

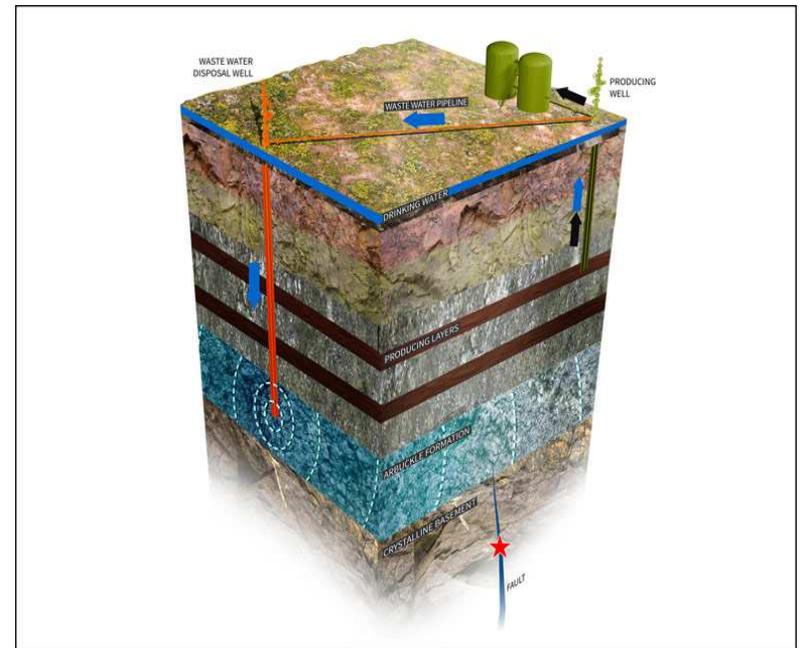
Kansas Underground Injection Control Program & Induced Seismicity



By: Benjamin Busboom
Stinson Leonard Street

What is underground injection?

- Underground injection is used to place fluid underground into porous geologic formations.
- These underground formations may range from deep sandstone or limestone, to a shallow soil layer.
- Injected fluids may include water, wastewater, brine (salt water), or water mixed with chemicals



What is the most publicized issue surrounding underground injection?

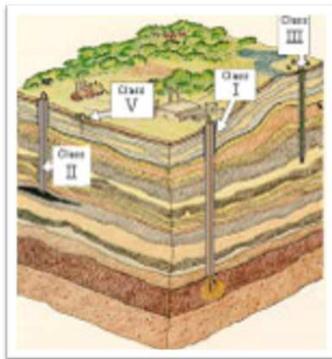
Induced Seismicity



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How is fluid injected?

- Unground injection is accomplished via an underground injection well.
- These wells are regulated based on their depth and what they are injecting.
- There are 5 classes of wells.

