

# EARTHQUAKES IN OKLAHOMA

## FREQUENTLY ASKED QUESTIONS

### Q. What is ‘induced seismicity’?

Induced seismicity is when human activities cause or contribute to earthquakes. The term is often used interchangeably with “triggered seismicity.” A number of human activities can result in earthquakes, including water or other fluids injected in underground wells (wastewater disposal), geothermal energy production (capturing energy from the earth’s natural temperature—hot or cold), and even reservoir impoundment such as constructing a dam to build a lake. Most induced seismic events are small and pose no risk to the public, and many cannot be felt.

### Q. Is hydraulic fracturing (fracking) causing the increased earthquakes in Oklahoma?

No, the earthquakes are not believed to be linked to hydraulic fracturing (fracking). Scientists are more closely studying a separate process – wastewater disposal – as a possible cause of the increased seismic activity. According to the **National Research Council**, “Hydraulic fracturing a well as presently implemented for shale gas recovery does not pose a high risk for inducing felt seismic events.”

### Q. What role do wastewater disposal wells play in Oklahoma’s recent seismic activity?

In Oklahoma, there are approximately 4,000 disposal wells used for oil and natural gas wastewater, and disposal has been used in the state for more than half a century. Experts believe that recent earthquakes could potentially be linked to a handful of these wells. According to the **Office of the Oklahoma Secretary of Energy and Environment**, “The Oklahoma Geological Survey has determined that the majority of recent earthquakes in central and north-central Oklahoma are very likely triggered by the injection of produced water in disposal wells.”

However, it’s worth noting that **wastewater volumes** in Oklahoma were actually about 30 percent higher in the 1980s than they have been in recent years, yet there were only a handful of recorded earthquakes in Oklahoma during that time. Data are sparse for that period, and some scientists have suggested that much of the water may have been injected into wells used for enhanced oil recovery (EOR). Regardless, this underscores the fact that any link between wastewater injection and seismicity is highly complex, and due to a variety of factors that are often site specific.

The overall risk of seismicity from wastewater disposal is low. The **U.S. Geological Survey** says that, of the 40,000 disposal wells used for oil and natural gas wastewater in the United States, “only a small fraction of these disposal wells have induced earthquakes that are large enough to be of concern to the public.” This is why scientists and regulators have stressed that effectively addressing induced seismicity requires a local or site-by-site approach.

### Q. Where are the earthquakes occurring in Oklahoma?

The Oklahoma Corporation Commission has identified “**Areas of Interest**” where most of the earthquake activity is occurring: central and north central Oklahoma. In these areas, there are high-volume and low-volume disposal wells, although similar wells operate in other parts of the state that are not experiencing an uptick in seismic activity. Also, according to **Reuters**, several earthquakes have “occurred in the Oklahoma City metropolitan area, where there are no high-volume wastewater injection wells.”

The Oklahoma Independent Petroleum Association (OIPA) has also **noted**: “Because crude oil and natural gas is produced in 70 of Oklahoma’s 77 counties, any seismic activity within the state is likely to occur near oil and natural gas activity.”

## Q. Are earthquakes in Oklahoma a new phenomenon?

No. There's a **long history** of seismic activity in Oklahoma, with the first known earthquake occurring in 1400, and another significant one in 1918. In regards to the recent uptick in earthquakes, the Oklahoma state geologist **has cautioned** that there were "zero seismograph stations prior to late 1970s" in the state, and now there are many. This suggests that recent observations about increased seismic activity may be due in part to the increased ability to detect when those events occur.

Earthquakes occur where there are faults and Oklahoma has a significant number of known subsurface faults. Earthquakes can be triggered by both natural and manmade activities. In order to either trigger or induce an earthquake, there must be an existing fault and the fault must be critically stressed.

There is acceptance that Oklahoma is experiencing more earthquakes in recent years than in prior decades, even accounting for better seismic tracking and other recent monitoring improvements.

## Q. If injection wells are causing earthquakes, why not ban injection?

While some **activist groups** have called for a moratorium on wastewater injection, this is not a realistic solution for Oklahoma's earthquakes. Underground wastewater disposal was originally developed – and has been used for decades – as a means of protecting surface and ground water. In fact, the EPA has long recommended underground disposal as the safest and best option for managing wastewater.

Most injection wells are not linked to seismic activity. An attempt to blame injection wells for recent earthquakes over simplifies the situation and ignores many **site-specific factors** that must be present for induced seismicity to occur. There are parts of Oklahoma with many injection wells and no increased seismic activity. Other states with thousands of injection wells, such as North Dakota, Louisiana and Utah, have not experienced any appreciable uptick in earthquakes.

Many experts also agree that seismicity is a manageable risk. **Dr. Bill Ellsworth with the U.S. Geological Survey** has stated, "We think society can manage the hazard. We don't have to stop production of oil and gas, but we think we can do so in a way that will minimize the earthquake hazard."

A blanket ban would shut down wells that are not linked to earthquakes. **Kim Hatfield**, chairman of the Oklahoma Independent Petroleum Association's (OIPA) regulatory committee, has noted that banning wastewater injection could "completely shut down oil and gas production" in Oklahoma.

Shutting down oil and natural gas production in the state would dramatically impact the economy – including jobs, wages and tax revenue. Oil and natural gas firms account for 3.2% of all business establishments, hire 5% of wage and salary workers, produce 10% of state GDP and generate 13.5% of total earnings statewide. The oil and natural gas industry is the largest source of state tax revenue in the state. At the very least, a ban would significantly increase the cost of production, and require additional surface handling of waste, which comes with its own environmental risks.

## Q. What are industry and Oklahoma regulators doing to address earthquakes?

In Oklahoma, the oil and natural gas industry has played an active role in finding a solution, including:

- Sharing information with geologists and regulators, including previously unmapped faults.
- Helping scientists identify data gaps to better understand subsurface geology.
- Partnering with research institutions such as Stanford University and the University of Oklahoma.
- Drafting best practices on disposal, in coordination with the Oklahoma Geological Survey and the Oklahoma Corporation Commission.
- Securing funding for **additional seismic monitoring stations** in Oklahoma.

Oklahoma regulators have implemented the "**traffic light**" system, a policy recommended by the National Academy of Sciences, which ascribes a color-coding policy for injection well permitting based on seismic data and history. Earlier this year, the Oklahoma Corporation Commission also **implemented a new set of requirements** that required operators to prove they were not injecting into the basement rock, which is believed to be the source of the earthquakes, or reduce disposal volumes by 50 percent.