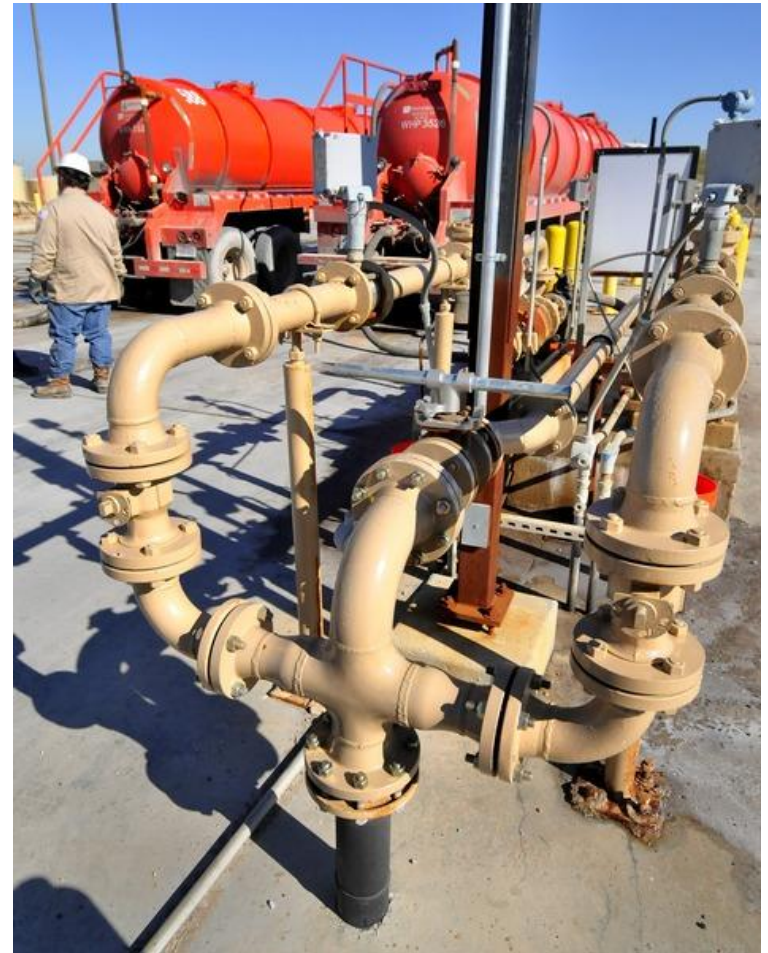


Wastewater Disposal Well Panel  
Presentation  
January & February 2012



# The disposal well proposal

- After a 10 year moratorium, the Fort Worth City Council appears poised to approve locating underground wastewater disposal wells inside the city in areas zoned J and K.
- They could be 1,000 feet from a protected use – such as your home – but would require Council approval if they were closer than 1,000 feet.
- Also called “saltwater” wells, these are dump sites for the cocktail of water, sand and fluid used in natural gas hydraulic fracturing operations. There is evidence that some of the “frack” fluids in this wastewater are toxic.

# The question is . . .

- “What has changed that would prompt the City to consider allowing the placement of such wells?”
- Ironically, there appear to be more concerns now about the wastewater produced in the fracking process and the disposal wells than there were even 5 years ago.

# Issues and Concerns with Wastewater Disposal Wells

- Why did Hillwood build its saltwater pipeline system before the moratorium on SWDs/WWDs was lifted?
- Earthquakes linked to disposal wells
  - Damage to cement casings in underground wells – front line defense to protect water from toxic frack fluids
  - Need for water conservation in ongoing drought and growing scarcity of water
  - Potential for leaks and spills of chemically laden frack water
  - Potential for contamination of well water or ground water
  - Radioactive isotopes in produced water
  - Presence of diesel in the frack fluid
  - Third party damage to saltwater (disposal water) pipelines
  - Proximity of WWDs to urban residential areas – size, noise, truck traffic, environmental concerns – “Who wants this stuff under the ground in his neighborhood?”

