

November 28, 2008

Jay Sandquist  
18510 WCR 39  
P.O. Box 193  
La Salle, CO 80645

RE: Water Quality Analytical Results for Your Water Well (Permit #243276)  
Section 32 – Township 4 North – Range 65 West  
Weld County, Colorado; Complaint No. 200197111

Dear Mr. Sandquist:

On October 23, 2008 Terracon Inc. of Wheat Ridge, Colorado (Terracon), under direction of the Colorado Oil and Gas Conservation Commission (COGCC), sampled your water well and submitted these samples for laboratory analysis. The purpose of this water sampling was to determine if natural gas drilling and production activities in your area might have impacted your well water. The water sample collected by the Terracon was submitted to Test America, Inc. (TA) in Arvada, Colorado, for analysis of inorganic chemical constituents, organic compounds associated with petroleum hydrocarbons, methane gas, and pH. A copy of the TA laboratory analytical report is enclosed.

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) has established drinking water standards for the protection of human health. The analytical results from the water samples from your well have been compared to applicable ground water and/or drinking water standards and are summarized below. Please keep in mind that these water standards were established for public drinking water supplies. Often people use and consume ground water from private wells that can exceed these standards.

**COMPARISON OF INORGANIC ANALYTICAL RESULTS TO STANDARDS**  
**(Please see enclosed STL Report Laboratory Report)**

- Total Dissolved Solids (TDS): CDPHE has established a TDS standard for human drinking water of 500 milligrams per liter (mg/l). The standard is called the secondary maximum contaminant level (SMCL) and is based on the aesthetic quality of the water (such as taste and odor) and is intended as a guideline for public water supply systems and is not an enforceable standard. Although CDPHE does not have an agricultural standard for TDS, other agencies recommend concentrations below 2,000 mg/l for irrigation, and below 5,000 mg/l for most livestock watering. TDS concentrations are related to the presence of naturally occurring

elements and chemical compounds such as chloride, sodium, potassium, calcium, magnesium, and sulfate.

**TDS was detected in the water sample from your well at concentration of 500 mg/l, which is just at the CDPHE SMCL, less than the recommended maximum concentration for irrigation, and less than the recommended maximum concentration for most livestock watering.**

- Sodium (Na): Although CDPHE does not have a standard for sodium, people on salt restricted diets should be aware of the Na concentration in the water they drink. A concentration of drinking water with a concentration of sodium less than 20 mg/l is recommended by some for people on salt restricted diets or for people suffering from hypertension or heart disease. Sodium occurs naturally in the ground water in many areas at concentrations that exceed the recommended level.

**Sodium was detected in the water sample from your well at a concentration of 130 mg/l, which is greater than the recommended level for people of salt restricted diets.**

- Fluoride (F): CDPHE has established a fluoride (F) standard for human drinking water is 4.0 mg/l. Where fluoride concentrations are in the range of 0.7 mg/l to 1.2 mg/l, health benefits such as reduced dental decay have been observed. Consumption of fluoride at concentrations of greater than 2.0 mg/l can result in mottling of teeth. Consumption of fluoride at concentrations greater than 4.0 mg/l can increase the risk of skeletal fluorosis or other adverse health effects.

**Fluoride was detected in the water sample from your water well at a concentration of 1.0 mg/l, which is less than the maximum human health drinking water standard.**

Chloride (Cl): The CDPHE chloride standard (SMCL) for drinking water is 250 mg/l. Chloride concentrations in excess of 250 mg/l usually produce a noticeable taste in drinking water.

**Chloride was detected in the water sample from your well at a concentration of 5.9 mg/l, which is less than the CDPHE SMCL.**

- Sulfate (SO<sub>4</sub>): The CDPHE sulfate standard for drinking water is 250 mg/l (SMCL). Although CDPHE does not have an agricultural standard for sulfate, other agencies recommend a concentration below 1,500 mg/l for livestock watering. Waters containing high concentrations of sulfate, typically caused by the leaching of natural deposits of magnesium sulfate (Epsom salts) or sodium sulfate (Glauber's salt), may be undesirable because of their laxative effects. Sulfate occurs naturally in the ground water in many areas in Colorado at concentrations that exceed the drinking water standard.

