerability

According to the Federal Emergency management Agency (FEMA), seismic hazard levels differ significantly across the United States, both between and within states.

The U.S Geological Survey (USGS) has produced a one-year, 2018 seismic hazard forecast map for the central and eastern United States from induced and natural earthquakes that updates the 2017 one-year forecast. This map is intended to provide information to the public and to facilitate the development of induced seismicity forecasting models, methods, and data. The 2018 hazard model applies the same methodology and input logic tree as the 2017 forecast, but with an updated earthquake catalog. As depicted by Figure 15-1, below, it was predicted that the eastern United States, Maryland specifically, had less than a 1-percent chance of receiving earthquake damage in 2018. For planning purposes, it may be assumed that this rate will remain relatively constant in the future.

Figure 15-1: Forecast for Earthquake Damage, 2018

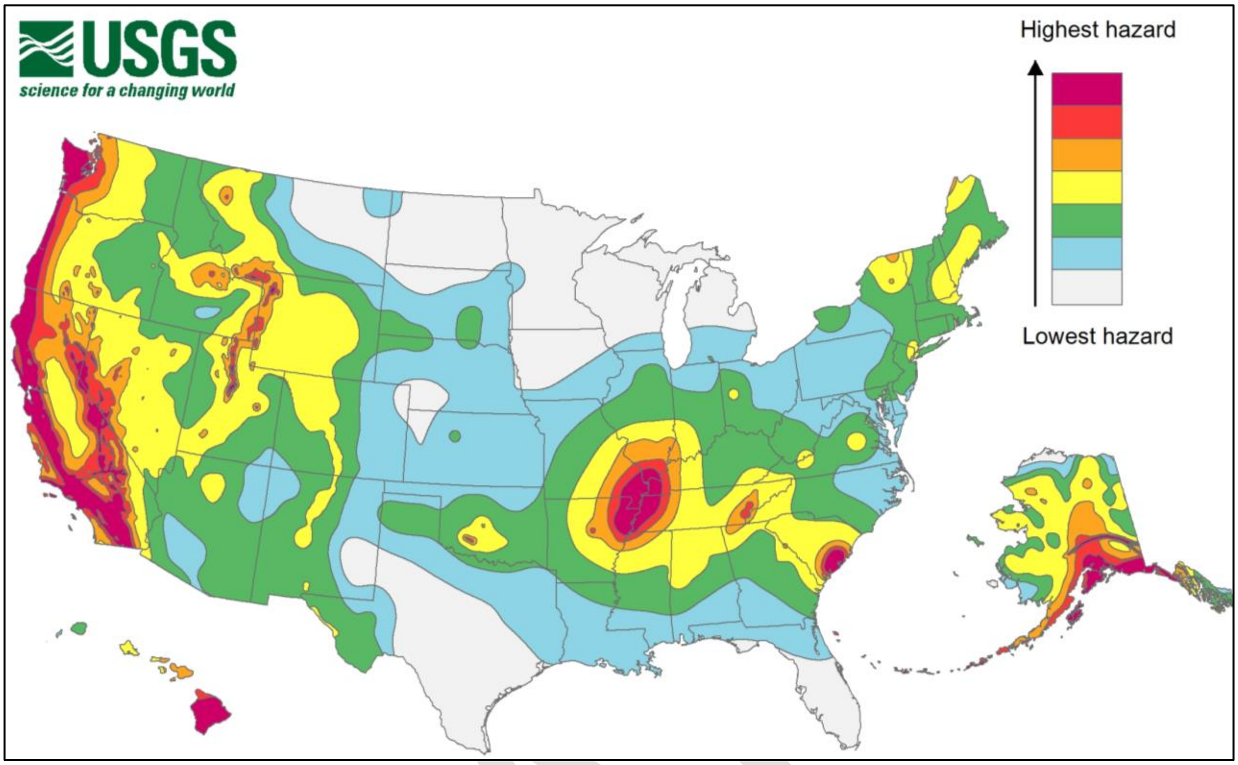


Source: United States Geological Service, 2018.

The following excerpt contains USGS Long-Term 2018 Model information, which indicates that Somerset County is located within an earthquake low-risk area. Figure 15-2 further illustrates Maryland's status as a low-risk area.

