Memorandum

To	Peter Gintautas, COGCC	**Ref #**	
CC		**Date**	December 19, 2012
From	Lacy Ledbeter Jones, Norwest Corporation		
Subject	608.b. Post-Completion Sampling for Rolls Royce 33-36 CBM Well		

The following attachment is a copy of the landowner letter sent to Mr. and Mrs. Robert & Nancy Trujillo for the testing of 0502533 Trujillo WW post-completion of the coal bed methane well Rolls Royce 33-36. The water sample was collected on September 19, 2012. Enclosed in the letter are the results of water quality testing. Also enclosed are copies of the laboratory reports from TestAmerica, Inc. Laboratory, Isotech Laboratory, Inc., and Colorado Analytical Laboratory.

December 19, 2012

Robert & Nancy Trujillo
PO Box 69
Bon Carbo, CO 81024

RE: Water Analysis Results for Domestic Water Well Sampling on September 19, 2012 in Section 36, Township 32S, and Range 66W

Dear Mr. and Mrs. Robert & Nancy Trujillo:

The Trujillo water well (WW), receipt number 0502533, was visited and sampled on September 19, 2012 in compliance with Colorado Oil and Gas Conservation Commission (COGCC) Rules and Regulations, 2 CCR 404-1, Rule 608.b-Water well sampling. This sample is a water quality test of the water well following the completion of the Rolls Royce 33-36 Coal Bed Methane (CBM) well by Pioneer Natural Resources USA, Inc. This is the follow-up sample to the initial baseline testing on 2011-08-08, and will be compared to these baseline water quality results.

Norwest Corporation (Norwest) was responsible for the sample collection, storage, shipping, handling and the chain of custody. Sampling protocols for the well water testing were followed according to Norwest Sampling and Analysis Plan (SAP) and Standard Operating Procedures (SOPs) approved by an independent contractor recognized as a specialist in the fields of CBM water quality and produced gas analysis. TestAmerica, Denver Laboratory (TestAmerica) – an independent laboratory recognized by the National Environmental Lab Accreditation Program (NELAP) – analyzed the samples for general chemistry parameters, metals and elements, inorganic ions and organic analytes. Colorado Analytical Laboratories, Inc. (Colorado Analytical) – an independent laboratory certified for total coliform analysis by the Colorado Department of Public Health and the Environment (CDPHE) – analyzed the sample for total coliform bacterial testing. Isotech Laboratories, Inc. (Isotech) performed isotope and dissolved gas composition analyses for samples with methane concentrations sufficiently high enough to permit analysis. Norwest performed a field bacterial analysis on the well using the Bacterial Activity Response Test (BART©) field kits for sulfate reducing bacteria (SRB), iron related bacteria (IRB), and slime forming bacteria (SLYM). Field observations such as odor, water color, sediment, and effervescence were also included. The analyses are thorough and consist of a larger suite of analytes than typically analyzed for in domestic water wells.

Attachment A is a detailed report of the sampling results following the September 19, 2012 water well sampling event. This includes Table 3, a summary of your well sampling results compared to the Water Quality Control Commission (WQCC) of the CDPHE groundwater standards for domestic water supply human health standards and drinking water standards in accordance with 5 CCR 1002-41. The Colorado Oil and Gas Conservation Commission (COGCC) is an implementing agency of the CDPHE Groundwater Standards for impacts associated with oil and gas exploration and production activities. Domestic use-quality standards are analogous to, but not the same as, standards established for municipal or public drinking water supplies. Groundwater from private wells may exceed these standards. In addition, Table 3 compares the previous pre-drilling water quality results to the current post-completion results. Attachment

B is the Test America laboratory data sheets. Attachment C is the Isotech laboratory data sheet. Attachment D is the Colorado Analytical laboratory data sheet. Attachment E includes pamphlets from CDPHE on coliform and soil bacteria in groundwater.

Please contact Janet Paul, Pioneer Natural Resources USA, Inc., at (303) 675-2683 with any concerns or questions you may have regarding this information.

Sincerely,

Lacy Ledbeter Jones
Geochemist/Data Validation and Quality Assurance Specialist

NORWEST CORPORATION

Summary of Water Quality Results for 0502533 Trujillo WW – ATTACHMENT A

The 0502533 Trujillo WW sample, collected on September 19, 2012, is within drinking water quality standards based on human health criteria in the CDPHE Groundwater Standards. The following is a list of the important results to note. Further explanations of these results are included in the next section on Water Quality Assessment and Potential Treatment Recommendations.

- The bacteria results for the well water had detectable levels of coliform bacteria and detectable levels of all three soil bacteria – iron related bacteria (IRB), sulfate reducing bacteria (SRB), and slime forming bacteria (SLYM). **Due to the presence of coliform and soil bacteria, it is recommended to disinfect the well.**
- Methane dissolved gas is no longer measurable in the post-completion sample.

Water Quality Assessment and Potential Treatment Recommendations

Field Testing

The field observations indicated the water collected on September 19, 2012 from 0502533 Trujillo WW was clear with no odor, sheen, effervescence, or sediment. The sample was collected from an outside faucet. From the State Engineer records the well was drilled in 2003 to a total depth of 160 feet, and the well is permitted for household use only. Water quality parameters collected in the field are summarized in the following table.

Table 1. Field Parameters for the 0502533 Trujillo WW.

Field Parameter	Post-Completion Results 2012-09-19	Pre-drilling Results 2011-08-08
Conductivity	525 µS/cm	555 µS/cm
pH	8.45 S.U.	8.16 S.U.
Temperature	17.4 ° C	17.2 ° C
Dissolved H_2S Test	0.0	0.0
Color, Effervescence, Odor, Sheen, or Sediment Observed	None	None

Conductivity units are Micro Siemens per Centimeter (µS/cm = µmhos/cm), pH values have no units (referred to as Standard Unit, S.U.), temperature units are degrees Celsius (°C), and H_2S units are mg/L.

