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Alexander B. Grannis
Commissioner

July 6, 2009

Mr. William Boria
Chautauqua County Dept. of Health
Hall R. Clothier Bldg.
7 North Erie Street
Mayville, NY 14757

Dear Mr. Boria:

I am responding to your letter of June 1, 2009 to Christopher Miller, our Region 9 Minerals Manager, concerning a water well complaint from Mr. Ferrugia of 2641 Donelson Road in Jamestown. Mineral Resources staff has investigated the complaint and have obtained additional information that was not included in Chautauqua County Department of Health's (CCDOH) analysis of the complaint. I believe it will be helpful to review the sequence of events, water test analyses, well inspections performed by regional Mineral Resources staff and my interviews with the Ferrugias and their neighbors

Sequence of events

The Ferrugia's contracted Caster Water Well Drilling (Caster) to drill their water well in 2001. The well was drilled through 7 feet of soil and till into shale and stayed in shale to a total depth of 85 feet. The driller noted flows of water in the well at 25 and 30 feet. Based on topographic information, the surface of the Ferrugia's leach field (approximately 273 feet away from the water well) is approximately 15 feet lower than the surface elevation of the water well. However, the noted water zones are stratigraphically 10 to 15 feet lower than the leach field. See attached elevation diagram (Attachment 1).

Caster hydraulically fractured Ferrugia's water well to increase the flow of water from the shale (2 gpm pre-frack to 15 gpm post-frack). Caster informed DEC regional Mineral Resources staff in June 2009 that the frack performed on the water well could extend as far as 200 feet from the well. Perhaps this explains the presence of coliform and the note in the 2005 report that the well was bacterially unsafe as sampled in the 2005 test. The rock units in this part of the state dip to the south in the Kiatone area and could create a pathway for the flow of fluids within the shale from north to south. Any leach field fluids entering the shale may very well flow south toward the Ferrugia's water well.

Adjacent landowner water well tests done by Nornew in 2005

Nornew tested the Ferrugia, Nordlund, Boardman, Pelham, Johnson and Legere water wells prior to drilling the Eckman 7 well in order to have baseline water quality data of the private water wells in the immediate vicinity of their proposed gas well (see Attachment 2). The Nordlund, Boardman and Ferrugia wells all tested as "bacterially unsafe" according to the Microbac Lab's report. Total dissolved solids (tds) were found, prior to the drilling of the Eckman well, to be in the 250 ppm (Ferrugia) to 881ppm (Pelham) range. The tests also discovered that sodium values were in the 76 ppm to 301 ppm range and chloride values were in the 3.8 ppm to 251 ppm range. It is clear from the 2005 tests that although the most recent water well installed (Ferrugia) was on the low end of the range, other nearby water wells completed in the same shale unit had significantly higher tds, chloride and sodium levels present in the well water before Nornew drilled the Eckman 7 well. Nornew tested the Ferrugia's water again on April 16, 2007. The results of these tests were included your June 1, 2009 letter.

Nornew drilled the adjacent gas wells and sealed off all the shallow zones by cementing the casing from the surface casing seat to the ground level. According to Division of Mineral Resources records, the closest gas well to Ferrugia's property, Eckman 7- 468 (hole number 24099), commenced drilling on August 8, 2005, finished drilling on August 14, 2005 and was completed as a productive well on September 1, 2005. Mineral Resources inspectors found the fluids from the well were contained in a lined pit and no violations occurred at the site. Nornew cemented the surface casing from 487 feet to the surface. The site was subsequently reclaimed without incident or complaint. Nornew submitted cement tickets to the Department for the surface casing cement job and these tickets document good cement returns to the surface which shows that the casing was cemented properly.

According to CCDOH, the Ferrugias began noticing a change in their drinking water in mid to late 2007, some two years after the Eckman 7 gas well was drilled. Regional DEC records show that Mrs. Ferrugia contacted Mineral Resources with her complaint on December 14, 2007. Mineral Resources staff, following the MOU with CCDOH, informed Mrs. Ferrugia that she needed to contact CCDOH and also told her that CCDOH would refer the complaint to Mineral Resources after ruling out other causes of contamination. It is important to note that regional Mineral Resources staff had not received any referral from CCDOH on this well until Chris Miller received your June 1, 2009 letter.