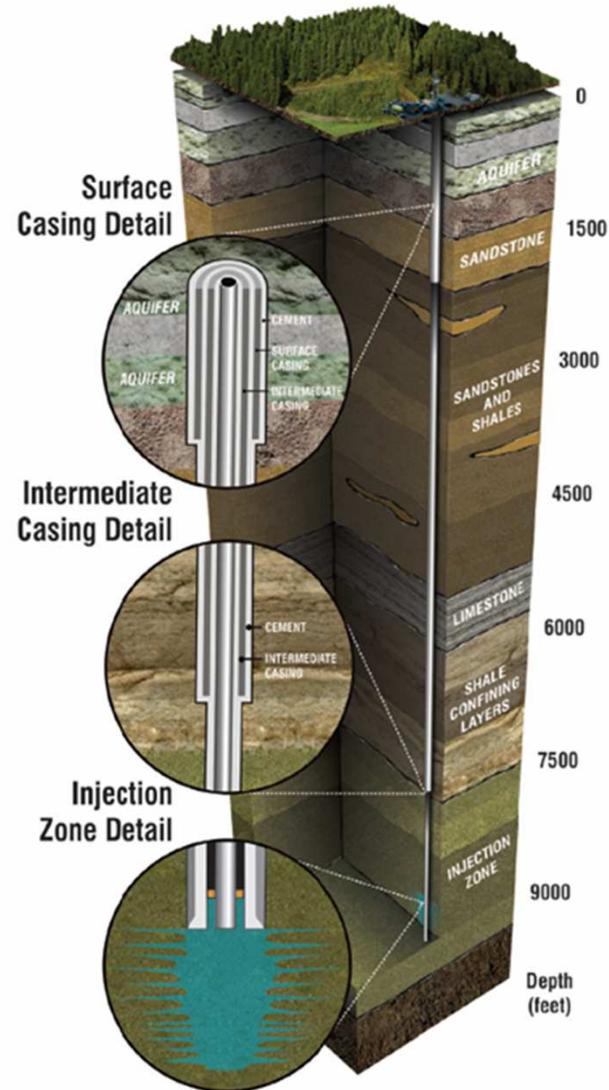


- ❖ Class I industrial and municipal waste disposal wells
- ❖ Class II oil and gas related injection wells
- ❖ Class III solution mining wells
- ❖ Class IV shallow hazardous and radioactive waste injection wells
- ❖ Class V wells that inject non-hazardous fluids into or above underground sources of drinking water
- ❖ Class VI geologic sequestration wells

Class II Wells

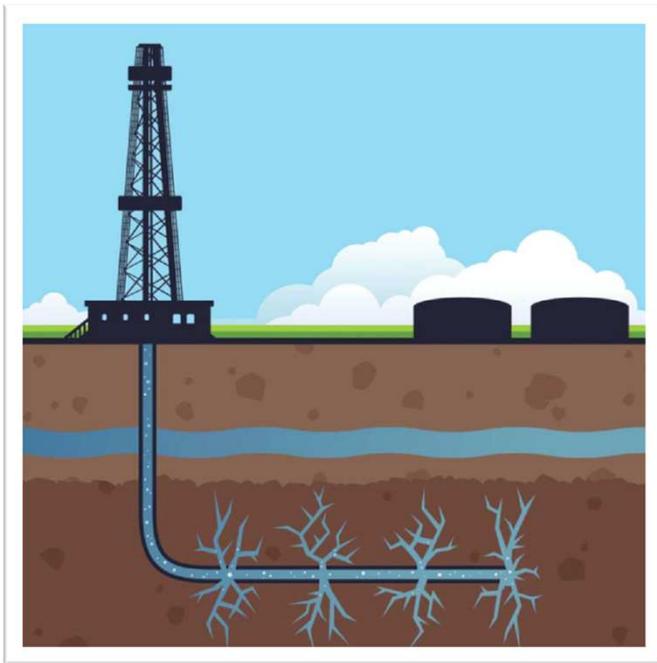
- Class II wells are used to inject fluids associated with oil and natural gas production. Class II fluids are primarily brines (salt water) that are brought to the surface while producing oil and gas.

Figure 2: Typical Class II Injection Well

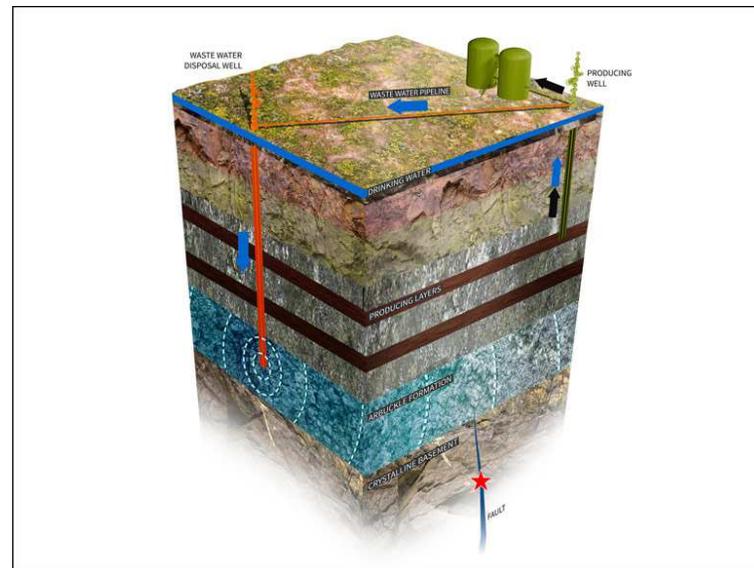


The difference between injection wells and hydraulic fracturing

- This is an area of rampant confusion.
- The differences are extremely important

