



COLORADO

Oil & Gas Conservation
Commission

Department of Natural Resources

1120 Lincoln Street, Suite 801
Denver, CO 80203

March 15, 2016

James Petras
3965 Cottonwood Ln
Brighton, CO 80603

RE: Complaint #200438711
Water Quality Results for your Domestic Water Well
NWNE Section 13, T-1-N, R-66-W

Dear Mr. Petras,

In response to your concerns regarding possible impacts to your water quality from oil and gas operations in the area near your home, the Colorado Oil and Gas Conservation Commission (COGCC) conducted a field visit to your property on February 16, 2016. Water samples were collected for general organic and inorganic water quality testing as well as for biological activity. This sample was collected in response to a complaint that you filed with the COGCC on January 12, 2016. The complaint record can be found by searching for the assigned complaint number, #200438711, on the Complaints page of the COGCC website, <http://www.cogcc.state.co.us/complaints.html>.

FIELD TESTING

The water sample was collected from an exterior spigot on the southwest corner (back side) of your house. The water was turned on at approximately 11:56 AM and allowed to run for 20 minutes at an estimated rate of 6.7 gallons per minute, until the temperature of the water stabilized (at 62°F). The water was clear with neither odor nor sheen observed and it was allowed to run into a bucket. No sediment accumulated in the bucket and the characteristics of the water did not change during the 20 minute purge. Additional field observations (and photos) are included in Attachment 1, most notably: iron-oxide staining of the front porch from an external spigot. The sample was collected (at a reduced flow rate of approximately 1.8 gallons per minute) at 12:20 and delivered the same day to Test America Laboratories (TestAmerica) in Arvada, Colorado for general inorganic and organic chemical analyses. Additional splits of the water sample were collected to perform a Biological Activity Reaction Test (BART) at the COGCC office in Denver.

P 303.894.2100 F 303.894.2109 www.colorado.gov/cogcc

Commissioners: Thomas L. Compton - Chairman, Richard Alward, John H. Benton, DeAnn Craig,
James W. Hawkins, Tommy Holton, Andrew L. Spielman, Dr. Larry Wolk

John W. Hickenlooper, Governor | Robert Randall, Interim Executive Director, DNR | Matthew J. Lepore, Director



DISCUSSION OF ANALYTICAL RESULTS

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) established "Domestic Use - Quality" Human Health and Secondary Drinking Water Standards in Regulation 41 "The Basic Standards for Groundwater" (5CCR 1002-41). It is important to note that these standards were established for **municipal public drinking water supplies**, and that people often use and consume groundwater from private wells that exceeds these standards. The COGCC is an implementing agency of the groundwater standards for impacts associated with oil and gas exploration and production activities.

Analytical data for the water sample from your domestic water well was compared to the CDPHE Human Health and Secondary Drinking Water Standards in Table 1, provided as Attachment 2. The complete laboratory analytical report is provided as Attachment 3.

Total Dissolved Solids (TDS): CDPHE has established a TDS standard for human drinking water of 500 milligrams per liter (mg/l). The standard, called the secondary maximum contaminant level (SMCL), is based on the aesthetic quality of the water (such as taste and odor) and is not an enforceable standard. It is intended as a guideline for public water supply systems. 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 concentrations are related to the presence of naturally occurring elements and chemical compounds such as chloride, sodium, potassium, calcium, magnesium, and sulfate.

TDS was detected in the water sample from your domestic water well at a concentration of 3,800 mg/l, which is greater than the CDPHE SMCL.

Barium (Ba): The CDPHE human health standard for barium is 2.0 mg/l. Barium is a contaminate metal.

Barium was detected in the water sample from your domestic water well at a concentration of 0.01 mg/l, which is less than the CDPHE human health standard.

Fluoride (F): CDPHE has established a fluoride (F) standard for drinking water of 4.0 mg/l. Where fluoride concentrations are in a 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 greater than 2.0 mg/l can result in mottling of teeth. Consumption of fluoride at concentrations greater than 4.0 mg/l can increase the risk of skeletal fluorosis or other adverse health effects.

Fluoride was not detected in the water sample from your domestic water well.

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

Chloride was detected in the water sample from your domestic water well at a concentration of 140 mg/l, which is less than the CDPHE secondary drinking water standard.

Sulfate (SO₄): The CDPHE sulfate standard for human drinking water is 250 mg/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 occurs naturally in the ground water in many areas in Colorado at concentrations that exceed the drinking water standard.

Sulfate was detected in the water sample from your domestic water well at a concentration of 2,200 mg/l, which is greater than the CDPHE secondary drinking water standard.

Total Nitrate (NO₃) + Nitrite (NO₂) as Nitrogen (N): The CDPHE total nitrate (NO₃) + nitrite (NO₂) as nitrogen (N) standard for human drinking water is 10 mg/l. Nitrate and nitrite are common contaminants in ground water from agricultural sources, such as fertilizer and animal wastes. They are known to cause infant cyanosis or "blue baby disease" in humans and, at concentrations greater than 100 mg/l as nitrogen (N), may be dangerous to livestock. High concentrations of nitrate and nitrite in ground water are known to occur in agricultural areas in Colorado.

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

Iron (Fe): The CDPHE iron standard for human drinking water is 0.3 mg/l. Small amounts of iron are common in ground water. Iron may produce a brownish-red color in laundered clothing, can leave reddish stains on fixtures, and may 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 water sample from your domestic water well.

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

Manganese was detected in the water sample from your domestic water well at a concentration of 0.08 mg/l, which is greater than the CDPHE secondary standard for drinking water.

Lead (Pb): The CDPHE human health standard for lead is 0.05 mg/l. Prolonged exposure to this metal can result in serious health effects.

Lead was not detected in the water sample from your domestic water well.

Chromium (Cr): The CDPHE human health standard for chromium is 0.1 mg/l. Chromium is a contaminate metal.

Chromium was not detected in the water sample from your domestic water well.

Arsenic (As): The CDPHE human health standard for arsenic is 0.01 mg/l. Arsenic is a highly poisonous metal.

Arsenic was not detected in the water sample from your domestic water well.

Selenium (Se): The CDPHE human health standard for selenium is 0.05 mg/l. Selenium is a contaminate metal.

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

pH: pH is a measure of hydrogen ion concentration in water. The pH of water in its natural state generally ranges from 5.5 to 9.0. The CDPHE standard for domestic and agricultural water is a range from 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 domestic water well at a value of 7.9, which is within the acceptable range for CDPHE drinking water and agricultural standards.

The following parameters were also measured as part of the laboratory analysis, although there are no CDPHE standards for their concentrations.

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

Sodium was detected in the water sample from your domestic water well at a concentration of 950 mg/l, which is greater than the recommended level for people on salt-restricted diets.

Calcium (Ca): The calcium concentration in the water sample from your domestic water well was 200 mg/l.

