

May 14, 2010

Mr. Lloyd Lambertson
35481 CR 124
Grover, CO 80729

RE: Response to Complaint Report – Baseline Water Sampling
Township 11 North – Range 63 West
Weld County, Colorado; Complaint No. 200240886

Dear Mr. Lambertson:

In response to your request, the Colorado Oil and Gas Conservation Commission (COGCC) conducted an investigation to establish water quality at several wells and springs on and around your property in northern Weld County. On April 8, 2010, Steven Lindblom of the COGCC and a COGCC contractor, Terracon Consultants, Inc., met with you at your residence to discuss potential sampling locations, water well construction and yield in your area, and to obtain ground water and surface water samples from domestic wells, stock wells and springs on your property. The water samples were analyzed by TestAmerica laboratories in Arvada, Colorado for organic and inorganic parameters and dissolved methane. This letter summarizes the analytical laboratory results of the water samples collected from these locations.

WATER SAMPLING

On April 8, 2010, a COGCC contractor collected samples of water from your domestic water supply well (Lambertson Domestic Well 1), your mother's domestic water well (Lambertson Domestic Well 2), two windmill-driven stock wells, and two surface water sample locations. Sampling locations included:

- **Lambertson Domestic Well 1 (Permit # 208588, SE/4 SW/4 Section 25, Township 11N, Range 63W).**
- **Lambertson Domestic Well 2 (No permit number, NW/4 NW/4 Section 8, Township 10N, Range 62W).**
- **Windmill Well 1 (No permit number, C SE/4 Section 24, Township 11N, Range 63W).**
- **Windmill Well 2 (Permit #271318, SE/4 NW/4 Section 22, Township 11N, Range 63W).**
- **Seep (NW/4 SE/4 Section 25, Township 11N, Range 63W).**
- **Pond (SE/4 SW/4 Section 25, Township 11N, Range 63W).**

Copies of the field data reports, including photographs of sample locations and bacterial testing samples are included in Attachment 1. Copies of the laboratory analytical reports are included in Attachment 2.

METHANE

Methane gas alone is physiologically inert and non-toxic to humans. Normal breath exhalation contains 1 to 99 parts per million of methane (parts per million [ppm] is the same units as milligrams per liter [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. The following discussion is provided as background information.

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 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, bubbles 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 often 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 concentrations in well water at or exceeding 7 mg/L.

Laboratory analysis for methane indicated that the concentration of dissolved methane in the two domestic water wells was less than the laboratory detection limit of 0.005 mg/L.

VOLATILE ORGANIC COMPOUNDS

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) has established drinking water standards for volatile organic compounds for the protection of human health. The analytical results from the water samples have been compared to applicable ground water and/or drinking water standards and are discussed below.

Benzene, Toluene, Ethylbenzene, Xylenes (BTEX Compounds): Often, water well impacts due to oil and gas exploration and production activities would be evidenced by elevated levels of BTEX compounds. Some of these constituents have been classified by the U.S. Department of Health and Human Services as carcinogens while others have been shown to have other detrimental health effects.

No BTEX compounds were detected in any surface or groundwater samples.

Semi-Volatile Organic Compounds (SVOCs): A target list of 66 semi-volatile organic compounds was utilized during analysis of water from your wells and surface water sample locations.

None of the target list compounds were present above the method detection limit in any samples.

BACTERIAL ANALYSIS

Samples were collected from two domestic water wells and one irrigation/stock well to analyze for the presence of iron, sulfate and slime bacteria. Samples were tested for the presence of iron-related (IRB), sulfate reducing (SRB) and slime forming (SLYM) bacteria using Biological Activity Reaction Test (BART) kits. The results of the tests are provided below and documented in photographs included in Attachment 1.