The pH measured in the laboratory at 8.39 S.U. was similar to the field pH of 8.45 S.U. (Table 3). A pH of 7.00 is considered neutral with pH greater than seven as basic and less than seven as acidic. The pH readings from your water well are within the CDPHE recommended pH range for domestic drinking water of 6.50 to 8.50. The recommended pH range is a secondary guideline as explained below. The laboratory conductivity value at 520 µS/cm confirms the field conductivity at 525 µS/cm (Table 3). There is no CDPHE recommended conductivity limit; this analyte is proportional to the total dissolved solids (TDS) analyte in Table 3.

Comparison of Results to CDPHE Groundwater Standards and to the Pre-Drilling Results

Table 3 provided at the end of the letter summarizes the numerical water chemistry of the 0502533 Trujillo WW compared to the "Basic Standards for Groundwater" (5CCR 1002-41) provided by the *CDPHE* (CDPHE Groundwater Standards). Because the 0502533 Trujillo WW is permitted for household use only, the results were compared against the Domestic Water Supply - Human Health Standards and the Domestic Water Supply - Drinking Water Standards within the CDPHE Groundwater Standards. The Domestic Water Supply – Human Health Standards have been established in regards to the health risks associated with every day, long-term (chronic) consumption of water with concentration levels higher than the respective constituent standard. The Domestic Water Supply – Drinking Water Standards are secondary guidelines that have been established for aesthetic characteristics of the water e.g. taste, odor, and color only.

In addition, Table 3 also compares the current post-completion results with the previous pre-drilling water quality results for this well.

There were no general chemistry parameters, metals and elements, inorganic ions, or organic constituents measured above the CDPHE Human Health Standards or the CDPHE Drinking Water Standards.

There were no significant changes between the pre-drilling and post-completion major chemistry results for the 0502533 Trujillo WW outside of expected natural variance. However, the gas concentrations measured within the sample and the bacteria results have changed.

The dissolved methane concentration has decreased from the 2011 pre-drilling sample to the current post-completion sample in the 0502533 Trujillo WW. It was 0.0064 mg/L for the baseline sample, and is now below the limits of detection (ND) in the current follow-up sample.

The coliform bacteria and BART kit results have changed between the baseline and current 0502533 Trujillo WW samples. Total coliform was detected in the current sample at a concentration of 17 Most Probable Number per 100 Milliliters of water (MPN/100mL), and the CDPHE Human Health Standard for total coliform is 23 CFU/100mL. This analyte was measured below the limits of detection in the pre-drilling, baseline result. The Iron Related Bacteria (IRB) soil bacteria measured in the BART kits have changed slightly to a more abundant level in the current sample. The BART kit results do not have CDPHE health standards for comparison. More information on coliform and soil bacteria is presented in the "Bacteria Analysis Results" section below.

The CDPHE groundwater regulatory standards are based mainly on the dissolved (i.e., filtered) species of a metal analyte. Metals in their dissolved species (ions) can affect the chemistry of the water differently from the total (i.e., unfiltered) species, so the dissolved metals are indicated in Table 3 using the abbreviation "diss." An additional note for Table 3, "ND" in the results field indicates an analyte was not detected above the detection limits provided by the laboratory instrumentation. Units are given as mg/L and micrograms per liter (µg/L) for some organic compounds at the bottom of Table 3. Units for the total

coliform analyte have been reported as MPN by Colorado Analytical and CFU by TestAmerica in the previous sample. These units are considered equal for our purposes.

Bacteria Analysis Results

Colorado Analytical analyzed the 0502533 Trujillo WW sample for total coliform for the September 19, 2012 sample date. Norwest analyzed the field BART© kits for IRB, SRB, and SLYM. These analyses are separate tests that complement each other for a comprehensive survey of possible bacterial issues in your well. Total coliform results from the laboratory came back detectable, while the field BART© kits showed the presence of all three bacteria types – IRB, SRB and SLYM. It is recommended to disinfect the well due to the presence of coliform bacteria and the aggressive nature of the IRB soil bacteria.

The total coliform is a broad-spectrum measurement of microscopic organisms that could possibly originate in the intestinal tract of warm-blooded animals. The presence of total coliform in well water could therefore indicate the possibility of pathogenic bacteria. The detected level is below the human health standard for coliform according to the CDPHE standard; however it is recommended to disinfect the well to gain control of the coliform population.

The BART© field kits measure bacterial groups that are natural to the soil environment and do not generally pose a health hazard to humans. The purpose of the BART© kit is a qualitative measurement of bacterial contaminations (presence/absence) with some degree of accuracy for detecting specific bacterial strains and colony numerical values.

The BART© results are summarized in the following table.

Table 2. Summary of Total Coliform and BART© Results for the 0502533 Trujillo WW.

Bacteria Test	Post-Completion Results 2012-09-19	Aggressivity in Current Sample	Pre-Drilling Results 2011-08-08
Total Coliform	17 MPN/100mL	NA	<1 CFU/100mL
BART© -- IRB	Present - Day 3	Aggressive	Present - Day 7
BART© -- SRB	Present - Day 7	Moderately Aggressive	Present - Day 5
BART© -- SLYM	Present - Day 5	Moderately Aggressive	Present - Day 5

Each component of the BART© kit was monitored over a period of ten days to inspect for signs of bacterial growth. The shorter the time period before growth is detected, the larger the numbers of bacteria are likely to be present in the water system, and the more "aggressive" the bacteria. The term aggressive does not correlate to the health concern of these bacteria; it is just a conventional choice of words used in the biology world.