Magnesium (Mg): The magnesium concentration in the water sample from your domestic water well was 56 mg/l.

Potassium (k): The potassium concentration in the water sample from your domestic water well was 11 mg/l.

Bicarbonate (HCO_3): Bicarbonate was detected in the water sample from your domestic water well at a concentration of 490 mg/l.

Bromide (Br): Bromide was not detected in the water sample from your domestic water well.

METHANE GAS CONCENTRATION

Methane gas is a colorless, odorless, and tasteless gas, which is common in water wells in Colorado. Although the presence of methane gas in groundwater has no known direct health effect in humans, concentrations of methane exceeding 1.1 mg/l may constitute safety concern if methane is allowed to accumulate and concentrate in confined, unventilated areas—resulting in an explosive risk.

A trace of methane was detected in the water sample collected from your domestic water well at a concentration of 0.01 mg/l. This concentration was below the threshold level of 1.1 mg/l for explosive risk.

SODIUM ADSORPTION RATIO & SPECIFIC CONDUCTANCE

The water sample from your domestic water well was also analyzed for sodium adsorption ratio (SAR) and electrical conductivity (EC). The result for SAR was 15. SAR is a proportion of sodium (Na) to calcium plus magnesium (Ca + Mg), and is used to determine the sodium hazard in irrigation water. Generally, water with SAR values between 1-9 has a low sodium hazard. The result for electrical conductivity (EC) in your water was 3.5 mmhos/cm (millimhos per centimeter). EC is often used to determine the salinity hazard of irrigation water. Water with EC of 0.25-0.75 mmhos/cm is considered good.

ANALYSIS FOR HYDROCARBONS

The water sample collected from your domestic water well was analyzed for Total Petroleum Hydrocarbons (TPH), Volatile Organic Compounds (VOCs), and Semi-Volatile Organic Compounds (SVOCs)—results are listed below.

- **Total Petroleum Hydrocarbons:** This is a common analytical method used to screen for dissolved petroleum hydrocarbons in water. Both gasoline-range organics (GRO) and diesel-range organics (DRO) were analyzed. TPH were not detected in the sample from your domestic water well.
- **Volatile Organic Compounds:** A target list of 52 VOCs was utilized during analysis of water from your well. VOCs were not detected in the water sample from your domestic water well.
- **Semi-Volatile Organic Compounds:** A target list of 64 SVOCs was utilized during analysis of water from your well. SVOCs were not detected in the water sample from your domestic water well.

BACTERIA OCCURRENCE

The COGCC also collected samples of your water for Biological Activity Reaction Tests (BART™) to determine the presence of bacteria, as described below. Photos related to the BART test are included as Attachment 4.

- **Iron-Related Bacteria (IRB):** Although not harmful, iron-related bacteria can become a nuisance by plugging the well pump, causing red staining on plumbing fixtures and laundered clothing, building up red, slimy accumulations on any surface that the water touches, and causing what appears to be a sheen on standing water. Signs that may indicate an IRB problem include yellowish, red, or orange-colored water, rusty deposits in toilet tanks, and strange smells resembling fuel oil, cucumbers, or sewage. Sometimes the odor will only be apparent in the morning or after other extended periods of non-use. IRB was detected in the water sample collected from your domestic water well.
- **Sulfate-Reducing Bacteria (SRB):** Sulfate-reducing bacteria are serious nuisance organisms in water, as they can cause severe taste and odor problems. These bacteria reduce sulfate that occurs naturally in water and generate hydrogen sulfide (H₂S) gas as they grow. The H₂S gas is a nuisance because it smells like rotten eggs, initiates corrosion on metal surfaces, and reacts with dissolved metals, such as iron, to generate black sulfide deposits. SRB was detected in the water sample collected from your domestic water well.
- **Slime-Forming Bacteria (SLYM):** Although not usually harmful, slime-forming bacteria can become a nuisance by plugging well pumps and causing slimy accumulations on plumbing fixtures and standing water. These bacteria are often gelatinous in nature and may range in color from white to red to black. As SLYM mats grow, they create an environment in which complex associations of other bacterial strains can develop. SLYM was not detected in the water sample collected from your domestic water well.

SURROUNDING WATER QUALITY

As part of the investigation, COGCC reviewed analytical results from water samples collected from domestic water wells in the vicinity of your residence. A review of these results indicated that the water quality of water produced from your domestic water well is similar to the water produced from surrounding water wells. In general these wells also produce a sodium sulfate rich water with relatively high Total Dissolved Solids.

CONCLUSIONS

The water sample collected from your domestic water well contained concentrations of manganese, sulfate, and Total Dissolved Solids that exceeded CDPHE secondary drinking water standards. None of the analyzed constituents exceeded the CDPHE primary drinking water standards.

The concentration of methane in the sample was below both the 1.1 mg/l level for safety considerations and the 1.0 mg/l COGCC threshold for additional isotopic analysis. The water sample did not contain concentrations of VOCs, SVOCs, or TPH above the method detection limits.

The Biological Activity Reaction Tests™ performed on the water sample indicated the presence of both iron-related and sulfate-reducing bacteria. This result is consistent with field observations of iron-oxide staining below the domestic water well at your front porch and, possibly, with the detection of hydrogen sulfide (H₂S) gas at the wellhead.

The water quality of the water produced from your domestic water well is similar to the water quality of water produced from water wells in the vicinity of your residence.

During our discussions of the well history, you indicated that no maintenance had been performed on the water well since it came into your possession, approximately twenty years ago. Attached to this letter is a booklet compiled by the COGCC, CDPHE, and the Colorado Division of Water Resources (DWR) entitled How Well Do You Know Your Water Well (Attachment 5). Please refer to this booklet for additional information on interpretation of the analytical data provided in addition to well maintenance techniques and agency contacts.

Based on the information gathered to date, there are no indications of oil and gas related impacts to your water well. As a result, your complaint regarding potential impacts to groundwater quality is closed with this letter. If you have any questions or would like to discuss the sample results further, please contact me via email, steven.arauza@state.co.us, or by phone at (303) 894-2100, ext. 5136.

Mr. James Petras

March 15, 2016

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Respectfully,

A handwritten signature in blue ink, appearing to read 'S. Arauza', with a stylized flourish at the end.

Steven J. Arauza, G.I.T.
Environmental Protection Specialist

Attachments:

- Attachment 1 - Field Conditions, Sampling Map, and Field Photos
- Attachment 2 - Analytical Summary - Table 1
- Attachment 3 - TestAmerica Laboratory Report
- Attachment 4 - BART Photos
- Attachment 5 - How Well Do You Know Your Water Well?

