

TROUBLED WATERS

Offshore Fracking's Threat to California's Ocean, Air and Seismic Stability



A Report from the Center for Biological Diversity
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Californians recently discovered that oil companies have fracked more than 200 offshore wells along the state's southern coast. Offshore fracking blasts water and industrial chemicals into the seafloor at high pressures to crack rocks and release oil and gas.

With little or no oversight from state and federal regulators, the oil industry has fracked offshore wells near Huntington Beach, Long Beach and Seal Beach, as well as in federal waters in the Santa Barbara Channel.

To determine the risks of offshore fracking in California, scientists with the Center for Biological Diversity analyzed independent scientific evidence, including the 2014 report by California Council on Science and Technology; published scientific studies; industry data; and state and federal information.

This report analyzes the following dangers associated with offshore fracking:

- Toxic fracking chemicals' threats to California's marine life, including already threatened species such as blue whales and sea otters,
- Health risks to coastal communities and climate damage caused by hazardous air pollutants released during offshore fracking,
- Increased earthquake risk linked to fracking and the injection of fracking wastewater into disposal wells, and
- Unique environmental concerns raised because fracking in California occurs at shallower depths and with higher concentrations of chemicals than in other areas.

KEY FINDINGS

1. Toxic discharges: Oil platforms off California's coast are permitted to dump 9 billion gallons of wastewater, including fracking chemicals, into the ocean each year.

2. Wildlife threats: At least 10 fracking chemicals routinely used offshore in California could kill or harm a broad variety of marine species, including sea otters, fish and benthic invertebrates. Some chemicals used in California fracking are acutely toxic to mammals, and many others have not been evaluated for toxicity or effects from acute and chronic exposure.

3. Hazardous air pollution: Fracking increases air pollution and can expose coastal communities to air pollutants that cause cancer and other illnesses. Most offshore frack jobs have occurred within three miles of the coast, near communities like Long Beach.

4. Earthquake risk: Injecting fracking wastewater underground can induce earthquakes, and all of Southern California's offshore injection wells are within three miles of an active fault.

These findings underscore the inherent risks of hydraulic fracturing in fragile ocean ecosystems. This toxic practice threatens to contaminate California's air and ocean, endanger marine wildlife and compromise the safety and well-being of coastal communities. To protect public health and the environment, California must halt offshore fracking.

DETAILED ANALYSIS

1. Fracking chemicals are being dumped into California's coastal waters.

Half of the oil platforms in the Santa Barbara Channel discharge all or a portion of their produced water, including fracking chemicals, into the ocean.¹ The federal government has given oil companies permission to dump more than 9 billion gallons of wastewater a year into the ocean off California's coast. These coastal waters provide key habitat for whales, sea otters, sea turtles and more than 500 fish species.

"Produced water" is fluid that comes to the surface once the production of oil and gas has begun. It can contain fracking chemicals in addition to substances mobilized from underground such as arsenic, lead and naturally occurring radioactive materials.

When wastewater is not dumped into the ocean, it is reinjected into the seafloor or transported for onshore underground injection. Even this disposal method can result in leaks. For example, 30 percent of offshore oil wells in the Gulf of Mexico experienced well casing damage in the first five years after drilling, and damage increased over time to 50 percent after 20 years.² Loss of well casing integrity is one of the main pathways for contamination of ground and surface waters.

Fracking may also raise the risk of well failure and consequent oil or chemical spills. The independent California Council on Science and Technology report found that fracking increases the stress on wells because of high pressures and horizontal drilling used in the practice.³

Fracking chemicals can enter the water through a number of other pathways, including leaks and spills at wells, platforms and pipelines, and during transportation of chemicals to or from the well. Spill records from platforms off California indicate that accidental spills of oil and other hazardous substances into the marine environment occur

routinely during normal operations. The aging of offshore infrastructure increases the risk of spills and leaks, which will be exacerbated as fracking operations extend the productive lifetime of wells, platforms and pipelines.⁴

California faces a unique, elevated risk of contamination from fracking. Compared to other regions, fracking onshore in California occurs at relatively shallow depths. The California Council on Science and Technology warns that this increases the potential for fractures to reach water sources.⁵ Fracking can create artificial fractures up to 2,000 feet in height.

Such findings raise serious questions about fracking offshore in the same formation. While offshore fracking may occur at deeper depths, it is critical to consider whether artificial fractures could pose an enhanced pollution threat to the state's ocean by creating pathways for fracking chemicals and other contaminants.