Iron related and sulfate reducing bacteria are two of the most common types of bacteria found in water supply systems due to their natural occurrence in soil. Colonization of these bacteria in well water is not a health consideration; rather they are considered nuisance bacteria. IRB bacteria thrive in environments where dissolved iron is found in the water. Even in situations where the supply pipes and equipment are all made of PVC, iron may be present in the well water due to its natural occurrence in the soil or

formation rocks surrounding the well. Growth of SRB bacteria in a water supply system can result in blackish water (black suspended particles). The bacteria can reduce sulfate to sulfide, which can react with iron and fall out of solution as black particulate matter or off gas as hydrogen sulfide gas giving off a rotten egg-like (sulfur) odor. The SLYM bacteria can provide a slime layer shield to the IRB and SRB bacteria making it more difficult to treat and disinfect the water well to control the population.

More information on coliform bacteria in drinking water can be found at the following link:
http://www.cdphe.state.co.us/wq/drinkingwater/pdf/FactSheets/ColiformBacteria.pdf

More information on bacteria in water wells and treating the well can be found at the following link, in addition to the CDPHE pamphlets at the end of the letter.
http://www.ext.colostate.edu/pubs/natres/06703.html

Dissolved Methane Gas, Sulfide Gas, and Isotope Results

Dissolved methane results are summarized with the organic constituent concentrations in Table 3. Because methane was not detected in the current sample, the methane isotopes could not be measured as well.

More information on domestic water wells can be found at the following CSU Extension and COGCC websites, respectively:
http://www.ext.colostate.edu/pubs/crops/00513.html

http://cogcc.state.co.us/Library/WaterWellBooklet.pdf

Table 3. Summary of 0502533 Trujillo WW Domestic Well Water Quality Results

0502533 Trujillo WW	Sample Date: 2012-09-19	Sample Date: 2011-08-08	CDPHE Groundwater Standards	
Inorganic Analyte			**Domestic Water Supply (Human Health Standards)**	**Domestic Water Supply (Drinking H2O Standards)**
Alkalinity, Total	230 mg/L as CaCO3	250 mg/L as CaCO3		
Aluminum (Al) Diss.	ND	ND		
Antimony (Sb) Diss.	ND	ND	0.006	
Arsenic (As) Diss.	ND	ND	0.01	
BART – IRB	Present - Day 3	Present - Day 7		
BART – SRB	Present - Day 7	Present - Day 5		
BART – SLYM	Present - Day 5	Present - Day 5		
Barium (Ba) Diss.	0.14 mg/L	0.15 mg/L	2.0	
Beryllium (Be) Diss.	ND	ND	0.004	
Bicarbonate	230 mg/L as CaCO3	240 mg/L as CaCO3		
Boron (B) Diss.	ND	ND		
Bromide (Br)	ND	0.23 mg/L		
Cadmium (Cd) Diss.	ND	ND	0.005	
Calcium (Ca) Diss.	5.4 mg/L	3.9 mg/L		
Carbonate	5.8 mg/L as CaCO3	ND		
Chloride	32 mg/L	33 mg/L		250
Chromium (Cr) Diss.	ND	ND	0.1	
Cobalt (Co) Diss.	ND	ND		
Coliform Total	17 MPN/100mL	<1 CFU/100mL	23	
Copper (Cu) Diss.	0.018 mg/L	0.025 mg/L		1
Fluoride (F)	0.95 mg/L	0.98 mg/L	4.0	
Hydroxide	ND	ND		
Iron (Fe) Diss.	ND	ND		0.3
Lead (Pb) Diss.	ND	ND	0.05	
Magnesium (Mg) Diss.	ND	ND		
Manganese (Mn) Diss.	ND	ND		0.05
Mercury (Hg) Diss.	ND	ND	0.002	
Molybdenum (Mo) Diss.	ND	ND	0.035	
Nickel (Ni) Diss.	ND	ND	0.1	
Nitrate as N (NO3-N)	ND	0.11 mg/L	10.0	
Nitrite as N (NO2-N)	ND	ND	1.0	
pH (lab)	8.39 S.U.	8.35 S.U.		6.50 - 8.50
pH (field)	8.45 S.U.	8.16 S.U.		
Potassium (K) Diss.	ND	ND		
Selenium (Se) Diss.	ND	ND	0.05	
Silica (SiO2) Diss.	7.3 mg/L	7.6 mg/L		
Silver (Ag) Diss.	ND	ND	0.05	
Sodium (Na) Diss.	120 mg/L	130 mg/L		
Sodium Adsorption Ratio (SAR)	14 No Units	17 No Units		
Solids-Total Dissolved (TDS)	300 mg/L	320 mg/L		500[a]
Solids-Total Suspended (TSS)	ND	ND		
Specific Conductance (lab)	520 µS/cm	640 µS/cm		
Specific Conductance (field)	525 µS/cm	555 µS/cm		
Specific Gravity	1.0001 25C/25C	1.0005 25C/25C		
Strontium (Sr) Diss.	0.14 mg/L	0.15 mg/L		
Sulfate (SO4)	ND	ND		250
Sulfide, Hydrogen (field)	0.0	0.0		
Sulfide Total	ND	ND		
Temperature (field)	17.4 ° C	17.2 ° C		
Thallium (Tl) Diss.	ND	ND	0.002	
Zinc (Zn) Diss.	0.022 mg/L	0.021 mg/L		5
Organic Analyte			**Organic Chemical Standards**	
Methane	ND	0.0064 mg/L		
Ethane	ND	ND		
Ethylene (Ethene)	ND	ND		
Diesel Range Organics	ND	ND		
Oil and Grease	ND	ND		
Benzene	ND	ND	5	
Ethylbenzene	ND	ND	700	
Toluene	ND	ND	560	1,000[b]
Xylenes, Total	ND	ND	1400	10,000[b]

Notes:

[a]CDPHE secondary drinking-water standard listed in regulation no. 5 CCR 1003-1.