Cc: Greg Deranleau - COGCC Environmental Manager
John Axelson - COGCC East Environmental Supervisor

Field Sampling Data Sheet

COGCC Facility ID: Pilkington 41-13D & 31-13D with Tank Battery (nearest)

Site Address: -17601 CR 10, Weld County, NWNE Sec. 13, T-1-N, R-66-W

Site Contact: n/a

Phone #: n/a

Date of Sample: 2/16/2016

Sample Type (baseline, post-drill, complaint): Complaint #200438711

Oil & Gas Well API Number: 123 23711 & 123 23174

Property Owner Name: James Petras

Property Owner Phone Number: _____

Property Owner Mailing Address: _____

Individuals Present (Who was on-site during the sampling event?)

Steven J. Arauza (COGCC EPS)

Water Well Information from Permit Records

Permit No.: n/a

Receipt No.: n/a

Total Depth (ft.): unknown

Static Water Level (ft.): unknown

Yield (GPM): unknown

Well Diameter (in.): unknown

Water Well Information Onsite

GPS Location (field): 40.05708 N, 104.72259 W

GPS Location (post-processed): n/a

Water well casing height (in.): -6"

Ground Elevation (ft.): 5042' How determined: GPS

Approximate distance to the Oil & Gas well pad: ~600', NW

%LEL at wellhead (if measured): 0%

%CH₄ at wellhead (if measured): 0% (0.5 ppm H₂S)

Weather conditions: Sunny, high-50s

Photo(s) Taken? **Y** **N** yes

Handed Out Landowner Introduction Letter? **Y** **N** no

Handed Out FAQ Sheet? **Y** **N** no

Handed Out "How Well Do You Know Your Water Well" Pamphlet? **Y** **N** no

Where was the Sample Taken? backyard spigot (front porch spigot had aerator, unable to remove)

(Outside Tap, Well House, Kitchen Tap, Spring, Seep, etc.)

Condition of the Well, Spring or Seep (Wellhead sealed? Does the ground slope away from the well?, Visible contamination of spring/seep?, etc.):

WH sealed, no visible contamination, 0.5 ppm H₂S detected by personal gas meter at WH. 28+ ppm CO measured at spigot after purging for ~15 min. Front spigot was not sampled, but abundant rust and precipitate observed.

Field Sampling Data Sheet – Page 2

Landowner Comments on Water Quality: Landowner reported: I can light the fumes coming from my faucets... via Form 18. Via phone, reported oily film/residue on water, no WW info provided but reported well to be 20 years old. Water system (reverse osmosis & softener) turned off--not bypassed. Reports that a neighbor was able to ignite their faucets a few years ago. Also alleged decline in water quality corresponding with workover operations at nearby KMG facility.

Water Quality Field Parameters:

Time	Purge Vol. (gal)	pH	Conductivity	Temp	Color/Appearance /Sediment	Odor	Bubbles/Effervescence?
1155	5			52	clear	none	none
1200	38			62	clear	none	none
1205	71			62	clear	none	none

Purge rate (gpm): -6.7 Purge Time (min.): 20

Total Purge Volume (gal.): -138

Sampling flow rate (gpm): -1.8

ADDITIONAL INFORMATION: Water Quality Field Parameters (Continued)

Time: 1210, Vol: 104 gal, Temp: 62 degrees, Appearance: clear, no odor nor effervescence

Time: 1215, Vol: 138 gal, Temp: 62 degrees, Appearance: clear, no odor nor effervescence

Sampled 250 - 1000 mL bottles at ~1.8 gpm, reduced flow rate for VOA vials and BART test.

Bottles and VOA vials hand-delivered to TestAmerica the same day.

Sampler's Name Steven J. Arauza Company: COGCC

Sampler's Signature (Print)  Date: 12/17/2016

Complaint #200438711 Aerial Photograph with water well and sampling locations



Field Photos for February 16, 2016 sampling of Petras water well related to COGCC Complaint #200438711.



Figure 1 – Petras water well (wellhead), located southeast of the house.



Figure 2 - External spigot located at front porch with aerator, scale-buildup, and rust-staining.



Figure 3 - Sample location: external spigot located at back porch.

TABLE 1
ANALYTICAL SUMMARY
Complaint #200438711
Petras Water Well

Parameter	Water Well Sample		CDPHE Standards		
	2/16/2016	Unit	Domestic	Agriculture	Unit
Boron	NA	mg/l	NS	0.75	mg/l
Copper	NA	mg/l	1	0.2	mg/l
Arsenic	ND	mg/l	0.05	0.1	mg/l
Barium	0.01	mg/l	2.0		mg/l
Cadmium	NA	mg/l	0.005	0.01	mg/l
Calcium	200	mg/l	NS		
Chromium	ND	mg/l	0.1	0.1	mg/l
Iron	ND	mg/l	0.3	5	mg/l
Lead	ND	mg/l	0.05	0.1	mg/l
Magnesium	56	mg/l	NS		
Manganese	0.08	mg/l	0.05	0.2	mg/l
Potassium	11	mg/l	NS		
Selenium	ND	mg/l	0.05	0.02	mg/l
Silver	NA	mg/l	0.05	NS	mg/l
Sodium	950	mg/l	NS		
Chloride	140	mg/l	250	NS	mg/l
Nitrite	ND	mg/l	1.0	10	mg/l
Nitrate	ND	mg/l	10.0	100	mg/l
Total Nitrite/Nitrate	ND	mg/l	10.0	100	mg/l
Fluoride	ND	mg/l	4.0	NS	mg/l
Total Dissolved Solids	3800	mg/l	500	*1500	mg/l
pH	7.9	No units	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	2200	mg/l	250		mg/l
Sodium Adsorption Ratio	15	No units	NS		
Bromide	ND	mg/l	NS		
Total Alkalinity	490	mg/l	NS		
Bicarbonate	490	mg/l	NS		
Carbonate	ND	mg/l	NS		
Conductivity	3.5	mmhos/cm	NS		
Methane	0.01	mg/l	NS		

Notes

CDPHE	Colorado Department of Public Health and the Environment.
Domestic	Standards for Domestic Water Supply, Human Health and Drinking Water Standards.
Agriculture	* Standards for agriculture complied from CDPHE and other of sources.
mg/l	Milligrams per liter (equals parts per million).
CDPHE Standards	Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards For Groundwater.
mmhos/cm	millimhos per centimeer
NA	Not analyzed.
ND	Not detected.
NS	No Standard.
**	Health Advisory.
	Human health standard.
	Secondary standard.

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: 280-79843-1

Client Project/Site: COGCC - Petras WW #200438711

For:

Colorado Oil&Gas Conservation Commision

1120 Lincoln St.

Suite 801

Denver, Colorado 80203

Attn: Mr. Steven Arauza



Authorized for release by:

3/14/2016 5:04:24 PM

Jessica DeHerrera, Project Mgmt. Assistant

jessica.deherrera@testamericainc.com

Designee for

Donna Rydberg, Senior Project Manager

(303)736-0192

donna.rydberg@testamericainc.com

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The test results in this report meet all 2003 NELAC and 2009 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.



