STATE OF COLORADO
OIL & GAS
CONSERVATION COMMISSION

DEPARTMENT OF NATURAL RESOURCES
John W. Hickenlooper, Governor
P.O. Box 2651
Durango, CO 81302
Phone: (970) 259-1619
FAX: (970) 259-9128
www.colorado.gov/cogcc

Document #1733486

February 14, 2011

Jeremy & Gina Schulz
910 CR 311
Ignacio, CO 81137

RE: Complaint #200291437
Water Well Permit #205300
NWNE Sec 16 T33N R8W
La Plata County, Colorado

Dear Jeremy & Gina:

Enclosed please find a copy of the results of the January 11, 2011 sampling of your domestic water well, located on your property at 910 CR 311 in La Plata County, Colorado. You contacted La Plata County (LPCO) staff on January 5, 2011 due to concerns that nearby oil & gas activities might be adversely impacting your water well. The complaint was forwarded to the COGCC for follow up. On January 11, 2011 COGCC staff and Four Corners Geoscience (FCG) collected well water samples for methane, hydrogen sulfide, field chemistries, bacteriology, COGCC Infill Order 112-156 parameters and methane isotopic and compositional chemistries. This letter presents the results of the COGCC sampling. The sampling was also observed by Ms. Courtney Krueger, LPCO Oil & Gas Planner.

Sampling Summary and Results

COGCC and Four Corners Geoscience (FCG) staff collected the sample from the frost-proof faucet located adjacent to a small shed to the SE of the main house. Staff noted the water to be clear to slightly cloudy with a strong hydrocarbon odor, which was consistent with past sampling observations. There was a slight grey-green tint to the sampled water with a trace of brown, fine sediment in the sample bucket. The water was effervescent. Samples were collected after pumping approximately 88 gallons. Samples were sent to FCG laboratory for methane analysis, Isotech Laboratories for isotopic and compositional gas analyses, San Juan Basin Health for total and fecal coliform analysis and Green Analytical Laboratories (GAL) for all other parameters. Results are discussed below and presented in Table 1 and Attachments. Your well was historically sampled on August 17, 2005, February 28, 2008, March 26, 2008, and May 20, 2008 and those results are included for comparison in Table 1. No significant changes in water quality are noted in your well water over this time frame.

In general, your well water is poor and benzene, chloride, fluoride, selenium and total dissolved solids exceed the Colorado Department of Public Health and Environment (CDPHE) and Environmental Protection Agency's (EPA) primary and secondary drinking water standards. Methane is present at a concentration of 21.10 mg/l which could pose a risk of explosion if allowed to accumulate in unventilated or confined spaces. Primary Drinking Water Standards

are legally enforceable standards that apply to public water systems only, but are used as a guideline for private water wells. The Secondary Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.

Calcium (Ca): There are no drinking water standards for calcium.

The calcium concentration in the sample collected from your well was 16.4 mg/l.

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

Chloride was detected in the sample collected from your water well at a concentration of **348 mg/L** which is above the secondary drinking water standard.

Fluoride (F): The CDPHE human health standard for fluoride 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 occurs naturally in the groundwater in many areas in Colorado at concentrations that exceed the drinking water standard. It is not sourced by oil and gas activities.

Fluoride was detected in the sample collected from your water well at a concentration of **5.3 mg/l** which is **above** the CDPHE human health standard. It is recommended that you do not drink this water without treatment due to fluorosis risks. A fact sheet on fluoride is included for your information.

Iron (Fe): The CDPHE secondary drinking water standard for iron is 0.3 mg/l. Small amounts of iron are common in groundwater. Iron produces 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 not detected in the sample collected from your water well.

Magnesium (Mg): There are no drinking water standards for magnesium.

Magnesium was not detected in the sample collected from your water well.

Manganese (Mn): The CDPHE secondary drinking water standard for manganese is 0.05mg/l. Manganese produces a brownish color in laundered clothing, may stain fixtures and affect the taste of coffee or tea.

Manganese was detected in the sample collected from your water well at a concentration of 0.043 mg/l.

Nitrate (NO3) and Nitrite (NO2): The CDPHE human health standard for nitrate is 10.0 mg/l. Nitrate can cause cyanosis in infants; a household water supply should not contain nitrate concentration in excess of 10 mg/l. The CDPHE human health standard for nitrite is 1.0 mg/l. Nitrite concentrations exceeding 1.0 mg/l should not be used for feeding infants.

Nitrate/Nitrite as N was detected at a concentration of **2.87 mg/l** in the sample collected from your water well.

Potassium (K): There are no drinking water standards for potassium.

Potassium was not detected in the sample collected from your well.

Selenium (Se): The CDPHE human health standard for selenium is 0.05 mg/l. Selenium is a contaminate metal which is commonly sourced from organic shales. The Oxford area of Colorado has been documented to contain high levels of selenium in the near surface soils.

Selenium was detected at **0.21 mg/l** in the sample collected from your water well, which is above the CDPHE human health standard. A fact sheet on selenium has been included for your reference.

Sodium (Na): People on salt restricted diets should be aware of the sodium concentration in the water they drink. A concentration of 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 groundwater in many areas of Colorado at concentrations that exceed this health advisory level.

Sodium was detected in the water sample from your well at a concentration of **355 mg/l** which is above the recommended level for people on salt restricted diets.

Sulfate (SO4): The CDPHE sulfate secondary standard for human drinking water is 250mg/l. 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 was not detected in the sample collected from your water well.

pH: pH is the measure of the hydrogen ion concentration in water. The pH of water in its natural state is generally from 5.5 to 9.0. The CDPHE standard for domestic and agricultural water is a range of 6.5 to 8.5. Seven (7) represents neutrality, while values less than 7 indicate increasing acidity and values greater than 7 indicate increasing alkalinity.

pH was measured in the water sample from your well with a value of 7.86 which is within the CDPHE drinking water and agricultural standards.

Total Dissolved Solids (TDS): CDPHE's TDS standard for human drinking water is 500 milligrams per liter (mg/l). Although CDPHE does not have an agricultural standard for TDS, other agencies recommend concentrations below 1,500 mg/l for irrigation, and below 5,000 mg/l for most livestock watering. TDS occurs naturally in the ground water in many areas of Colorado at concentrations that exceed the drinking water standard.

TDS was detected in the water sample collected from your well at a concentration of **955 mg/l** which is above the drinking water standard.

Hardness: Hardness is the soap-consuming capacity of water; that is, the more soap required to produce lather, the harder the water. Hardness is reported as calcium carbonate in milligrams per liter (mg/l).

Hardness was reported in the water sample collected from your well at 41 mg/l which is classified as soft water.

Methane Gas Analysis: The concentration of methane in the water that could theoretically allow methane to accumulate in confined, unventilated spaces and potentially be explosive is 1.1-2.0 mg/l.

Methane gas was detected in the sample collected from your well at a concentration of **21.10 mg/l**. This could pose a risk of explosion if the methane is allowed to accumulate in confined and unventilated air spaces. You may wish to consult with a water well professional to mitigate the gas concentration prior to entry to the homes. Fact sheets regarding methane gas in well water treatment are attached for your reference.

Hydrogen Sulfide Gas Analysis: Sulfur-reducing bacteria, which use sulfur as an energy source, are the primary producers of large quantities of hydrogen sulfide. These bacteria chemically change natural sulfates in water to hydrogen sulfide. Sulfur-reducing bacteria live in oxygen-deficient environments such as deep wells, plumbing systems, water softeners and water heaters. These bacteria usually flourish on the hot water side of a water distribution system.

Hydrogen sulfide gas also occurs naturally in some groundwater. It is formed from decomposing underground deposits of organic matter such as decaying plant material. Hydrogen sulfide often is present in wells drilled in shale or sandstone, or near coal or peat deposits or oil fields.

Hydrogen sulfide gas was detected at concentrations at 0.3 mg/l in the sample collected from your well.