[b]Concentration is the maximum contaminant level established under the Safe Drinking Water Act (Source: 5 CCR 1002-41.5.C Table A).

Attachment B

TestAmerica Lab Reports

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Denver
4955 Yarrow Street
Arvada, CO 80002
Tel: (303)736-0100

TestAmerica Job ID: 280-33487-1
Client Project/Site: Water Well Baseline

For:
Pioneer Natural Resources USA, Inc.
1401 17th Street
Suite 1200
Denver, Colorado 80202

Attn: David Castro

Danielle Harrington

Authorized for release by:
9/28/2012 3:14:37 PM

Danielle Harrington
Project Manager I
danielle.harrington@testamericainc.com

Client: Pioneer Natural Resources USA, Inc.
Project/Site: Water Well Baseline

TestAmerica Job ID: 280-33487-1

Client Sample ID: 0502533 TRUJILLO WW
Date Collected: 09/19/12 12:47
Date Received: 09/20/12 10:00

Lab Sample ID: 280-33487-1
Matrix: Water

Method: 8021B - Volatile Organic Compounds (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		0.50		ug/L			09/25/12 22:12	1
Ethylbenzene	ND		0.50		ug/L			09/25/12 22:12	1
Toluene	ND		0.50		ug/L			09/25/12 22:12	1
Xylenes, Total	ND		0.50		ug/L			09/25/12 22:12	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
a,a,a-Trifluorotoluene	*101*		*85 - 115*		*09/25/12 22:12*	*1*

Method: RSK-175 - Dissolved Gases (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Methane	ND		0.0050		mg/L			09/25/12 15:28	1
Ethylene	ND		0.0050		mg/L			09/25/12 15:28	1
Ethane	ND		0.0050		mg/L			09/25/12 15:28	1

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	ND		0.24		mg/L		09/21/12 11:45	09/25/12 14:46	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*100*		*50 - 115*	*09/21/12 11:45*	*09/25/12 14:46*	*1*

Method: 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Calcium	**5.5**		0.20		mg/L		09/25/12 08:45	09/25/12 21:36	1
Magnesium	**0.39**		0.20		mg/L		09/25/12 08:45	09/25/12 21:36	1
Sodium	**120**		5.0		mg/L		09/25/12 08:45	09/25/12 21:36	1

Method: 200.7 Rev 4.4 - Metals (ICP) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		0.10		mg/L		09/24/12 09:00	09/24/12 16:26	1
Barium	**0.14**		0.10		mg/L		09/24/12 09:00	09/24/12 16:26	1
Beryllium	ND		0.0020		mg/L		09/24/12 09:00	09/24/12 16:26	1
Calcium	**5.4**		1.0		mg/L		09/24/12 09:00	09/24/12 16:26	1
Chromium	ND		0.010		mg/L		09/24/12 09:00	09/24/12 16:26	1
Copper	**0.018**		0.010		mg/L		09/24/12 09:00	09/24/12 16:26	1
Iron	ND		0.10		mg/L		09/24/12 09:00	09/24/12 16:26	1
Potassium	ND		1.0		mg/L		09/24/12 09:00	09/24/12 16:26	1
Magnesium	ND		1.0		mg/L		09/24/12 09:00	09/24/12 16:26	1
Manganese	ND		0.010		mg/L		09/24/12 09:00	09/24/12 16:26	1
Sodium	**120**		5.0		mg/L		09/24/12 09:00	09/24/12 16:26	1
Nickel	ND		0.020		mg/L		09/24/12 09:00	09/24/12 16:26	1
SiO2	**7.3**		0.20		mg/L		09/24/12 09:00	09/24/12 16:26	1
Strontium	**0.14**		0.010		mg/L		09/24/12 09:00	09/24/12 16:26	1
Zinc	**0.022**		0.020		mg/L		09/24/12 09:00	09/24/12 16:26	1

Method: 200.8 - Metals (ICP/MS) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cadmium	ND		0.00050		mg/L		09/27/12 09:05	09/27/12 16:33	1
Molybdenum	ND		0.0010		mg/L		09/24/12 09:00	09/25/12 01:44	1
Cobalt	ND		0.00050		mg/L		09/27/12 09:05	09/27/12 16:33	1
Silver	ND		0.00010		mg/L		09/24/12 09:00	09/25/12 01:44	1
Aluminum	ND		0.050		mg/L		09/27/12 09:05	09/27/12 16:33	1

Client: Pioneer Natural Resources USA, Inc.
Project/Site: Water Well Baseline

TestAmerica Job ID: 280-33487-1

Client Sample ID: 0502533 TRUJILLO WW
Date Collected: 09/19/12 12:47
Date Received: 09/20/12 10:00

Lab Sample ID: 280-33487-1
Matrix: Water

Method: 200.8 - Metals (ICP/MS) - Dissolved (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Thallium	ND		0.00020		mg/L		09/24/12 09:00	09/25/12 01:44	1
Arsenic	ND		0.0025		mg/L		09/27/12 09:05	09/27/12 16:33	1
Lead	ND		0.0015		mg/L		09/27/12 09:05	09/27/12 16:33	1
Antimony	ND		0.0050		mg/L		09/27/12 09:05	09/27/12 16:33	1
Selenium	ND		0.0025		mg/L		09/27/12 09:05	09/27/12 16:33	1