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Case Narrative

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Job ID: 280-79843-1

Laboratory: TestAmerica Denver

Narrative

CASE NARRATIVE

Client: Colorado Oil&Gas Conservation Commission

Project: COGCC - Petras WW #200438711

Report Number: 280-79843-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 02/16/2016; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 3.4°C.

One of nine hydrochloric preserved VOA vials for sample PETRAS WATER WELL (280-79843-1) was broken prior to receipt. Sufficient volume remained to proceed with the requested analysis. The client was notified on 2/17/2016.

SEMIVOLATILE ORGANIC COMPOUNDS (GC-MS)

Sample PETRAS WATER WELL (280-79843-1) was analyzed for semivolatile organic compounds (GC-MS) in accordance with EPA SW-846 Method 8270C. The samples were prepared on 02/21/2016 and analyzed on 03/03/2016.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with analytical batch 280-314238. Method precision and accuracy have been verified by the acceptable LCS/LCSD analysis data.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

GAS RANGE ORGANICS

Sample PETRAS WATER WELL (280-79843-1) was analyzed for gas range organics in accordance with EPA SW-846 Method 8015B - GRO. The samples were analyzed on 02/29/2016.

Matrix spike/matrix spike duplicate (MS/MSD) is not reported for analytical batch 280-315066. The batch MS/MSD was originally performed on another sample, and this sample required reanalysis in another batch. This MS/MSD result does not have immediate bearing on any samples except for the actual sample spiked. Method precision and accuracy have been verified by the acceptable LCS/LCSD analysis data.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

VOLATILE ORGANIC COMPOUNDS (GC)

Sample PETRAS WATER WELL (280-79843-1) was analyzed for volatile organic compounds (GC) in accordance with EPA SW-846 Method 8021B. The samples were analyzed on 02/26/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

DISSOLVED GASES

Sample PETRAS WATER WELL (280-79843-1) was analyzed for dissolved gases in accordance with RSK_175. The samples were analyzed on 02/29/2016.

Analytes Acetylene/Ethane co-eluted on one of the columns used for this analysis. As a result, there are no results reported for the

Case Narrative

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Job ID: 280-79843-1 (Continued)

Laboratory: TestAmerica Denver (Continued)

%Difference in the concentration on the associated Form X.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

DIESEL RANGE ORGANICS

Sample PETRAS WATER WELL (280-79843-1) was analyzed for Diesel Range Organics in accordance with EPA SW-846 Method 8015B - DRO. The samples were prepared on 02/18/2016 and analyzed on 02/23/2016.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with analytical batch 280-314015. Method precision and accuracy have been verified by the acceptable LCS/LCSD analysis data.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

DISSOLVED METALS

Sample PETRAS WATER WELL (280-79843-1) was analyzed for dissolved metals in accordance with EPA SW-846 Method 6010B. The samples were prepared on 02/23/2016 and analyzed on 03/02/2016, 03/03/2016 and 03/07/2016.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

SODIUM ABSORPTION RATIO

Sample PETRAS WATER WELL (280-79843-1) was analyzed for Sodium Absorption Ratio in accordance with USDA Handbook 60 - 20B. The samples were analyzed on 03/03/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ALKALINITY

Sample PETRAS WATER WELL (280-79843-1) was analyzed for Alkalinity in accordance with SM20 2320B. The samples were analyzed on 02/17/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

SPECIFIC CONDUCTIVITY

Sample PETRAS WATER WELL (280-79843-1) was analyzed for specific conductivity in accordance with SM20 2510B. The samples were analyzed on 02/21/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TOTAL DISSOLVED SOLIDS

Sample PETRAS WATER WELL (280-79843-1) was analyzed for total dissolved solids in accordance with SM20 2540C. The samples were analyzed on 02/17/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ANIONS (28 DAYS)

Sample PETRAS WATER WELL (280-79843-1) was analyzed for anions (28 days) in accordance with EPA Method 300.0. The samples were analyzed on 02/17/2016 and 02/18/2016.

Sample PETRAS WATER WELL (280-79843-1) required dilution prior to analysis due to the Matrix Conductivity Threshold (MCT) of the instrument for fluoride and bromide. The reporting limits have been adjusted accordingly.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ANIONS (48 HOURS)

Sample PETRAS WATER WELL (280-79843-1) was analyzed for anions (48 hours) in accordance with EPA Method 300.0. The samples were analyzed on 02/17/2016.

Case Narrative

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Job ID: 280-79843-1 (Continued)

Laboratory: TestAmerica Denver (Continued)

Sample PETRAS WATER WELL (280-79843-1) required dilution prior to analysis due to the Matrix Conductivity Threshold (MCT) of the instrument for nitrite and nitrate. The reporting limits have been adjusted accordingly.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

CATION ANION BALANCE

Sample PETRAS WATER WELL (280-79843-1) was analyzed for Cation Anion Balance in accordance with Cation Anion Balance. The samples were analyzed on 03/04/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

CORROSIVITY (PH)

Sample PETRAS WATER WELL (280-79843-1) was analyzed for corrosivity (pH) in accordance with SM20 4500 H+ B. The samples were analyzed on 02/18/2016.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Definitions/Glossary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Qualifiers

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Detection Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Client Sample ID: PETRAS WATER WELL

Lab Sample ID: 280-79843-1

Analyte	Result	Qualifier	RL	Unit	Dil Fac	D	Method	Prep Type
Methane	11		5.0	ug/L	1		RSK-175	Total/NA
Sodium Adsorption Ratio	15		0.40	No Unit	1		20B	Total/NA
Calcium	200000		200	ug/L	1		6010B	Dissolved
Magnesium	56000		200	ug/L	1		6010B	Dissolved
Manganese	79		10	ug/L	1		6010B	Dissolved
Potassium	11000		3000	ug/L	1		6010B	Dissolved
Sodium	950000		1000	ug/L	1		6010B	Dissolved
Barium	13		10	ug/L	1		6010B	Dissolved
Chloride	140		6.0	mg/L	2		300.0	Total/NA
Sulfate	2200		100	mg/L	20		300.0	Total/NA
Total Anions	60			meq/L	1		SM 1030E	Total/NA
Total Cations	56			meq/L	1		SM 1030E	Total/NA
Percent Difference	-2.9			%	1		SM 1030E	Total/NA
Anion/Cation Balance	-2.9			%	1		SM 1030E	Total/NA
Total Alkalinity	490		5.0	mg/L	1		SM 2320B	Total/NA
Bicarbonate Alkalinity as CaCO3	490		5.0	mg/L	1		SM 2320B	Total/NA
Specific Conductance	3500		2.0	umhos/cm	1		SM 2510B	Total/NA
Total Dissolved Solids	3800		20	mg/L	1		SM 2540C	Total/NA
pH	7.90	HF	0.100	SU	1		SM 4500 H+ B	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Denver