2. Many fracking chemicals can harm or kill a broad array of marine species.

As compared to fracking in other areas, oil companies in California use fracking fluids with more concentrated chemicals, including chemicals acutely toxic to mammals.⁶ The Center analyzed chemicals used in California state waters in 19 fracking events reported between 2011 and 2013. Scientific studies indicate that at least 10 of the fracking chemicals routinely used during these fracking events could kill or harm a broad variety of marine species, including sea otters, fish and benthic invertebrates.

Some of these chemicals can break down into nonylphenol, a very toxic substance with a wide range of harmful effects that include the development of intersex fish and altered sex ratios at the population level. Nonylphenol can also inhibit development, growth and survival of marine invertebrates.⁷ This chemical has also been shown to bioaccumulate, or become dangerously concentrated, in sea otters, which are already threatened in California.⁸

Phenol formaldehyde resins were also reported in all 19 fracking events studied. These resins are toxic and can cause cancer and mutations. If released into the marine environment, these pollutants have the potential to absorb other chemical compounds such as nonylphenol, increasing their toxicity to marine life.⁹

The following table summarizes the harmful effects on marine species of 10 fracking chemicals used in 19 California offshore frack jobs analyzed by Center scientists.

10 Offshore Fracking Chemicals Hazardous to Marine Wildlife		
Chemical (CAS Identifier)	Number of Wells Used (Out of 19)	Known Toxic Effects on Marine Life
Nonylphenol Ethoxylates	16	Extremely toxic to aquatic organisms as an endocrine disruptor and inhibitor of development, behavior, growth and survival
Methylisothiazolinone	19	Genotoxic, neurotoxic
Phenol Formaldehyde Resins	19	Mutagenic, acute toxicity, target organ toxicity and carcinogen hazards
Boron Compounds	19	Harms development, growth and reproduction
Crystalline silica: quartz (X-cide)	19	Reductions in species richness and biodiversity in benthic communities
Glyoxal	19	Genotoxic, reproductive toxicity, degenerative effects on pancreas and kidney, toxicity to animals
Methanol	19	Negative effects on swimming behavior
Isotridecanol, ethoxylated	12	Very toxic to aquatic life, accumulation in organisms possible
Monoethanolamine	4	Moderate ecotoxicity to aquatic organisms
Alcohols, C12-14, ethoxylated propoxylated	2	Inherently toxic to aquatic organisms, bioaccumulative

Because oil companies sometimes invoke trade secret protections, the full list of chemicals used in offshore fracking is not always available and could include even more hazardous materials.

Previous research has reported that 40 percent of the chemicals added to fracking fluids have been found to have ecological effects, indicating that they can harm aquatic animals and other wildlife.¹⁰ Furthermore, the toxicity of fracking chemicals can increase when they are combined with other chemicals and environmental stressors such as climate change. For example, when combined with other chemicals, some endocrine disruptors become more dangerous and produce effects even when the chemicals are below the threshold known to cause endocrine disruption.¹¹

But overall, far too little is known about the toxicological and ecological effects of many fracking chemicals. The California Council on Science and Technology recently noted that, "An evaluation of eco-toxicological effects, including the potential impacts of these chemicals on aquatic organisms is needed."¹²

Fracking chemicals raise grave ecological concerns because the waters around California's offshore oil platforms are important for whales, seabirds, sea turtles and fish.

The Santa Barbara Channel, for example, hosts the world's densest summer seasonal congregation of endangered blue whales. The Channel Islands support about half the global population of ashly storm-petrels and western gulls, about 80 percent of the breeding population of Scripps's murrelet, and the only breeding populations of California brown pelicans in the United States.

There is also designated critical habitat for black abalone and leatherback sea turtles in the vicinity of California's offshore oil platforms.

These biologically sensitive and important habitat areas could be significantly affected by water pollution associated with fracking.

3. Offshore fracking threatens air quality.

Air pollution from fracking is now well documented,¹³ and pollutants released during offshore fracking pose serious health risks, including carcinogenicity and endocrine disruption.¹⁴ Most offshore fracking in California has occurred near coastal communities, including Long Beach, which has some of the worst air quality in the nation.

Volatile organic compounds (VOCs) emitted during offshore fracking include the "BTEX compounds" — benzene, toluene, ethyl benzene and xylene — which Congress has listed as Hazardous Air Pollutants.¹⁵ Many of these VOCs are associated with serious short-term and long-term effects to the respiratory, nervous or circulatory systems.¹⁶ Additionally, VOCs create ground-level ozone, or smog, which can contribute to asthma,¹⁷ premature death, stroke, heart attack and low birth weight.

