

How will High-Volume (Slick-water) Hydraulic Fracturing of the Marcellus (or Utica) Shale Differ from Traditional Hydraulic Fracturing?

Many gas industry representatives are saying that hydraulic fracturing (also called hydrofracking or simply “fracking”) is old, and has been used for years. People concerned about drilling in the Marcellus shale are saying this is a new process. Who is correct? They both are.

Hydraulic Fracturing is Old:

Hydrofracking—injecting fluid (a mixture of water, sand, and highly toxic chemicals) under high pressure into oil and gas wells—has been used for years. It was developed by Halliburton in the late 1940s.¹ This fact sheet will refer to traditional hydraulic fracturing as “old hydrofracking” and the wells as “traditional wells.” Hydrofracking, without the chemical additives, even has been used locally to stimulate flow from shallow water wells.

High-Volume (Slick-water) Hydraulic Fracturing is New and Different:

The type of hydraulic fracturing gas companies will employ in the Marcellus shale (and other shale layers, such as the Utica)² was *developed in the late 1990s*, not the 1940s. It is called “slick-water hydraulic fracturing” because it uses a *different mix of chemicals* than the older methods—reducing the amount of gelling agents and adding friction reducers (thus the term “slick”).³

The hydraulic fracturing technique to be used in the Marcellus shale is also known as “high-volume” hydraulic fracturing (HVHF) because it uses *much more fluid* than old hydraulic fracturing.⁴ In old hydrofracking, typically 20,000 to 80,000 gallons of fluid were used each time a well was hydrofractured,⁵ but HVHF uses 2 to 7.8 million gallons of fluid⁶ (on average 5.6 million⁷), the exact amount depending on the length of the well bore and the number of fractures created along it.

Thus: HVHF uses 70 to 300 times more fluid than old hydrofracking.

Greater Adverse Impacts of High-Volume Hydraulic Fracturing

- **More Chemicals:** Per fracturing, old hydrofracking used 700 to 2,800 lbs. of chemical additives,⁸ but HVHF will use 205,000 to 935,000 lbs.,⁹ many of which are toxic to humans and wildlife. A typical 7-well site could receive 4 million lbs. of chemicals.⁹
- **More Toxic Waste Requiring Disposal:** Assuming HVHF wells use 150 times more fluid than traditional wells (within the 70 to 300x range noted above), the drilling of 7 HVHF wells (assuming one 7-well pad per 640 acres [square mile]) creates an amount of toxic waste fluid equivalent to that from 1,000 traditional wells per square mile.¹⁰
- **More Truck Traffic:** To construct one traditional well requires fewer than 225 to 387 tanker truck trips, but one HVHF well requires 1,760 to 1,905 trips.¹¹ Thus, a typical Marcellus well pad with 7 wells adds about 13,000 round-trip truck trips to local roads.
- **More Fresh Water Used:** With HVHF, more fresh water will be removed from local streams, lakes, and aquifers; because it will be contaminated, it probably will not be returned to the watershed, although how the volumes of waste will be disposed of has yet to be determined. HVHF of just one well would remove 5.6 million gallons (MG) of fresh water, 1.9 times the 2.98 MG the City of Ithaca uses each day to supply 30,000 people.¹²
- **More Drill Cuttings Requiring Disposal¹³:** A traditional vertical well 3,000’ deep¹⁴ creates about 54 cu. yds. of drill cuttings, but a HVHF well to the same depth will create 94 cubic yards, 74% more.¹⁵ Cuttings may contain radioactive materials (NORM), heavy metals, and various toxic chemicals, depending on the types of drilling muds (fluids) used.
- **Larger Disturbed Areas:** HVHF well pads will be larger (4 to 5 cleared acres¹⁶) than those for traditional wells (2 to 3 acres¹⁷) because (1) they must store more fluid, chemicals, drill cuttings, drilling fluids, and equipment, and (2) they are expected to contain multiple wells. Thus any given HVHF well pad will create more run-off, siltation, and visual scars, and disturb more forest or agricultural land.

How Else is Drilling in the Marcellus Shale New and Different?

Intense, Industrial-Scale Development: Extraction of gas from shales is intensive, and done on an industrial scale: the gas industry prefers to drill many wells in a region, because of the high investment in gas-drilling infrastructure.

The most dense gas drilling in New York is in Chautauqua County, where in 2008 the average density of vertical wells was 3 per square mile [SGEIS, p. 5-13]. HVHF well density in the Marcellus shale is expected to range from about 6 to 8 wells per square mile (if the spacing unit is 640 acres) to 16 or more wells per square mile. Infill wells and drilling in other shale layers in the same region can increase the well density beyond these levels.

If we assume only 8 HVHF wells per square mile, the impact on Tompkins County (300,000 drillable acres, 469 square miles) is: 3,752 wells, 770 million to 3.5 billion lbs. of chemical additives, 6.6 to 7.1 million tanker truck trips, 21 billion gallons of fresh water removed, 353,000 cubic yards of drill cuttings, and more than 2,345 acres cleared (assuming 1 well pad of 5 acres with 8 wells, on each square mile).

The impact of High-Volume Hydraulic Fracturing is many magnitudes greater than anything New York has ever experienced; it has the potential to irrevocably damage our state.