Method Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method	Method Description	Protocol	Laboratory
8270C	Semivolatile Organic Compounds (GC/MS)	SW846	TAL DEN
8015B	Gasoline Range Organics - (GC)	SW846	TAL DEN
8021B	Volatile Organic Compounds (GC)	SW846	TAL DEN
RSK-175	Dissolved Gases in Water	RSK	TAL DEN
8015B	Diesel Range Organics (DRO) (GC)	SW846	TAL DEN
20B	Sodium Adsorption Ratio	USDA	TAL DEN
6010B	Metals (ICP)	SW846	TAL DEN
300.0	Anions, Ion Chromatography	MCAWW	TAL DEN
SM 1030E	Cation Anion Balance	SM	TAL DEN
SM 2320B	Alkalinity	SM	TAL DEN
SM 2510B	Conductivity, Specific Conductance	SM	TAL DEN
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL DEN
SM 4500 H+ B	pH	SM	TAL DEN

Protocol References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

RSK = Sample Prep And Calculations For Dissolved Gas Analysis In Water Samples Using A GC Headspace Equilibration Technique, RSKSOP-175, Rev. 0, 8/11/94, USEPA Research Lab

SM = "Standard Methods For The Examination Of Water And Wastewater",

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

USDA = "USDA Agriculture Handbook 60, section 20B".

Laboratory References:

TAL DEN = TestAmerica Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

Sample Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
280-79843-1	PETRAS WATER WELL	Water	02/16/16 12:20	02/16/16 14:26

Client Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS)

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
2,2'-oxybis[1-chloropropane]	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,4,5-Trichlorophenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,4,6-Trichlorophenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,4-Dichlorophenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,4-Dimethylphenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,4-Dinitrophenol	ND		28	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,4-Dinitrotoluene	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2,6-Dinitrotoluene	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2-Chloronaphthalene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
2-Chlorophenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2-Methylnaphthalene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
2-Methylphenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2-Nitroaniline	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
2-Nitrophenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
3 & 4 Methylphenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
3,3'-Dichlorobenzidine	ND		47	ug/L		02/21/16 10:50	03/03/16 15:46	1
3-Nitroaniline	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
4,6-Dinitro-2-methylphenol	ND		47	ug/L		02/21/16 10:50	03/03/16 15:46	1
4-Bromophenyl phenyl ether	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
4-Chloro-3-methylphenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
4-Chloroaniline	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
4-Chlorophenyl phenyl ether	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
4-Nitroaniline	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
4-Nitrophenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Acenaphthene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Acenaphthylene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Acetophenone	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Anthracene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Atrazine	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Benzidine	ND		94	ug/L		02/21/16 10:50	03/03/16 15:46	1
Benzo[a]anthracene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Benzo[a]pyrene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Benzo[b]fluoranthene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Benzo[g,h,i]perylene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Benzo[k]fluoranthene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Bis(2-chloroethoxy)methane	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Bis(2-chloroethyl)ether	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Bis(2-ethylhexyl) phthalate	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Butyl benzyl phthalate	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Caprolactam	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Carbazole	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Chrysene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Cresols, Total	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Dibenz(a,h)anthracene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Dibenzofuran	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Diethyl phthalate	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Dimethyl phthalate	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Di-n-butyl phthalate	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Di-n-octyl phthalate	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1

TestAmerica Denver

Client Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoranthene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Fluorene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Hexachlorobenzene	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Hexachlorobutadiene	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Hexachlorocyclopentadiene	ND		47	ug/L		02/21/16 10:50	03/03/16 15:46	1
Hexachloroethane	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Indeno[1,2,3-cd]pyrene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Naphthalene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Nitrobenzene	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
N-Nitrosodi-n-propylamine	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
n-Nitrosodiphenylamine(as diphenylamine)	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Pentachlorophenol	ND		47	ug/L		02/21/16 10:50	03/03/16 15:46	1
Phenanthrene	ND		3.8	ug/L		02/21/16 10:50	03/03/16 15:46	1
Phenol	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Pyrene	ND		9.4	ug/L		02/21/16 10:50	03/03/16 15:46	1
Surrogate	%Recovery	Qualifier	Limits			Prepared	Analyzed	Dil Fac
2,4,6-Tribromophenol	82		48 - 135			02/21/16 10:50	03/03/16 15:46	1
2-Fluorobiphenyl	76		48 - 135			02/21/16 10:50	03/03/16 15:46	1
2-Fluorophenol	76		41 - 135			02/21/16 10:50	03/03/16 15:46	1
Nitrobenzene-d5	78		42 - 135			02/21/16 10:50	03/03/16 15:46	1
Phenol-d5	78		46 - 135			02/21/16 10:50	03/03/16 15:46	1
Terphenyl-d14	82		20 - 135			02/21/16 10:50	03/03/16 15:46	1

Method: 8015B - Gasoline Range Organics - (GC)

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics (GRO) -C6-C10	ND		25	ug/L			02/29/16 21:43	1
Surrogate	%Recovery	Qualifier	Limits			Prepared	Analyzed	Dil Fac
a,a,a-Trifluorotoluene	102		82 - 110				02/29/16 21:43	1

Method: 8021B - Volatile Organic Compounds (GC)

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		0.50	ug/L			02/26/16 19:31	1
Ethylbenzene	ND		0.50	ug/L			02/26/16 19:31	1
Toluene	ND		0.50	ug/L			02/26/16 19:31	1
m-Xylene & p-Xylene	ND		0.50	ug/L			02/26/16 19:31	1
o-Xylene	ND		0.50	ug/L			02/26/16 19:31	1
Surrogate	%Recovery	Qualifier	Limits			Prepared	Analyzed	Dil Fac
a,a,a-Trifluorotoluene	91		85 - 115				02/26/16 19:31	1

TestAmerica Denver

Client Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: RSK-175 - Dissolved Gases in Water

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Ethane	ND		5.0	ug/L			02/29/16 19:28	1
Methane	11		5.0	ug/L			02/29/16 19:28	1
Propane	ND		5.0	ug/L			02/29/16 19:28	1

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

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C10-C36	ND		0.47	mg/L		02/18/16 21:54	02/23/16 21:57	1
Surrogate	%Recovery	Qualifier	Limits			Prepared	Analyzed	Dil Fac
<i>o</i> -Terphenyl	90		50 - 115			02/18/16 21:54	02/23/16 21:57	1

Method: 20B - Sodium Adsorption Ratio

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Sodium Adsorption Ratio	15		0.40	No Unit			03/03/16 15:29	1

