



**What is Methane?**

Methane (CH<sub>4</sub>) is a chemical compound. It is the primary component of natural gas and is the most abundant organic compound on earth.<sup>i</sup> Methane is not toxic and therefore the U.S. Environmental Protection Agency (EPA) has not established primary or secondary contamination standards for its presence in drinking water. Methane was first discovered in the 1770's and is so abundant in areas of Pennsylvania and portions of New York that records of its presence date back to 1795 when local settlers found that water that was flammable due to high methane content.<sup>ii</sup>



Figure 1: USGS

**There are Two Primary Forms of Methane**



**KLAMATH FALLS, Ore., Jan. 1 (AP)—**L. C. Gilder turned on his faucet today and got fire-water. On New Year's, too.  
This was both fire and water, though. Gilder explained it was from the new well he dug at his home. He said natural gas apparently rises from the 400-foot well. He gets the flame by lighting a match close to the spout of water from the faucet.  
It's spectacular, but chancy. Gilder's face and arms were singed. He explained the first time he happened to strike a match near the faucet, flames shot out five feet. They burned 30 minutes that time.

Spokeman Review, January 1951

- **Organic Methane:** is microbial in origin (subsurface and near-surface) and originates from sources such as landfills, marshes, and the fermentation of organic matter like manure and feedstock.
- **Thermogenic methane:** is formed in the deeper subsurface as pressure and heat builds as organic particles are covered in mud and other sediment. Over time, increased sediment, mud and debris accumulate on top of the organic matter, increasing heat and pressure to produce oil and natural gas. While oil is formed at lower temperatures and shallower deposits natural gas forms at higher temperatures and greater depths.

**Methane Fingerprinting**

Testing enables methane sources to be identified. Geochemical and isotopic fingerprinting techniques can differentiate between organic methane and thermogenic methane. By understanding the form of methane present, further understanding of potential sources and monitoring requirements can be determined.

**Methane Concentrations Are Highly Variable**

*Pressure, weather, temperature, geography, well depth and other natural conditions such as heavy rain fall effect methane concentrations in the groundwater.* Even neighboring wells may have different methane content as a result of varying depths of wells and associated pressures. As a result, natural methane spikes are common in areas where methane is prevalent. This is entirely independent of the presence of natural gas exploration.

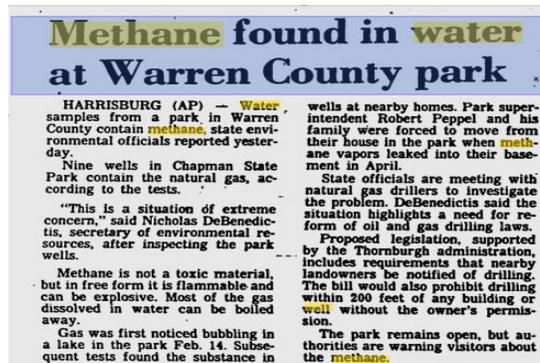
**How Can Methane Enter Private Water Wells**

Methane travels to the point of lowest pressure (e.g., water wells and valley bottoms) and tends to migrate along a path of least resistance. For this reason, methane can enter private water wells through poorly constructed well components, also referred to as pathways. Water wells potentially offer a less-resistant pathway if they are not properly designed and constructed with casings and other protective measures. Improper spacing between the well casing and the surrounding environment can also form a pathway for potential migration. These spaces allow for the transfer of contaminants, including methane, into the water well. For more information on how methane can enter a water well and recommended ways to remove unwanted methane from a water well please visit

<http://pubs.cas.psu.edu/FreePubs/pdfs/XH0010.pdf>

**Methane Migration and Natural Gas Production**

A recent comprehensive study was conducted on "The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies" by the Pennsylvania State University. This study concluded: "when comparing dissolved methane concentrations in the 48 water wells that were sampled both before and after drilling (from Phase 1), research found no statistically significant increases in methane levels after drilling and no significant correlation to distance from drilling [operations]."<sup>iii</sup>



Pittsburgh Post-Gazette, June 21, 1983

Previous studies that have attempted to address this issue had significantly limited sample size and did not account for baseline methane presence in water wells.



