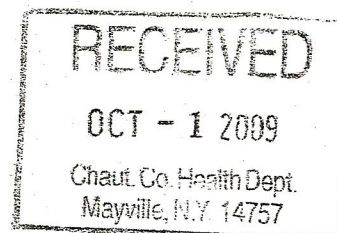




Department of Geosciences

September 30, 2009

Mr. David Wilson
Chairman, Water Quality Task Force
c/o
Soil and Water Conservation District
Chautauqua County
Bratt Ag. Center
3542 Turner Road
Jamestown, NY 14701



Mr. William Boria
Water Resources Specialist
Chautauqua County Department of Health
Clothier Building, 4th Floor
7 North Erie St.
Mayville, NY 14757

Mr. Jack Dahl
Director
Bureau of Oil and Gas Regulation
NYS Dept. of Environ. Conservation
625 Broadway
Albany, NY 12233

Regarding: Water well contamination, 2641 Donelson Rd., Jamestown, NY 14701

Dear Mr. Wilson, Mr. Boria, and Mr. Dahl:

Conclusory Statement

After reviewing letter reports by Mr. William Boria (6-1-09) and Mr. Jack Dahl (7-6-09), and inspecting land conditions in the Donelson Road region with reference to air photos, topographic and soil maps, I concluded that the Boria and Dahl reports make a powerful case that a thorough site investigation be conducted of the causation(s) of contamination of the Ferrugia home water well at 2641 Donelson Road, Jamestown, NY. Such investigation must include data from test borings, monitoring wells, and soil and water samples that result in analyses of aquifer geometry, hydraulic connection, and chemical or other finger-printing.

Reason for this Report

While attending the Chautauqua County Water Quality Task Force (WQTF) meeting of 8-17-09, attendees discussed the Ferrugia drinking water supply degradation. We decided that one or more of us should review the case, volunteers were requested, and I agreed to review the case and write comments.

The purpose of the WQTF is to track water resources issues in the county and provide a forum for interagency and public communication and education about water issues. The goals are for more effective agency decisions and functions and a better public water supply. WQTF is similar to other county water quality coordinating committees created across New York State by actions of the New York State Department of Environmental Conservation (NYS-DEC) and the United States Environmental Protection Agency (US-EPA), beginning about 1989.

Review of Letter Reports on Ferrugia Well

In a letter of 6-1-09 Mr. William Boria of the Chautauqua County Department of Health (CCDOH) described his investigation of possible contamination of the Ferrugia water well near Jamestown, NY. Mr. Boria had sufficient information to describe and analyze the three basic components of a ground water contamination investigation: aquifer geometry, hydraulic connection and fingerprinting (chemical, in this case). Aquifer geometry for the site consists of glacial till over highly fractured shale over shale bedrock. The soil and fractured rock aquifer dip from a petroleum well toward a water well and then toward septic-system treatment components. The hydraulic connection information consists of topographic slope as control of hydraulic flow and pressure; the resulting flow direction is from the gas well to the water well. Chemical fingerprinting consists of chemical analyses viewed as Piper diagrams; these diagrams indicate a change in water quality from regional background chemistry to brine impacted. Mr. Boria concluded that the available information was evidence for gas well brine contamination of the home water well. Then, in his letter, Mr. Boria requested that the NYS-DEC Division of Mineral Resources, "...thoroughly investigate to identify the cause of contamination and assist the Ferrugias in correcting their water quality problems."

Mr. Jack Dahl, Director of NYS-DEC Bureau of Oil and Gas Regulations, responded to Mr. Boria in a letter of 7-6-09. Mr. Dahl added information and insight to the case history. Relative to aquifer geometry, Mr. Dahl drew attention to the southerly dip of bedrock bedding planes and the potential influence of artificial hydraulic fracturing on aquifer geometry (fracturing that was used to stimulate the home water well). Next, owing to the artificial hydraulic fracturing around the home water well, a hydraulic flow direction to that well in opposition to topographic-controlled flow was postulated. Lastly, chemical-fingerprints were described as resulting from near-surface shale-bedrock sources (non-brine). Mr. Dahl ended his letter by saying that unless new evidence emerged, "...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."