# Getting it straight about disposal wells and earthquakes

- “There is scientific evidence that injecting high pressure fluids into the ground increases pressure within a rock’s pores, loosening it up and making it more prone to faulting . . .” Mike Besonen, Assistant Professor of Earth System Science, Texas A &M – Corpus Christi, *Corpus Christi Caller-Times, October 20, 2011*
- “Tectonic pressures cause the vast majority of earthquakes, but geophysicists also recognize the existence of human-induced seismicity. Hydropower reservoirs . . . Frequently cause small, shallow quakes as shifting water levels change the strains in the rock layers below. Such microseismicity – up to magnitude 4 on the Richter scale – is also caused by wells that inject hazardous waste and wastewater into deep rock formations at high pressure. . . . It is possible that even very small earthquakes can eventually “unlatch” a seismic fault and cause larger quakes.” Peter Fairley, Environmental Journalist, *Energy Wise & Spectrum,*

# Getting it straight . . .

- “Is that what has created . . . Some of these earthquakes that we’ve seen happen in odd areas?” Leith: “It’s the disposal of the flowback water. And it doesn’t occur, of course, at every disposal well. And the things that are a factor are, how deep is the injection activity, how high is the pressure at which they are disposing of the fluid, how much fluid is disposed of in these wells? The best documented recent case of this is in Arkansas, that magnitude 4.7 earthquake . . . Where they were injecting large volumes of water over a period of many months and triggering earthquakes that we actually could track with a local seismic network as they moved along a fault. Scientifically, I think that the issue is whether or not the earthquakes can be controlled. . . . Can one reduce the pressure or the volume . . . And continue to operate it . . . And really, we don’t have the data that we would like in order to make that determination.
- Many of the well operators don’t keep that information. And so it’s sort of an open question as to whether these wells, once they’ve triggered a moderate-sized earthquake, can be managed so as to minimize the earthquake risk.”
- *William Leith, senior science advisor for earthquake and geologic hazards at the U.S. Geological Survey (USGS)/manager of the Advanced National Seismic System at the USGS on The Diane Rehm Show, December 19, 2011*

# Earthquakes and WWDs in our own backyard

- In 2010, a study of seismic activity near Dallas/Fort Worth International Airport by SMU and University of Texas at Austin researchers showed that wastewater disposal wells were a “plausible cause” for the series of small earthquakes that occurred in the area between October 2008 and May 2009.
- A state tectonic map showed a northeast-trending fault intersects the Dallas-Tarrant county line approximately at the place where the DFW quakes occurred.
- A wastewater disposal well was placed on or near that fault. When the injections stopped, the quakes stopped.

# What the scientists say

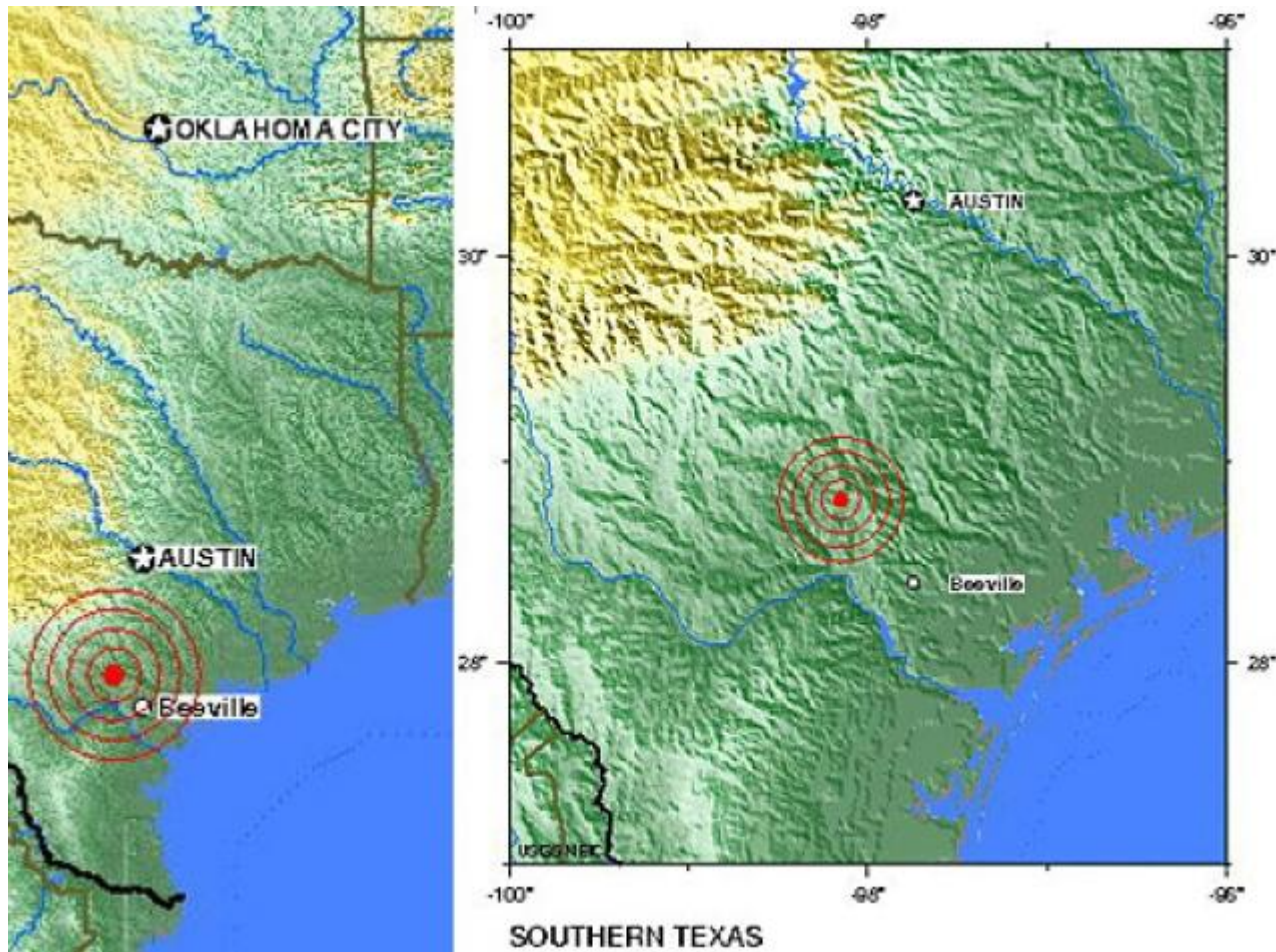
- Scientists have taken earthquake data and, like detectives, tracked its causes to deep injections of lots of liquid under high pressure, such as the ones that peaked at magnitude 3.3 at the Dallas-Fort Worth airport in 2008 and 2009 – *William Ellsworth, U.S. Geological Survey geophysicist*