Offshore fracking can also result in airborne crystalline silica dust. While the most common exposure to silica dust is in workers close to silica sand, there are also documented cases of silica dust exposure and resultant harms in neighboring communities.¹⁸ Silica quartz, commonly used in offshore frack jobs, can create dangerous health problems, including cancer and silicosis.¹⁹

Ambient air off the southern California coast includes chemicals used in fracking, including benzene, a known carcinogen.²⁰ Fracking and drilling can emit benzene, which raises troubling questions about how much these activities are contributing to southern California's air quality problems.

Offshore drilling has been found to account for the majority of air pollution in other coastal areas: A 2004 inventory of air pollution in the Gulf of Mexico found that Outer Continental Shelf oil and gas activities accounted for 72 percent of volatile organic compounds, 69 percent of particulate matter emissions, and 66 percent of sulfur dioxide.²¹

Exposure to ambient benzene has been documented in people living within a 10-mile radius of fracked wells in Colorado,²² raising concerns about residents living within 10 miles of offshore oil and gas production rigs. More than 90 percent of offshore frack jobs have occurred within three miles of the California coast.

On top of toxins released during fracking, vehicles used to support offshore oil and gas operations such as helicopters, boats and trucks emit their own pollution, most noticeably in the form of PM_{2.5} from diesel engines.²³ Truck traffic is already significantly impacting Port Hueneme, which is the primary support facility for the offshore oil industry in southern California and averaged 264 truck trips per day between 2003 and 2007.²⁴ Impacts on adjacent residential neighborhoods such as noise, vibration and noxious fumes increase with truck traffic.²⁵

Finally, offshore fracking severely undermines California's goal of leading the nation's effort to combat climate change. Offshore operations can result in both vented and fugitive emissions — a very large proportion of which is methane, a dangerous greenhouse gas that is 86 times more powerful in warming the atmosphere than carbon dioxide over a 20-year period and 34 times more powerful over a 100-year period.²⁶

Vented and fugitive emissions are significant, accounting for roughly 13 percent of all carbon dioxide equivalent emitted by oil and gas operations in California, according to state survey data.²⁷

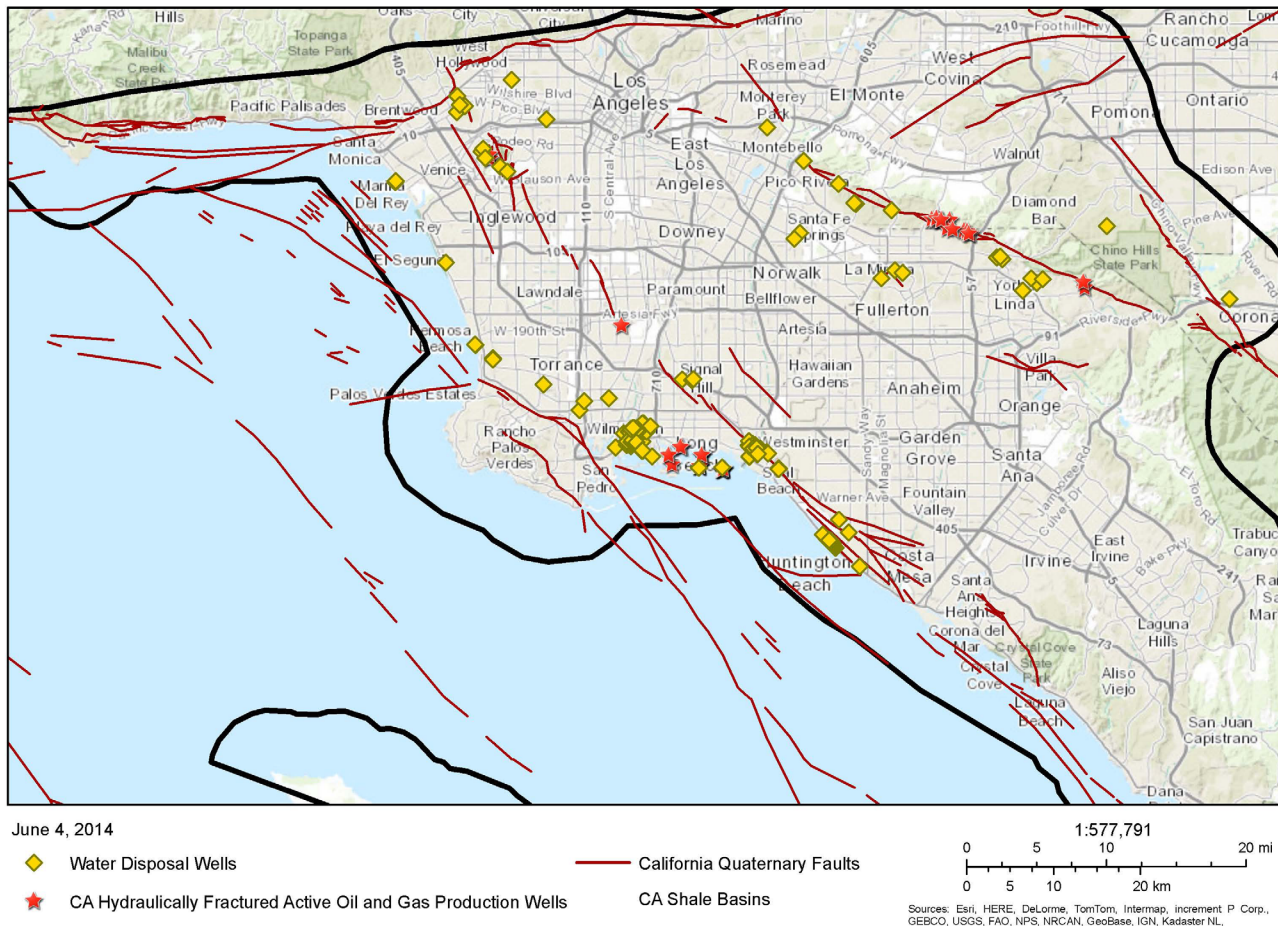
4. Fracking and the disposal of fracking wastewater can trigger earthquakes.