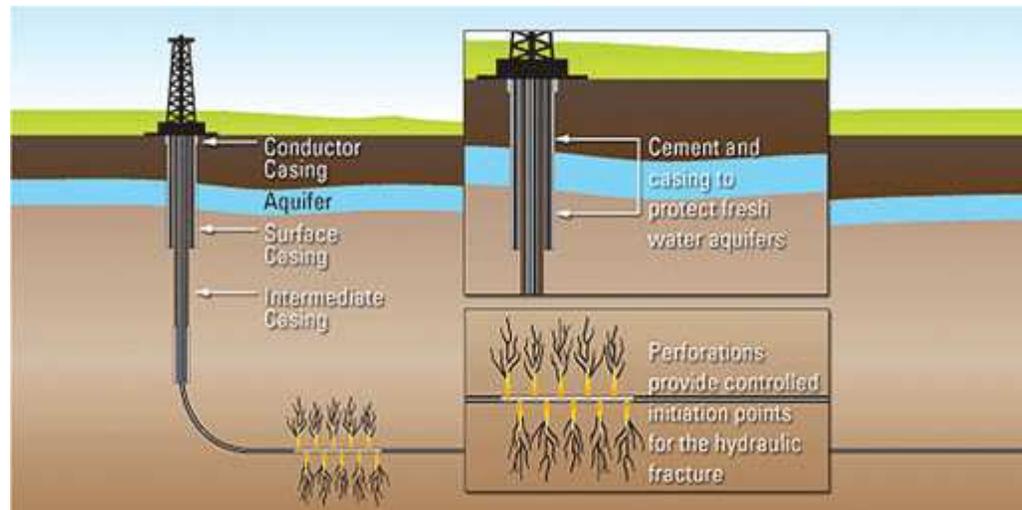


VS.



The difference between injection wells and hydraulic fracturing

- Hydraulic fracturing involves injecting liquid, under pressure, into a geologic formation in order to release oil or gas resources.
- When the well is “completed” the pressure within the geologic formation causes liquids to move up the well bore.



But Does Fracturing Cause Earthquakes

- While hydraulic fracturing does cause a change in the geologic makeup of a shale formation it is rarely linked with earthquakes.
- Fracturing causes micro seismic events (generally less than a magnitude 1.0)
- The events are nearly always highly localized and not considered a significant hazard the midcontinent region.
- The USGS has stated there is “no evidence to suggest hydraulic fracturing itself is the cause of the increased rate of earthquakes”.



Produced Water

- Produced water is water trapped in underground formations that is brought to the surface during oil and gas exploration and production.
- In traditional oil and gas wells, produced water is brought to the surface along with oil or gas.
- Because the water has been in contact with the hydrocarbon-bearing formation for centuries, it has some of the chemical characteristics of the formation and the hydrocarbon itself