# Arkansas, 1000 earthquakes between Guy & Greenbrier from Sept. 2010 to July 2011

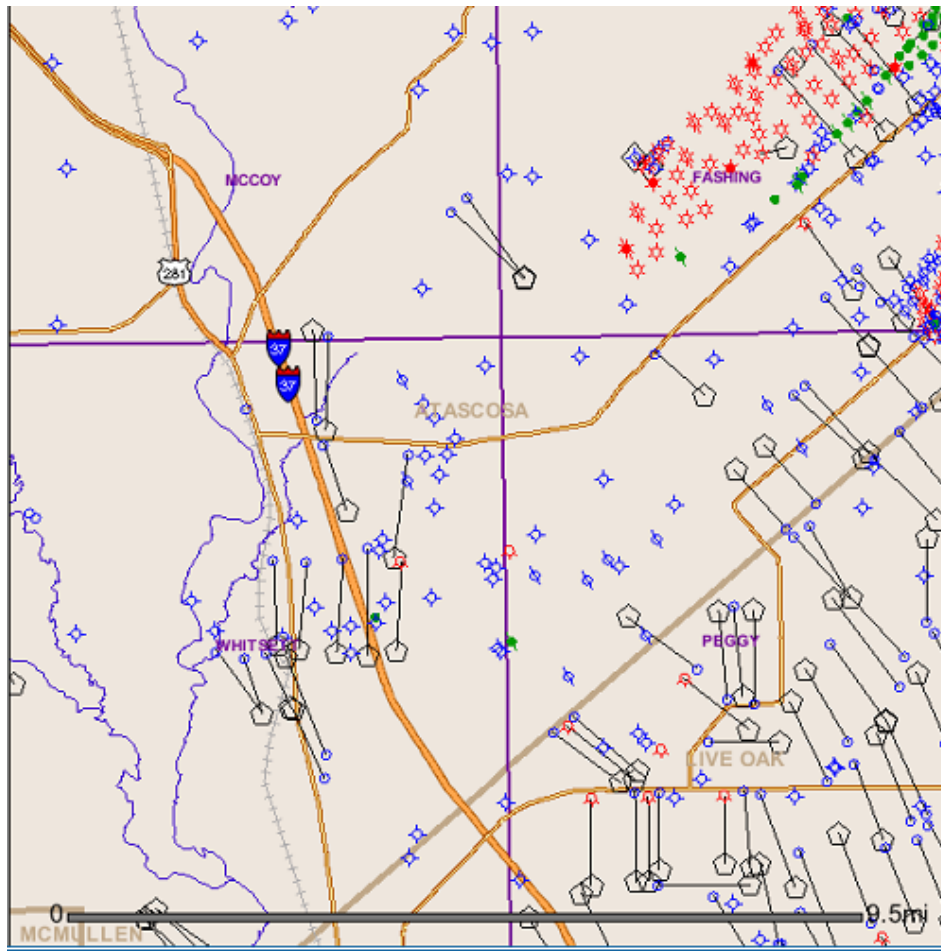
- In early August 2011, the Arkansas Oil and Gas Commission banned fracking disposal wells in central Arkansas, near the communities of Greenbrier and Guy and for a 1,150 square mile radius because of earthquakes.
- A state geologist reported evidence that certain earthquakes occurred when massive amounts of waste were put in disposal wells in the affected area.