Fracking and other types of extreme oil extraction (including gravel packing and acidization) create large quantities of wastewater that are most commonly disposed of through permanent injection into deep wells often near the wellsite.²⁸ Flowback volumes can range from hundreds of thousands to millions of gallons per fracking event.²⁹ Numerous studies have documented that underground injection of oil and gas wastewater can induce large earthquakes, including felt and damaging earthquakes of magnitudes 4 and 5.³⁰

Wastewater injection has been scientifically linked to earthquakes of magnitude 3 and greater in at least six states: Oklahoma,³¹ Texas,³² Arkansas,³³ Colorado,³⁴ New Mexico³⁵ and Ohio.³⁶ The largest of these was a magnitude 5.7 earthquake near Prague, Okla., outside of Oklahoma City, which was the biggest in the state's history. It destroyed 14 homes, damaged a federal highway, injured two people, and was felt in 17 states.³⁷

Most of California's active oil and gas wastewater injection wells are close to faults. A recent analysis showed that over half of California's 1,553 active and new wastewater injection wells are within 10 miles of a recently active fault (active in the past 200 years). At least 30 of California's offshore wastewater injection wells are located within three

Earthquake Risk: Faults and Wastewater Injection Wells On Southern California Coast



Ferrar, K. 2014. California's Faults and Wastewater Injection Wells. The FracTracker Alliance. www.fracktracker.org. Accessed 6/4/14.

miles of a fault. Dozens more wastewater injection wells line the southern California coast, often located close to one or more faults.³⁸

Fracking itself can also induce earthquakes. Fracking intentionally cracks the shale rock around wells to release oil and gas deposits and routinely produces small earthquakes typically not felt at the surface.³⁹ However, several recent studies have reported that fracking has induced felt earthquakes of magnitudes 2 and 3 in Oklahoma,⁴⁰ Ohio,⁴¹ British Columbia,⁴² and the United Kingdom,⁴³ including a magnitude 3.8 event.⁴⁴ Even when fracking directly generates only small earthquakes, it could contribute to increased stress in faults that leaves those faults more susceptible to otherwise naturally triggered earthquakes of a greater magnitude.⁴⁵

CONCLUSION

Offshore fracking and similar methods of oil extraction are inherently dangerous, posing unacceptable risks to our fragile marine ecosystem, the health of coastal communities, our climate, and California's infrastructure through increased earthquake risk. In light of the mounting evidence of offshore fracking's threats, California must move quickly to end oil companies' use of this toxic technique.

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