

1. When a large earthquake does end up striking, how can we tell that it's the Big One earthquake? For example, in 2019, when a magnitude 6.4 earthquake struck Ridgecrest, there was confusion as to if that was the Big one.
 - a. The concept of "the Big One" often refers to a hypothetical, catastrophic earthquake expected to strike a major fault like the San Andreas Fault, causing significant damage. However, it's essential to understand that earthquake scientists, including those at the California Geological Survey (CGS), prioritize evaluating the potential impact of any large earthquake, regardless of whether it fits the "Big One" narrative.
 - b. When assessing earthquakes that have recently occurred or that could occur in the future, several factors are considered to assess its significance and potential for widespread damage. Chief among them is "shaking intensity", which is largely controlled by distance from the epicenter. A moderate earthquake that is very close to a densely populated area can do more damage than a large magnitude earthquake farther away from the same area.
2. What effects could the Big One have on California's economy? As you know, California's and the US's economies are slowly recovering from the COVID-19 pandemic. Do you believe Californians can expect the same effects from the pandemic, such as inflation and unemployment, for as long, if not longer?
 - a. I would encourage you to review the two very thorough earthquake scenarios that have been prepared. The first is for a hypothetical M7.8 earthquake on the southern San Andreas Fault, referred to as the ["ShakeOut Scenario"](#), that was released in 2008. The second is called the ["HayWired Earthquake Scenario"](#) (released in 2018) and is a hypothetical, detailed, and scientifically plausible model of what could happen during and after a magnitude 7.0 earthquake on the Hayward Fault in the San Francisco Bay Area. CGS contributed to both of these reports, which address immediate damage and fatality estimates as well as long-term economic ramifications.
 - b. Could lead to 77,000 to 152,000 households being displaced, and property damages and business losses could exceed \$82 billion dollars. With wildfires, a possible \$30 billion more would be added to the losses. On top of that, internet disconnections everywhere and many working adults moving away.

- c. With this in mind, yes, the Big one earthquake could very well see California through effects equal to if not greater than the COVID Pandemic.
- 3. Many experts say the Big One earthquake will strike the southern end of the San Andreas Fault, would that mean that the severity of the earthquake in cities near the opposite end of the fault would be reduced? If so, would this reduction be enough to reduce concerns there?
 - a. The ShakeOut Scenario models a hypothetical M7.8 earthquake on the southern San Andreas Fault rupturing from the Salton Sea up to Palmdale. There are extensive discussions of the predicted shaking intensities and maps depicting the affected areas in the online report.
- 4. After some research, and looking at multiple sources, including FEMA, I've found that only around 10 percent of Californians own earthquake insurance of any kind. In Cal Geological survey 's efforts to prepare California for earthquakes, is this, in particular, a concern for them? If so, what is the Geological survey doing to ensure widespread access to earthquake insurance?
 - a. (According to CEA) It is one of the best ways for a family to recover from the damage an earthquake can cause. So, absolutely, at the California Earthquake Authority, we want more Californians to consider getting earthquake insurance.
 - b. Earthquakes happen pretty much daily in our state, but really big, damaging earthquakes are less predictable. So, when people are deciding what to spend their money on, earthquake protection sometimes isn't on their minds. At CEA, we think a lot about people who don't have earthquake insurance and ways to make it as affordable as possible for them while keeping the protection it provides worthwhile.
 - c. Insurance is important, but it isn't just insurance. Californians can often do things to strengthen their homes structurally, making them more resilient to earthquake damage. Taken together, the word we use for all these steps is "mitigation."
 - d. Lots of California living spaces are good candidates for seismic retrofit projects, and there is more than one approach to the project depending on the type of living space.
 - e. Generally, doing a seismic retrofit means reinforcing a building so it better resists damage caused by the shaking of an earthquake. You may have heard of seismic retrofits being done for public buildings like hospitals or even dams. But Californians should know that many dwellings could benefit from a