# Eagle Ford Shale Earthquakes, South Texas October and November 2011



# Railroad Commission map shows wells in Eagle Ford area in vicinity of earthquake



# More on the Eagle Ford quakes

- “In South Texas, where gas is being produced in the Eagle Ford Shale, a magnitude 3.3 earthquake shook a rural area south of San Antonio in mid-November. That followed a magnitude 4.8 quake in the area in October, the largest recorded in South Texas since the U.S. Geological Survey began keeping track.
- Scientists say the likelihood of a link between fracking and earthquakes is extremely remote, that thousands of fracking and disposal wells operate nationwide without causing earthquakes, and that the relatively shallow depths of these wells mean that any earthquakes that are triggered would be minor.
- “But still, you don’t want it to happen,” said Mark Zoback, a geophysicist at Stanford University. *Corpus Christi Caller-Times, October 20, 2011*

# Results, please

- “There have been concerns that deep disposal wells where fluids are being injected into the ground could be tied to small earthquakes. It won’t be clear for a long time if that might be the case here (in the Eagle Ford Shale).
- Tests are ongoing in more established shale plays in North Texas’ Barnett Shale and in Arkansas’ Fayetteville Shale.”

[www.eaglefordshale.com](http://www.eaglefordshale.com), October 21, 2011

And then there was Oklahoma's November 5, 2011  
Magnitude 5.6 earthquake, largest in state history

After the OSU game at the  
Oklahoma State stadium



**ESPN's Kirk Herbstreit . . .**

- Doesn't just get excited about college football – the on air reaction to the earthquake he was feeling now immortalized on YouTube

# Magnitude 5.6

## Earthquake strikes Oklahoma November 2011

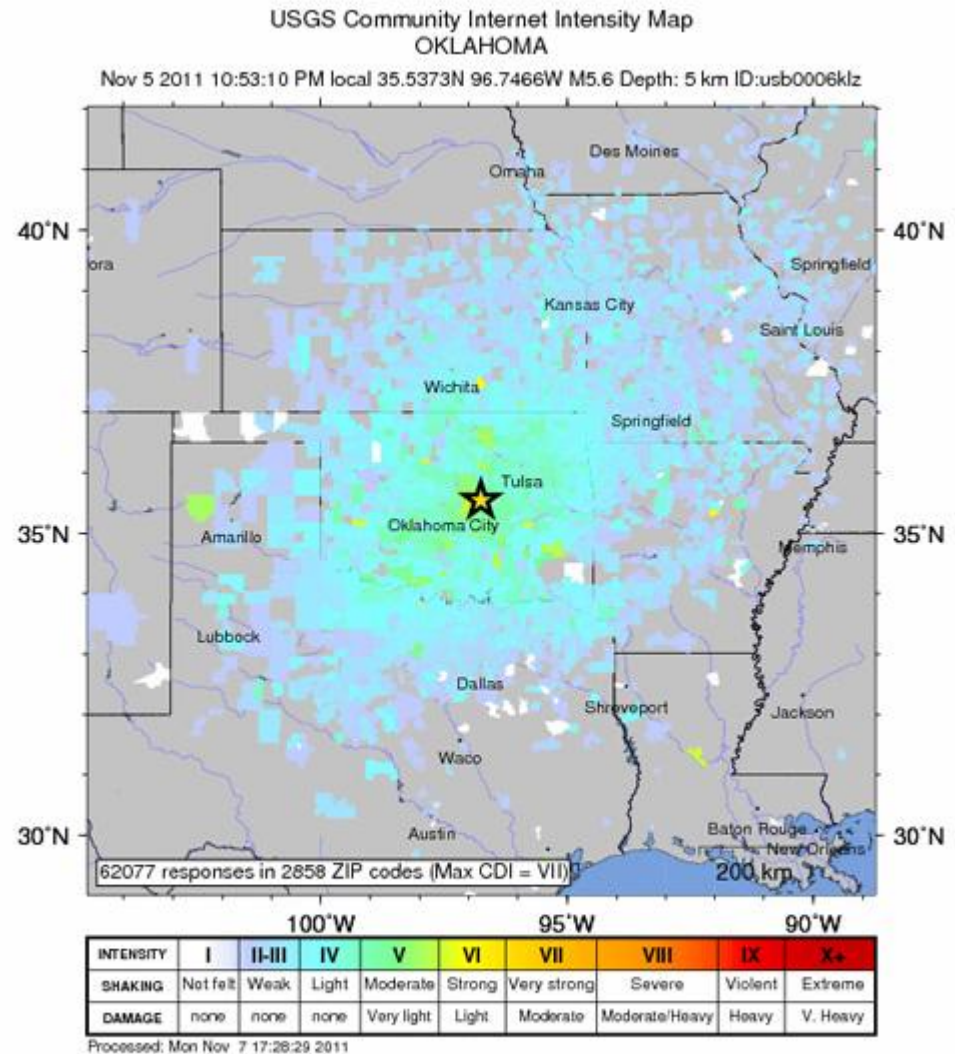
- **Strongest earthquake in Oklahoma history**
- “Microseismicity can, over time, unlatch the fault like a spring, releasing tectonic strain built up over so many years, centuries or even millennia to produce a major shake.
- The Oklahoma quake could well have been similarly “triggered” according to Paul Earle, a U.S. Geological Survey scientist quoted by the *Intelligencer/Wheeling News Register*. As Earle told me . . . “I believe the earthquake *\*could\** be natural but more studies need to be done to rule out the possibility of an anthropomorphic trigger.” *Paul Fairley, Energy Wise, Spectrum*