Method: 20B - Sodium Adsorption Ratio

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Sodium Adsorption Ratio	**14**		0.40		No Unit			09/25/12 10:47	1

Method: 7470A - Mercury (CVAA) - Dissolved

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00020		mg/L		09/26/12 12:40	09/26/12 21:02	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HEM (Oil & Grease)	ND		4.7		mg/L		09/26/12 15:51	09/26/12 19:26	1
Bromide	ND		0.20		mg/L			09/20/12 14:54	1
Nitrate as N	ND		0.10		mg/L			09/20/12 14:54	1
Chloride	**32**		1.0		mg/L			09/20/12 14:54	1
Nitrite as N	ND		0.10		mg/L			09/20/12 14:54	1
Fluoride	**0.95**		0.20		mg/L			09/20/12 14:54	1
Sulfate	ND		5.0		mg/L			09/20/12 14:54	1
Total Alkalinity	**230**		5.0		mg/L			09/21/12 14:21	1
Bicarbonate Alkalinity as CaCO3	**230**		5.0		mg/L			09/21/12 14:21	1
Carbonate Alkalinity as CaCO3	**5.8**		5.0		mg/L			09/21/12 14:21	1
Hydroxide Alkalinity	ND		5.0		mg/L			09/21/12 14:21	1
Total Dissolved Solids	**300**		10		mg/L			09/24/12 09:22	1
Total Suspended Solids	ND		4.0		mg/L			09/25/12 18:22	1
Sulfide	ND		0.050		mg/L			09/25/12 07:55	1

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Specific Gravity	**1.0001**				No Unit			09/24/12 13:03	1
Specific Conductance	**520**		1.0		umhos/cm			09/25/12 11:17	1
pH	**8.39**		0.100		SU			09/21/12 08:12	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	NONE	NONE	Unit	D	Prepared	Analyzed	Dil Fac
Field pH	**8.45**				SU			09/19/12 12:47	1
Field Conductivity	**525**				umhos/cm			09/19/12 12:47	1
Field Temperature	**17.4**				Degrees C			09/19/12 12:47	1

Attachment C

Isotech Lab Reports

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #:	265032	Job #:	19275
Sample Name/Number:	0502533 Trujillo WW		
Company:	Pioneer Natural Resources		
Date Sampled:	9/19/2012		
Container:	Dissolved Gas Bottle		
Field/Site Name:	Raton Basin, CO		
Location:			
Formation/Depth:			
Sampling Point:			
Date Received:	9/20/2012	Date Reported:	10/11/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰
Carbon Monoxide	nd			
Hydrogen Sulfide	na			
Helium	na			
Hydrogen	nd			
Argon	0.630			
Oxygen	17.52			
Nitrogen	81.36			
Carbon Dioxide	0.49			
Methane	nd			
Ethane	nd			
Ethylene	nd			
Propane	nd			
Propylene	nd			
Iso-butane	nd			
N-butane	nd			
Iso-pentane	nd			
N-pentane	nd			
Hexanes +	nd			
Water			-87.2	-11.04
Dissolved Inorganic Carbon		-12.5		

Total BTU/cu.ft. dry @ 60deg F & 14.73psia, calculated: 0 Specific gravity, calculated: 0.997

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.78
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

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

Attachment D

Colorado Analytical Lab Reports

Colorado Analytical Laboratories, Inc.

Analytical Results

TASK NO: 120920011

Report To: David Castro
Company: Pioneer Natural Resources USA
1401 17th Street Suite 1200
Denver CO 80202

Bill To: David Castro
Company: Pioneer Natural Resources USA
1401 17th Street Suite 1200
Denver CO 80202

Task No.: 120920011
Client PO:
Client Project: Raton Basin

Date Received: 9/20/12
Date Reported: 9/24/12
Matrix: Water - Ground

Customer Sample ID 0502533 Trujillo WW
Sample Date/Time: 9/19/12 12:47 PM
Lab Number: 120920011-01

Test	Result	Method	LQL	Date Analyzed	Analyzed By
Total Coliform	**17 mpn/100ml**	SM 9221-B	1	9/21/12	ISG

Abbreviations/ References:

LQL = Lower Quantification Limit
mg/L = Milligrams Per Liter or PPM
ug/L = Micrograms Per Liter or PPB
mpn/100 mls = Most Probable Number Index/ 100 mls
Date Analyzed = Date Test Completed
SM = "Standard Methods for the Examination of Water and Wastewater"; APHA; 19th Edition; 1995
EPA = "Methods of Chemical Analysis of Water and Wastes"; USEPA; EPA-600/4-79-020 Rev 3/83

DATA APPROVED FOR RELEASE BY

240 South Main Street / Brighton, CO 80601-0507 / 303-659-2313
Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Attachment E

CDPHE Documents on Bacteria in Drinking Water

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Fact Sheet – Coliform Bacteria and Drinking Water

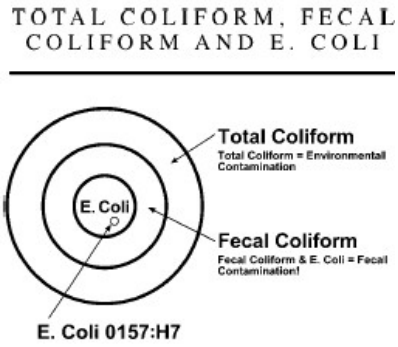
Public water systems are required to deliver safe and reliable drinking water to their customers 24 hours a day, 365 days a year. If the water supply becomes contaminated, consumers can become seriously ill. Fortunately, many steps are taken to ensure that the public is provided with safe drinking water. One of the most important steps is to have the water tested for coliform bacteria to confirm that all of the other steps are working properly. Public water systems must test for coliform bacteria regularly.