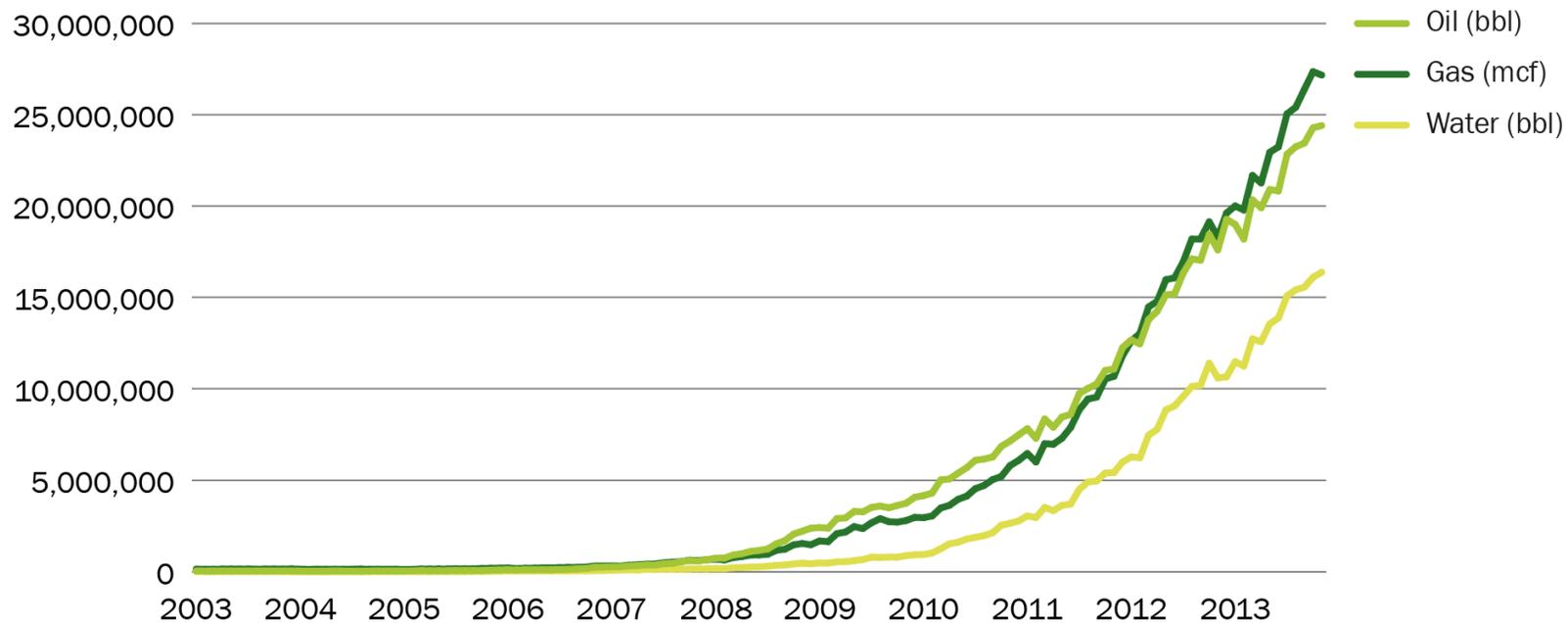
Produced Water

- The physical and chemical properties of produced water vary considerably depending on:
 - The geographic location of the field
 - The geological formation
 - The type of hydrocarbon product being produced.
- Produced water properties and volume can even vary throughout the lifetime of a reservoir.



Produced Water

- The same variation can be true for water volume
- Produced water is by far the largest volume byproduct stream associated with oil and gas exploration and production



What to do with Produced Water

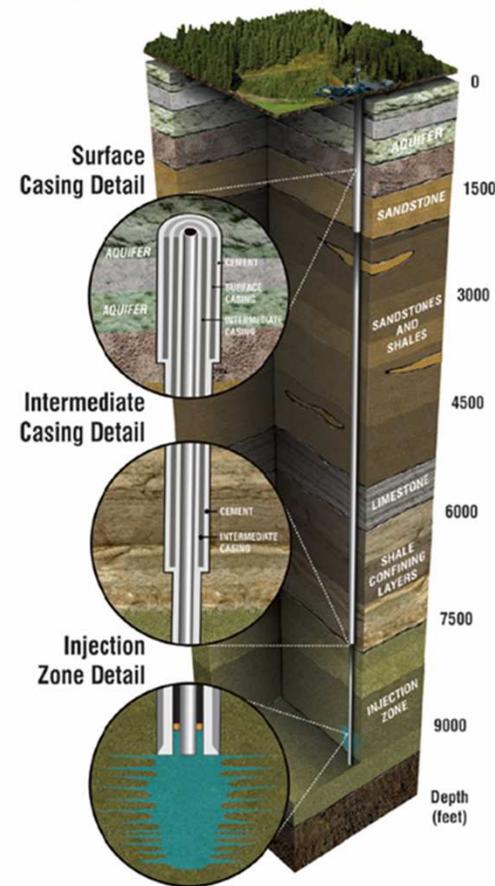
- Traditionally, produced water was disposed of in large evaporation pools.
 - This practice has become less prevalent due to environmental concerns.
- The water may also be applied to “beneficial use”
 - This practice is growing, however at times it may be cost prohibitive.



Injection Produced Water

- The most common method of disposal is via Class II injection wells.
- There are three types of injection wells
 - Enhanced Recovery Wells
 - Used to further produce oil and gas
 - Hydrocarbon Storage Wells
 - Used to store resources for future use
 - Disposal Wells
 - Permanent disposal