Isotopic/Compositional Gas Analysis: A water sample was collected from your well to be tested for stable isotopes of methane ($\delta^{13}C$ and δD) which can help identify the source of methane when present. The isotopic signature of methane collected from your well water indicates it is of biogenic (microbial) origin. This is consistent with the data collected from your water well since 2005 as presented in Table 2 and the attached Isotopic Plot. Gas produced from the Fruitland Coal and deeper formation exhibit a thermogenic signature which does not match the methane in your water well.

Table 2 – Isotopes from Schulz Water Well

Date	$\delta^{13}C$ of Methane (per mil)	δD of Methane (per mil)
Schulz Water Well Gas		
01/11/2011	-68.31	-319.6
05/20/2008	-69.02	-314.9
02/28/2008	-69.34	-316.5
08/17/2005	-69.80	-315.9

Hydrocarbons: During the first sampling of your water well in 2005 the water exhibited a strong hydrocarbon odor. In 2008 the COGCC performed a full screening of volatile organic constituents (VOCs) and semi-volatile organic constituents (SVOCs) to determine the source of the odor. Results indicated the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX), isopropylbenzene, p-isopropyltoluene, naphthalene, n-propylbenzene, tetrachloroethene (PCE), 1,3,5-trimethybenzene, and 1,2,4-trimethybenzene, all components of gasoline or industrial solvents. Results of a soil gas survey on both the adjacent gas well pad and your property indicated a probable on-site source of surface hydrocarbons that appear to have impacted your well. Results of the January 2011 sampling indicates the ongoing presence of BTEX in your water at concentrations similar to previous tests. Benzene was detected at a concentration of **9 µg/l** which is above the CPDHE human health standard of 5 µg/l.

Bacterial Analysis: The COGCC collected samples to analyze for the presence of coliform bacteria in your water well.

Coliform Bacteria: Coliforms are bacteria that are always present in the digestive tracts of animals, including humans, and are found in their wastes. They are also found in plant and soil material. Total coliform counts give a general indication of the sanitary condition of a water supply. When coliforms have been detected, repairs or modifications of the water system may be required.

Total coliform bacteria were not present in the water sample collected at this well. E. coli bacteria were not identified in the water sample.

Conclusions

The water quality from your well appears similar to past testing events and there is no indication that recent activities on the nearby gas well pad have resulted in changes to your water quality. Methane gas concentrations have increased since 2008 but continue to show a strong biogenic (microbial activity) isotopic signature which is does not match the thermogenic signature of gas produced from area gas wells. This concentration of methane does pose a risk of explosion if it collects in confined spaces without ventilation. Brochures on how to address the methane in your water well are attached for your reference.

Without appropriate treatment the water from your well is not potable and should not be consumed or used for cooking or bathing. We understand that a water treatment system was installed during the past couple of years and it is strongly recommended that the post-treatment

water be tested to confirm the removal of VOCs, fluoride and selenium. The treatment system was frozen and inoperable during our January 2011 sampling event and we were unable to collect a sample. However FCG staff has been instructed to collect a post-treatment sample for analysis upon your consent and I understand they have attempted to contact you to schedule this. I encourage you to have this testing conducted to ensure the water is appropriately treated and your family is safe.

Please feel free to give me a call or email me at karen.spray@state.co.us if you want to discuss these results further.

Sincerely,
Colorado Oil & Gas Conservation Commission Staff

Karen L. Spray

Digitally signed by Karen L. Spray
DN: cn=Karen L. Spray, o, ou, email=karen.spray@state.co.us, c=US
Date: 2011.02.14 11:34:28 -07'00'

Karen L. Spray, PG
SW Environmental Protection Specialist

Cc: Dave Neslin – COGCC Director w/o attachments
Debbie Baldwin – COGCC Environmental Manager w/o attachments
Alex Fischer – COGCC Environmental Supervisor w/o attachments
File #200291437

Attachments: FCG Field Report
GAL Analytical Report
San Juan Basin Health Bacterial Report
Isotech Report – Schultz Water Well
Isotopic Plot – Schultz Water Well Investigation
Methane Gas In Well Water Brochure – Alberta AFRD
Methane Gas and Your Water Well Fact Sheet – Kentucky DEP
Fact Sheet: Private Well Water and Fluoride FAQs – CDC
Fact Sheet: Selenium – Agency for Toxic Substances and Disease Registry

TABLE 1
ANALYTICAL SUMMARY
Complaint 200291437
Schulz Water Well

Parameter	Water Sample						CDPHE Standards		
	Sample Date								
	Jan 11, 2011	May 20, 2008	Mar 26, 2008	Feb 28, 2008	Aug 17, 2005	Unit	Domestic	Agriculture	Units
Alkalinity, Total	186	368	NT	380	342	mg/l	NS	NS	
Alkalinity, Bicarbonate	184	328	NT	380	342	mg/l	NS	NS	
Alkalinity, Carbonate	<10	40	NT	<10	<10	mg/l	NS	NS	
Alkalinity, Hydroxide	<10	<10	NT	<10	<10	mg/l	NS	NS	
Calcium	16.4	20.1	NT	18.3	18.2	mg/l	NS	NS	
Chloride	**348**	**380**	NT	**400**	**364**	mg/l	250	NS	mg/l
Conductivity	2050	1870	NT	1840	1820	umhos/cm	NS	NS	
Fluoride	**5.3**	**5.3**	NT	**4.9**	**5.2**	mg/l	4.0	NS	mg/l
Iron	<0.05	0.17	NT	<0.05	<0.05	mg/l	0.3	5	mg/l
Magnesium	<0.5	<0.5	NT	0.5	<0.5	mg/l	NS	NS	
Manganese	0.043	NT	NT	0.0494	NT	mg/l	0.05	0.2	mg/l
Nitrate/Nitrite as N	2.87	1.14	NT	0.04	5.61	mg/l	10.0	100	mg/l
pH	7.86	7.74	NT	7.86	8.11	S.U.	6.5-8.5	6.5-8.5	S.U.
Potassium	<0.5	0.9	NT	0.7	<0.5	mg/l	NS	NS	
Selenium	**0.21**	NT	NT	0.027	**0.269**	mg/l	0.05	0.02	mg/l
Sodium	355	389	NT	436	395	mg/l	NS	NS	
Sulfate	<10	<10	NT	<10	<10	mg/l	250	NS	
TDS	**955**	**905**	NT	**1030**	**985**	mg/l	500	*1500	mg/l
Hardness	41	52	NT	48	45	mg/l	NS	NS	
Other Parameters									
Methane	**21.10**	**15.06**	**12.76**	**17.39**	**19.22**	mg/l	NS	NS	
Hydrogen sulfide	0.3	<0.1	<0.1	<0.1	<0.1	mg/l	NS	NS	
Total Coliform	Absent	NT	NT	Absent	Present		zero	NS	
E. Coli	Absent	NT	NT	Absent	Absent		zero	NS	
Benzene	**9**	**10**	**7**	**7.9**	**10**	**12**	NT	µg/l	5		µg/l
Toulene	39	500	380	38	52	59	NT	µg/l	1000		µg/l
Ethylbenzene	37	37	25	35	49	44	NT	µg/l	700		µg/l
Xylenes	130	151	102	177	210	220	NT	µg/l	10000		µg/l
GRO (C6-C10)	<1.0	3.7	NT	NT	NT	mg/l			
DRO (>C10-28)	<1.0	<0.50	NT	NT	NT	mg/l			

CDPHE Colorado Department of Public Health and the Environment
Domestic Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards for Groundwater.
Agriculture * Standards for agriculture complied from CDPHE and other sources.
mg/l milligrams per liter (ppm or parts per million).
µg/l micrograms per liter (ppb or parts per billion).
µmhos/cm micromhos per centimeter

NT Not analyzed.
NS No Standard.
Human health standard.
Secondary standard.