What are coliform bacteria?

Coliform bacteria are organisms that are, by themselves, present in the environment and in the feces of all warm-blooded animals and humans. Coliform bacteria will not likely cause illness. However, the presence of coliform bacteria in drinking water indicates that disease-causing organisms (pathogens) may be present in the water system. Most pathogens that can contaminate water supplies come from the feces of humans or animals. Testing drinking water for all possible pathogens is complex, time-consuming and expensive. It is relatively easy and inexpensive to test for coliform bacteria. If coliform bacteria are found in a water sample, steps are taken to find the source of contamination and restore safe drinking water. There are three different groups of coliform bacteria (total coliform, fecal coliform and E. coli); each has a different level of risk.

Total coliform, fecal coliform, and *E. coli*

The total coliform group is a large collection of different kinds of bacteria. The fecal coliform group is a sub-group of total coliform and has fewer kinds of bacteria. *E. coli* is a sub-group of fecal coliform. (See the diagram below.) When a water sample is sent to a lab, it is tested for total coliform. If total coliform is present, the sample will also be tested for *either* fecal coliform or *E. coli*, depending on the lab testing method.



Total coliform bacteria are commonly found in the environment (e.g. soil or vegetation) and are generally harmless. If only total coliform bacteria are detected in drinking water, the source is most likely environmental. Fecal contamination is not likely. However, if environmental contamination can enter the system, there may be a way for pathogens to enter the system too. Therefore, it is important to determine the source and to resolve the problem.

Fecal coliform bacteria are a sub-group of the total coliform group. They appear in great quantities in the intestines and feces of people and animals. The presence of fecal coliform in a drinking water sample often indicates recent fecal contamination – meaning that there is a greater risk that pathogens are present.

E. coli is a sub-group of the fecal coliform group. Most *E. coli* are harmless and are found in great quantities in the intestines of people and warm-blooded animals. Some strains, however, may cause illness. The presence of *E. coli* in a drinking water sample almost always indicates recent fecal contamination – meaning that there is an even greater risk that pathogens are present.

A Note about *E. coli*: *E. coli* outbreaks receive much media coverage. Most outbreaks have been related to food contamination, caused by a specific strain of *E. coli* known as ***E. Coli* O157:H7.** When a drinking water sample is reported as "E. coli present", it does not mean that this specific strain is present. It is probably not present. However, the sample result does indicate some level of recent fecal contamination. Boiling or treating contaminated drinking water with disinfectant destroys all forms of *E. coli* including *O157:H7*.

What happens if coliform bacteria are found in my water?

When coliform bacteria are found, steps are taken to identify where the contamination may have entered the water system. More "repeat" samples are collected and an inspection is recommended. Taking repeat samples helps determine whether an actual ongoing problem exists in the system. Sometimes a sample shows the presence of coliform because of poor sampling techniques or because a contaminated faucet was used – not because an actual problem exists. If any of the repeat samples detect coliform bacteria, the initial findings are considered confirmed.

What happens if total coliform bacteria are confirmed in my water?

If total coliform bacteria are confirmed in your drinking water, a system inspection should be conducted to find and eliminate any possible sources of contamination. Once the source is identified, it can usually be eliminated by making system repairs, flushing, and/or "shock" chlorinating the system (adding chlorine for a short period of time.) The Colorado Department of Public Health and Environment (Department) is usually in contact with water systems and utility managers to help address the problem. Your water system or utility is required to notify you within 30 days about the situation. The department recommends that notice be distributed as soon as possible. The notice will inform you of actions being taken to correct the problem, when the problem will likely be resolved and will advise you of any actions that you may need or want to take until then.

What happens if fecal coliform bacteria or *E. coli* are confirmed in my water?

Confirmation of fecal coliform bacteria or *E. coli* in a water system indicates recent fecal contamination, which may pose an immediate health risk to anyone consuming the water. Responding to health emergencies is the department's highest priority. The Department will coordinate with water system officials to develop response actions and determine the need for the Department to participate in an inspection of the system to assist the water system in resolving the problem. More sampling will be conducted to find and eliminate potential contamination sources, and shock chlorination and flushing of the system will most likely occur. A "Public Notice" will be issued within 24 hours to alert all water users that there is a health risk associated with the water supply. In cases where the cause of the contamination has not been identified and eliminated, the use of boiled or bottled water will be recommended for drinking and cooking. The notice will inform you of actions being done to correct the problem and when the problem will likely be resolved. The Public Notice will remain in effect until the situation is resolved and the water is considered safe to drink.

For more Information:

Denver Regional Office	303-692-3500
Grand Junction Regional Office	970-248-7150
Pueblo Regional Office	719-545-4650

CAUTION

- During the seven- to 13-hour procedure, purchase water for drinking, cooking and laundry. Do not use well water for drinking or cooking while chlorine level is exceptionally strong.
- All concentrated chlorine solutions are corrosive and care should be taken to avoid splashing them onto skin or into eyes. Skin areas or eyes contacted by the disinfection solution should be flushed immediately with clean water.
- Never mix chlorine solutions with compounds containing acids or ammonia to improve their cleaning ability because toxic gases will form.

Glossary

Contaminant: Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

Disinfection: Killing a larger portion of the harmful and objectionable bacteria in water.

Groundwater: Water that fills wells from aquifers (natural reservoirs below the earth's surface).

Resample: Any water sample taken after the initial sampling of a well.

Sample: Water that is analyzed by a laboratory for the presence of drinking water contaminants.