Figure 2: Typical Class II Injection Well



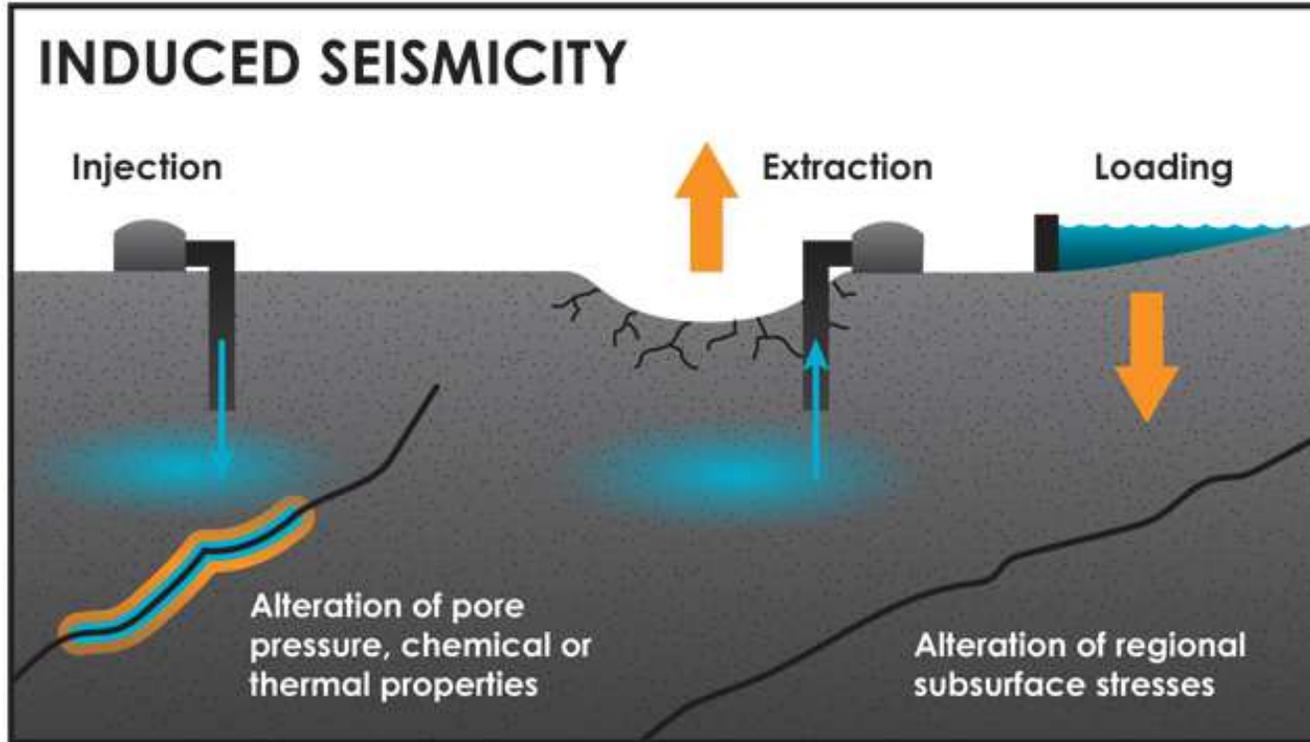
Injection of Produced Water

- In Class II disposal wells, brines are separated from hydrocarbons at the surface and reinjected into the same or similar underground formations for disposal. Wastewater from hydraulic fracturing activities can also be injected into Class II wells.
- Class II disposal wells make up about 20 percent of the total number of Class II wells in the country.



