2016 Tarleton State University Invitational ENR CDE
National/Global Issues Scenario

The "water-energy nexus" has recently become a critical focus for both environmental organizations and governmental agencies. The production of energy production requires significant amounts of water. At the same time, the provision of water, involving treatment and pumping, requires significant amounts of energy. Human population increases, along with expectations regarding standards of living, place increasing demands on both energy and water. Yet, both of these resources are becoming scarce at the same time that both are affected by climate change.

The increasing use of hydraulic fracturing or "fracking" to mine natural gas in Texas provides a practical example of the integrated environmental, social, and economic concerns associated with the "water-energy nexus." First implemented on the Barnett Shale in 1991, horizontal fracking involves drilling wells into shale rock, located up to 2.6 km (1.6 miles) below the soil surface. Drilling then proceeds horizontally for another 1.6 km (1.0 mile). The fracturing process occurs when water, combined with a mixture of sand and chemicals called "fracking fluid," is pumped into the well, creating pressure that cracks the shale. Natural gas is extracted when the water is pumped back out of the well. Since 2005, more than 12,000 wells have been fracked just in the Fort Worth area.

While the development of horizontal fracking in shales for natural gas extraction has provided well-paying jobs and has enhanced the ability of the U.S. to become energy independent, this extraction process has also raised numerous environmental concerns. The United States Environmental Protection Agency (U.S. EPA) reports that between 40,000 – 1,000,000 gallons of water are required to drill each well. Then, the fracturing process requires at least 2 million, and possibly as much as 13 million gallons of water per well. Water that is pumped back out of the well to capture the natural gas, called flow back water. This water contains various contaminants, including radioactive material such as radon, heavy metal, hydrocarbons, and toxins associated with the fracking fluids. In addition, flow back water often has a very high concentration of total dissolved solids or salts, in some cases nearly three times the concentration of salts in sea water.

Despite the large amount of water required for fracking shale wells, fracking water use in the Barnett Shales in 2010 represented only approximately 9% of the water used by the City of Dallas. However, during the drought of 2011, while water agencies imposed mandatory reductions in water use by city residents and businesses, natural gas companies purchased water from local farmers, offering $9,500 to nearly $17,000 per million gallons of water. Farmers who could provide the water obtained an economic windfall. Meanwhile neighbors, who depended on the same aquifer for their drinking and household water, found their wells, which had continuously provided them with water for generations, going dry.

Most of the flow back water cannot be reused for fracking due to its high levels of salts and other contaminants. Instead, this water is often injected into underground wells. This injection process has been implicated in producing low-level earthquakes. Fracking water use can also impact the quality and quantity of surface water. Water withdrawals from aquifers can reduce streamflow, which, in turn, can concentrate existing contaminants within the stream. Land disturbances and the potential for spills around the well heads can create contaminants, which can be transported into nearby streams through runoff during rainfall events. Research has shown that populations of stoneflies, a biological indicator of water quality, are typically lower in streams adjacent to fracking wells.

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1. What aspect is contributing to the increased demand for water and energy?
   a. loss of well-paying jobs
   b. increase in human population
   c. an increase in the salinity of Earth's water
   d. disease

2. Up to how many gallons of water have been known to be utilized in the fracking process?
   a. "less than 10,000 gallons"
   b. "4,000,000 gallons"
   c. "10,000-30,000 gallons"
   d. "13,000,000 gallons"

3. Water that is pumped back out of the well to capture the natural gas is called?
   a. flow back water
   b. recharge water
   c. backwash water
   d. supersaturated

4. What biological indicator of water quality is less present in streams adjacent to fracking wells?
   a. freshwater plants
   b. leeches
   c. amphibians
   d. stoneflies

5. Injecting contaminated flow back water into underground wells has been found to produce?
   a. man-made geysers
   b. low-level earthquakes
   c. nothing, it is well contained"
   d. "richer, more fertile soil"

6. Where and when was horizontal fracking first implemented in Texas?
   a. Barnett Shale 1991
   b. Permian Basin 2000
   c. Marcellus Shale 1990
   d. Barrow 2005

7. Flow back water contains?
   a. only nonradioactive elements
   b. only organic compounds
   c. a portion of water safe enough to drink
   d. nearly three times the salt concentration as sea water

8. Fracking fluid is made up of?
   a. flow back water
   b. natural gas
   c. a mixture of sand and chemicals
   d. organic matter

9. "Hydraulic fracturing or ""fracking"" mines for?"
   a. gems
   b. natural gas
   c. coal
   d. oil

10. Fracking water has what effect on surrounding surface water?
    a. increased concentration of contaminants
    b. reduced streamflow
    c. reduced survival rate of native plants and animals
    d. all of the above

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11 Where and when was horizontal fracking first implemented in Texas?
- a Barnett Shale 1991
- b Permian Basin 2000
- c Marcellus Shale 1990
- d Barrow 2005

12 "Since 2005, about how many wells have been fracked in the Fort Worth area?"
- a "<2,000 wells"
- b "5,000 wells"
- c ">12,000 wells"
- d "3,500 wells"

13 Fracking water used in the Barnett Shale in 2010 represented what percentage of total water utilized by the city of Dallas?
- a 9%
- b 25%
- c 70%
- d 3%

14 The U.S. EPA evaluates environmental concerns related to fracking. What does this acronym stand for?
- a United States Energy Propagation Agency
- b "United States Environment, People, and Animals"
- c United States Energy Problem Awareness
- d United States Environmetal Protection Agency

15 Flowback water contains radioactive material such as?
- a heavy metal
- b radon
- c hydrocarbons
- d all of the above