> "The 2018 Update of the U.S. National Seismic Hazard Model defines the potential for earthquake ground shaking for various probability levels across the conterminous United States and is applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. The updated model represents an assessment of the best available science in earthquake hazards and incorporates new findings on earthquake ground shaking, seismicity, and long-period amplification over deep sedimentary basins. The new model represents an update of the seismic hazard model; previous versions were developed in 1996, 2002, 2008, and 2014."

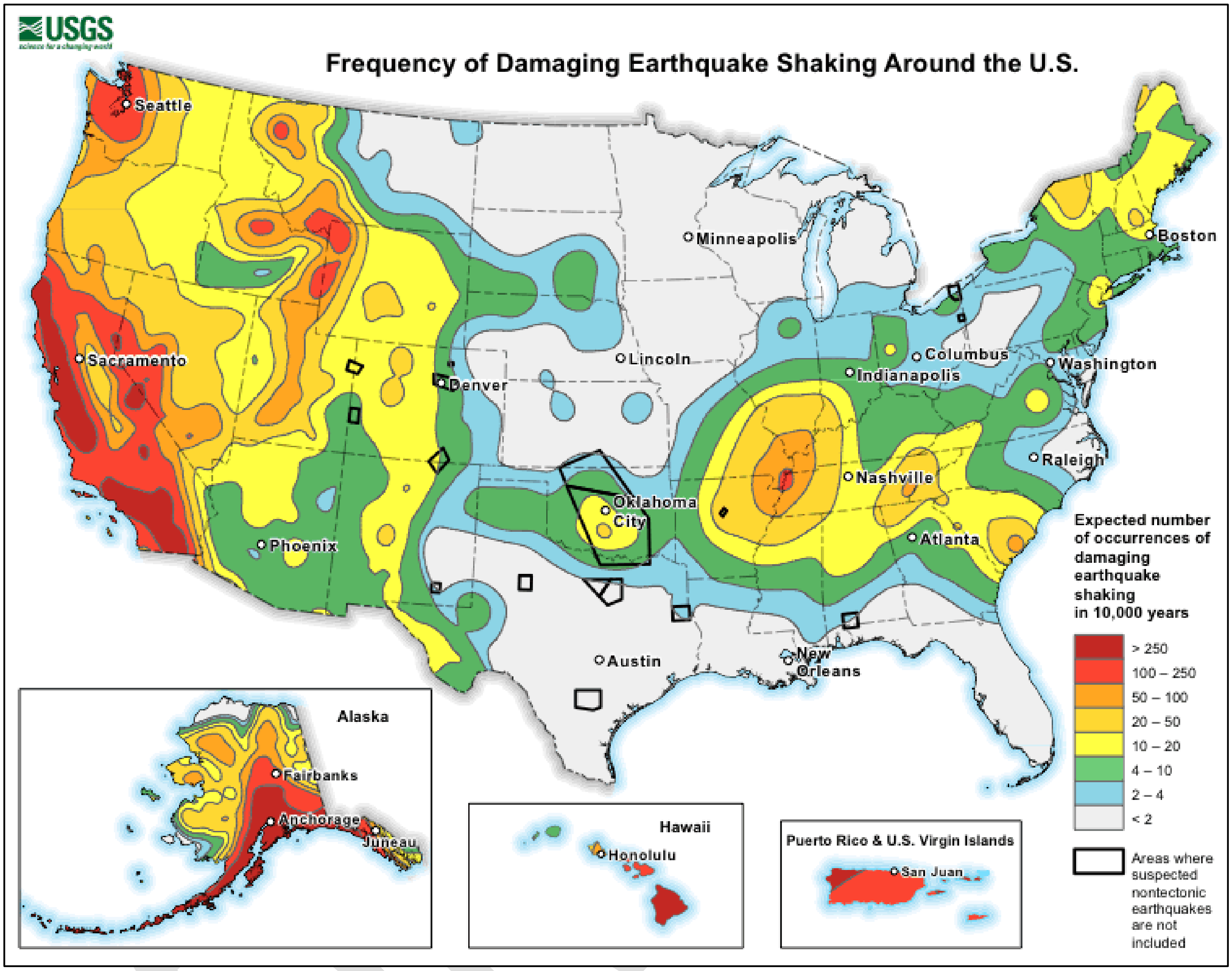
Figure 15-2: U.S. Earthquake Seismic Hazard Map, 2018