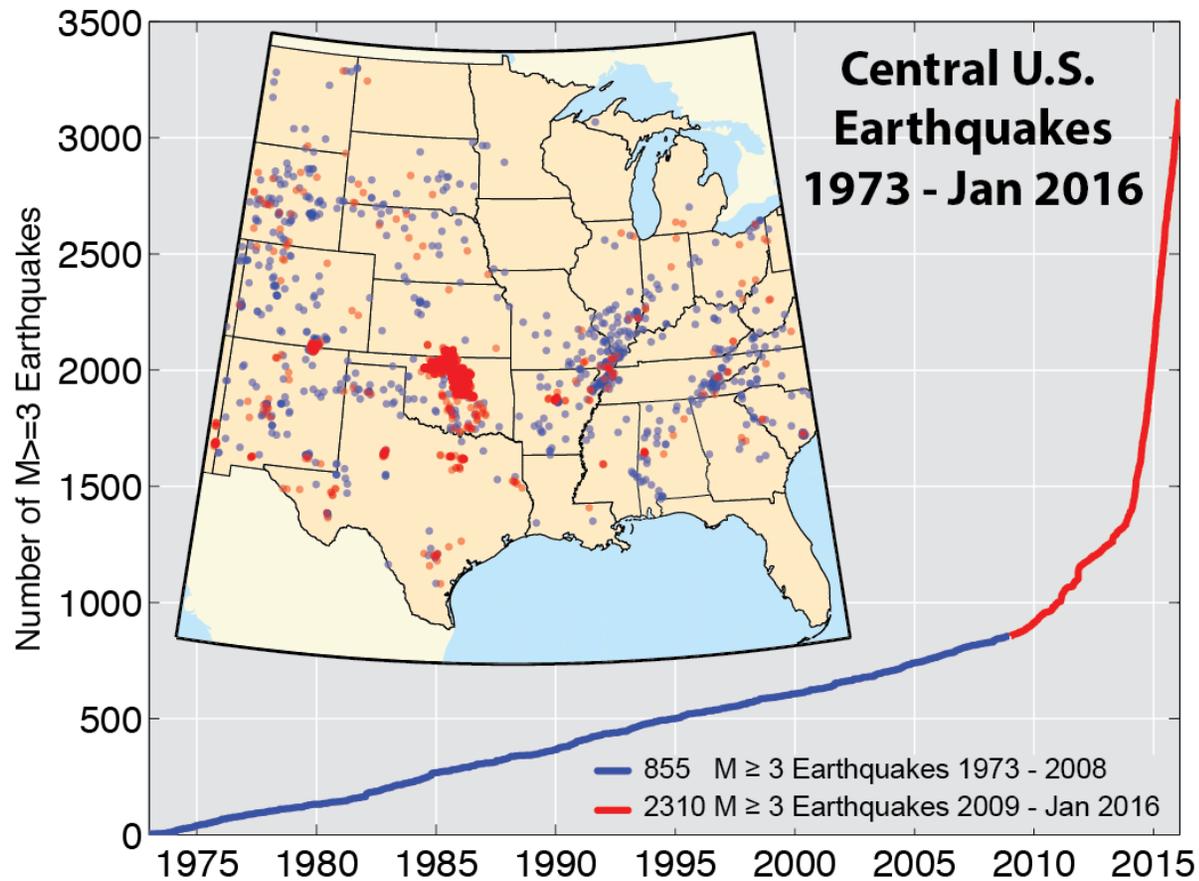
Induced Seismicity

- Is a term which refers to seismic activity caused by human actions.



Induced Seismicity

- Recently induced seismicity has been thought to be linked to Class II injection.



Induced Seismicity

- In Early 2014 Kansas Governor Sam Brownback established the induced seismicity task force, led by the Kansas Geological Survey (KGS), and comprised of the Kansas Corporation Commission (KCC), and Kansas Department of Health and Environment (KDHE),
- The group was tasked with developing a State Action Plan for potential induced seismic activity in Kansas

Task Force Members:



Rex Buchanan
Interim Director
KGS



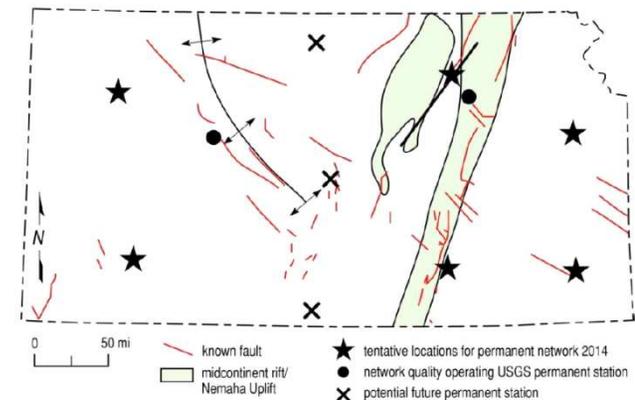
Ryan Hoffman
Director, Conservation Division
KCC