Four Corners Geoscience
P.O. Box 4224
Durango,CO 81302
Water Well Test Field Report

Client
Colorado Oil and Gas Conservation Commisssion
Karen Spray

IID(COGCC) 1321

FCG # 011111-L1

1/11/2011
DATE

NAME Jeremy & Gina Schulz Complaint

910 CR 311 Ignacio, CO 81137
AddressWaterWell

MAILINGADD 910 CR 311 Ignacio, CO 81137

TELEPHONE_ 970-749-6286

Water Well Permit # and Information-Colorado DWR

WaterWellPermit# 205300

QTRQTR NWNE SECTION 16 TWP North 33 RGE West 8 FTG 1150N1750E

Depth FT 396 Water Level FT 140 Yield(gpm) 0.33 GallonsPumped 88

Latitude LongitudeDecimal Degrees NAD 83 LatDecDegrees 37.10789 LongDecDegrees -107.71834

Field Chemistries

PH_FIELD 8.03 ElecConductivity(us) 1890 TDS_CALC 1181 WaterTp(Celsius)_ 12

Water samples collected and delivered to Green Analytical Lab

Methane Result (mg/L)Dissolved

CH4_MG_L 21.10 *Detection Limit 0.0005 mg/L*

State of Colorado-ColiAlert test-presence or absence of Coliform Bacteria

Absent
SanJuanBasin HlthSOCBacteria

HACH(TM)HydrogenSulfide Test

H_2_S_MG_L 0.3 *Detection Limit 0.1 mg/L*

COMMENTS
Met Gina & Jeremy.Sample from frostfree next to shed.Water clear to sl.cloudy,strong hydrocarbon odor,sl.grey-green tint,effervescent,trace brown fine sediment.BTEX,GRO,DRO,Isotope.

Green Analytical Laboratories
75 Suttle Street
Durango, CO 81303

COGCC
PO Box 2651
Durango, CO 81302
Attention: Karen Spray

GAL I.D.: 1101-032-01
Date Received: 01/11/11
Date Reported: 01/27/11
QC Batches:

PROJECT NAME: Schulz
PROJECT NUMBER:
SAMPLE I.D.: Jeremy & Gina Schulz

Sample Date: 01/11/11
Sample Matrix: Water

Laboratory Report

RESULTS

PARAMETER	METHOD	REPORT LIMIT	RESULT	DIL	UNITS	Maximum Contamination Level
Alkalinity as CaCO3	2320B	10	186	1	mg/L	
Bicarbonate as CaCO3	2320B	10	184	1	mg/L	
Carbonate as CaCO3	2320B	10	<10	1	mg/L	
Hydroxide as CaCO3	2320B	10	<10	1	mg/L	
Calcium	200.7	0.5	16.4	1	mg/L	
Chloride	4500CL	10	348	1	mg/L	
Conductivity	2510B	1.0	2050	1	uS/cm	
Fluoride	4500F C	0.2	5.3	1	mg/L	4.0
Iron	200.7	0.05	<0.05	1	mg/L	
Magnesium	200.7	0.5	<0.5	1	mg/L	
Manganese	200.8	0.005	0.043	10	mg/L	
Nitrate/Nitrite as N	353.3	0.02	2.87	1	mg/L	
pH	150.1	NA	7.86	NA	SU	
Potassium	200.7	0.5	<0.5	1	mg/L	
Selenium	200.8	0.01	0.21	10	mg/L	0.05
Sodium	200.7	0.5	355	1	mg/L	
Sulfate	4500SO4	10	<10	1	mg/L	
TDS	2540C	10	955	1	mg/L	
Hardness	Calc	10	41	1	mg/L	
CAB	Calc		9.68		%	
BTEX	8021		Attached			
TPH Extended	8015		Attached			

Debbie Zufelt, Laboratory Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Analytical Results For:

Green Analytical Laboratories
Debbie Zufelt
75 Suttle Street
Durango CO, 81303
Fax To: (970) 247-4227

Received:	01/13/2011	Sampling Date:	01/11/2011
Reported:	01/19/2011	Sampling Type:	Water
Project Name:	COGCC	Sampling Condition:	Cool & Intact
Project Number:	1101-032-01	Sample Received By:	Jodi Henson
Project Location:	NOT GIVEN		

Sample ID: SCHULZ (H100088-01)

BTEX 8260B mg/L **Analyzed By: AB/**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
Benzene*	**0.009**	0.001	01/18/2011	ND	0.023	114	0.0200	13.2	
Toluene*	**0.039**	0.001	01/18/2011	ND	0.021	106	0.0200	12.5	
Ethylbenzene*	**0.037**	0.001	01/18/2011	ND	0.022	111	0.0200	14.9	
Total Xylenes*	**0.130**	0.003	01/18/2011	ND	0.065	109	0.0600	12.9	

Surrogate: Dibromofluoromethane	*104 %*	*80-120*
Surrogate: Toluene-d8	*103 %*	*80-120*
Surrogate: 4-Bromofluorobenzene	*101 %*	*80-120*

TPH 8015M mg/L **Analyzed By: AB**

Analyte	Result	Reporting Limit	Analyzed	Method Blank	BS	% Recovery	True Value QC	RPD	Qualifier
GRO C6-C10	<1.00	1.00	01/18/2011	ND	25.0	79.9	31.2	6.67	
DRO >C10-C28	<1.00	1.00	01/18/2011	ND	24.7	78.9	31.2	8.81	
EXT DRO >C28-C35	<1.00	1.00	01/18/2011						

Surrogate: 1-Chlorooctane	*105 %*	*70-130*
Surrogate: 1-Chlorooctadecane	*111 %*	*70-130*

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

January 19, 2011

Debbie Zufelt

Green Analytical Laboratories

75 Suttle Street

Durango, CO 81303

RE: COGCC

Enclosed are the results of analyses for samples received by the laboratory on 01/13/11 9:15.

Cardinal Laboratories is accredited through Texas NELAP for:

Method SW-846 8021	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method SW-846 8260	Benzene, Toluene, Ethyl Benzene, and Total Xylenes
Method TX 1005	Total Petroleum Hydorcarbons

Certificate number T104704398-08-TX. Accreditation applies to solid and chemical materials and non-potable water matrices.

Cardinal Laboratories is accreditated through the State of Colorado Department of Public Health and Environment for:

Method EPA 552.2	Haloacetic Acids (HAA-5)
Method EPA 524.2	Total Trihalomethanes (TTHM)
Method EPA 524.4	Regulated VOCs (V2, V3)

Accreditation applies to public drinking water matrices.

This report meets NELAP requirements and is made up of a cover page, analytical results, and a copy of the original chain-of-custody. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Celey D. Keene

Celey D. Keene
Lab Director/Quality Manager

CARDINAL Laboratories

PHONE (575) 393-2326 ° 101 E. MARLAND ° HOBBS, NM 88240

Notes and Definitions

ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference
**	Samples not received at proper temperature of 6°C or below.
***	Insufficient time to reach temperature.
-	Chloride by SM4500Cl-B does not require samples be received at or below 6°C
	Samples reported on an as received basis (wet) unless otherwise noted on report

Cardinal Laboratories

*=Accredited Analyte

Celey D. Keene

Celey D. Keene, Lab Director/Quality Manager

San Juan Basin Health Department
Water Bacteriology Result

Coli Alert Test for Presence or Absence
Coliform Bacteria in Water Wells and other Water Sources

A coli-form bacteria sample was collected at the time of your water well test by Four Corners Geoscience, Inc.
This sample was delivered to San Juan Basin Health Department laboratory located in Durango,Colorado.
Please see copy of the original report below.

Please call San Juan Basin Health at 970-247-5702 for more information if you have questions.

You may, also, refer to your water well booklet Page 19 for more information. Please contact a water treatment specialist in your area for further instructions regarding water well disinfection.