ENDNOTES:

¹ www.halliburton.com

² Shale contains gas distributed in microscopic pores and thus must be extensively hydrofracked to extract the most gas. Wells into shale layers may be drilled vertically or horizontally, but horizontal wells bore through the most rock and thus are thought to be able to extract more gas. When a horizontal well is hydrofracked, much more fluid is used because of the greater distance the well bore extends and the many fractures induced; extra lubrication (friction reducers) is used to allow the fluid to move more easily through the long bore and the many induced fractures.

³ *Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program* (SGEIS), September 2009, New York State Department of Environmental Conservation, Section 5-3, pp. 5-32 to 5-33.

⁴ SGEIS, Section 5-3, p. 5-33.

⁵ *Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program* (GEIS), 1992, New York State Department of Environmental Conservation, Chapter 9, Part F, p. 9-26.

⁶ SGEIS, Section 5.62, p. 5-73.

⁷ Water Use in Marcellus Deep Shale Gas Exploration: Fact Sheet, March 2010. Chesapeake Energy Corporation. http://www.chk.com/Media/MarcellusMediaKits/Marcellus_Water_Use_Fact_Sheet.pdf

⁸ Chemical additives used in water gel hydraulic fracturing are gels (20 lbs. per 1,000 gallons), surfactants (1 gallon per 1,000 gallons), and small amounts of bactericides, iron controllers, and clay stabilizers (GEIS, Chapter 9, Section F, pp. 9-26 and 9-27). Assuming the surfactant density is around 10 lbs./gallon (just slightly more dense than water) and taking bactericide, iron control, and clay stabilizer concentrations as given in the SGEIS (Chapter 5, Section 5.4.3, p. 5-44), the weight of chemicals in a water gel hydraulic fracture is roughly 35 lbs./1,000 gallons. Water gel hydraulic fracturing uses 20,000 to 80,000 gallons of water (GEIS, Chapter 9, Section F, p. 9-26), so 700 to 2,800 lbs. of chemicals are used.

⁹ The typical percentage of chemicals in hydraulic fracturing solutions for the Fayetteville Shale is reported as 0.44% by weight (SGEIS, Section 5.4.3, p. 5-44). 0.44% by weight of 5.6 million gallons is 205,000 lbs. (water weighs 8.34 lb./gallon). The SGEIS also states that chemical additives typically comprise 2% or less of the fracturing fluid (Section 5.4, p. 5-33). 2% by weight of 5.6 million gallons is 935,000 lbs. Averaging these two weights yields 570,000 lbs. per well, or 4 million pounds for 7 wells.

¹⁰ Since each HVHF well uses about 150 times more fluid than a traditional well (the rough average of 70 and 300), there is also about 150 times more waste fluid for each HVHF well, assuming HVHF and traditional wells have similar fractions of returned fluid. 7 wells x 150 = 1,050 times the waste fluid.

¹¹ HVHF one well one time requires about 1,540 tanker truckloads of water and waste, assuming 5.6 million gallons of water are used, truck capacity is 5,460 gallons, and half of the fracking fluid comes back out. This estimate of tanker truck size is based on road sizes and conditions in the Southern Tier of NY. Trucks could be somewhat larger or smaller, affecting the number of trips. 220 to 365 more trips are needed to bring in equipment, materials, and employees. [Moss, K. "Potential Development of the Natural Gas Resources in the Marcellus Shale." National Park Service Geologic Resources Division. http://blogs.cce.cornell.edu/gasleasing/files/2008/12/grd-m-shale_12-11-2008_view.pdf]. So, assume 1,760 to 1,905 trips to build, drill, and HVHF one well. Old hydrofracking requires 20,000 to 80,000 gallons of water. Making the same assumptions, this is 5 to 22 tanker truckloads of water and waste. Assuming the same number of trucks are needed to bring in equipment and materials as for HVHF (SGEIS, p. 6-138), 225 to 387 truck trips were required for each traditional well.

¹² City of Ithaca, *2009 Drinking Water Quality Report*, Table 1, p. 3. <http://www.cityofithaca.org/vertical/Sites/%7B5DCEB23D-5BF8-4AFF-806D-68E7C14DEB0D%7D/uploads/%7B03EB90C7-A888-4A48-8C66-B0B67A439D17%7D.PDF>

¹³ Drill cuttings generated using water-based drilling muds (fluids) may be buried on-site, but cuttings from oil- or polymer-based muds must be landfilled.

¹⁴ SGEIS, p. 4-19. A 3,000-foot depth is roughly the average in New York.

¹⁵ SGEIS, p. 5-29. A vertical well drilled 7,000' deep generates 125 cubic yards of cuttings, but the average Marcellus shale well in NY will be shallower (SGEIS p. 4-19, map). A vertical well 3,000' deep would generate 54 cu. yds. of drill cuttings (scaled down from 7,000' and 125 cu. yds.). A 3,000' horizontal extension adds 40 cu. yds. of cuttings (SGEIS p. 5-30). Thus total cuttings are 94 cu. yds. 94 is 74% bigger than 54.

¹⁶ SGEIS, p. 5-26.

¹⁷ SGEIS, p. 5-20.