Mike Tate
Director, Bureau of Water
KDHE

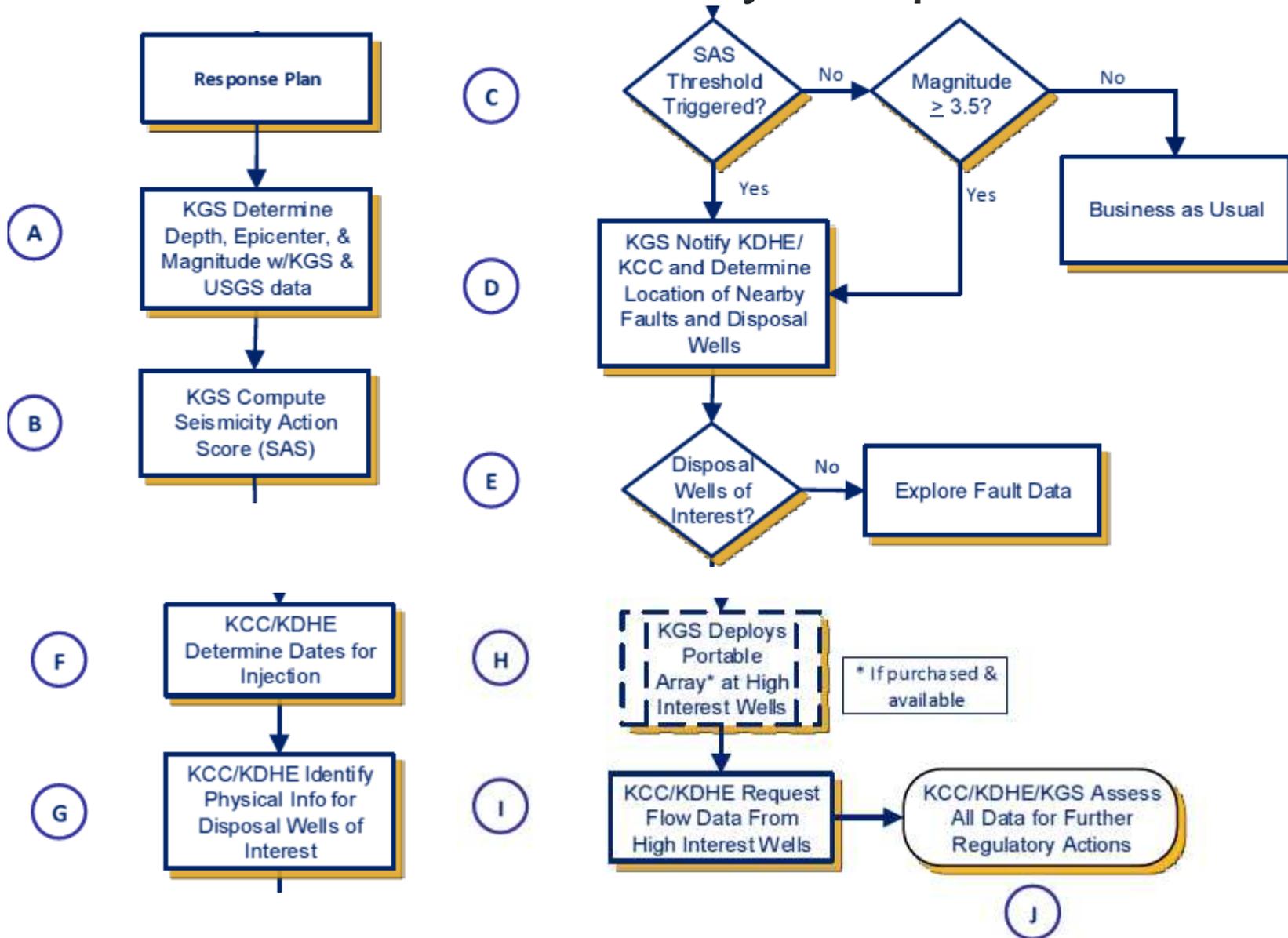
Induced Seismicity

- In October 2014 the task force submitted its “Seismic Action Plan” to the governor.
- The consisted of two major components
 - Enhanced seismic monitoring
 - Permanent network of monitoring stations
 - Portable monitoring arrays
 - Response plan
 - Risk assessment formula



$$\begin{aligned}
 \text{SAS} = & \text{Magnitude}^2 + \text{Score}_{\text{felt}} + \text{Score}_{\text{structure}} + (2 \times \text{Score}_{\text{number}}^3) + \text{Score}_{\text{local recursion}}^3 \\
 & + \text{Score}_{\text{recursion regional}} + \text{Score}_{\text{recursion time}}
 \end{aligned}$$