Colorado Department of Public Health and Environment

San Juan Basin Health Department/Laboratory
281 Sawyer Drive
P.O. Box 140
Durango, CO 81302

WATER BACTERIOLOGY

Fee Stamp TO BE BILLED

FC6# 011111-L1

SAMPLE INFORMATION: ☐ COMMUNITY ☐ NON-COMMUNITY ☒ PRIVATE

PWS ID ☐ ROUTINE ☒ RAW ☐ REPEAT FOR THE MONTH OF
☐ SPECIAL PURPOSE ☐ FINISHED

SCHULZ
NAME OF SYSTEM

MG/L
CHLORINE RESIDUAL

ADDRESS CITY COUNTY

	DATE	TIME	BY
COLLECTED	1/11/11	1150	☑ AM ☐ PM LF
RECEIVED	/ /		☐ AM ☐ PM

ORDERED BY: (SAMPLE MAY NOT BE TESTED IF ALL INFORMATION IS NOT PROVIDED)

LAB PROCEDURE
STD. MTH
20th ED
9223C

Four Corners Geo
NAME
( ) PHONE
PO Box 4224
ADDRESS
Durango, CO 81302
CITY / STATE / ZIP

☐ TEST ORDERED ☒ STD BACT. ☐ OTHER

COGCC

RESULTS: SEE REVERSE FOR EXPLANATION

TOTAL COLIFORM ☐ PRESENT ☒ ABSENT
E. COLI ☐ PRESENT ☒ ABSENT
MOST PROBABLE NO. COLIFORM/1000ML

JAN 11'11 14:16

☒ Colilert-18 ☐ Colilert-24 ☐ Colisure-24 48

ANALYST

Reverse Side
*Explanation of Results

Coliform absent:	Indicates a safe sample.
Coliform present:	Unsafe Sample, greater than or equal to 1 coliform per 100ml; water should be treated and retested.
Outdated Samples:	Samples greater than 30 hours old when received. Please resample.
QNS:	Quantity not sufficient for testing. Please resample.
Overfilled:	Unsatisfactory; laboratory cannot process accurately. Please resample.

*Copied from actual San Juan Basin Health Water Bacteriology Form

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #: 202155 Job #: 14522

Sample Name: Jeremy & Gina Schultz Co. Lab#: FCG #011111-L1

Company: Colorado Oil & Gas Conservation

Date Sampled: 1/11/2011

Container: Dissolved Gas Bottle

Field/Site Name: IGE 138

Location: Sec 16 T33N R8W

Formation/Depth:

Sampling Point:

Date Received: 1/13/2011 Date Reported: 2/09/2011

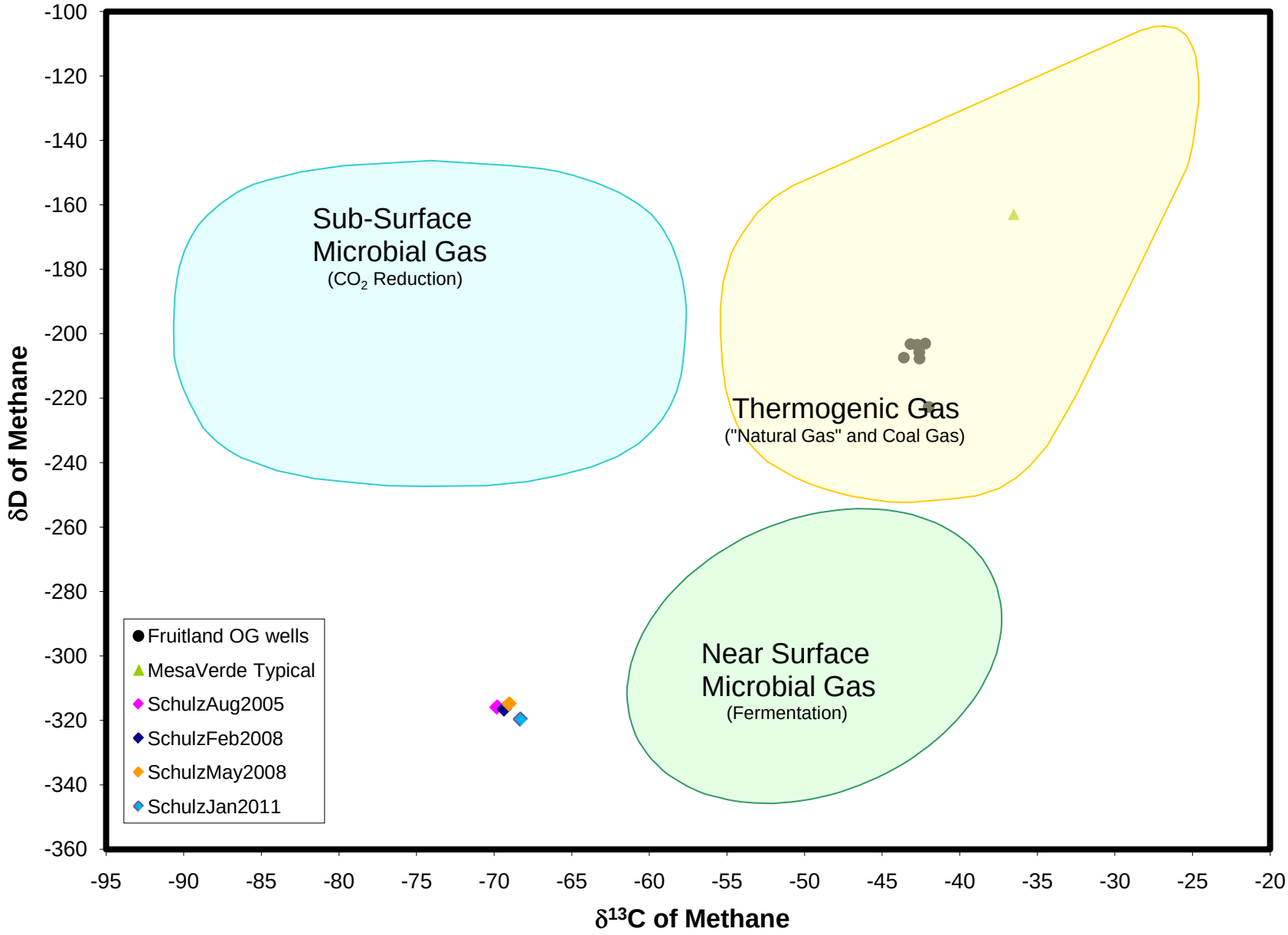
Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{15}N$ ‰
Carbon Monoxide	nd			
Hydrogen Sulfide	nd			
Helium	0.0046			
Hydrogen	nd			
Argon	0.279			
Oxygen	0.23			
Nitrogen	16.03			
Carbon Dioxide	0.67	2.64		
Methane	82.30	-68.31	-319.6	
Ethane	0.218			
Ethylene	nd			
Propane	0.0447			
Iso-butane	0.0705			
N-butane	0.0172			
Iso-pentane	0.0426			
N-pentane	0.0081			
Hexanes +	0.0854			

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 848

Specific gravity, calculated: 0.636

nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen is relative to VSMOW. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

Isotopic Analyses
Schulz Water Well & Area O&G Wells



AGRI-FACTS
Practical Information for Alberta's Agriculture Industry

June 2006 Agdex 716 (D63)

Methane Gas in Well Water

Methane is a colourless, odourless gas and is lighter than air. Methane is not considered toxic, but it is an asphyxiant at a concentration of over 50 per cent in air. Methane is extremely flammable and can be easily ignited by heat, sparks or flames. Methane is explosive at volumes of 5 per cent to 15 per cent (50,000 ppm to 150,000 ppm) in air. Although methane will rise, it can displace oxygen in confined spaces such as cisterns, pumphouses or well pits.

Common terms

Gas concentrations are commonly referred to in percentage of air by volume (%) or parts per million (ppm). The following examples indicate how to convert between ppm and per cent. The lower explosive limit (LEL) is the minimum amount of a gas in the air that can cause an explosion. This limit is 5 per cent for methane.

1. convert ppm to %
   5 ppm ÷ 10,000 = 0.0005%
2. convert % to ppm
   78% x 10,000 = 780,000 ppm

A gas concentration of **10 per cent or more of the Lower Explosive Limit in a confined space** is considered to be a safety hazard. For methane, this limit works out to over 5,000 ppm.

Methane in well water

Gases (not dissolved in water) can migrate into wells that are not properly cased. Gas can also be naturally present in the water in an aquifer. For example, the Ardley coal zone is present in the Scollard Formation, which is the major aquifer in central Alberta. A water well completed in the Scollard Formation can yield gas if the gas-bearing zone is not cased and sealed off. Well drillers are required to report and seal off gas that could be dangerous to the drilling operation or operation of the well.