Method: 6010B - Metals (ICP) - Dissolved

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Calcium	200000		200	ug/L		02/23/16 14:40	03/02/16 01:15	1
Iron	ND		100	ug/L		02/23/16 14:40	03/02/16 01:15	1
Magnesium	56000		200	ug/L		02/23/16 14:40	03/03/16 21:10	1
Manganese	79		10	ug/L		02/23/16 14:40	03/03/16 21:10	1
Potassium	11000		3000	ug/L		02/23/16 14:40	03/02/16 01:15	1
Sodium	950000		1000	ug/L		02/23/16 14:40	03/07/16 20:33	1
Barium	13		10	ug/L		02/23/16 14:40	03/02/16 01:15	1
Arsenic	ND		15	ug/L		02/23/16 14:40	03/02/16 01:15	1
Lead	ND		9.0	ug/L		02/23/16 14:40	03/02/16 01:15	1
Selenium	ND		15	ug/L		02/23/16 14:40	03/02/16 01:15	1
Chromium	ND		10	ug/L		02/23/16 14:40	03/02/16 01:15	1

General Chemistry

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromide	ND		0.40	mg/L			02/17/16 14:46	2
Nitrate as N	ND		1.0	mg/L			02/17/16 14:46	2
Chloride	140		6.0	mg/L			02/17/16 14:46	2
Nitrite as N	ND		1.0	mg/L			02/17/16 14:46	2

TestAmerica Denver

Client Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

General Chemistry (Continued)

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		1.0	mg/L			02/17/16 14:46	2
Nitrate Nitrite as N	ND		1.0	mg/L			02/17/16 14:46	2
Sulfate	2200		100	mg/L			02/18/16 05:29	20
Total Anions	60			meq/L			03/04/16 14:58	1
Total Cations	56			meq/L			03/04/16 14:58	1
Percent Difference	-2.9			%			03/04/16 14:58	1
Anion/Cation Balance	-2.9			%			03/04/16 14:58	1
Total Alkalinity	490		5.0	mg/L			02/17/16 17:14	1
Bicarbonate Alkalinity as CaCO3	490		5.0	mg/L			02/17/16 17:14	1
Carbonate Alkalinity as CaCO3	ND		5.0	mg/L			02/17/16 17:14	1
Hydroxide Alkalinity	ND		5.0	mg/L			02/17/16 17:14	1
Specific Conductance	3500		2.0	umhos/cm			02/21/16 11:39	1
Total Dissolved Solids	3800		20	mg/L			02/17/16 15:10	1
pH	7.90	HF	0.100	SU			02/18/16 19:15	1

Surrogate Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS)

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)					
		TBP (48-135)	FBP (48-135)	2FP (41-135)	NBZ (42-135)	PHL (46-135)	TPH (20-135)
280-79843-1	PETRAS WATER WELL	82	76	76	78	78	82
LCS 280-314238/2-A	Lab Control Sample	90	82	82	84	83	84
LCSD 280-314238/3-A	Lab Control Sample Dup	86	79	79	82	81	81
MB 280-314238/1-A	Method Blank	82	75	80	83	84	86

Surrogate Legend

TBP = 2,4,6-Tribromophenol

FBP = 2-Fluorobiphenyl

2FP = 2-Fluorophenol

NBZ = Nitrobenzene-d5

PHL = Phenol-d5

TPH = Terphenyl-d14

Method: 8015B - Gasoline Range Organics - (GC)

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)					
		TFT1 (82-110)					
280-79843-1	PETRAS WATER WELL	102					
LCS 280-315213/5	Lab Control Sample	101					
LCSD 280-315213/6	Lab Control Sample Dup	103					
MB 280-315213/3	Method Blank	103					

Surrogate Legend

TFT = a,a,a-Trifluorotoluene

Method: 8021B - Volatile Organic Compounds (GC)

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)					
		TFT1 (85-115)					
280-79843-1	PETRAS WATER WELL	91					
280-79907-B-1 MS	Matrix Spike	97					
280-79907-B-1 MSD	Matrix Spike Duplicate	98					
LCS 280-315066/6	Lab Control Sample	103					
LCSD 280-315066/7	Lab Control Sample Dup	99					
MB 280-315066/5	Method Blank	99					

Surrogate Legend

TFT = a,a,a-Trifluorotoluene

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

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)					
		OTPH1 (50-115)					
280-79843-1	PETRAS WATER WELL	90					

TestAmerica Denver

Surrogate Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

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

Matrix: Water

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	OTPH1 (50-115)
LCS 280-314015/2-A	Lab Control Sample	96
LCSD 280-314015/3-A	Lab Control Sample Dup	97
MB 280-314015/1-A	Method Blank	93

Surrogate Legend

OTPH = o-Terphenyl

QC Association Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

GC/MS Semi VOA

Prep Batch: 314238

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	3520C	
LCS 280-314238/2-A	Lab Control Sample	Total/NA	Water	3520C	
LCSD 280-314238/3-A	Lab Control Sample Dup	Total/NA	Water	3520C	
MB 280-314238/1-A	Method Blank	Total/NA	Water	3520C	

Analysis Batch: 315694

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	8270C	314238
LCS 280-314238/2-A	Lab Control Sample	Total/NA	Water	8270C	314238
LCSD 280-314238/3-A	Lab Control Sample Dup	Total/NA	Water	8270C	314238
MB 280-314238/1-A	Method Blank	Total/NA	Water	8270C	314238

GC VOA

Analysis Batch: 315046

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	RSK-175	
280-80176-V-4 DU	Duplicate	Total/NA	Water	RSK-175	
280-80176-Y-4 MS	Matrix Spike	Total/NA	Water	RSK-175	
280-80176-Y-4 MSD	Matrix Spike Duplicate	Total/NA	Water	RSK-175	
LCS 280-315046/10	Lab Control Sample	Total/NA	Water	RSK-175	
MB 280-315046/9	Method Blank	Total/NA	Water	RSK-175	

Analysis Batch: 315066

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	8021B	
280-79907-B-1 MS	Matrix Spike	Total/NA	Water	8021B	
280-79907-B-1 MSD	Matrix Spike Duplicate	Total/NA	Water	8021B	
LCS 280-315066/6	Lab Control Sample	Total/NA	Water	8021B	
LCSD 280-315066/7	Lab Control Sample Dup	Total/NA	Water	8021B	
MB 280-315066/5	Method Blank	Total/NA	Water	8021B	

Analysis Batch: 315213

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	8015B	
LCS 280-315213/5	Lab Control Sample	Total/NA	Water	8015B	
LCSD 280-315213/6	Lab Control Sample Dup	Total/NA	Water	8015B	
MB 280-315213/3	Method Blank	Total/NA	Water	8015B	

GC Semi VOA

Prep Batch: 314015

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	3510C	
LCS 280-314015/2-A	Lab Control Sample	Total/NA	Water	3510C	
LCSD 280-314015/3-A	Lab Control Sample Dup	Total/NA	Water	3510C	
MB 280-314015/1-A	Method Blank	Total/NA	Water	3510C	