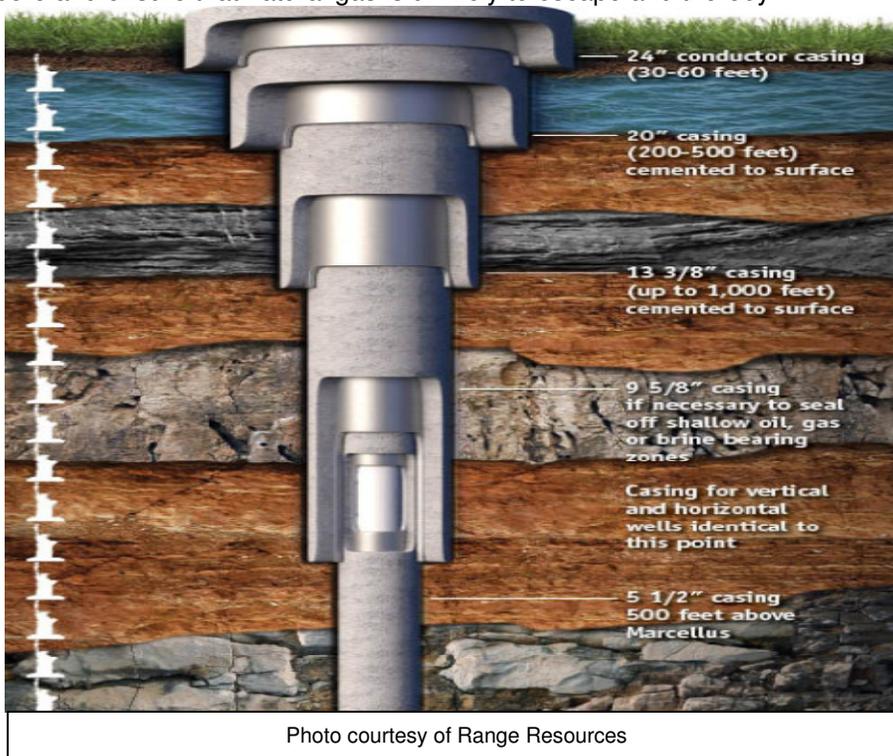
### **Precautions Taken In Natural Gas Production**

Working closely with state regulatory authorities natural gas producers in the Marcellus Shale take multiple precautions to ensure that natural gas wells are properly evaluated and designed so methane contamination does not occur as a result of natural gas production. To fully isolate the wellbore and ensure that natural gas is unlikely to escape and thereby impact nearby water sources, multiple steel casings are inserted and fully cemented into place prior to production. In Pennsylvania, regulations require the utilization of three layers of casing and cement protections however in the Marcellus Shale many operators are currently exceeding this requirement and are using up to five layers of these protective safeguards.

### **State Regulations in Pennsylvania**

Pennsylvania, Chapter 78 of the Oil and Gas Act regulate proper natural gas well construction standards in regards to appropriate design, cementing and casing procedures for natural gas wells. Recent revisions ensure the protection of private water wells from methane migration from natural gas wells. These revisions include:

- Operators must have a pressure barrier plan to minimize well control events;
- Operators must ensure an adequate bond between the cement, casing and the producing formation;
- Operators must use centralizers to ensure casings are properly positioned in the wellbore; and
- Operators must perform quarterly inspections and annual reports to ensure well integrity.
- Operators must use specific cement mixtures and setting processes that improve the quality of the cement placed in the casing that protects fresh groundwater.



<sup>i</sup> [www.naturalgas.org](http://www.naturalgas.org)

<sup>ii</sup> Pennsylvania Department of Environmental Conservation and Natural Resources, [Salt Springs State Park](#).