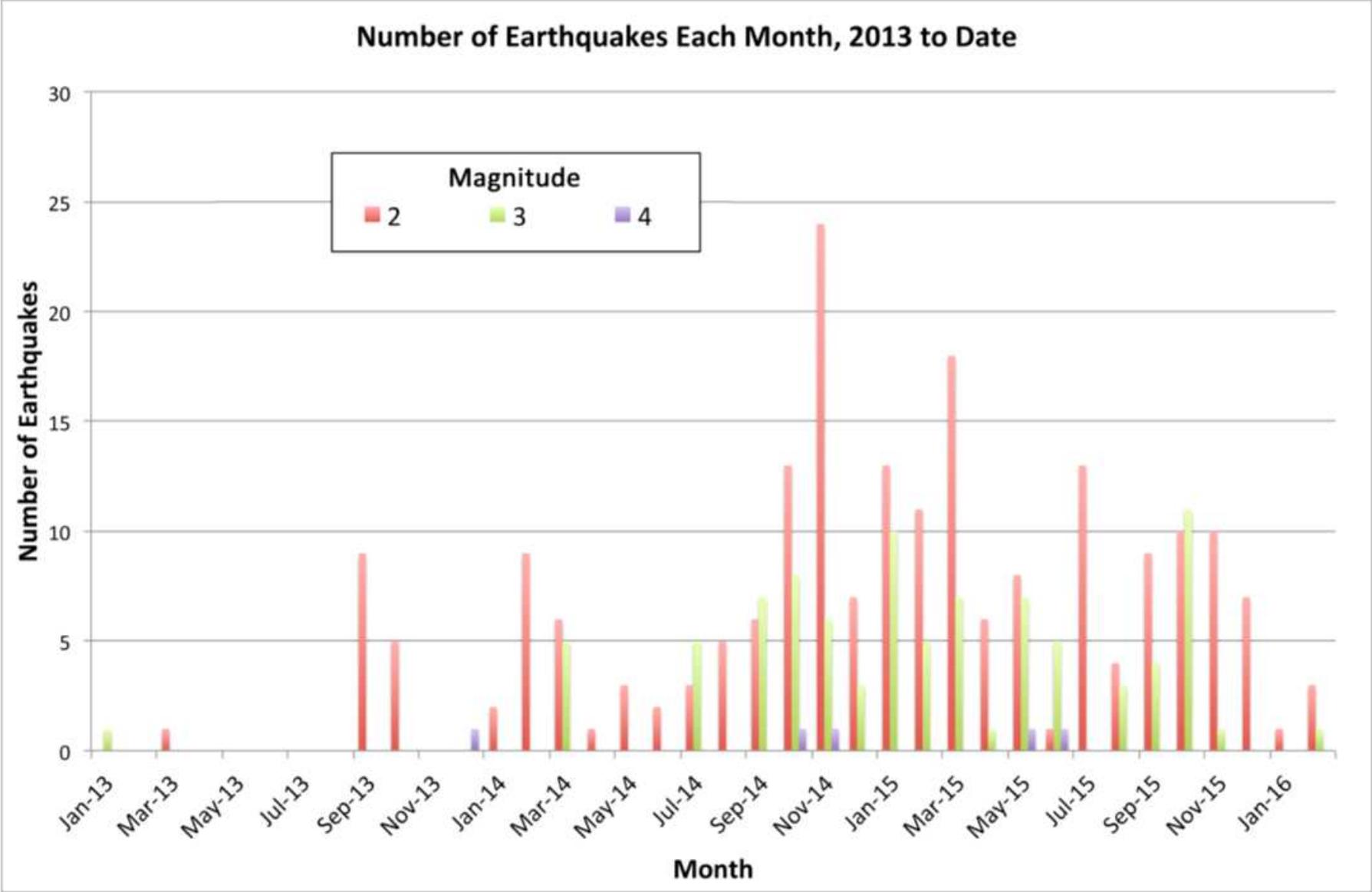
Induced Seismicity Response Plan



KS Injection Restrictions

- In March 2015, the KCC issued an order requiring operators to reduce the rate of injection into the deep Arbuckle aquifer in five areas of Harper and Sumner counties where the KGS had identified events with high SAS scores.
 - Operators also had to verify the depth of each well and, for any well penetrating below the Arbuckle, cement the bottom up to the base of the Arbuckle. They were required to regularly report data showing compliance with the order, and the KGS continued measuring seismic activity in the areas.
- The order set a maximum daily injection limit for all injection wells in Harper and Sumner counties, not just in the five areas of concern.
- On October 29, 2015 the KCC extended its order limiting wastewater disposal until March of 2016.

Induced Seismicity



Induced Seismicity Legislative Update

- House Bill No. 2349
 - Introduced in February of 2015
 - Seeks to establish the earthquake risk pool fund to compensate personal injury or property damages due to induced earthquakes resulting from saltwater injection disposal wells.
 - Grants the KCC authority to suspend all licenses for Class II wells until KCC determines that the earthquake risk pool fund is sufficiently funded.
 - Require a licensing fee for Class II wells.
 - The bill is currently sitting with the committee on Energy and Environment.



Induced Seismicity Legal Update

- February 2016- Sierra Club sues Chesapeake, Devon, and New Dominion.
 - The suit was filed the same day the Oklahoma Corporation Commission released its plan to reduce injection volumes by up to 40%.
 - The suit is based in the Resource Conservation Recovery Act (RCRA)
 - The SDWA does not provide an avenue to recovery.
 - RCRA may because it allows citizens to bring a suit against “any person . . . who has contributed or who is contributing to . . . disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment.”



Induced Seismicity Legal Update

- Using RCRA is a novel approach
 - RCRA involves misappropriation of waste.
 - Classic examples include, pollutants leaching into groundwater or improper disposal of a hazardous waste
 - Here the suit seeks a more direct argument.
 - The suit states that produces water is a “waste” as defined by RCRA and that disposal of the waste is endangering health and environment.
 - However, under RCRA there must be a “reasonable cause for concern”
 - Additionally, oil and gas production wastes, including produced water, are excluded from regulation as a hazardous waste under 42 U.S.C. § 6921 (b)(2)(A).



Questions?



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