Methane can also migrate from coal seams into sandstone aquifers. If methane is present in an aquifer, it will likely exist as a dissolved gas in the water. When the well is pumped, the water level is drawn down. The drawdown will lower the pressure in the well and allow more gas to be released from the water. Methane will readily move from the water phase to the gas phase when water pressure is reduced to atmospheric pressure at the ground surface.

Methane can displace oxygen in confined spaces such as cisterns, pumphouses or well pits

Detecting methane in wells and air

Handheld gas detectors can be rented from a number of environmental equipment suppliers for approximately $60 per day. There are many types of equipment, so it is important to discuss what equipment will be useful to test for methane. The supplier should calibrate the equipment, so that you can take accurate measurements, and should also provide an operation manual. Some suppliers will provide training on equipment use.

Field monitoring equipment is only useful for air measurements above ground. These results will not be as accurate as a laboratory test but may tell you whether or not a laboratory test is necessary and will provide an immediate indication of methane levels.

A water sample or a gas sample can be collected and analyzed for methane content. Testing for methane dissolved in well water must be performed carefully because methane will move into the gas phase easily. A laboratory should be consulted regarding appropriate sample collection procedures and sample containers.

Alberta
Agriculture, Food and Rural Development

Most laboratories will analyze water or gas for methane content. The laboratory results will indicate the ppm or per cent concentration of methane present.

Removing methane from well water

Methane will escape from the water when the pressure is released or when the water is heated. Depending on the amount of methane and pressure, some gas will often separate from the water in a pressure tank or a hot water heater. It is not uncommon to have this gas "spurt" out of household water taps. Gas will also build up in the tank and escape into water lines.

A galvanized pressure tank with an automatic air vent will allow gases to escape from the tank to the outside air. If large volumes of gas are present in the well, a vented pressure tank may not be sufficient to disperse the gas. In this case, a cistern with a spray unit and vent can be installed before the pressure tank. The spray unit helps separate dissolved gases from water, so they can be vented outside. Figure 1 and 2 illustrate both the pressure tank and aeration options.

Some wells have enough dissolved gas in them to cause gas locking of the pump. For more information, see the factsheet *Dissolved Gases in Well Water*, Agdex 716 (D18), on the Alberta Agriculture, Food and Rural Development website (http://www1.agric.gov.ab.ca).

Protecting your water wells

It is important to monitor your water wells on a regular basis, especially before seismic and oil/gas drilling activities start. Have both a routine analysis and a microbiological analysis performed. The non-pumping water level should also be monitored on a regular basis.

A professional should be contracted if a test for methane in water is required and to test well production. Well production tests do not need to test how hard the well can be pumped but should be pumped at a sustainable rate using a test procedure that can be duplicated at a later date.

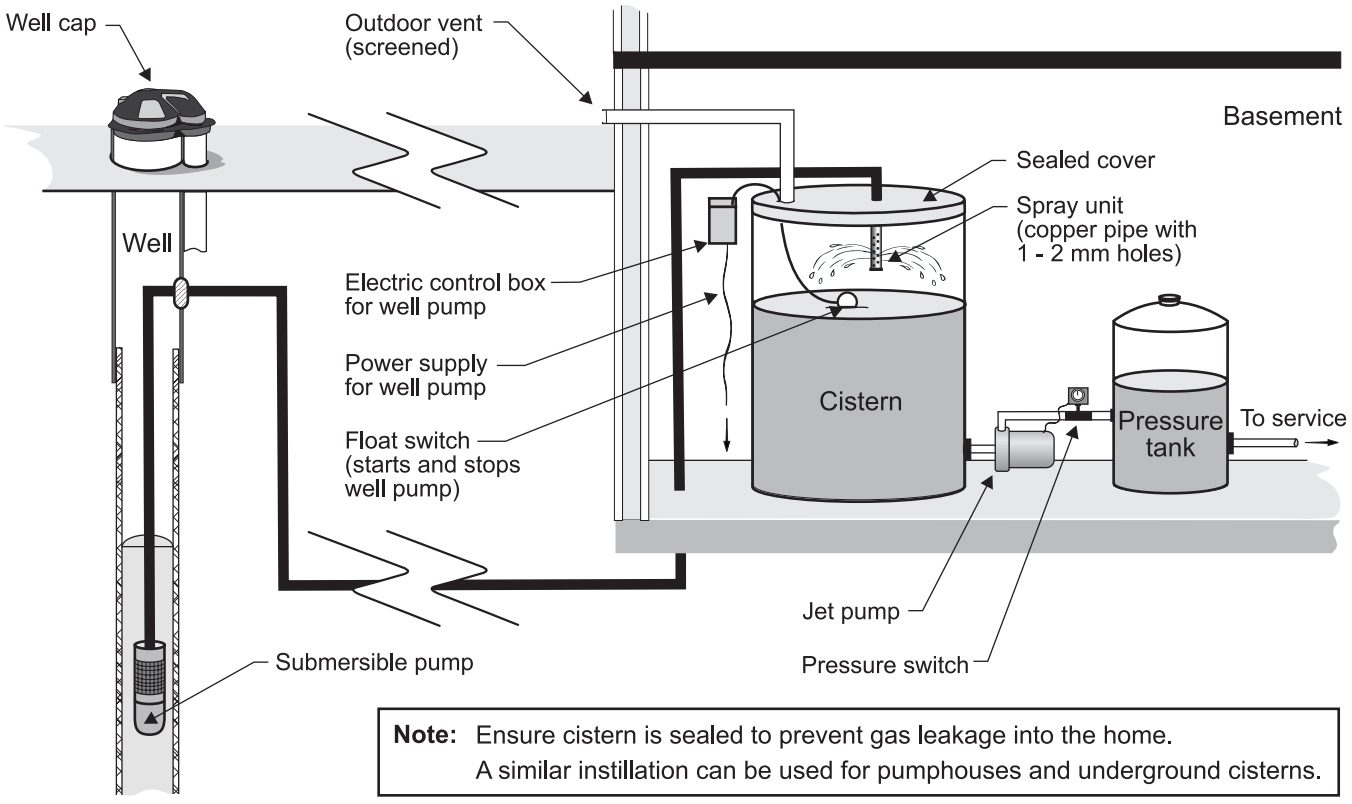
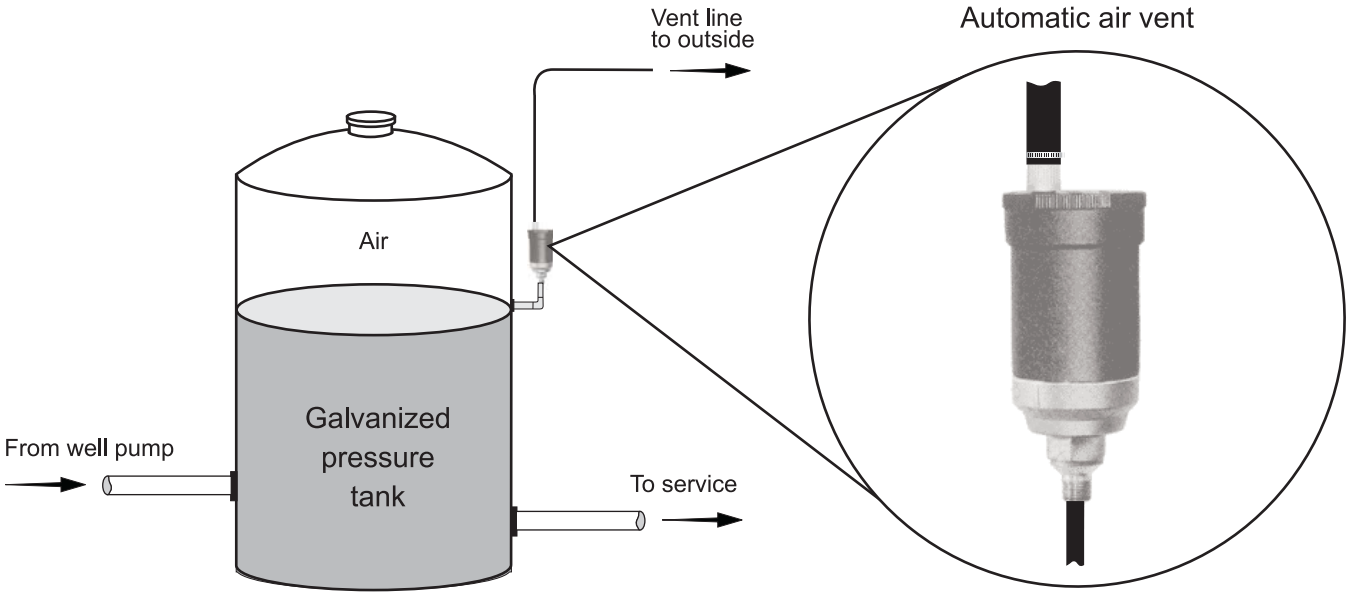


Figure 1. Aeration and ventilation system



Note: Use a galvanized pressure tank without a diaphragm so that the excess gas can be vented from the tank. The figure shows a Braukmann EA122A automatic air vent however other similar vents can also be used.