TestAmerica Denver

QC Association Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

GC Semi VOA (Continued)

Analysis Batch: 314515

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	8015B	314015
LCS 280-314015/2-A	Lab Control Sample	Total/NA	Water	8015B	314015
LCSD 280-314015/3-A	Lab Control Sample Dup	Total/NA	Water	8015B	314015
MB 280-314015/1-A	Method Blank	Total/NA	Water	8015B	314015

Metals

Filtration Batch: 314112

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Dissolved	Water	FILTRATION	
280-79843-1 MS	PETRAS WATER WELL	Dissolved	Water	FILTRATION	
280-79843-1 MSD	PETRAS WATER WELL	Dissolved	Water	FILTRATION	
LCS 280-314112/2-D	Lab Control Sample	Dissolved	Water	FILTRATION	
MB 280-314112/1-D	Method Blank	Dissolved	Water	FILTRATION	

Prep Batch: 314423

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Dissolved	Water	3005A	314112
280-79843-1 MS	PETRAS WATER WELL	Dissolved	Water	3005A	314112
280-79843-1 MSD	PETRAS WATER WELL	Dissolved	Water	3005A	314112
LCS 280-314112/2-D	Lab Control Sample	Dissolved	Water	3005A	314112
MB 280-314112/1-D	Method Blank	Dissolved	Water	3005A	314112

Analysis Batch: 315500

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Dissolved	Water	6010B	314423
280-79843-1 MS	PETRAS WATER WELL	Dissolved	Water	6010B	314423
280-79843-1 MSD	PETRAS WATER WELL	Dissolved	Water	6010B	314423
LCS 280-314112/2-D	Lab Control Sample	Dissolved	Water	6010B	314423
MB 280-314112/1-D	Method Blank	Dissolved	Water	6010B	314423

Analysis Batch: 315820

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Dissolved	Water	6010B	314423
280-79843-1 MS	PETRAS WATER WELL	Dissolved	Water	6010B	314423
280-79843-1 MSD	PETRAS WATER WELL	Dissolved	Water	6010B	314423
LCS 280-314112/2-D	Lab Control Sample	Dissolved	Water	6010B	314423
MB 280-314112/1-D	Method Blank	Dissolved	Water	6010B	314423

Analysis Batch: 315853

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	20B	
280-79843-1 DU	PETRAS WATER WELL	Total/NA	Water	20B	
MB 280-315853/1	Method Blank	Total/NA	Water	20B	

Analysis Batch: 316079

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Dissolved	Water	6010B	314423
280-79843-1 MS	PETRAS WATER WELL	Dissolved	Water	6010B	314423
280-79843-1 MSD	PETRAS WATER WELL	Dissolved	Water	6010B	314423

TestAmerica Denver

QC Association Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Metals (Continued)

Analysis Batch: 316079 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 280-314112/2-D	Lab Control Sample	Dissolved	Water	6010B	314423
MB 280-314112/1-D	Method Blank	Dissolved	Water	6010B	314423

General Chemistry

Analysis Batch: 313725

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	300.0	
280-79846-A-1 DU	Duplicate	Total/NA	Water	300.0	
280-79846-A-1 MS	Matrix Spike	Total/NA	Water	300.0	
280-79846-A-1 MSD	Matrix Spike Duplicate	Total/NA	Water	300.0	
280-79846-A-2 MSD	Matrix Spike Duplicate	Total/NA	Water	300.0	
LCS 280-313725/4	Lab Control Sample	Total/NA	Water	300.0	
LCS 280-313725/49	Lab Control Sample	Total/NA	Water	300.0	
LCSD 280-313725/5	Lab Control Sample Dup	Total/NA	Water	300.0	
LCSD 280-313725/50	Lab Control Sample Dup	Total/NA	Water	300.0	
MB 280-313725/53	Method Blank	Total/NA	Water	300.0	
MB 280-313725/6	Method Blank	Total/NA	Water	300.0	
MRL 280-313725/3	Lab Control Sample	Total/NA	Water	300.0	

Analysis Batch: 313726

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	300.0	
280-79843-1	PETRAS WATER WELL	Total/NA	Water	300.0	
280-79846-A-1 DU	Duplicate	Total/NA	Water	300.0	
280-79846-A-1 MS	Matrix Spike	Total/NA	Water	300.0	
280-79846-A-1 MSD	Matrix Spike Duplicate	Total/NA	Water	300.0	
280-79846-A-2 MSD	Matrix Spike Duplicate	Total/NA	Water	300.0	
LCS 280-313726/4	Lab Control Sample	Total/NA	Water	300.0	
LCS 280-313726/49	Lab Control Sample	Total/NA	Water	300.0	
LCSD 280-313726/5	Lab Control Sample Dup	Total/NA	Water	300.0	
LCSD 280-313726/50	Lab Control Sample Dup	Total/NA	Water	300.0	
MB 280-313726/53	Method Blank	Total/NA	Water	300.0	
MB 280-313726/6	Method Blank	Total/NA	Water	300.0	
MRL 280-313726/3	Lab Control Sample	Total/NA	Water	300.0	

Analysis Batch: 313791

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	SM 2540C	
280-79855-A-1 DU	Duplicate	Total/NA	Water	SM 2540C	
LCS 280-313791/2	Lab Control Sample	Total/NA	Water	SM 2540C	
MB 280-313791/1	Method Blank	Total/NA	Water	SM 2540C	

Analysis Batch: 313827

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79841-F-10 DU	Duplicate	Total/NA	Water	SM 2320B	
280-79843-1	PETRAS WATER WELL	Total/NA	Water	SM 2320B	
LCS 280-313827/30	Lab Control Sample	Total/NA	Water	SM 2320B	
MB 280-313827/31	Method Blank	Total/NA	Water	SM 2320B	

TestAmerica Denver

QC Association Summary

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

General Chemistry (Continued)

Analysis Batch: 314005

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	SM 4500 H+ B	
280-79896-G-1 DU	Duplicate	Total/NA	Water	SM 4500 H+ B	
LCS 280-314005/4	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 314254

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79684-B-1 DU	Duplicate	Total/NA	Water	SM 2510B	
280-79843-1	PETRAS WATER WELL	Total/NA	Water	SM 2510B	
LCS 280-314254/29	Lab Control Sample	Total/NA	Water	SM 2510B	
MB 280-314254/30	Method Blank	Total/NA	Water	SM 2510B	

Analysis Batch: 315883

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-79843-1	PETRAS WATER WELL	Total/NA	Water	SM 1030E	
MB 280-315883/1	Method Blank	Total/NA	Water	SM 1030E	

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS)