Shock chlorination: Adding chlorine to water for the purpose of disinfection or other biological or chemical results.

Well: An artificial excavation constructed for the purpose of exploring for or producing ground water.

Laboratory Services Division – (303) 692-3090
Fax: (303) 344-9989
http://www.cdphe.state.co.us/lr
Chemistry Laboratory – (303) 692-3048
Microbiology Laboratory – (303) 692-3490
Bottle Order Line (menu driven) –
(303) 692-3074

Colorado Department of Public Health and Environment
Laboratory Services Division
8100 Lowry Boulevard
Denver, CO 80230

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

LABORATORY SERVICES DIVISION

Shock Chlorination of Wells and Water Systems

CHEMISTRY LABORATORY
(303) 692-3048
MICROBIOLOGY LABORATORY
(303) 692-3490

Determining Amount of Chlorination for Your Well

Table I

Casing Diameter (Inches)	Gallons of Water in 1 Foot of Casing	Casing Diameter (Inches)	Gallons of Water in 1 Foot of Casing
2	0.16	18	13.21
4	0.65	24	23.50
5	1.02	30	36.72
6	1.47	36	52.87
8	2.61	42	71.97
10	4.08	48	94.00
12	5.88		

Table II

Gallons of Water in Well	Laundry Bleach	Chlorinated Lime	High Test Hypochlorite
5	5.5 oz.	1.2 oz.	.5 oz.
50	56 oz.	12 oz.	4 oz.
100	112 oz.	24 oz.	8 oz.
150	168 oz.	36 oz.	12 oz.
200	224 oz.	48 oz.	16 oz.
300	336 oz.	72 oz.	24 oz.
Each addtional 100 gallons add:	112 oz.	24 oz	8 oz.

Bacterial contamination of well water can come from many sources. The most common include repairing the pump or casing without follow-up chlorination, surface water entering pump or casing, poor construction of the well, or leaks in the well or well casing.

Shock chlorination of the well may eliminate the bacterial contamination, but well rehabilitation may be necessary if contamination continues to occur (as in a rusted or leaking casing).

To determine the amount of chlorine needed to shock chlorinate your well, first determine the approximate volume of water contained in your well. Determine the volume of water in your well by multiplying the depth of your well times the amount of water in one foot of casing (Table I).

Well Depth x Gallons of Water in 1 Foot of Casing (see Table I) = Volume of Water in Well

Once you have determined the volume of water in your well, refer to Table II to determine the amount of chlorine compound required to shock chlorinate your well.

Forms of Chlorine Used in Shock Chlorination

Format	Chemical Mixture
Liquid	Laundry Bleach (Sodium Hypochlorite, 5.25%)
Powder or Tablet Form	Chlorinated Lime (Chloride of Lime, 25-30%)
Powder or Tablet Form	High-Test Hypochlorate (Calcium Hypochlorite, 65-75 %)

Treatment of Casing and Drop Pipe

During the shock chlorination process it is necessary to thoroughly wet down the inside of the well casing and drop pipe. This can be accomplished by one of the three methods mentioned below:

- If liquid bleach is used, mix the recommended amount (Table II) to at least 10 gallons of water. Pour down the inside of the casing, thoroughly wetting down everything inside the casing.
- If powdered or tablet chlorine is used, dissolve the recommended amount (Table II) in a small quantity of water, then add the clear solution to a larger quantity of water (at least 20 gallons). Pour this solution into the casing, thoroughly wetting down everything inside the casing.
- If a hose will extend from a nearby hydrant or faucet to the well casing, pour the recommended amounts of chlorine (Table II) into the casing and wash down the inside of the casing with the hose. Make sure the chlorine solution in the well is coming through the hose during the wash-down procedure. Pumping the solution into the casing will help to mix the chlorine solution with the standing water in the well.

Once the chlorine is thoroughly mixed with the water in the well casing, allow it to stand for about six to12 hours. At the end of the six- to12-hour period, all faucets should be allowed to run until a strong odor of chlorine is observed at each faucet, then turn off the faucets and allow the water to stand in the pipes for one hour.

Flushing the System

Begin flushing the system by running all outside faucets until you no longer smell chlorine. Run this water into the street or onto an area where there is no lawn or flowers, such as a rocked area. You may severely damage lawns, landscape plantings, flowers or septic tanks with heavily chlorinated water.

Once you have removed most of the chorine at the outside faucets, go into the house and run all inside faucets. If you have a septic tank or leaching field, you may want to dechlorinate the water at the drain by using approximately two (2) ounces of sodium bisulfite for every gallon run. Sodium bisulfite can be purchased at hardware stores.

Hot water heaters should be drained after a well is treated with chlorine. If possible, run a hose from the water heater outside to an area that does not contain lawn or other sensitive plants.

CAUTION
- Do not flush more than 100 gallons of chlorinated water from the system into the septic system.
- Avoid draining heavily chlorinated water to lawns and do not allow puddles to form.
- Do not chlorinate carbon or charcoal filters because this will deplete their capacity.

Raising the water heater temperature will temporarily solve the odor problem, but sulfur-reducing bacteria will quickly reinvade unless more permanent measures are taken.

Removing the sacrificial anode will eliminate the problem, but it can also shorten the water heater's lifespan significantly and may void the warranty. Replacing the magnesium rod with one made of zinc won't totally eliminate sulfur-reducing bacteria, but it will greatly reduce the number of bacteria. Consult with a plumber before attempting to modify your water heater.

Point-of-Use Treatment (Carbon Filters)

Some point-of-entry (POE) and point-of-use (POU) systems can inhibit reproduction of bacteria and reduce associated odors and tastes. To determine the best system, you can use the NSF International online product database of drinking water treatment units. Visit the NSF International website at www.nsf.org or call 1-800-673-6275.