Figure 2. Galvanized pressure tank

Coal bed methane (CBM) requirements

In April 2006, Alberta Environment released the document *Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations*. This document states that CBM developers must test water wells within a minimum 600 metre radius of a CBM well that is completed above the base of groundwater protection.

The base of groundwater protection is the depth above which potable water can be found and varies throughout the province. Potable water is considered to have less than 4,000 mg/L of total dissolved solids (TDS). If no water wells are located within a 600 metre radius, testing must be performed on water wells within an 800 metre radius.

The testing that must be performed includes water well capacity, routine potability, bacteriological, and presence and analysis of gas.

References

For more information, see the following publications:

Methane Safety, Agdex 729-2, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex9038

Alberta Environment's *Standard for Baseline Water-Well Testing for Coalbed Methane/Natural Gas in Coal Operations*, April 2006 http://www.waterforlife.gov.ab.ca/coal/docs/CBM_Standard.pdf

Alberta Agriculture, Food and Rural Development *Dissolved Gases in Well Water*, Agdex 716 (D18), http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex637?opendocument

Coal Bed Methane (CBM) Wells and Water Well Protection http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng9758

More information

For further information, contact any of the Agricultural Water Specialists with Alberta Agriculture, Food and Rural Development at the following locations:

Red Deer (403) 340-5324
Edmonton (780) 427-2963

Prepared by:

Rachelle Ormond – Agricultural Water Engineer
Technical Services Division

06/06/1M

Methane Gas and Your Water Well

A Fact Sheet for Domestic Water Well Owners

August 2003

Kentucky Department for Environmental Protection

Kentucky Division of Water

EDUCATION PAYS

Printed on recycled paper with state funds

Methane Gas and Your Water Well

A Fact Sheet--Kentucky Department for Environmental Protection

High concentrations of methane in enclosed structures may lead to an explosion. Water wells located in a pump houses, well pits, basements or any enclosed structure should be properly vented as a safety precaution to prevent the buildup of methane. The followng is an explanation of methane gas occurrence in wells and some suggested practices to help keep your well and your well house safe.

Naturally occurring gases, such as methane and hydrogen sulfide, may be present in some wells. These gases occur naturally in the subsurface, accumulating in voids within the rock and as dissolved gas in groundwater. Methane and hydrogen sulfide can enter a well through damaged or corroded well casing, improperly sealed well casing, uncased formations, and as dissolved gases being released from well water.

Methane and hydrogen sulfide gases, in the right mixture with air, can be highly explosive. A lower explosive limit (LEL) value defines the percentage of gas in air that can be explosive. If the concentration is below the LEL, there is not enough of the gas in the air to ignite. Once the concentration reaches the LEL, any ignition source may set of an explosion. Ignition sources include: light switches; pump relays; heat from light bulbs or engines; natural gas appliances such as furnaces and hot water heaters (including the pilot light); lit cigarettes and other flame or spark sources.

What is Methane?

Methane is a colorless, odorless gas and the chief constituent of natural gas. It is especially prevalent in coal beds, but occurs in non-coal rocks as well. Methane is lighter than air, and it will rise easily from the well to the surface. Methane is highly flammable, with an LEL of 5.3 percent. Because methane is colorless and odorless, it can accumulate undetected in well bores and enclosed structures to explosive levels if not properly vented.

What is Hydrogen Sulfide?

Hydrogen sulfide is a colorless gas with a strong rotten egg odor. Most hydrogen sulfide odors are associated with hydrogen sulfide that is dissolved in groundwater being released when exposed to the atmosphere. Hydrogen sulfide may also occur in the presence of methane. Hydrogen sulfide's LEL is 4.0 percent making it more flammable than methane. However, as it is more dense than air, hydrogen sulfide does not rise out of the well naturally (it must be carried or forced out), and does not pose as much of an explosion risk as methane does. Because hydrogen sulfide is corrosive to metals, it may corrode steel well casing sufficiently to allow methane to enter the well that the well driller had previously sealed out.

Recommended venting procedures for wells not enclosed in structures

For wells located outside of any structure, simply installing a vented well cap (Figure 1) provides sufficient venting prior to water entering the home. These well caps are designed to use on wells equipped with a pitless adapter (a device designed for the water pipe to exit the well below ground level).

Figure 1. Vented well cap.

A sanitary seal (Figure 2) is used on wells where the water pipe exits the well through the top of the well casing. These seals consist of a rubber gasket between metal flanges. When the bolts on the metal flange are tightened, the rubber gasket seals against the well casing, electrical conduit, discharge pipe and well vent tube.

Figure 2. Sanitary seal.

The well vent tube should be inserted approximately six to twelve inches into the well below the sanitary seal (Figure 3). The well vent tube should extend above the sanitary seal to a level above any possible flood, secured in position and sealed watertight in the sanitary seal. The upper end of the well vent tube should be turned down to prevent the entry of rainwater and it should be screened with 24-mesh or smaller durable screen or filtered in such a manner as to prevent the entry of insects or small animals. The well vent tube should be large enough to allow the equalization of air pressure in the well; a minimum of one-half inch diameter is recommended.

Methane Gas and Your Water Well

A Fact Sheet--Kentucky Department for Environmental Protection

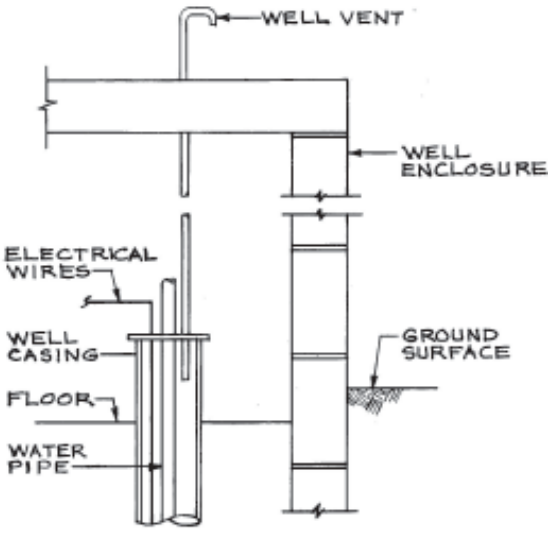


Figure 3. Recommended venting procedures for wells not enclosed in structures.

Recommended venting procedures for wells located in enclosed structures

When a well is located inside of a structure, such as a well house or even a home, the well vent tube must vent gas outside of the structure, as shown in Figure 4. A sanitary seal (Figure 2) that seals tightly against the well casing should be used. All openings through the sanitary seal should be properly sealed to prevent methane from escaping into the structure. Vented well caps (Figure 1) or well caps that do not have a gasket seal should not be used.