Discussion

The Boria letter builds a case for adverse gas well impact on the Ferrugia water well, acknowledges that a more complete investigation is warranted, and requests such investigation. The Dahl letter extends the investigation, as requested by Boria, but closes the investigation prematurely. I commend Boria and Dahl for their efforts in spite of what I suspect were severely constraining budgets, but at this stage the investigation can only be described as preliminary and sufficient to conclude that a modern, state-of-the-art contaminant investigation is warranted.

The two reports provide information for the Piper diagrams used to analyze contaminant source(s), but the quantities of available aquifer geometry, hydraulic and chemical-background data are inadequate for providing perspective on the Piper diagrams. Available data are enough to identify that a problem exists and to suggest how the next phase of investigation should proceed. Below are discussions of examples of specific interpretation difficulties, later followed by recommended techniques of investigation.

In contrast to Dahl's conclusions, the Ferrugia well values of 600 mg/l TDS and 223 mg/l chlorides may indicate contamination from brine of 100,000 mg/l TDS when flow rates and dilution are factored. The Ferrugia-well background (or pre-contamination) value for chloride of 3.8 mg/l on 8-1-05 fits regional background values of 2 to 6 mg/l for stream base-flows and ground waters. For comparison, salt stock-pile contamination of ground water would be expected to range from 10s to 1,000s mg/l chlorides in off-site plumes and 10s of mg/l in affected stream base-flows. There needs to be sampling that defines plumes against background at the Ferrugia-well area.

Another fundamental issue not sufficiently addressed is the sequence of events. For example, temporal change in values for chlorides of 3.8, 223, and 122 may indicate diluted brine passing by the Ferrugia well as a subsurface plume. Where is the plume's leading edge now? Is the plume seasonal? And so forth.

Another reason that more extensive investigation is needed is because of complex on-site and off-site development that includes: multiple gas wells, gas-well hydro-fracing, home-well hydro-fracing, septic systems, and "mud pits". The initial monitoring well study could focus on the Ferrugia water well, septic system, and nearby gas well.

Appropriate site investigation should commence now and include: test borings with continuous split-spoon sampling and rock cores followed by monitor well installations, with wells up-gradient and down-gradient of suspected sources and interspersed among suspected sources. Monitor well nests will be needed for the variety of depths. Three dimensional characteristics of the aquifer(s) must be established. Monthly samples need to be taken after a quality assurance and control document is developed that includes items such as blind duplicates. Hydraulic conductivity tests and aquifer pressure tests will be needed to evaluate hydraulic response and connection. Static water levels will need to be measured through time to establish regional and local flow characteristics. In other words, a standard site investigation as commonly practiced during the past twenty or twenty-five years should commence as soon as possible.

Other specific investigatory tasks that are recommended include: geophysical surveys for source and plume mapping, such as terrain conductivity; tests such as for surfactants (methylene blue active substances), toluene, xylene, benzene, and TOC; tests for drilling, stimulation and production fluids; and tests for fracturing additives.

Historic Perspective

There is a history in western New York of concern for petroleum contamination of water resources (Crain 1969; Harrison 1984, 1985). The current Ferrugia case is reminiscent of the Levant, NY case that was investigated and discussed between 1985 and 1989 (Hewitt 1986; Anonymous 1989). The Levant case centered on methane hazard, but precipitated much regional concern for ground water quality (Mr. Short's well had chlorides at 124 mg/l). Discussions among representatives of industry, agencies, and the public at that time led to aquifer drilling regulations and eventually occasional testing of water wells prior to petroleum drilling.

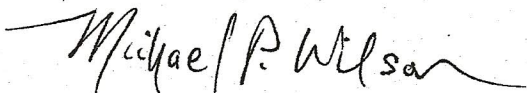
While there were many incidents of alleged contamination, I am not aware that any detailed investigations were ever completed using a modern approach as described above. For example, when I reviewed the interim report for the Levant case I suggested in my letter of 6-25-86 that a more detailed investigation be completed of the aquifer geometry and hydraulic connections using piezometers; this was not done.

In recent times, we are also seeing the use of hydro-fracing to stimulate water wells. There have been alleged incidents of one neighbor depleting another's water supply.

