ARKANSAS SEISMIC NETWORK

HOBBS STATE PARK AND CONSERVATION AREA HAS AN EARTHQUAKE MONITORING STATION!

Overview

Public awareness on the occurrence of earthquakes in the United States has tended to be focused on California, Alaska, or the western United States in general. HOWEVER, Arkansas has had its share of earthquake activity and an area known as the New Madrid seismic zone (NMSZ) puts Arkansas and surrounding states at a significant risk for future earthquakes. Named for a small town in Missouri on a bend of the Mississippi River (see Figure 1), the NMSZ is an active fault system that extends northward from around Marked Tree in northeastern Arkansas to near Cairo in southern Illinois. In the winter of 1811-1812, a series of at least three catastrophic earthquakes with estimated magnitudes greater than 7.0 rattled the region. Cabins collapsed, people were frightened, and there was widespread land deformation. The NMSZ remains active and scientists believe it is still capable of producing large and damaging earthquakes. On average, there is an earthquake on the NMSZ every other day, though most are too small to be felt. The felt threshold for earthquakes is generally above a magnitude 2.5, though there can be exceptions.

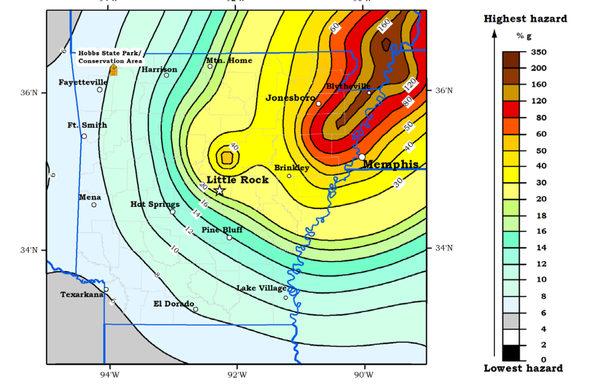
Prior to 2010, most of the seismic stations in Arkansas were concentrated around the NMSZ in northeast Arkansas. However, earthquakes can occur at any time across the entire state. In 2008, a series or "swarm" of small earthquakes struck near Magnet Cove in Hot Spring County. An earthquake swarm is a series of earthquakes that occur in a localized area over a relatively short period of time. The Magnet Cove Swarm, coupled with the seismic risk that continues to be posed by the NMSZ, served as the impetus for the establishment of the Arkansas Seismic Network (ASN). The ASN consists of six state-of-the-art permanent broadband seismic stations strategically placed within selected state parks across Arkansas. The ASN was funded through the Arkansas Governor's General Improvement Fund in 2008. The goal of the ASN is to establish better and more uniform earthquake detection outside of the NMSZ throughout the state. The network was installed in the spring of 2010 and is seamlessly integrated with the regional and national seismic networks. The ASN was assigned the code of **AG** within the Advanced National Seismic System (ANSS). The ASN is operated and maintained in cooperation with the Arkansas Geological Survey (AGS), Center for Earthquake Research and Information (CERI) at the University of Memphis, and Arkansas State Parks. Since its installation, the ASN has recorded seismic activity such as the Guy-Greenbrier swarm in Faulkner County.

The ASN stations are located within state parks because these properties are owned by the State of Arkansas and the visitor centers have internet access. Internet access allows the seismic data generated at the station to be efficiently transmitted to CERI and the National Earthquake Information Center (NEIC) in Denver, Colorado for processing. Because of vehicular traffic and other human causes of vibrations or "noise" common in the immediate area of the park visitor centers, the stations were installed in remote or relatively quiet areas of the parks away from the visitor centers. The remoteness of the sites requires the seismic stations to be equipped with a radio transmitter and directional antenna which allows wireless transmission of the continuous stream of seismic data to a receiving antenna mounted at each of the visitor centers. The Hobbs seismic station is located approximately 1,150 feet south-southwest of the park visitor center. Its ASN network acronym is **HHAR**. The AG network can be accessed via the AGS or CERI websites.

Each ASN station consists of an above-ground equipment enclosure with a partially buried fiberglass vault located no more than twenty feet away. The above-ground equipment enclosure is weather-tight and contains a digitizer, radio transmitter, and four 12-volt batteries. Two south-facing solar panels mounted directly above the enclosure keep the batteries charged, ensuring that the seismic instrumentation will operate on a continuous basis (Figure 3). Ideally, the hole for the vault is excavated to the top of bedrock, however, this is not always possible due to the local geologic conditions at the site. Seismic instrumentation installed in the fiberglass vault includes a broadband seismometer and accelerometer. The seismometer is a digital version of the traditional seismograph which senses vibrations over a large range of seismic wave frequencies or bands. An accelerometer is a special type of seismometer which is also known as a "strong motion" sensor. Strong ground motion is the engineers' measure of an earthquake's size. Accelerometers measure the movement of the ground at a particular site in terms of a percentage of gravity (g). Wiring that supplies power to the vault and cables that convey seismic data from the vault to the above-ground equipment enclosure are run through a two-inch PVC conduit with a burial depth of approximately six inches. A removable lid is bolted down on top of the vault after instruments are installed. Like the above-ground equipment enclosure, the fiberglass vault is weather-tight to protect the instruments from moisture intrusion.