**At least \$200 million in damage – governor asks for disaster declaration, seeks federal assistance for property owners**

**Estimates from the Oklahoma Insurance Department show less than 1 percent of Oklahoma homeowners carry earthquake insurance.**

**A 5.6 magnitude earthquake centered near Sparks in Lincoln County shook Oklahoma Nov. 5, damaging more than 200 homes, buckling part of a highway and causing the collapse of a tower at St. Gregory’s University in Shawnee.**

**There are 181 injection wells in the Oklahoma county where most of the weekend earthquakes happened, said Matt Skinner, spokesman for the Oklahoma Corporation Commission, which oversees oil and gas production in the state and intrastate transportation pipelines.**



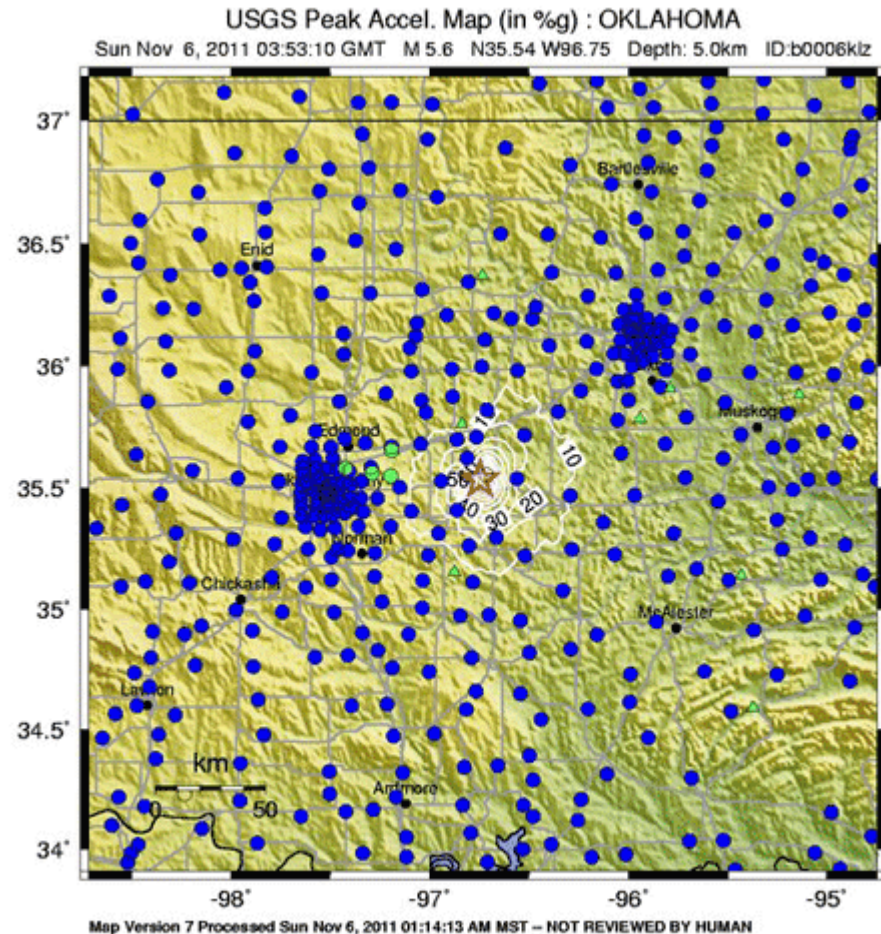
## The shakemap doesn't lie

The increased seismicity has spurred installation of a large number of seismograph stations in the region, as shown below by blue circles in the USGS shakemap of peak ground acceleration.