**Sulfate was detected in the water sample from your well at a concentration of 92 mg/l, which is less than the CDPHE SMCL water standard and less than the recommended concentration for livestock watering.**

- Total Nitrate (NO<sub>3</sub>) + Nitrite (NO<sub>2</sub>) as Nitrogen (N): The CDPHE total nitrate (NO<sub>3</sub>) + nitrite (NO<sub>2</sub>) as nitrogen (N) for standard for human drinking water is 10 mg/l. Nitrate and nitrite are common contaminants in ground water from agricultural sources, such as fertilizer and animal, including human, wastes. They are known to cause infant cyanosis or “blue baby disease” in humans and, at concentrations greater than 100 mg/l as nitrogen (N), may be dangerous to livestock. High concentrations of nitrate and nitrite in ground water are known to occur in agricultural areas in Colorado.

**Total nitrate/nitrite, as N was not detected in the water sample from your well.**

- Iron (Fe): The CDPHE standard for human drinking water for iron is 0.3 mg/l (SMCL). Small amounts of iron are common in ground water. Iron may produce a brownish-red color in laundered clothing, can leave reddish stains on fixtures, and impart a metallic taste to beverages and food made with it. After a period of time iron deposits can build up in pressure tanks, water heaters, and pipelines, reducing the effective flow rate and efficiency of the water supply.

**Iron was detected in the water sample from your well at a concentration of 1.5 mg/l, which is greater than the CDPHE SMCL water standard.**

- Selenium (Se): The CDPHE selenium standard for human drinking water is 0.05 mg/l and the agricultural standard is 0.02 mg/l. Excessive selenium (Se) (concentrations greater than 0.05 mg/l) can cause loss of hair and/or fingernails as well as adverse effects on the central nervous system. Selenium (Se) occurs naturally in the ground water in many areas of Colorado at concentrations that exceed the drinking water standard.

**Selenium was not detected in the sample from your water well.**

- Calcium (Ca), Potassium (K), and Magnesium (Mg) were also tested for in your water. There are no standards from CDPHE for these parameters. In addition, the COGCC also collected samples for metals and the Table 1 (attached) presents the analytical laboratory results. Please note that Primary standard (P) is the CDPHE Human Health Standard and the Secondary standard (S) is the CDPHE secondary maximum contaminant level (SMCL).

**Table 1**  
**SANDQUIST WATER WELL**

METAL/INORGANIC	October 23, 2008 Sample Concentration (in Milligrams per liter [mg/l])	CDPHE Water Quality Standard (P – Primary S-Secondary) (in Milligrams per liter [mg/l])
Arsenic (As)	ND	0.05 (P)
Barium (Ba)	0.031	2.0 (P)
Calcium (Ca)	41	NS
Cadmium (Cd)	ND	0.005 (P)
Chromium (Cr)	ND	0.1 (P)
Potassium (K)	34	NS
Manganese (Mn)	0.19	0.05 (S)
Magnesium (Mg)	19	NS
Lead (Pb)	ND	0.05 (P)
pH	7.6 pH units	NS

NS – no standard

ND – not detected in the sample

### **ORGANIC COMPOUNDS ASSOCIATED WITH PETROLEUM HYDROCARBONS**

(please see enclosed TA METHOD E 602/SW 8021B, BTEX DATA REPORT)

- Benzene: CDPHE's basic ground water standard for benzene is 5 micrograms per liter (µg/l). **Benzene was not detected in the sample from your water well.**
- Toluene: CDPHE's basic ground water standard for toluene is 1,000 µg/l. **Toluene was not detected in the sample from your water well.**
- Ethylbenzene: CDPHE's basic ground water standard for ethylbenzene is 680 µg/l. **Ethylbenzene was not detected in the sample from your water well.**
- Total Xylenes (sum of m,p, and o-xylene): CDPHE's basic ground water standard for total xylenes is 10,000 µg/l. **Total xylenes were not detected in the sample from your water well**

### **METHANE GAS CONCENTRATION**

- **Methane was detected in the sample from your water well at a concentration of 1.4 mg/l.**

Methane gas alone is physiologically inert and non-toxic to humans. Normal breath exhalation contains 1 to 99 ppm of methane (parts per million [ppm] is the same units as mg/l). The presence of methane in drinking water does not present a known health hazard to humans or other animals via ingestion; however, methane in domestic water supplies can be associated with undesirable and potentially serious side effects. Methane gas dissolved in water “exsolves” when exposed to the

atmosphere and dissipates rapidly because it is lighter than air. This is often responsible for the “fizzing” observed in water wells that may contain methane gas. 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, then pockets of free gas form within the water and cause the well pump to cavitate and no longer bring water to the surface.