Arkansas Seismic Hazard Map

Figure 2

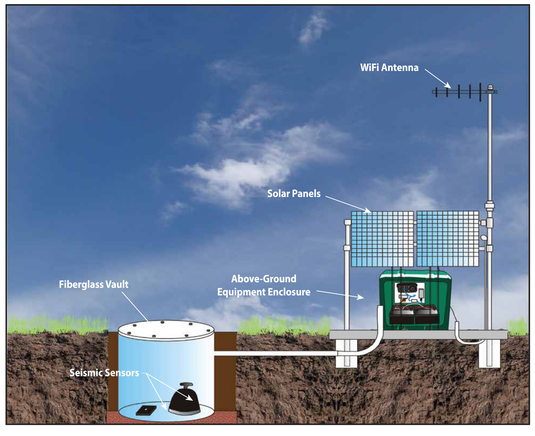


Seismic Hazard is expressed as peak ground acceleration (PGA) on firm rock, in percent g, expected to be exceeded in a 50 year interval with a probability of two percent Source: National Seismic Hazard Mapping Project (2014)

NOTE: **g** denotes acceleration of gravity

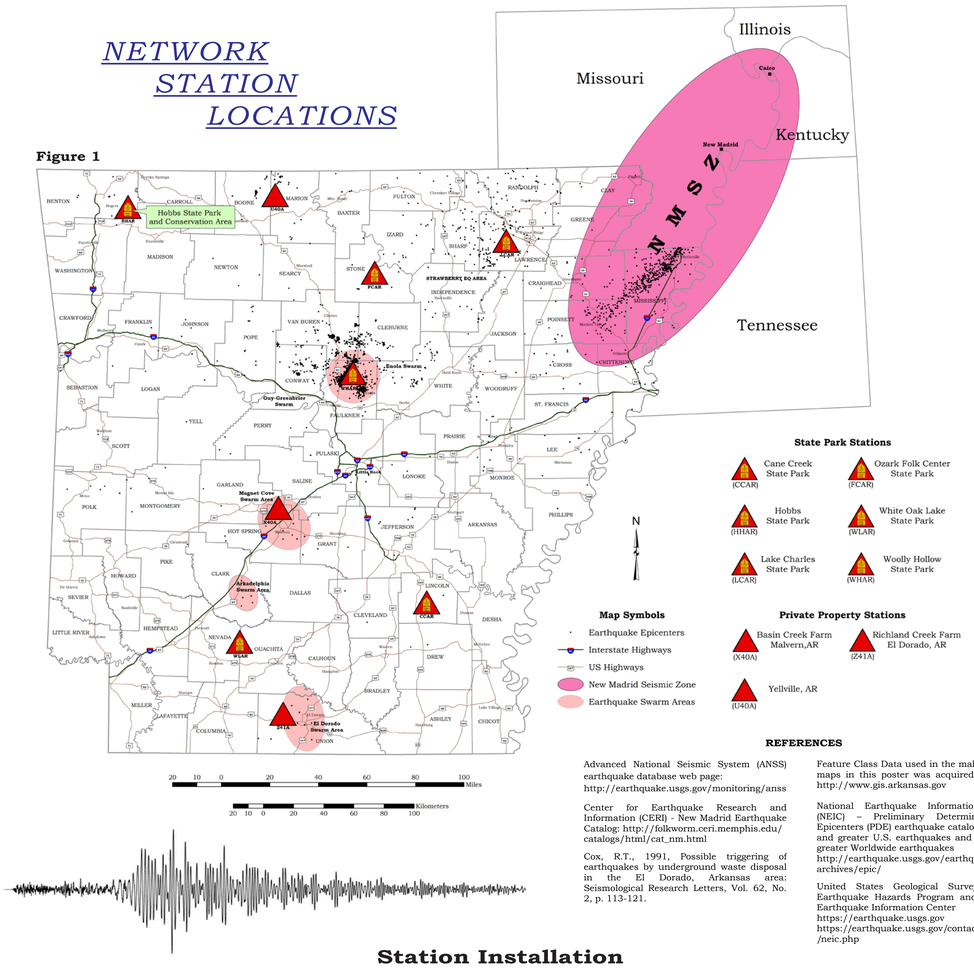
Seismic Station Schematic

Figure 3



NETWORK STATION LOCATIONS

Figure 1



Station Installation

PLATE 1

Excavating 3 ft. Deep Hole For Placement of 3 x 3.5 ft. Cylindrical Fiberglass Vault

PLATE 4

Placing Fiberglass Vault Below-Ground

PLATE 7

Backfilling Around Fiberglass Vault

PLATE 2

Leveling Form For Above-Ground Equipment Enclosure's Concrete Pad

PLATE 5

Pouring Concrete Pad For Above-Ground Equipment Enclosure

PLATE 8

Placing Seismometer In Fiberglass Vault

PLATE 3

Interior of Above-Ground Equipment Enclosure

PLATE 6

Installing WiFi Receiving Antenna At Visitor Center

PLATE 9

Installation Team

REFERENCES

Advanced National Seismic System (ANSS) earthquake database web page: http://earthquake.usgs.gov/monitoring/anss

Center for Earthquake Research and Information (CERI) - New Madrid Earthquake Catalog: http://folkworm.ceri.memphis.edu/catalogs/html/cat_nm.html

Cox, R.T., 1991, Possible triggering of earthquakes by underground waste disposal in the El Dorado, Arkansas area: Seismological Research Letters, Vol. 62, No. 2, p. 113-121.