Oklahoma Gov. Mary Fallin has requested a federal disaster declaration in the wake of the series of earthquakes that have rumbled through the state in recent weeks.

Fallin made the formal request on Nov. 22 to help individuals, families and businesses in Lincoln and Pottawatomie counties, where the earthquakes and aftershocks have been centered. Early damage estimates show that nearly 200 homes and businesses in those two counties were damaged.

If approved, the Federal Emergency Management Agency program provides grants. Approved low-interest loans to homeowners, renters and business owners affected by the earthquake are made by the Small Business Administration Office of Disaster Assistance programs.



## This is “minor?” \$2.8 million in damage at St. Gregory’s University

St. Gregory's University reopens  
campus landmark in Shawnee

Two months after it was damaged in  
an earthquake, St. Gregory's  
University's Benedictine Hall  
reopened the week of January 12,  
2012. The building was closed after  
the 5.6-magnitude earthquake in  
November.

Published: January 12, 2012

[SHAWNEE](#) — Two months after it was  
damaged in an earthquake, the most  
prominent landmark at [St. Gregory's  
University](#) reopened this week.



# Earthquake damage in Oklahoma

**Buckled public roads**



**Damaged private residences**



## Earthquakes in Youngstown, Ohio December 2011/January 2012 – Magnitude 4.0 on New Year's Eve, 2011

Ohio Governor Kasich ordered that Northstar Disposal Services' well be shut down as well as four other injection wells set to open in the same area – these are 9,000 foot deep wells within a five mile radius. “We are being overly cautious in order to ensure public safety,” deputy director Andy Ware said. Pittsburgh Tribune-Review, Jan. 3, 2012

- Officials said Saturday they believe the latest earthquake activity in northeast Ohio is related to the injection of wastewater into the ground near a fault line, creating enough pressure to cause seismic activity. Four injection wells are within a five mile radius of an already shuttered well.
- The eleventh in a series of minor earthquakes in the area, many of which have struck near the Youngstown injection well – Associated Press, Jan. 1, 2012
- “The more precise data from the Dec. 24 quake came from instruments installed by scientists from Lamont-Doherty Earth Observatory, a part of Columbia University. John Armbruster, a seismologist with Lamont, said, “In our minds, we were already pretty convinced that these events were connected to the well. Having that many earthquakes fairly close to a well in Ohio, where there aren't a lot of earthquakes, was suspicious.” New York Times, Jan. 1, 2012

# What scientists learned in Ohio

- “Nine quakes in eight months in a seismically inactive area is unusual. But Ohio seismologists found another surprise when they plotted the quakes’ epicenters: Most coincided with the location of a 9,000-foot well in an industrial lot along the Mahoning River two miles from downtown Youngstown. At the well, a local company has been disposing of brine and other liquids from natural gas wells . . . In Pennsylvania. The location and timing of the quakes led to the suspicion that the well was responsible for Youngstown’s seismic awakening. As the wastewater was injected into the well under pressure, the thinking went, some of it might have migrated into deeper rock formations, unclamping ancient faults and allowing the rock to slip.
- Armbruster said the instruments recorded a rich stream of data during a Christmas Eve temblor and a 4.0 New Year’s Eve quake that demonstrated “beyond a reasonable doubt” that wastewater induced a slippage **along a previously unknown fault**. [Wow-Basics.com](http://Wow-Basics.com)

# The growing volume of drilling wastewater and its implications

- “The growing volume of wastewater generated by industry’s increasing reliance on hydraulic fracturing to extract oil and gas is likely to contribute to an increase in seismic events as more waste needs to be disposed of, said Art McGarr, a seismologist with the U.S. Geological Survey in Menlo Park, California.
- It’s a problem that’s only going to grow as more oil and gas development occurs, as well as geothermal development,” he said. [Wow-Basics.com](http://Wow-Basics.com)

# Points for consideration

- When wells are all around, even small quakes have a big effect.
- Can you dispose of fracking fluid without causing earthquakes? Reuters says the answer is yes, but with a high price:
- “It costs about \$10 million a pop. A thorough seismic survey to assess tracts of rock below where oil and gas drilling fluid is disposed of could help detect quake prone areas. But that would be far more costly than the traditional method of drilling a bore hole, which takes a limited sample of a rock formation **but gives no hint of fault lines or plates.**” [www.earth-issues.com](http://www.earth-issues.com)
- “Many of these earthquakes are ‘small’ earthquakes. But as the seismic activity in Ohio and Oklahoma is showing, it is possible that even very small earthquakes can eventually ‘unlatch’ a seismic fault and cause larger quakes.” Press Action, January 8, 2012