- **Iron-Related Bacteria (IRB):** Although not harmful, iron-related bacteria 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 appears to be a sheen on standing water. Signs that may indicate an iron bacteria problem include “yellowish, red or orange colored water, rusty deposits in toilet tanks and strange smells resembling fuel oil, cucumbers or sewage. Sometimes the odor will only be apparent in the morning or after other extended periods of non-use” (CDPHE, Laboratory Services Division).

IRB bacteria were detected in the water samples collected from your domestic water well, your mother’s domestic water well, and at the location named “windmill 2”. IRB are present when an orange cloudy layer, at the bottom of the IRB tube (red cap) and foam at the top develop.

- **Sulfate-Reducing Bacteria (SRB):** Sulfate reducing bacteria 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 (H₂S) gas as they grow. In turn, the hydrogen sulfide (H₂S) gas is a nuisance because it smells like rotten eggs, initiates corrosion on metal surfaces and reacts with dissolved metals such as iron to generate black sulfide deposits.

SRB bacteria were detected in the water samples collected from your domestic water well but were absent in your mother’s domestic well and in the sample from “windmill 2”. SRB are present when black particulates develop at the bottom of the sample vial.

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

SLYM bacteria were detected in the water samples collected from your domestic water well, your mother’s domestic water well, and at the location named “windmill 2”.

INORGANIC ANALYTICAL RESULTS

The WQCC has also established drinking water standards for inorganic constituents in groundwater. The analytical results from the water samples 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. People often use and consume ground water from private wells that can exceed these standards.

- **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.

The concentrations of TDS measured in water samples were as follows:

- Lambertson Domestic Well 1 – 260 mg/L.
- Lambertson Domestic Well 2 – 260 mg/L.
- Windmill Well 1 – 220 mg/L.
- Windmill Well 2 – 220 mg/L.
- Seep – 250 mg/L.
- Pond – 260 mg/L.

Samples from all locations were below the CDPHE established guideline for TDS (SMCL).

- Sodium (Na): Although CDPHE does not have a standard for sodium, people on salt restricted diets should be aware of the sodium concentration in the water they drink. 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 ground water in many areas at concentrations that exceed the recommended level.

The concentrations of sodium measured in water samples were as follows:

- Lambertson Domestic Well 1 – 20 mg/L.
- Lambertson Domestic Well 2 – 93 mg/L.
- Windmill Well 1 – 68 mg/L.
- Windmill Well 2 – 79 mg/L.
- Seep – 18 mg/L.
- Pond – 19 mg/L.

The surface water samples from the seep and pond were below the health guideline for sodium of 20 mg/L. Groundwater samples from the domestic and windmill stock wells were equal to or exceeded the guideline.

- 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.

The concentrations of chloride measured in water samples were as follows:

- Lambertson Domestic Well 1 – 7.2 mg/L.
- Lambertson Domestic Well 2 – 9.4 mg/L.
- Windmill Well 1 – 3.9 mg/L.
- Windmill Well 2 – 6.4 mg/L.
- Seep – 6.3 mg/L.
- Pond – 8.2 mg/L.

Samples from all locations were below the CDPHE established guideline for chloride (SMCL).

- **Sulfate (SO₄):** 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.

The concentrations of sulfate measured in water samples were as follows:

- **Lambertson Domestic Well 1 – 15 mg/L.**
- **Lambertson Domestic Well 2 – 33 mg/L.**
- **Windmill Well 1 – 29 mg/L.**
- **Windmill Well 2 – 30 mg/L.**
- **Seep – 12 mg/L.**
- **Pond – 15 mg/L.**

Samples from all locations were below the CDPHE established guideline for sulfate (SMCL).

- **Total Nitrate (NO₃) + Nitrite (NO₂) as Nitrogen (N):** The CDPHE total nitrate (NO₃) + nitrite (NO₂) as nitrogen (N) 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, may be dangerous to livestock. High concentrations of nitrate and nitrite in ground water are known to occur in agricultural areas in Colorado.