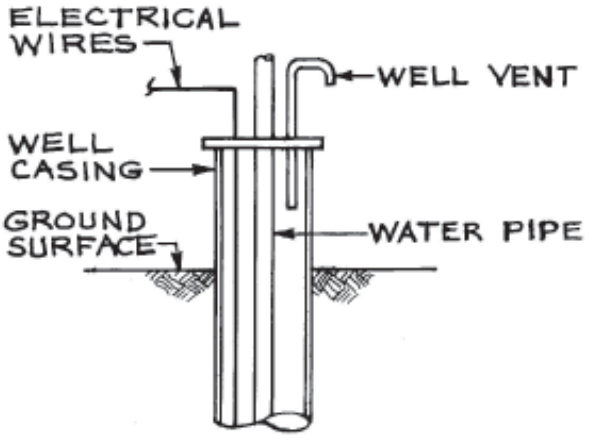


Figure 4. Recommended venting procedures for wells located in enclosed structures.

The well vent tube should extend outside of the well enclosure and terminate a minimum of 18 inches above the ground surface and above known flood elevations, as shown in Figure 4. The upper end of the well vent tube should be turned down to prevent rainwater from entering. It should be secured in position and screened with 24-mesh or smaller durable screen or filtered in such a manner as to prevent the entry of insects or small animals. The well vent tube should be large enough to allow the equalization of air pressure in the well; a minimum of one-half inch diameter is recommended. You should periodically inspect your well venting system to ensure it is functioning properly.

Additional Precautions

In addition to venting the well, you may wish to vent the structure in which the well is located in the event methane does enter the structure. There are a variety of vents available, such as roof vents, attic vents, etc. used to vent attics of houses. You may also consider a gas monitor that sounds an alarm if flammable gases are detected.

Methane and hydrogen sulfide may be dissolved in groundwater, and may not leave the well water until it arrives at the faucet, resulting in the accumulation of gas in the home. In this case, well venting alone will not remove these gases. Commercially available treatment systems are available to remove these gases before they enter a home. Most of these treatment systems involve aeration of the water which forces the gases out through a sealed vent system to the outdoors.

Be sure all wiring meets local electric codes and that no wires are exposed. Bare electrical wires can cause arcing and sparking, igniting gas, if present. You may consider installing intrinsically safe switches and light fixtures, and intrinsically safe electric pump motors (for surface mounted pumps). Intrinsically safe electric motors, switches and fixtures are designed to prevent arcing and sparking.

Do not store or use fuels, solvents or other pollutants in the well house or other enclosure. Fumes from these materials may accumulate in the structure and result in explosive levels. In addition, spills of these materials may lead to contamination of the well.

Water Well Construction and Inspection

Proper well construction and routine well maintenance, including disinfection help ensure your well provides a safe water supply. The following are general recommendations.

Methane Gas and Your Water Well

A Fact Sheet--Kentucky Department for Environmental Protection

Well casing serves two purposes: it prevents collapse of the well boring during drilling and it helps prevent contaminants and gas from migrating into the well. Your well should have a minimum of 20 feet of casing below the ground surface. The amount of casing required will vary depending on the depth to groundwater and the type of soils and bedrock in which the well is located. The well casing should extend a minimum of four inches above ground surface and be fitted with a well cap or sanitary seal.

The space between the casing and the sides of the well bore, called the casing annulus, provides a direct conduit for surface water and pollutants to reach the water table if improperly sealed. The annulus should be sealed with drill cuttings, neat cement or bentonite. Be sure the outside of the well casing is sealed at the ground surface or floor of the structure. This prevents pollutants from seeping into the well.

Well owners should visually inspect the condition of their well casings for holes or cracks. Steel casing may be corroded by hydrogen sulfide. Examine the casing above ground as well as inside the casing using a flashlight. Push on the casing. If it moves from side to side, the well casing seal has failed and the well casing may also be damaged. Listen for the sound of water trickling into the well when the pump is not running. Running water means the well casing may be broken or corroded.

To prevent contaminants from entering through the top of the well casing, a tight-fitting, tamper-resistant, vermin-proof well cap must be installed to prevent the entry of insects, small animals, surface water, and pollutants. All piping and electrical connections to the well casing or well cap should have watertight seals. All holes in the well cap or seal should be used or have a watertight plug.

Well maintenance

As a well owner, you are responsible to maintain your well. Protecting Your Well and Water Supply - a Groundwater Protection Plan for Domestic Well Owners, is available for download from the Division of Water's Groundwater Branch Web page, or by calling the Division of Water.

All wells should meet current construction standards. If a well is no longer in service, all plumbing connections should be disconnected to prevent methane from entering structures. A certified driller should be hired to properly plug unused wells to prevent groundwater contamination.

Gasoline, motor oils, pesticides, and other pollutants should not be used or stored in the vicinity of a well or inside of a structure in which a well is located.

You should disinfect your well annually. Well disinfection procedures are outlined in Routine Well Maintenance and Disinfection Guide, which is available for download from the Division of Water's Groundwater Branch Web page or by calling the Division of Water.

You should have your well water tested annually for coliform bacteria. Your local health department can provide this service, or you may consider using a private laboratory.

Certified Water Well Drillers

Kentucky law requires that only a Kentucky Certified Water Well Driller may construct, repair or plug a water well. The Directory of Certified Drillers is available on the Division of Water's Groundwater Branch Web page or by calling the Division of Water.

If you have any questions regarding your well, please contact the Division of Water or a certified water well driller in your area.

Contact Information

Division of Water
Groundwater Branch
14 Reilly Road
Frankfort, Kentucky 40601 Phone: (502) 564-3410

Division of Water Web Page: http://water.nr.state.ky.us/dow/
Groundwater Branch Web Page: http://water.nr.state.ky.us/dow/dwgr.htm

Fact Sheet: Private Well Water and Fluoride FAQs

This fact sheet addresses questions that consumers may have on fluoride levels in groundwater from private wells.

How do I know if my water is from a public water system or a private well?
The U.S. Environmental Protection Agency defines a Public Water System as a system that serves 25 or more people per day. If you have water service from a well that has a limited delivery, such as to your house but not to your neighbor's house, then you likely have a private well.

What are the governmental regulations for private wells?
Although most U.S. households are connected to a public water system, the U.S. Geological Survey report "**Estimated Use of Water in the United States in 2005**" estimates that 14% of United States residents rely on private wells that are not regulated by the EPA Safe Drinking Water Act. In most states, private wells are not regulated by governmental regulatory entities. Therefore, it is the responsibility of the homeowner to know and understand the quality of the water from their well. The U.S. Environmental Protection Agency suggests that all wells should be tested for quality once every three years since influences to well water quality can change over time. Contact your public health office for their advice on testing of private wells in your state or area. Additional information on testing well water quality in private wells serving homes can be found on the **U.S. Environmental Protection Agency Web site**.

My home gets its water from a private well. What do I need to know about fluoride and groundwater from a well?
Fluoride is present in virtually all waters at some level, and it is important to know the fluoride content of your water, particularly if you have children. A **2008 U.S. Geological Survey** study found that 4% of sampled wells had natural fluoride levels above the EPA Secondary Maximum Contaminant Level (SMCL) of 2 mg/L. A smaller set of 1.2% of all wells exceeded the Maximum Contaminant Level (MCL) of 4 mg/L. If you have a home well, the EPA recommends having a sample of your water analyzed by a laboratory at least once every three years. Check with your dentist, physician, or public health department to learn how to have your home well water tested.

What should I do if the water from my well has less fluoride than what is recommended (0.6 mg/L)? Can I add fluoride?
The optimum fluoride level in water for good oral health is between 0.7 to 1.2 mg/L (milligrams per liter). If you have water fluoride levels under 0.6 mg/L, your child's dentist or pediatrician should evaluate whether your child can benefit from daily fluoride supplements. Their recommendation will depend on your child's risk of developing tooth decay and as well as exposure to other sources of fluoride (e.g., drinking water at school or daycare, toothpaste). It is not feasible to add fluoride to an individual residence's well.

What should I do if the water from my well has fluoride over 1.2 mg/L?
Drinking water with fluoride levels greater than 1.2 mg/L is higher than the optimum recommendation. Fluoride levels greater than 1.2 mg/L continue to provide beneficial protection against tooth decay, but at increased levels children aged 8 years and younger that are still developing teeth will have an increased chance of developing **enamel fluorosis**. If your water has a fluoride level greater than 2 mg/L but less than 4 mg/L, you should consider an alternate source of drinking water for young children. Adults and children older than age 8 years can safely consume the water at these levels, If the fluoride content in your well water is greater than 4 mg/L, consider an alternate source of water for your family, or install a device to remove the fluoride from the water.