# More points to consider

- How much is too much to inject into disposal wells?
- “Scientific research needs to be done to understand the data on fluid injections and volumes,” said William Leith, senior science adviser for earthquake and geologic hazards at USGS, which has re-established a project to study induced seismicity in response to the strong of suspicious quakes in shale-gas areas.
- Seismologists say that these deeper, older rocks (in formations beneath the shale), collectively called “the basement” are littered with faults, that, although under stress, have reached equilibrium over hundreds of millions of years.
- But drilling and disposal companies do not usually know that those faults exist. Seismic surveys are costly, and states do not require them for oil or gas wells. Larger companies routinely conduct seismic tests as part of exploration.
- Regulations for disposal wells are concerned about protecting aquifers, not about seismic risk. The EPA . . . Has no seismic requirements for disposal wells it regulates.” Wow-Basics.com
- The Texas RRC requires a distance of  $\frac{1}{4}$  mile from a known fault line for new disposal wells. Is it enough?

# The Washington Post's advice on earthquakes and disposal wells

- “Fracking will produce wastewater but energy companies can dispose of it more carefully.
- The U.S. Geological Survey’s Arthur McGarr points out that, of the 144,000 storage wells of this type in America, only a tiny fraction have been linked to earthquakes. He suggests:
  - 1. Seismic monitoring at active well sites, so operators can shut down operations at the first sign of trouble
  - 2. Storing waste water farther from population centers – (square that with the Fort Worth proposal)
  - 3. Lowering water pressure in wells could help.
  - 4. Wastewater treatment techniques could also improve, making underground storage unnecessary and reducing fears of drinking water contamination.” WAPO editorial, January 8, 2012

# “But there are so many disposal wells and so few with any problems”

- Ian Urbina, New York Times reporter : “Indeed there had been a lot of wells drilled without problems. **I think the concern is that it only takes one mistake,** and because we're talking about drinking water and we're talking about aquifers that are deep underground that are difficult to decontaminate if there is a problem, there is where the attention being paid to these instances to ensure that we figure out if they -- if it can occur, how might it occur and what sort of regulations would be put in place to prevent that from ever happening.” Diane Rehm Show, December 19, 2011
- Witness Deepwater Horizon

# Why industry discloses more to shareholders than to landowners about risks

- “Rehm:
- Have we, in fact, learned that shareholders are told more about those possible risks than the landowners themselves?
- **HORWITT (Dusty Horwitt, senior counsel, Environmental Working Group)**
- That appears to be the case according to our recent investigation. We found that about two dozen landowners in five different states told us that they have not been told the risks of natural gas drilling when agents of drilling companies approach them and ask them to lease their land from -- for drilling. They supplied us with copies of their leases. We reviewed those leases, and they did not include any significant disclosure of risks.
- **HORWITT**
- We spoke to attorneys in the industry, and they said, typically, companies don't disclose risks to landowners. And then, at the same time, we found that multiple drilling companies were disclosing long lists of risks to their shareholders, including leaks, spills, explosions, blowouts, environmental damage, inadequate insurance, bodily injury and death. Under -- they are required to disclose these risks under federal law, and they're required to disclose only the most significant risks to shareholders.
- **HORWITT**
- So when we make these disclosures, that's an indication that the companies themselves believe that these risks are significant, and our investigation showed landowners are generally not hearing these risks.
- **REHM**
- Why are shareholders, though, entitled to know more than landowners?
- **HORWITT**
- Well, they shouldn't be. We think that landowners should get at least as much disclosure as shareholders. The shareholders are entitled to this disclosure as a result of the Great Depression. Congress responded to the Great Depression in 1933 and 1934, passing laws to prevent stock fraud, which was viewed as a major cause of the Great Depression.

# Industry responds

- “I think the industry needs to be a greater participant in sharing information.
- Much of what's being said there is not specifically focused on individual risk. It's focused on the fact that these operations are construction operations. They are energy raw material extraction operations. They create a certain amount of potential for risk, either a failure, in other words, that the well isn't completed, and therefore, the shareholder might be at risk for that, as well the potential for litigation.”
- *Lee Fuller, vice president of government relations for the Independent Petroleum Association of America on the Diane Rehm Show, December 19, 2011*