Source: United States Geological Service, 2018

According to FEMA E-74, *Reducing the Risk of Nonstructural Earthquake Damage – a Practical Guide* (December 2012), due to the low risk of earthquake and minimal to low potential for shaking due to seismic activity, the need for seismic anchorage and bracing of non-structural components is not necessary. However, if a non-essential facility is located in a low frequency of damaging shaking area (depicted on Figure 15-3), then only parapets and exterior unreinforced masonry walls should be considered for seismic retrofit.

Figure 15-3: Frequency of Damaging Earthquake Shaking Around the U.S.



Source: United States Geological Service, 2014

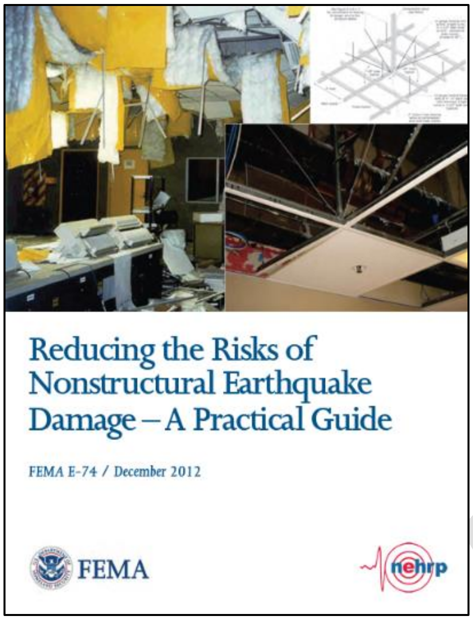
15.5 Mitigation Efforts

According to the FEMA E-74, *Reducing the Risk of Nonstructural Earthquake Damage – a Practical Guide* (December 2012), essential facilities located in a low-level shaking area may want to consider seismic retrofit. An excerpt from the guide states:

"The first step toward reducing the nonstructural hazards in an existing building is to perform a survey to assess the extent and magnitude of the potential risks. This chapter includes survey guidelines for nonstructural components and describes the inventory form, the checklist, and the risk ratings that are included in the appendices. To make informed decisions regarding nonstructural seismic risks, owners and managers will need to address the following questions:

1. What types of nonstructural components are present in a facility?
2. Are these items adequately braced or anchored?

3. How will a specific nonstructural item perform in an earthquake, and what are the consequences of failure of that item in terms of life safety, property loss, and functional loss?
4. If the decision is made to upgrade a facility, which problems should be addressed first?



The focus of this guide is on reducing nonstructural seismic hazards, particularly in those areas where the seismic shaking intensity is expected to be moderate or high and where significant structural hazards do not exist or will be addressed independently. If the expected shaking for the facility in question is minimal, then the survey procedures and seismic protection measures described in this guide might be undertaken on a voluntary basis but may not be necessary, and in most cases, they would not be required for new construction."

The complete guide can be accessed here: www.fema.gov/emergency-managers/risk-management/earthquake/training/fema-e-74.

15.6 Future Conditions

Data compiled by the National Oceanic and Atmospheric Administration (NOAA) shows that the number of earthquakes per year has seen significant variation, but the overall trend shows an increasing frequency. However, it should be noted that a century-based timeframe is minuscule compared with geological timescales that run into millions of years. Therefore, the increased frequency of earthquakes does not necessarily point towards a geological change.

One likely explanation for this is that earthquake detection centers have become more advanced and span the globe, and so are more likely to pick up on seismic activity. Along with an increase in the number of earthquakes, the NOAA data shows a decline in the frequency of high-intensity earthquakes (i.e., above six in magnitude). This suggests that there has been an increase in the frequency of low-intensity tremors around the world – which further reinforces the idea that better equipment allows us to record more earthquake events.

For low-risk earthquake areas such as Somerset County, it is highly unlikely that the annual frequency of earthquake events (the County currently experiences 0.5 per year, on average) will change to any appreciable degree.