Site Remediation Section

Railroad Commission of Texas

Review of Analytical Data - Murray Complaint (7B-10736) and Singleton Complaint (7B-10612)

April 28, 2015

Background

On February 20, 2014, the Railroad Commission of Texas (RRC) District 7B office was contacted by Mr. Richard Singleton regarding the smell of gas from his water well. An initial inspection was performed on the 20th of February. Subsequent sampling and analysis of water from his well in April 2014 confirmed the presence of methane in the water sample from his well. The Singleton Complaint was assigned Complaint No. 7B-10612. On August 2, 2014, Mr. Cody Murray contacted the RRC District 7B office regarding a flash fire that originated from his water well. An initial inspection was performed on the 2nd of August. The Murray Complaint was assigned Complaint No. 7B-10736. Both homes are located within 1,400 feet of each other in northeastern Palo Pinto County.

On August 7, 2014, District Office staff visited homes within a one-mile radius of the Singleton and Murray properties to leave packets of information with a request to sample water wells. One person responded. Consequently, commission staff initiated a plan to collect water samples from the Murray and Singleton water wells, and additional water wells if permission could eventually be obtained.

On August 21, 2014, Terracon, on behalf of the RRC, collected groundwater samples from the Singleton and Murray water wells. During and subsequent to that sampling event, RRC staff made arrangements to sample three additional water wells in the general area. The three additional water wells (identified as Parker, Mills and Hill) were sampled on August 28, 2014. Groundwater samples were analyzed for dissolved methane, ethane, and propane, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, and xylenes (BTEX), chloride and sulfide. Samples were also analyzed for natural gas composition and carbon and hydrogen isotopes of methane, ethane and propane.

Water wells were purged for several minutes prior to sampling. The Hill property water well, however, was not purged due to low well yield. Water samples were collected using low flow sampling techniques from the wellhead spigot, or as close to the wellhead as possible. Samples for BTEX, TPH, sulfide and chloride analyses were collected in 40 ml VOA vials and 250 ml plastic containers. Samples for dissolved gas concentration, composition, and isotopes were collected using IsoFlask technology.

Copies of the water well sampling reports were submitted to the five property owners in separate correspondence dated October 20, 2014.

In addition to the dissolved gas samples from water wells, Commission staff requested from operators (EOG and Fairway Resources) sampling and analysis of gas samples from nearby oil and gas production wells.

A figure depicting the locations of water wells and oil and gas production wells sampled for this study is attached as Figure 1. Information about water well construction is provided in Table 1. The oil and gas production wells in the area are producing from the Barnett Shale, at a depth of approximately 5100'-5500' and from shallower fields including the KRS (Marble Falls) and Palo Pinto Co. Regular fields, at depths of approximately 4600'-4900' and 3190'-3210', respectively. The water wells are completed at depths ranging from 190' to 220' depth.

Based on a review of geological studies in the area, the study area is within the outcrop of the Pennsylvanian Canyon Group, which has been described as a sequence of carbonate and terrigeneous clastic rocks deposited in a generally carbonate- and mud-rich environment (Nicot, J.P, et al., 2013, Brown, et al., 1973). Limestones of the Palo Pinto Formation (within the Canyon Group) are reported to be water-bearing with accessible water present mostly in fractures (Nicot, J.P., et al., 2013).

Review of Analytical Data

Data summary tables and plots of isotope analyses are attached. Dissolved constituent data are presented in Table 2. Sulfide (a test for the occurrence of hydrogen sulfide gas) was not detected in any water well sample. Chloride was detected in each well in concentrations ranging from 230 mg/L to 1,060 mg/L. TPH, ethylbenzene, and xylenes were not detected in any sample. Benzene and toluene were detected in only one water well (Singleton) at concentrations of 0.009 mg/L and 0.0007 mg/L, respectively. Dissolved methane, ethane and propane were detected in each water well. Methane concentrations ranged from 0.0014 mg/L (Parker) to 55 mg/L (Mills). Ethane ranged from 0.0002 mg/L (Parker) to 13 mg/L (Mills). Propane ranged from 0.0002 mg/L (Parker) to 6.9 mg/L (Mills). The presence of ethane and propane suggest that the gas is thermogenic in origin, rather than biogenic.

The gas composition and isotope data from the water wells and production wells are presented in Tables 3 and 4, respectively. Isotope and composition ratio data are graphically presented on four separate graphs (attached) to further evaluate the source of the gas and to look for similarities or differences in groups of samples. The Parker water well did not contain enough gas to analyze for isotopes. Samples from two of the EOG wells were analyzed for gas composition only.

A plot of hydrogen (deuterium) vs. carbon isotopes of methane (Figure 2) confirms that the gas is thermogenic in origin. When plotted on a finer scale (Figure 3), the data appear to cluster such that the water well isotope data plot in a unique area and production gas isotopes reveal greater variability. A plot of wetness (i.e., the ratio of methane [C1] to the sum of heavier gases [C2+C3]) vs. carbon isotope of methane and a plot of carbon isotope of ethane vs. the ratio of methane to ethane content are presented as Figures 4 and 5, respectively. Collectively, Figures 3, 4, and 5, reveal a separation between production gas and water well gas. However, the separation appears more distinct for Barnett Shale gas than for the gas produced from the Palo Pinto Co. Regular and KRS (Marble Falls) fields.

Therefore, while the data appear to suggest that the gas in groundwater is not migrating directly from the Barnett Shale into the water wells, the data are inconclusive with respect to specific migration pathways from shallower sources. Furthermore, the natural occurrence of shallow gas (less than 500 feet deep) and natural gas seeps in Palo Pinto County have been documented in earlier reports (Wegemann, 1915).

Recommendations

Based on the information described above, staff recommends further detailed review of well construction records for oil and gas production wells in the immediate vicinity of the study area, to include a detailed review of cementing records and monitoring of bradenhead pressure gauges to ensure that producing wells in the area are sufficiently cemented to isolate groundwater from underlying producing formations.

Peter G. Pope, P.G.

References:

Brown, L.F. Jr., et al., 1973, Pennsylvanian Depositional Systems in North-Central Texas: A Guide for Interpreting Terrigenous Clastic Facies in a Cratonic Basin, Guidebook Number 14, Prepared for the Annual Meeting of the Geological Society of America, November, 1973. Bureau of Economic Geology.

Nicot, J.P, et al., 2013, Flow and Salinity Patterns in the Low-Transmissivity Upper Paleozoic Aquifers of North-Central Texas, GCAGS Journal, v.2 (2013) p. 53-67.

Terracon, 2014, Water Well Sampling – Hill Property, Report Prepared for the Railroad Commission of Texas, October 16, 2014.

Terracon, 2014, Water Well Sampling – Mills Property, Report Prepared for the Railroad Commission of Texas, October 16, 2014.

Terracon, 2014, Water Well Sampling – Murray Property, Report Prepared for the Railroad Commission of Texas, October 16, 2014.

Terracon, 2014, Water Well Sampling – Parker Property, Report Prepared for the Railroad Commission of Texas, October 16, 2014.

Terracon, 2014, Water Well Sampling – Singleton Property, Report Prepared for the Railroad Commission of Texas, October 16, 2014.

Wegemann, Carroll H., 1915, A Reconnaissance in Palo Pinto County, Texas, With Special Reference to Oil and Gas, *Contributions to Economic Geology*, 1915, Part II.