The concentrations of nitrate/nitrite as nitrogen measured in water samples were as follows:

- **Lambertson Domestic Well 1 – 3.7 mg/L.**
- **Lambertson Domestic Well 2 – 0.34 mg/L.**
- **Windmill Well 1 – not detected.**
- **Windmill Well 2 – not detected.**
- **Seep – 3.8 mg/L.**
- **Pond – 3.4 mg/L.**

Samples from all locations were below the CDPHE established guideline for nitrate/nitrite as nitrogen.

- **Iron (Fe):** The CDPHE standard for iron in human drinking water 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.

The concentrations of iron measured in water samples were as follows:

- **Lambertson Domestic Well 1 – not detected.**
- **Lambertson Domestic Well 2 – not detected.**
- **Windmill Well 1 – 2.9 mg/L.**
- **Windmill Well 2 – 0.14 mg/L.**

- Seep – 0.18 mg/L.
- Pond – not detected.

Samples from all locations were below the CDPHE established standard.

- **Selenium (Se):** The CDPHE selenium standard for human drinking water is 0.05 mg/L. Excessive selenium (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 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 water samples from any location.

- **Fluoride (F):** CDPHE has established a fluoride standard for human drinking water of 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 only in the water sample from Windmill 2 at a concentration of 0.51 mg/L. Water samples from this and all other locations had concentrations of fluoride below the CDPHE established standard.

- Calcium (Ca), Magnesium (Mg), Manganese (Mn), Potassium (K), Bicarbonate (HCO_3), Carbonate (CO_3), pH, and Specific Conductance (Conductance) were also tested for in water from both wells. No primary standards exist for these parameters and a secondary standard (S) has only been established for manganese and pH. These results are summarized in the following table. 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. Lambertson Water Samples, April 2010
Concentrations in mg/L

PARAMETER	Domestic Well 1	Domestic Well 2	Windmill 1	Windmill 2	Seep	Pond	CDPHE Standard P –Primary S-Secondary
Ca	48	15	16	12	46	47	NS
Mg	9.7	3.3	2.6	1.9	9.3	9.7	NS
Mn	<0.010	<0.010	0.019	0.022	<0.010	<0.010	0.05 (S)
K	5.6	3.8	4.6	3.7	5.2	5.4	NS
HCO_3	160	190	170	160	170	170	NS
CO_3	<5	<5	<5	<5	<5	<5	NS
pH*	7.89	8.12	8.08	8.33	8.23	7.96	6.5-8.5 (S)
Conductance (umhos/cm)	390	450	380	380	380	390	NS

*- pH measured in field

NS – No standard

CDPHE – Colorado Department of Public Health and Environment

CONCLUSION

As noted in the discussion above and summarized in Table 1, the overall quality of water from samples collected from all locations is very good. None of the parameters tested exceeded the CDPHE established groundwater and drinking water standards. Sodium in samples from the domestic and windmill stock wells.

Given that bacteria were detected, you may want to consider a program for disinfection and periodic maintenance of these wells to help control the bacteria present in it. Odor and taste problems with water wells are frequently caused by the presence of bacteria in the system. A pamphlet titled *How Well Do You Know Your Water Well* that provides more information concerning water well maintenance and shock chlorination treatment of bacteria is available in the Library section of the COGCC website (www.cogcc.state.co.us) under the heading Water Well Related Reports and Papers. Additional information and assistance can be provided through the State of Colorado Health Department. Contact information for the agency is provided below.

Colorado Department of Public Health and Environment
Colorado Drinking Water Program
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Phone: 303-692-3500
Fax: 303-782-0390

If you have any questions or would like to discuss these matters further, please contact me at the COGCC in Denver via e-mail (steven.lindblom@state.co.us) or by phone at 303-894-2100, extension 5114.

Respectfully,



Steven R. Lindblom, P.G.
Environmental Supervisor - Eastern Colorado

Attachments

cc: Steve Smith – EOG Resources w/o attachments
Debbie Baldwin – COGCC w/o attachments
John Axelson – COGCC w/o attachments