Unfortunately, the historic perspective is that alleged gas well contamination of water has not been appropriately investigated. Likewise, hydro-fracing impacts to water resources are not properly understood, regardless of whether the purposes were to stimulate petroleum wells or to stimulate water wells.

The Ferrugia case should be investigated by an independent commission financed by industry and state or federal sources.

Sincerely,



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References Cited

Crain, Leslie J., 1969, Ground-water pollution from natural gas and oil production in New York: Report of Investigation RI-5, New York State Conservation Department, Water Resources Commission, 15 p. (prepared by US Geological Survey and NYS Health Department).

Harrison, Samuel S., 1984, Evaluating system for ground-water contamination hazards due to gas-well drilling on the glaciated Appalachian Plateau: *Ground Water*, vol. 21, no. 6, p. 689-700.

Harrison, Samuel S., 1985, Contamination of aquifers by over pressuring the annulus of oil and gas wells: *Ground Water*, vol. 23, no. 3, p. 317-324.

Hewitt, Jeanne L., 1986, Investigation into the source of natural gas affecting residents of Levant, NY (Interim Report): NY State Department of Environmental Conservation, Division of Mineral Resources, 37 p. (with 70 pages of appendices).

Anonymous, 1989, Investigation into ebullient gas in Levant, New York (Final Report): New York State Department of Environmental Conservation, Division of Mineral Resources, 23 p. (with approx. 70 pages of appendices).

Michael P. Wilson

September 2009

Qualifications - Biographical Summary

Professional interests – all aspects of Earth surface processes, especially water related

Ph.D. - Syracuse Univ., 1981; geology; minor geotechnical engineering

M.S. – SUNY Fredonia, 1974; geology

A.B. – SUNY Fredonia, 1971; earth science education

Holds NY State permanent teaching license for grades 7-12

Academic Appointments – 1984-present SUNY Fredonia; 1980-83 Texas A & M Univ.;
1976-80 UNC-Charlotte; 1976 Syracuse University

Taught 11 different introductory and 21 different upper-division and graduate courses

Supervised approximately 190 undergraduate research experiences

Supervised or co-supervised 17 M.S. theses; numerous grad teaching and research assistants

Consultant or expert witness on 34 projects

Recipient of approximately 60 grants (other than consulting)

Author or coauthor of more than 75 documents, including monographs, journal papers, reports

Service activities included elections to 8 professional society offices; >50 general-public lectures; coordinator of academic programs in Geophysics, in GIS, and in Environmental Science; coordinator of several academic research programs (GIS, water supply, engineering geology); recent government committee assignments included Chautauqua Lake Management

Commission, County Water Quality Task Force, Environmental Management Council, and reviewer for state and local government grant proposals. Dr. Wilson served on the Editorial Board of the Association of Engineering Geologists Bulletin, presented stream erosion research to the North Carolina Sediment Control Commission, and was North Carolina's representative to the Southeast Conference on Groundwater Management. He was appointed by the New York State Department of Health to the New York State Source Water Assessment Program (SWAP) and featured in a thousand-attendee teleconference.

Wilson has completed many projects related to erosion, erosion control and landscape evolution, as well as projects related to contamination and environmental management. Wilson investigated watershed loading in southwestern NY for Chautauqua Lake, Findley Lake, Green Lake, Fredonia Reservoir, Brocton Reservoirs, and Westfield Reservoir, involving 22 watersheds. Because of the frequent problems at these sites with erosion and turbidity, he has investigated erosion controls at numerous southwest NY locations. Previously, Wilson conducted erosion and erosion control studies in east Texas and several North Carolina locations.

Wilson also conducted many ground water contamination studies of both hazardous and municipal wastes (landfills, poultry, cyanide, salt, septic systems, sewers, etc.). He is expert in ground water and surface water interactions such as temporal concepts of micro-organism transport and natural filtration, having worked on projects in New York, Connecticut, and Wyoming.