Feature Class Data used in the making of the maps in this poster was acquired online at http://www.gis.arkansas.gov

National Earthquake Information Center (NEIC) – Preliminary Determination of Epicenters (PDE) earthquake catalog for M2.5 and greater U.S. earthquakes and M4.5 and greater Worldwide earthquakes http://earthquake.usgs.gov/earthquakes/eqarchives/epic/

United States Geological Survey (USGS) Earthquake Hazards Program and National Earthquake Information Center https://earthquake.usgs.gov https://earthquake.usgs.gov/contactus.golden/neic.php

Completed Seismic Station Installation Hobbs State Park-Conservation Area

Helicorder Displays: Digital seismogram from ASN seismic stations. Two displays are generated each day (AM and PM)

Go to AGS Website to view near real-time displays: http://www.geology.ar.gov

Figure 4

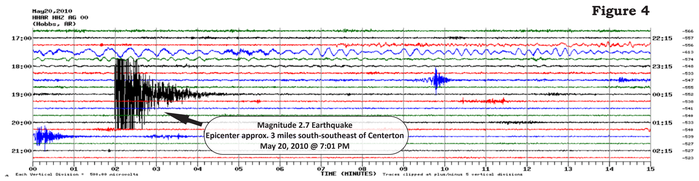
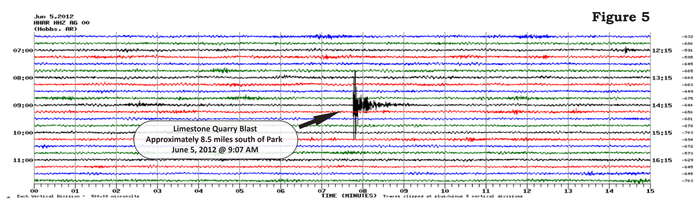
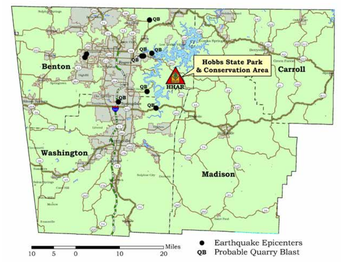


Figure 5



Area Seismicity

Figure 6



As depicted on the seismic hazard map at the far left (Figure 2), northwest Arkansas has a relatively low seismic hazard risk. A total of nine earthquakes have been reported by the United States Geological Survey (USGS) in the area that includes Benton, Carroll, Madison, and Washington Counties (see Figure 6 above). All nine earthquakes occurred in 2010, and each measured at less than 2.7 in magnitude. These earthquakes were recorded shortly after the Hobbs station went online. At this time, only two are believed to have been natural earthquakes: a magnitude 2.5 event that occurred on April 29, 2010 with its epicenter near Centerton in Benton County and a magnitude 2.6 event that occurred on May 20, 2010, also with its epicenter near Centerton. Both events were felt throughout Benton County and parts of Washington County with many people reporting that their homes shook and were accompanied by what sounded like an explosion.

The remaining seven events recorded by the USGS, two in Washington County and five in Benton County, are suspected to be associated with blasting that occurred at local limestone quarries. For example, a magnitude 2.0 earthquake that was reported by the USGS on September 10, 2010 with its epicenter two miles south-southwest of the Hobbs visitor center was deleted by the USGS after it was discovered that a nearby quarry had detonated a blast at the same time. Such event misidentification can occur because the seismic signature of a quarry blast has many of the characteristics of a small, nearby earthquake. Additionally, it's important to make the distinction that these "earthquakes" were not triggered by the quarry blasts, rather the seismometer detected the surface vibrations (i.e., seismic waves) produced by the blast. These seismic waves will travel away from the site of detonation in all directions. As with the seismic signature of a nearby earthquake, there is typically an abrupt onset followed by an exponential decay of the seismic waves generated by a blast. However, in most instances, a detailed computer evaluation or "waveform analysis" of a seismic signature allows researchers and seismologists to distinguish between a true earthquake and a quarry blast. Furthermore, the area quarries typically blast only on weekdays and the time frame is generally between 10:00 AM and 2:00 PM.

The first digital seismogram or helicorder display above (Figure 4) highlights the seismic signature of the April 29, 2010 magnitude 2.5 earthquake that occurred near Centerton. The second helicorder display (Figure 5) shows a confirmed quarry blast signature that resulted from the detonation of an explosive charge at a nearby quarry on June 5, 2012. There are currently four active quarries within ten miles of the Hobbs station.

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