Your June 1 referral package included information that Caster faxed Ferrugia's water well drilling information to CCDOH on February 12, 2008. Mineral Resources staff inspected the natural gas wells adjacent to the Ferrugia property in June of 2008 due to a transfer of ownership request. Staff found that the Eckman 7 drilling pit had been reclaimed, the site restored to grade and noted that the 4,000 gallon brine tank was approximately 20% full. Production brine is typically flowed from the well through a gas/water separator and contained in a water-tight brine tank until the operator calls for a brine hauler to take the brine to a treatment facility. Our inspector found no evidence of gas leaks, brine discharge or pollution at the Eckman 7 or any of the other wellsites in 2008.

Your June 1 letter stated that you had investigated the Ferrugia's water well complaint on April 20, 2009. After receiving the CCDOH referral, Mineral Resources performed a records search of the natural gas wells in question and inspected the gas wells in proximity to the Ferrugia property. Staff

found that the Eckman 7 brine tank was approximately 50% full. Mineral Resources wellsite inspections on June 8, 2009 found no evidence of gas leaks, brine discharges or other pollution at the Eckman 7 or any other of the nearby wellsites.

Staff's conversations with Mr. Ferrugia on June 8, 2009 were quite productive and very informative. We discovered that shortly after your investigation commenced, the Ferrugias decided to test their water well for a fourth time. Benchmark Analytics Inc. took water samples from the well on April 23, 2009, analyzed the samples and sent a report to Dave Ferrugia. Mr. Ferrugia told staff about the water test and allowed our inspector to make a copy (see Attachment 3). Information contained in this test provides valuable data regarding the present day condition of the Ferrugia well water. Mr. Ferrugia also informed us that the well water was not safe to drink so he dumped chlorine (amount unknown) down the well to kill the bacteria. He did not provide a date or say whether the chlorine treatment was a one time only event or if multiple treatments were done (a second shock treatment was mentioned during my interview with Ferrugia on June 23, 2009).

Water well test information – first two tests

The June 1, 2009 letter contains information and analyses on the first two water well tests. The data was plotted on Piper diagrams (see CCDOH Attachment 6) and you observed that the water quality shifted from sodium carbonate dominated to sodium chloride dominated. Although the data plots in an area between "typical NaCl brine" and "normal shale water", you concluded that "This is a well documented case showing drinking water impacts that are **seemingly related** to gas well development" (emphasis added). It should be noted that typical natural gas well brine values are > 10,000 ppm as shown on your Attachment 7 and not in the 600 ppm range as found in the 2007 test.

Water well test information - third test

I spoke with Mrs. Ferrugia on June 23, 2009 and she informed me that they had their water tested on January 7, 2008 but the only test done was for methane/ethane. The Department does not have a copy of the results of this test and believes it would have little value due to the lack of water quality/chemistry data

Water well test information - fourth test

The Ferrugia's April 2009 test results found that chloride levels had dropped significantly from 223 ppm to 122 ppm (- 45%) when compared to the 2007 test. The total dissolved solids (tds) concentration did increase slightly over the past two years from 600 ppm to 650 ppm (+ 8%) but this increase is due to greater concentrations of calcium, magnesium, barium and sodium. The sodium level had increased from 111 ppm to 144 ppm even though the chloride concentration decreased when compared to the 2007 test. Mineral Resources staff plotted concentration data from the 2005, 2007 and 2009 tests on the attached Piper diagram (see Attachment 4) and this data clearly shows movement away from the typical brine area of the plot and toward the shale formation water concentration area. I assume that the report and data from the fourth test was not considered in your analysis since you did not mention it in your June 1, 2009 letter.

The nearby natural gas wells were completed in the Medina formation and the production brine concentrations from this formation are in the 130,000 to 200,000 ppm range. Contamination from Medina brines, if occurring, would be expected to greatly exceed 650 ppm total dissolved solids.

