



November 7, 2013

Ms. Melba Farley
PO Box 363
Platteville, CO 80651

RE: Stable Isotope Analysis
Farley Water Wells – DWR Permits No. 247419 and No. 231884
COGCC Sample IDs 752812 and 752813 (Project Facility ID 434043)

Dear Ms. Farley:

On September 5, 2013 the Colorado Oil and Gas Conservation Commission (COGCC) collected a water sample from three water wells located on your properties. The purpose of the sampling was to determine whether methane was present in the water produced from your water wells. COGCC also analyzed the samples for general organic and inorganic constituents. COGCC reported the analytical results to you in letters dated October 14, 2013.

The water in the two deeper of the three water wells on your properties contains methane at concentrations high enough to warrant further investigation. Therefore, COGCC submitted the samples to Isotech Laboratories in Champaign, Illinois for gas composition and stable isotope analysis to determine if the methane present in the well water is biogenic or thermogenic in origin. This information is used to determine whether oil and gas drilling and production activity may have impacted the water wells.

GAS COMPOSITION

The gas produced from the oil and gas wells around your home is thermogenic methane. Thermogenic methane gas is formed by the thermal breakdown of organic material in rocks resulting from high temperatures created by deep burial. With the thermogenic methane gas are other higher carbon number compounds (“heavier”) gases such as propane (C3), iso-butane (iC4), normal butane (nC4), iso-pentane (iC5), normal pentane (nC5), and hexane (C6).

Biogenic methane gas occurs in most near-surface environments and is a principal product of the decomposition of buried organic material. In Weld County many of the coal zones in the Laramie-Fox Hills aquifer, in which your water well is completed, contain biogenic methane gas.

WATER WELL PERMIT NO. 231884

Laboratory results of the gas sample collected from your water well with permit number 231884 show it contains nitrogen (46.83 percent), methane (47.63 percent), oxygen (3.79 percent), argon (0.879 percent), carbon dioxide (0.82 percent), and trace amounts of ethane and propane. The nitrogen, oxygen, argon, and carbon dioxide are components of air. The presence of methane (C1) in the absence of the "heavier" carbon compounds (propane, butanes, pentanes, etc.) indicates the methane is likely biogenic in origin.

WATER WELL PERMIT NO. 247419

Laboratory results of the gas sample collected from your water well with permit number 247419 show it contains nitrogen (48.73 percent), methane (46.75 percent), oxygen (2.86 percent), argon (0.940 percent), carbon dioxide (0.65 percent), and trace amounts of ethane and propane. The nitrogen, oxygen, argon, and carbon dioxide are components of air. The presence of methane (C1) in the absence of the "heavier" carbon compounds (propane, butanes, pentanes, etc.) indicates the methane is likely biogenic in origin.

STABLE ISOTOPE ANALYSIS OF METHANE*WATER WELL PERMIT NO. 231884*

- The deuterium/hydrogen isotope ratio for the methane in the water sample from your water well is -243.2 parts per mil (‰).
- The carbon-13/carbon-12 isotope ratio for the methane in the water sample from your water well is -69.19 ‰.

WATER WELL PERMIT NO. 247419

- The deuterium/hydrogen isotope ratio for the methane in the water sample from your water well is -253.0 parts per mil (‰).
- The carbon-13/carbon-12 isotope ratio for the methane in the water sample from your water well is -68.61 ‰.

STABLE ISOTOPE CROSS-PLOT

I have included a cross-plot of the stable isotopes for methane in your water well samples to help discuss the sample results for your water well. On the cross-plot you will notice the yellow-shaded area near the top right corner as defined a "Thermogenic Gas". This is the area of the cross-plot where the natural gas produced by the gas wells in the Denver Basin plots. There are is also a blue-shaded area in the middle left area of the cross-plot defined as "Sub-Surface Microbial Gas (CO₂ Reduction)". This is the area of the cross-plot where the biogenic

gas that is commonly found naturally in the Laramie-Fox Hills aquifer plots. The samples collected from your water wells also plot in the "Sub-Surface Microbial Gas (CO₂ Reduction)" area. This result indicates that the methane present in your wells water is most likely from a biogenic source that naturally occurs in the zone of the Laramie-Fox Hills aquifer that your water wells produce from.

CONCLUSION

Based on the analysis of the gas composition and stable isotopes of methane for the gas from your water wells, the methane gas present is most likely biogenic gas that is naturally present in the Laramie-Fox Hills aquifer. COGCC does not currently have plans to conduct any further investigations involving your water wells at this time. However, COGCC appreciates your cooperation in obtaining samples for analysis to better our understanding of the distribution of methane in the area around your wells.

You should be aware that the concentration of dissolved methane detected in the samples collected from your two deeper water wells (6.9 milligrams per liter, and 7.8 milligrams per liter) is near the concentration where methane may exsolve when exposed to air. If the methane occurs at a high enough concentration and if it is allowed to accumulate in a confined space, such as a well pit, crawl space, closet, etc., an explosion hazard can be established. In addition, if methane concentrations in well water are high, bubbles of free gas form within the water and cause the well pump to cavitate and no longer bring water to the surface.

I have included some additional information on mitigation of methane from home water wells. You may want to review your well and distribution system construction with a licensed water well contractor to ensure the safety of your system.

If you have any questions regarding this information, please contact me at 970-461-2970 or rick.allison@state.co.us.

Sincerely,

Colorado Oil and Gas Conservation Commission



Richard Allison, PG

Environmental Protection Specialist – Northeast Colorado

Enclosures Attachment 1 – Stable Isotope Cross-Plot
 Attachment 2 – Isotech Laboratories Report
 Attachment 3 – Water Well Information