Follow-up Procedures

Shock chlorination or the other methods discussed should solve the immediate problems associated with iron or sulfur bacteria, but they may not be long-term solutions. Iron and sulfur bacteria tend to build up again a few months after treatment. Bacteria problems are much easier to control after the initial contamination has been treated. However, to keep down bacterial regrowth, well owners can periodically disinfect their wells by shock chlorinating with a weaker chlorine solution, or by installing a chlorination unit that will constantly chlorinate the water. A licensed well contractor can advise you on which option is best for you.

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Colorado Department of Public Health and Environment
Laboratory Services Division
8100 Lowry Boulevard
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COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

LABORATORY SERVICES DIVISION

Iron and Sulfur Bacteria in Water Supplies

CHEMISTRY LABORATORY
(303) 692-3048
MICROBIOLOGY LABORATORY
(303) 692-3490

Bacterial contamination of a water supply doesn't always indicate the existence of a health hazard. Some types of bacterial contamination are more annoying than harmful. The normal bacteria test performed on drinking water is specific for coliform and E. coli. A sample may test negative for coliform but still contain other nuisance bacteria. Two of the most common bacterial contaminants are iron and sulfur bacteria. They are not particularly harmful, but they can be incredibly annoying.

Iron Bacteria

Iron bacteria are generally more common than sulfur bacteria because iron is abundant in ground water. Iron bacteria are oxidizing agents and combine iron or manganese dissolved in ground water with oxygen. A side effect of the process is a foul-smelling brown slime that can cause unpleasant odors, corrode plumbing equipment and fixtures, and clog well screens and pipes. If conditions are right, the bacteria can grow at amazing rates, rendering an entire well system useless in just a few months.

Signs that may indicate an iron bacteria problem include yellow-, red- or orange-colored water; rusty slime 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.

Sulfur Bacteria

There are two categories of sulfur bacteria; sulfur oxidizers and sulfur reducers. Sulfur-reducing bacteria are the more common. Sulfur-oxidizing bacteria produce effects similar to those of iron bacteria. They convert sulfide into sulfate, producing a dark slime that can clog plumbing. Sulfur-reducing bacteria live in oxygen-deficient environments. They break down sulfur compounds, producing hydrogen sulfide gas in the process. The distinctive "rotten egg" odor of hydrogen sulfide gas is the most obvious sign of a sulfur bacteria problem. Hydrogen sulfide gas is foul smelling and highly corrosive. As with odors caused by iron bacteria, the sulfur smell may only be noticeable when the water hasn't been run for several hours.

If the odor is only present when hot water is run, sulfur-reducing bacteria could be building up in the water heater. Blackening of water or dark slime coating the inside of the toilet tank may also indicate a sulfur bacteria problem.

Iron bacteria and sulfur bacteria contaminations are often difficult to tell apart because the symptoms are so similar. To complicate matters, sulfur-reducing bacteria often live in complex symbiotic relationships with iron bacteria, so both types may be present. Fortunately, both types of bacteria can be treated using the same methods.

Prevention

The best treatment for both iron and sulfur bacteria is prevention. Unsanitary well drilling can often introduce bacteria into a previously clean water supply. Therefore, anything that will be going into the ground during the drilling process needs to be disinfected. Tools, pumps, pipes, gravel pack material, and even water used during drilling should be treated with a 200-milligrams-per-liter chlorine solution. When the well is completed, it should be shock chlorinated. Well owners should be alert for any signs of iron or sulfur bacteria contamination.

Shock Chlorination

Shock chlorination involves adding chlorine to water to disinfect the water or to obtain other biological or chemical results. Chlorine is a common disinfectant used in water systems, and is highly toxic to coliform and similar types of bacteria. Iron and sulfur bacteria are more resistant to chlorine's effects because iron and sulfur bacteria occur in thick layers and are protected by the slime they secrete. A standard chlorine treatment may kill off bacterial cells in the surface layer but leave the rest untouched. In the case of iron bacteria, iron dissolved in the water may absorb disinfectant before it reaches the bacteria.

For all of these reasons, iron and sulfur bacteria may be able to survive a chlorine treatment that would kill other types of bacteria. For information on shock chlorinating iron- or sulfur-bacteria contaminated wells, contact the Laboratory Services Division at 303-692-3048 and request the "Shock Chlorination of Wells and Water Systems" fact sheet.

Acid Treatment

For severe cases, treatment with a strong acid and salt solution following thorough shock chlorination may be required. The acid solution (commercial hydrochloric acid, commonly known as muriatic acid) may be able to penetrate thick incrustations of bacteria that the chlorine solution was unable to kill. This procedure should only be performed by a licensed well contractor.

Water Heater Treatment

As noted earlier, sulfur-reducing bacteria can often contaminate water heaters, creating a foul smell when hot water is turned on. A water heater provides a good environment for sulfur-reducing bacteria because it contains a "sacrificial anode." This anode is a magnesium rod that helps protect the water heater by corroding instead of the tank lining. Electrons released from the anode as it corrodes nourish sulfur-reducing bacteria.

Water heaters infested with sulfur-reducing bacteria can be treated. Sulfur-reducing bacteria die at temperatures of 140 degrees Fahrenheit or above, which is roughly equivalent to the "medium" setting on most home water heaters. Setting the water heater on "high" will raise the water temperature to approximately 160 degrees Fahrenheit and kill any sulfur-reducing bacteria in the tank. (Do this only if the water tank has a pressure relief valve and everyone in the house is warned, to prevent scalding.) After about eight hours, the tank can be drained and the temperature setting returned to normal.