- seismic retrofit too- especially older homes and apartment buildings.
- f. Here's one specific example: called a brace and bolt retrofit, older homes with crawl spaces can be bolted to their foundations and supported with some additional bracing pieces. This can help minimize side-to-side jiggling during an earthquake, which can make a big difference to a home's survivability during an earthquake.
 - g. getting a seismic retrofit is not a replacement for earthquake insurance, and earthquake insurance isn't a replacement for a seismic retrofit.
 - h. We'd like Californians to consider both mitigation steps; each functions differently in the earthquake recovery process.
5. With the Big One upcoming, environmental concerns are also an issue. For example, in the 1994 Northridge earthquakes, a freight train was derailed, spilling sulfuric acid into the air. What else poses an environmental concern during an earthquake? What can the Geological Survey and Californians do to minimize the issues that arise in this aspect of earthquakes?
- a. CGS contributes to technologies that help minimize negative environmental impacts from earthquakes. Our Strong Motion Instrumentation Program (SMIP) installs and manages a network over 1,300 seismic instrument stations, many of which contribute to the ShakeAlert earthquake early warning system. The goal of the system is to provide warning prior to the arrival of earthquake shaking, allowing for measures to be taken that can reduce the impact of earthquakes and save lives and property. The seismic stations detect ground motion and, if the estimated shaking intensity meets predetermined thresholds, alerts are issued through FEMA's Wireless Emergency Alert System (WEA) and smartphone apps, like MyShake. These alerts can be programmed to trigger protective actions like:
 - i. Slowing or stopping trains.
 - ii. Controlling valves and pumps in water and sewage systems.
 - iii. Providing alerts in buildings and public spaces.
 - iv. All these actions can reduce the damaging effects of earthquakes on the built environment and infrastructure.
6. As California has just gone through a drought, lots of water has been taken from the ground in California, both natural sources and with pumping of groundwater. With all this water displacement comes instability in the ground. To what extent do you think that this issue is exacerbating California's earthquake issue? Do you believe that if the Cal Geological Survey were to use this fact in a cause for preserving water in CA, we would see

more conservation of water?

- a. Lower groundwater levels can lead to ground subsidence, which has happened historically in California, but that doesn't require an earthquake to happen. However, over the last two rainy seasons much of California has seen above average rainfall, reducing drought effects and even raising groundwater levels in many areas of the state.
7. Is there any human activity that has any factor in causing earthquakes, be it commercial or noncommercial?
 - a. The primary cause of earthquakes in California is natural tectonic activity, specifically the movement of the Earth's plates along faults such as the San Andreas Fault. While most earthquakes are a result of these natural geologic processes, some human activities can potentially induce seismic activity. For example, activities like geothermal energy production, wastewater injection, and certain types of mining have been associated with small, localized seismic events. However, these induced earthquakes are generally much smaller in magnitude and less frequent compared to those caused by natural tectonic forces. CGS monitors both natural and human-induced seismic activities to better understand and mitigate their impacts.
 8. As much of the San Andreas fault is near the Pacific Ocean, do you believe that California's coast is in danger of a tsunami wave from this earthquake? If so, relative to the earthquake, how much more will it cost in terms of money?
 - a. While the San Andreas Fault is near the Pacific Ocean, it primarily generates horizontal movement along the fault, which does not typically generate significant tsunamis. The primary tsunami risk for California's coast comes from offshore subduction zones like that off the coast of far northern California and the Pacific Northwest or local underwater landslides, rather than the San Andreas Fault itself. Therefore, while there is always a potential for tsunami events along the coast, they are not directly linked to the San Andreas Fault. The focus remains on preparing for earthquake impacts on land, which involves infrastructure resilience and emergency response planning. The California Tsunami Program (CTP), led by the California Geological Survey (CGS) Tsunami Unit in collaboration with the California Governor's Office of Emergency Services (Cal OES) and local entities, plays a crucial role in understanding and preparing for tsunami hazards along the coast. The CTP works closely with the Tsunami

Research Center at the University of Southern California and other partners to produce statewide Tsunami Hazard Area Maps and provide preparedness information. More information is at our Tsunami Program webpage: <https://tsunami.ca.gov>

9. I've seen many cracks in the road whenever out and about, more so in California than any other state I've traveled to. Can these cracks in the road tell us anything about an earthquake and if so, what can we gain from them?
 - a. No. Asphalt cracks are not reliable indicators of earthquake hazards. Asphalt road cracks are more commonly influenced by traffic loads, soil moisture changes, shrinking/swelling from heat/cold, asphalt quality, and age.

10. Lastly, in addition to the San Andreas fault, many earthquake faults lie along California, such as the Hayward fault line, and the San Jacinto fault line. In some cases, when an earthquake strikes one major fault line, it can spread to other minor fault lines, spreading the damage of the earthquake further. Do you believe this is what we'll see with the Big One Earthquake? What does this mean for the range of towns in California affected by the Big One?
 - a. Yes, earthquake fault rupture can "jump" from one fault to another, if the gap between them is small enough. Our current modeling of potential earthquakes on the various faults and fault zones in California (called UCERF3) already takes this phenomenon into account.