What should I do if my well water was measured as having too much fluoride (level greater than 4 mg/L)?
It is unusual to have the fluoride content of water exceed 4 mg/L. If a laboratory report indicates that you have such

excessive fluoride content, it is recommended that the water be retested. At least four samples should be collected, a minimum of one week apart, and the results compared. If one sample is above 4 mg/L and the other samples are less than 4 mg/L, then the high value may have been an erroneous measurement. If all samples register excessive levels greater than 4 mg/L, then you may want to consider investigating alternate sources of water for drinking and cooking, or installing a device to remove the fluoride from your home water source. Physical contact with high fluoride content water, such as bathing or dishwashing, is safe since fluoride does not pass through the skin.

What are the health risks of consuming water with fluoride levels greater than 4 mg/L?
Children aged 8 years and younger have an increased chance of developing severe tooth enamel fluorosis. Consumption over a lifetime may increase the likelihood of bone fractures, and may result in skeletal fluorosis, a painful or even crippling disease. The U.S. Environmental Protection Agency has determined that safe exposure of fluoride is below 4 mg/L in drinking water to avoid those effects. The National Research Council recently completed a report on health effects of excessively high fluoride consumption, and CDC has a **Statement on the 2006 National Research Council (NRC) Report on Fluoride in Drinking Water .**

Will using a home water filtration system take the fluoride out of my home's water?
Removal of fluoride from water is difficult. Most home point-of-use treatment systems that are installed at single faucets use activated carbon filtration, which does not remove the fluoride. Reverse osmosis point-of-use devices can effectively remove fluoride although the amount may vary given individual circumstances. For a home point-of-use device to claim a reduction in fluoride, it must meet National Sanitation Foundation (NSF) Standard 58 criteria for fluoride removal. Standard 58 requires that a device must achieve a 1.5 milligrams per liter (mg/L) concentration in the product water if the original concentration was 8.0 mg/L, or approximately 80 percent removal. This percentage removal may not be consistent at lower concentrations of fluoride. Check with the manufacturer of the individual product for specific product information. Fluoride is not released from water when it is boiled or frozen. One exception would be a water distillation system. These systems heat water to the boiling point and then collect water vapor as it evaporates. Water distillation systems are typically used in laboratories. For home use, these systems can be expensive and may present safety and maintenance concerns.

Can I use water with fluoride for preparing infant formula?
Yes. People have used optimally fluoridated tap water to prepare infant formula for many years. However, if your infant is exclusively consuming formula reconstituted with optimally fluoridated water (0.7 to 1.2 ppm or mg/l), there may be an increased potential for them to develop mild dental fluorosis on their developing teeth. Consult with your pediatrician for proper infant formula feeding advice. Additional information can be found in a fact sheet on **Infant Formula**.

Page last reviewed: February 9, 2010
Page last modified: February 9, 2010
Content source: **Division of Oral Health**, **National Center for Chronic Disease Prevention and Health Promotion**.
Page Located on the Web at http://www.cdc.gov/fluoridation/fact_sheets/wellwater.htm

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

SELENIUM

CAS # 7782-49-2

Division of Toxicology ToxFAQs™ **September 2003**

This fact sheet answers the most frequently asked health questions (FAQs) about selenium. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: People may be exposed to low levels of selenium daily through food and water. Selenium is a trace mineral needed in small amounts for good health, but exposure to much higher levels can result in neurological effects and brittle hair and deformed nails. Occupational inhalation exposure to selenium vapors may cause dizziness, fatigue, irritation of mucous membranes, and respiratory effects. This substance has been found in at least 508 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is selenium?

Selenium is a naturally occurring mineral element that is distributed widely in nature in most rocks and soils. In its pure form, it exists as metallic gray to black hexagonal crystals, but in nature it is usually combined with sulfide or with silver, copper, lead, and nickel minerals. Most processed selenium is used in the electronics industry, but it is also used: as a nutritional supplement; in the glass industry; as a component of pigments in plastics, paints, enamels, inks, and rubber; in the preparation of pharmaceuticals; as a nutritional feed additive for poultry and livestock; in pesticide formulations; in rubber production; as an ingredient in antidandruff shampoos; and as a constituent of fungicides. Radioactive selenium is used in diagnostic medicine.

What happens to selenium when it enters the environment?

❏ Selenium occurs naturally in the environment and can be released by both natural and manufacturing processes.
❏ Selenium dust can enter the air from burning coal and oil. This selenium dust will eventually settle over the land and water.
❏ It also enters water from rocks and soil, and from agricultural and industrial waste. Some selenium compounds will dissolve in water, and some will settle to the bottom as particles.
❏ Insoluble forms of selenium will remain in soil, but soluble forms are very mobile and may enter surface water from soils.
❏ Selenium may accumulate up the food chain.

How might I be exposed to selenium?

❏ The general population is exposed to very low levels of selenium in air, food, and water. The majority of the daily intake comes from food.
❏ People working in or living near industries where selenium is produced, processed, or converted into commercial products may be exposed to higher levels of selenium in the air.
❏ People living in the vicinity of hazardous waste sites or coal burning plants may also be exposed to higher levels of selenium.

How can selenium affect my health?

Selenium has both beneficial and harmful effects. Low doses of selenium are needed to maintain good health. However, exposure to high levels can cause adverse health effects. Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting, and diarrhea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities (such as numbness and other odd sensations

in the extremities).
Brief exposures to high levels of elemental selenium or selenium dioxide in air can result in respiratory tract irritation, bronchitis, difficulty breathing, and stomach pains. Longer-term exposure to either of these air-borne forms can cause respiratory irritation, bronchial spasms, and coughing.
Levels of these forms of selenium that would be necessary to produce such effects are normally not seen outside of the workplace.
Animal studies have shown that very high amounts of selenium can affect sperm production and the female reproductive cycle. We do not know if similar effects would occur in humans.

How likely is selenium to cause cancer?

Studies of laboratory animals and people show that most selenium compounds probably do not cause cancer. In fact, studies in humans suggest that lower-than-normal selenium levels in the diet might increase the risk of cancer.
The International Agency for Research on Cancer (IARC) has determined that selenium and selenium compounds are not classifiable as to their carcinogenicity to humans.
The EPA has determined that one specific form of selenium, selenium sulfide, is a probable human carcinogen. Selenium sulfide is not present in foods and is a very different chemical from the organic and inorganic selenium compounds found in foods and in the environment.

How can selenium affect children?

It is likely that the health effects seen in children exposed to selenium will be similar to the effects seen in adults.
However, one study found that children may be less susceptible to the health effects of selenium than adults.
Selenium compounds have not been shown to cause birth defects in humans or in other mammals.

How can families reduce the risk of exposure to selenium?

❑ Certain dietary supplements and shampoos contain selenium; these should be used according to the manufacturer's directions.
❑ Children living near waste sites that contain selenium or coal burning plants should be encouraged to wash their hands before eating and to avoid putting their unwashed hands in their mouths.

Is there a medical test to show whether I've been exposed to selenium?

Low levels of selenium are normally found in body tissues and urine. Blood and urine tests for selenium are most useful for people who have recently been exposed to high levels. Toenail clippings can be used to determine longer-term exposure. These tests are not usually available at your doctor's office, but your doctor can send the samples to a laboratory that can perform the tests. None of these tests, however, can predict whether you will experience any health effects.

Has the federal government made recommendations to protect human health?

The EPA restricts the amount of selenium allowed in public water supplies to 50 parts total selenium per billion parts of water (50 ppb).
The Occupational Safety and Health Administration (OSHA) sets a limit of 0.2 mg selenium/m^3 of workroom air for an 8-hour work shift.
ATSDR and the EPA have determined that 5 micrograms of selenium per kilogram of body weight taken daily would not be expected to cause any adverse health effects over a lifetime of such intake.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological Profile for Selenium (Update) Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.