Methane gas is common in water wells in Colorado. It occurs naturally and the source of the methane is commonly from one or more of the sources listed below.

1. Methane is commonly found as a gas in coal or black shale seams in the subsurface.
2. Methane is commonly found as a byproduct of the decay of organic matter and the presence of bacteria in water wells can provide the conditions favorable for the production of methane either from the activity or decay of bacteria.

**As the result of extensive testing for methane gas in water wells throughout Colorado, concentrations of methane gas below 1 mg/l are considered harmless, with concern for possible hazards from the methane increasing at concentration levels in well water at 7 mg/l and higher.**

### **BACTERIA OCCURENCE**

Terracon also collected samples of your well water for the determination of the presence of bacteria using the Biological Activity Reaction Test (**BART™**) for the following; Iron Related Bacteria (IRB), Sulfate Reducing Bacteria (SRB), and Slime Forming Bacteria (SFB). In addition, an estimation of the size of the population and/or the rate at which they can metabolize and/or grow to generate an observable change or reaction was made. This reaction rate is referred to as the “aggressivity” of the bacterial population. The aggressivity levels of the bacteria are described as **Not Detected, Non Aggressive (Background), Moderately Aggressive, Very Aggressive, or Extremely Aggressive Levels**. Your well water showed the presence of the IRB, SRB, and SFB types.

**Iron Related Bacteria:** Although not usually harmful, iron related bacteria (IRB) can become a nuisance by plugging the well pump, causing red staining on plumbing fixtures and laundered clothing, building up red, slimy accumulations on any surface the water touches, and causing what may appear to be a oily sheen on standing water. In rare cases, IRB may cause sickness.

- **Very Aggressive IRB bacteria were detected in the water sample from your well.**

**Sulfate Reducing Bacteria:** Sulfate reducing bacteria (SRB) are serious nuisance organisms in water since they can cause severe taste and odor problems. These bacteria reduce sulfate that occurs naturally in the water and generate hydrogen sulfide (H<sub>2</sub>S) gas as they grow. In turn, the hydrogen sulfide (H<sub>2</sub>S) gas is a nuisance because it smells like rotten eggs, it initiates corrosion on metal surfaces, and it reacts with dissolved metals such as iron to generate black sulfide deposits.

- **Moderately Aggressive, SRB bacteria were detected in the water sample from your well.**

**Slime Forming Bacteria:** Although not usually harmful, Slime Forming Bacteria (SFB) also can become a nuisance by plugging well pumps and causing slimy accumulations on plumbing fixtures and standing water. Slimes often are gelatinous in nature and may range in color from white, to red, to black. As slim bacteria mats grow they create an environment in which complex associations of other strains of bacteria can develop.

- **Aggressive SFB bacteria were detected in the water sample from your well.**

## **CONCLUSION**

Because your water exceeded the CDPHE drinking water (SMCL) standard for total dissolved solids (TDS), iron (Fe), and manganese (Mn), and the health advisory for sodium (Na), and because you or your livestock and/or pets drink your water, you may wish to discuss the possible health effects of continued consumption with your physician and/or veterinarian. There are no indications of any oil & gas related impacts to your water well and the unusual odor you have observed is related to bacteria in your water system.

The positive bacteria result from your well indicates that treating your water well for bacteria may help to improve your water quality. The Colorado Oil & Gas Conservation Commission has participated in the publication of a general information pamphlet on water supply wells. Although the pamphlet was written for water well owners in Southwest Colorado, much of the information presented is applicable to any water well within the state and includes a simple well disinfection procedure to help control nuisance bacteria. I have enclosed a copy.

If you have any questions or would like to discuss these matters further, please contact me at the COGCC in Denver via e-mail ([robert.chesson@state.co.us](mailto:robert.chesson@state.co.us)) or by phone at 303-894-2100, extension 112.

Respectfully,

Robert H. Chesson, C.P.G., P.G.  
Environmental Protection Specialist

Enclosures

cc: Dave Neslin – COGCC w/o enclosures  
Debbie Baldwin – COGCC w/o enclosures  
John Axelson – COGCC w/o enclosures