Landowner interviews June 23 – 29, 2009

I personally contacted Ferrugia, Pelham, Johnson, Nordlund and Legere to inquire about the present quality of their water. The Boardmans could not be reached because their phone number was no longer in service. None of the landowners, except for Ferrugia, had tested their water subsequent to the 2005 Nornew tests. Johnson, Legere and Nordlund informed me that they still use their wells for drinking water and other home uses. Pelham and Ferrrguia do not drink their well water but do use it for laundry, cooking and other home uses. All landowners, except Pelham, stated to me that their water well was completed in the shale at depths of approximately 85 – 110 feet and that the water pumps are located several feet above the bottom of the well. Mr. Pelham was unsure about depth of his water well because the well was drilled many decades before he purchased the property. Mrs. Johnson mentioned that it now takes longer for groundwater to flow into their water well than has been the case in the past. Mr. Ferrugia told me that they had performed two chlorine shock treatments to kill the bacteria in their well (dates of treatment unknown). Ferrugias also stated that they had sent the April 23, 2009 water test report to Mr. Boria just before they received a copy of CCDOH's June 1, 2009 letter.

Mineral Resources' Analysis of the data

Based upon the trend interpreted by CCDOH from the first two Ferrugia water tests, the chloride levels should continue to rise if production brine were escaping from the well into the fractured shale where the Ferrugias get their water. The fourth water test found that this is not the case and documented a decrease in chloride concentration. All the data collected to date is typical of shallow shale formation water and not leakage from cased and cemented gas wells. Mineral Resources inspectors found no evidence of gas well brine discharges to the surface in 2008 or 2009 thereby eliminating surface discharge as a source of brine contamination. Department records show that the Eckman 7 surface casing was cemented properly and that the production casing cement has isolated the Medina from the shallower zones.

Water wells completed in shale will have chloride and tds concentrations that vary over time with the volume of recharge and shale formation water present in the well. Landowners that complete their water wells in shale formations run the risk of producing shale formation waters/minerals from the well. Freshwater recharge is essential to maintain good drinking water. As Mineral Resources Manager in Region 9 from 1990 - 2001, it was my experience that water well complaints of foul odors, bad taste, increased mineralization and sulfur smell seemed to increase when rainfall shortages occurred. After we received a copy of the CCDOH complaint, I reviewed the Jamestown Station rainfall data and found that from late December 2007 to April of 2009 the Jamestown/Kiantone area had experienced an accumulated deficit of over 10 inches of rain when compared to the norm (go to www.fredonia.edu/org/waternet/JamestownPrecip.asp). Mrs. Johnson stated in June of 2009 that it took more time for the groundwater to fill up their well now than it had taken in the past.

I cannot explain the rising level of sodium in the Ferrugia's well water at the same time when chlorides have decreased by almost 50%, but do note that New York State Department of Health's (NYSDOH) Individual Water Supply Wells – Fact Sheet #3 (see Attachment 5) shows that there is "no designated limit" with respect to the maximum contaminant level (MCL) for sodium. NYSDOH does state in Fact Sheet #3 that water containing more than 270ppm sodium should not be used for drinking by people on moderately restricted sodium diets. Except for the Pelham water well, all other wells in the vicinity of and including Ferrugia's water well are less than 270ppm sodium (see Attachment 6).

The Stearns and Wheler Piper Diagram - Generalized Water Quality Types (CCDOH Attachment 7) appears to indicate that several of the water well tests plotted on Mineral Resources' Attachment 4 Piper Diagram are more similar to the characteristics of leachate rather than typical NaCl brine. I don't conclude that leachate is present in the water wells but make this observation based upon the relative position of the data points using CCDOH Attachment 7 as a guide.

Conclusions

As a result of my analysis, our investigation and Mineral Resource site inspections, I disagree with your June 1 conclusion that this case shows a "well documented case showing drinking water impacts that are seemingly related to gas well development". As stated above, the test data, looked at in its entirety, appears to show that shale formation water is likely present in Ferrugia's shale water well and the neighbors' wells. CCDOH may have reached a different conclusion than what was stated in the June 1, 2009 letter if it had incorporated all of the 2005 and 2009 water test data/reports in its analysis. Based upon the information stated above, I conclude that the water quality impacts to Ferrugia's water well are unrelated to gas well drilling or development and that consequently the Division will take no further action. This concludes our investigation of the complaint. If any evidence emerges that requires further investigation, please contact either Chris Miller or me immediately.

Sincerely,

Jack Dahl
Director, Bureau of Oil & Gas Regulation
NYSDEC

c: Mr. and Mrs. David Ferrugia
Mr. Gregory J. Edwards, County Executive
Mr. Bradley J. Field, NYSDEC
Mr. James Dezolt, NYSDEC
Mr. David Rowley, NYSDOH
Mr. Paul Heisig, USGS
Mr. Chris Miller, NYSDEC