Other recent studies included: snow hydrology and chemistry; ground temperatures; landscape visualization such as the appearance of pre-European settlement landscape; paleohydraulics of glacial meltwaters; GIS application to ground-water lake-water interactions; climate statistics for southwest NY; writing a lake management plan; and maintaining a water quantity measuring network and website at <http://www.fredonia.edu/org/waternet/>

Dr. Wilson has investigated the development of many landscapes across North America and elsewhere, including morphogenesis of modern and ancient northeastern US uplands, valleys and subsurface landforms, both north and south of the Pleistocene glacial limit. He is an expert on several distinct locations such as water and geology of Big Bend National Park, Texas.

Examples of Wilson's recent reports are:

"Overview of Geologic Issues Regarding the Retrievable Storage of Nuclear Waste Near the Connecticut River, Southeastern Vermont"; April 2009; by Michael Wilson; a project of Synapse Energy Economics, Inc. for Vermont State Legislature.

"The Real Costs of Cleaning Up Nuclear Waste"; November 2008; by Napoleon, Fisher, Steinhurst, Wilson, Ackerman, and Resnikoff; a project of Synapse Energy Economics, Inc. for NYS Legislature and a consortium including: Citizen's Environmental Coalition; Center for Health, Environment and Justice; West Valley Coalition; and Nuclear Info. & Resource Service.

"Independent Review of the Draft Environmental Impact Statement for Decommissioning and/or Long Term Stewardship at the West Valley Demonstration Project and Western New York

Nuclear Service Center"; September 2008; by Garrick (chairperson), Bell, Bennett, Fakundiny, Neuman, Parker, Ryan, Swift, Whipple, and Wilson; for New York State Energy Research and Development Authority (NYSERDA).

"Expert Elicitation Summary – Landslides"; August 2008; by Wilson and Fakundiny; reported to Garrick et al for use in "Quantitative Risk Assessment of the State-Licensed Radioactive Waste Disposal Area" for NYSERDA.

"Sources of Unwanted Nutrients at Findley Lake, NY"; March 2007; by Dawn Shermet and Michael Wilson; for Chautauqua County (NY) Department of Health.

Qualifications – Institutional Memory

Institutional memory is a concept that is still being defined. Generally speaking, institutional memory refers to knowledge of the history of environmental actions related to an issue or place where the memory was gained by personal participation. Institutional memory, or event memory, has become important for environmental issues and policy because many people who have participated in the modern environmental era (approximately syn or post National Environmental Policy Act, ca. 1970) have ended or are ending their careers, or other participation in environmental issues.

I can provide institutional memory (or event memory) for potential gas well contamination of water supply in New York. Qualifications are summarized below:

During graduate studies at SUNY Fredonia in the early 1970s and Syracuse University in the mid-1970s, I was schooled in geophysics, water resources, and petroleum science, including projects in New York.

During the mid-1980s, I joined SUNY Fredonia and was appointed by then Chautauqua County Executive John Glenzer to a "panel of scientist experts" to review threats to water quality and explosions from natural gas emanation at Levant, NY. An invitation was given by NYS-DEC to review their interim report on the Levant, NY case. During this time period I provided informal advice to members of the Seneca Nation on their concerns for constructing brine injection wells, and advice to many individuals concerning potential for water contamination by petroleum drilling. Courses in geophysics and hydrogeology were taught, including petroleum exploration geophysics. A gravity geophysical study of the Bass Island oil trend was completed. I provided news media interviews about brine injection wells to the Westfield *Republican* and Jamestown *Post-Journal* newspapers.

The following public talks were provided by me:

<u>Year</u>	<u>Location</u>	<u>Sponsor</u>	<u>Title</u>
1985	Buffalo, NY	Buffalo Assoc. Prof. Geologists	"The Potential for Oil & Gas Contamination of Aquifers In Western New York"
1986	Jamestown Community College	Cooperative Extension	"Potential for Brine Injection Contamination"

1986

Jamestown
Community College

Cooperative
Extension and
Chautauqua County
Department of Planning

"Natural Water Systems of
Chautauqua County" (part of
Chautauqua County Drinking
Water Seminar Series)

During the mid-1980s, I worked with Chautauqua County legislators to create a position in county government for a Water Resources Specialist to respond to gas well contamination and other issues, and wrote part of the NY State Civil Service exam for such positions in NY.