# The Texas water reality

- In the Eagle Ford Shale formation in South Texas, oil and gas companies are forecast to increase water consumption to 44,800 acre-feet of water in 2020, up from 5,800 in 2010, according to a study by the University of Texas' Bureau of Economic Geology. **An acre-foot is about 325,000 gallons, enough to supply three average households for a year.**
- **Water use in the Barnett Shale is projected to increase to 40,300 acre-feet in 2020 from 27,900 in 2010 during the same period, the study said.**
- **(In 2020, that's enough water to supply 120,900 average households for a year in the Barnett Shale.) *Mike Lee for Bloomberg, Sept. 30, 2011***

# The relevance of water to a disposal well discussion in Texas

- **Texas Senator Troy Fraser focuses on the energy industry's water use**
- “According to the Texas Energy Report, **Senate Natural Resources Committee Chairman Troy Fraser**, called the energy industry a bit too “thirsty” during a record one-year drought, and warned the oil and gas companies to ramp up the recycling of water consumed during hydraulic fracturing.
- Currently much of the chemical-laced water and sand that Texas companies blast into shale formations to release oil and gas is later pumped back underground for disposal.
- “It’s going to be an issue next session. I continue to tell the industry they’ve got to get aggressive about water reuse,” Fraser, a Republican from Horseshoe Bay in the Central Texas Highland Lakes region, said during a joint interim hearing on drought held by the Natural Resources and the **Senate Agriculture and Rural Affairs Committees**.
- “In a drought situation, it’s starting to be a problem, a big problem in some areas,” Fraser added of the millions of gallons of water used in fracking. “I’ve been projecting for multiple months that this is coming and we’ve got a crisis out there.”

*Texas Vox, November 4, 2011*

# Recycle, Recycle, Recycle



# The cool kids on the block are recycling

Fountain Quail Water Management LLC, a subsidiary of Calgary-based Aqua-Pure Ventures Inc., has nine mobile evaporators in service in the Barnett Shale and has now processed in excess of 14 million barrels of frac flow-back fluid in the Barnett play.



Aqua-Pure's processing systems use mechanical vapor recompression evaporation technology packaged in a self-contained, skid-mounted mobile unit that consists of a pretreatment module, an evaporator module and a compressor module.

# Just a few examples

- “Devon Energy Corp. has been using portable distilling plants since about 2007 to recycle water in the Barnett Shale and has a goal of recycling a third of the water it uses in the Granite Wash field in North Texas, said Tony Thornton, a spokesman for Oklahoma City-based Devon.” Mike Lee for Bloomberg, September 30, 2011



# Fun facts to know and tell

- ProPublica reports that, in 2008, the Texas Railroad Commission had 106 enforcement staff for 263,704 wells in Texas
- SMU Seismologist Brian Stump, commenting on the research he did calling disposal wells at DFW a “plausible” cause for earthquakes there: “There needs to be collaboration between universities, the state of Texas, local government, the energy industry and possibly the federal government for study of this complicated question of induced seismicity. Everyone wants quick answers. What I can tell you is the direction these questions are leading us.”

## EPA Plans to Issue Rules Covering Fracking Wastewater, October 20, 2011

- “The [Independent Petroleum Association of America](#) issued a statement today saying it would work with the EPA to develop new standards and noted that drillers are increasingly cleaning and reusing their wastewater. Officials in Pennsylvania and at the EPA have said that increased recycling has been an important factor in reducing wastewater discharges.” *ProPublica, Oct. 20, 2011*

## Information we need BEFORE a decision on disposal wells

- **The National Academy of Sciences is studying the seismic effects of energy drilling and mining and will issue a report next spring. (2012)**
- **The U.S. Geological Survey (USGS) is working on ways to head off quakes from waste-water wells by performing seismic surveys before drilling the wells or limiting the amount of water going into wells. USGS geologists have learned that the more water injected, the bigger an ensuing quake.**
- **The Earthquake Science Center at the U.S. Geological Survey is conducting a study to determine if there's a way to predict if locating a well in a certain location would be more likely to produce earthquakes**
- **The EPA is producing a study on fracking and its impact on drinking water**
- **The EPA will issue rules covering fracking wastewater**
- **The Secretary of Energy's Advisory Board: Shale Gas Production Subcommittee 90 Day reports – August 2011 and November 2011 – recommendations for implementation**

# The bottom line

- The Fort Worth League of Neighborhoods recommends that the City continue its moratorium on wastewater disposal wells and encourage the use of new technology to deal with the issue.
- We would like for Fort Worth to be able to say that it supports the production of “cleaner burning” natural gas in a manner consistent with our obligation to be effective stewards of local natural resources and to have firm oversight of those business activities which may adversely affect the health, safety and economic welfare of our citizens.

# An opportunity . . .

- To comprehensively plan for gas drilling infrastructure in our city – we have not done this before but planning late is better than never planning at all

Is this what we want more of in Fort Worth?