Lab Sample ID: MB 280-314238/1-A

Matrix: Water

Analysis Batch: 315694

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 314238

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
2,2'-oxybis[1-chloropropane]	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,4,5-Trichlorophenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,4,6-Trichlorophenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,4-Dichlorophenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,4-Dimethylphenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,4-Dinitrophenol	ND		30	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,4-Dinitrotoluene	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2,6-Dinitrotoluene	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2-Chloronaphthalene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
2-Chlorophenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2-Methylnaphthalene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
2-Methylphenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2-Nitroaniline	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
2-Nitrophenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
3 & 4 Methylphenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
3,3'-Dichlorobenzidine	ND		50	ug/L		02/21/16 10:50	03/03/16 13:53	1
3-Nitroaniline	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
4,6-Dinitro-2-methylphenol	ND		50	ug/L		02/21/16 10:50	03/03/16 13:53	1
4-Bromophenyl phenyl ether	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
4-Chloro-3-methylphenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
4-Chloroaniline	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
4-Chlorophenyl phenyl ether	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
4-Nitroaniline	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
4-Nitrophenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Acenaphthene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Acenaphthylene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Acetophenone	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Anthracene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Atrazine	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Benzidine	ND		100	ug/L		02/21/16 10:50	03/03/16 13:53	1
Benzo[a]anthracene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Benzo[a]pyrene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Benzo[b]fluoranthene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Benzo[g,h,i]perylene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Benzo[k]fluoranthene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Bis(2-chloroethoxy)methane	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Bis(2-chloroethyl)ether	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Bis(2-ethylhexyl) phthalate	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Butyl benzyl phthalate	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Caprolactam	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Carbazole	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Chrysene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Cresols, Total	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Dibenz(a,h)anthracene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Dibenzofuran	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Diethyl phthalate	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Dimethyl phthalate	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Di-n-butyl phthalate	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 280-314238/1-A

Matrix: Water

Analysis Batch: 315694

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 314238

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Di-n-octyl phthalate	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Fluoranthene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Fluorene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Hexachlorobenzene	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Hexachlorobutadiene	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Hexachlorocyclopentadiene	ND		50	ug/L		02/21/16 10:50	03/03/16 13:53	1
Hexachloroethane	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Indeno[1,2,3-cd]pyrene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Naphthalene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Nitrobenzene	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
N-Nitrosodi-n-propylamine	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
n-Nitrosodiphenylamine(as diphenylamine)	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Pentachlorophenol	ND		50	ug/L		02/21/16 10:50	03/03/16 13:53	1
Phenanthrene	ND		4.0	ug/L		02/21/16 10:50	03/03/16 13:53	1
Phenol	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1
Pyrene	ND		10	ug/L		02/21/16 10:50	03/03/16 13:53	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
2,4,6-Tribromophenol	82		48 - 135	02/21/16 10:50	03/03/16 13:53	1
2-Fluorobiphenyl	75		48 - 135	02/21/16 10:50	03/03/16 13:53	1
2-Fluorophenol	80		41 - 135	02/21/16 10:50	03/03/16 13:53	1
Nitrobenzene-d5	83		42 - 135	02/21/16 10:50	03/03/16 13:53	1
Phenol-d5	84		46 - 135	02/21/16 10:50	03/03/16 13:53	1
Terphenyl-d14	86		20 - 135	02/21/16 10:50	03/03/16 13:53	1

Lab Sample ID: LCS 280-314238/2-A

Matrix: Water

Analysis Batch: 315694

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 314238

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	Limits
1,2,4-Trichlorobenzene	80.0	55.9		ug/L		70	44 - 135
1,4-Dichlorobenzene	80.0	52.5		ug/L		66	40 - 135
2,4,5-Trichlorophenol	80.0	72.4		ug/L		90	64 - 135
2,4,6-Trichlorophenol	80.0	74.1		ug/L		93	62 - 135
2,4-Dinitrotoluene	80.0	77.1		ug/L		96	65 - 135
2-Chlorophenol	80.0	70.0		ug/L		88	58 - 135
2-Methylnaphthalene	80.0	65.8		ug/L		82	56 - 135
2-Methylphenol	80.0	69.5		ug/L		87	62 - 135
4-Chloro-3-methylphenol	80.0	74.5		ug/L		93	65 - 135
4-Nitrophenol	160	157		ug/L		98	56 - 135
Acenaphthene	80.0	68.5		ug/L		86	61 - 135
Anthracene	80.0	68.7		ug/L		86	65 - 135
Carbazole	80.0	71.4		ug/L		89	65 - 135
N-Nitrosodi-n-propylamine	80.0	68.4		ug/L		86	65 - 135
Pentachlorophenol	160	137		ug/L		86	52 - 135
Phenol	80.0	68.1		ug/L		85	61 - 135
Pyrene	80.0	68.1		ug/L		85	65 - 135

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8270C - Semivolatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 280-314238/2-A

Matrix: Water

Analysis Batch: 315694

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 314238

Surrogate	LCS %Recovery	LCS Qualifier	Limits
2,4,6-Tribromophenol	90		48 - 135
2-Fluorobiphenyl	82		48 - 135
2-Fluorophenol	82		41 - 135
Nitrobenzene-d5	84		42 - 135
Phenol-d5	83		46 - 135
Terphenyl-d14	84		20 - 135

Lab Sample ID: LCSD 280-314238/3-A

Matrix: Water

Analysis Batch: 315694

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 314238

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
1,2,4-Trichlorobenzene	80.0	58.4		ug/L		73	44 - 135	4	42
1,4-Dichlorobenzene	80.0	55.6		ug/L		69	40 - 135	6	50
2,4,5-Trichlorophenol	80.0	70.7		ug/L		88	64 - 135	2	30
2,4,6-Trichlorophenol	80.0	72.7		ug/L		91	62 - 135	2	30
2,4-Dinitrotoluene	80.0	71.4		ug/L		89	65 - 135	8	32
2-Chlorophenol	80.0	63.6		ug/L		80	58 - 135	10	46
2-Methylnaphthalene	80.0	64.8		ug/L		81	56 - 135	2	32
2-Methylphenol	80.0	68.7		ug/L		86	62 - 135	1	40
4-Chloro-3-methylphenol	80.0	70.4		ug/L		88	65 - 135	6	30
4-Nitrophenol	160	146		ug/L		91	56 - 135	7	50
Acenaphthene	80.0	66.4		ug/L		83	61 - 135	3	30
Anthracene	80.0	67.2		ug/L		84	65 - 135	2	30
Carbazole	80.0	69.5		ug/L		87	65 - 135	3	30
N-Nitrosodi-n-propylamine	80.0	65.6		ug/L		82	65 - 135	4	30
Pentachlorophenol	160	132		ug/L		83	52 - 135	4	30
Phenol	80.0	66.4		ug/L		83	61 - 135	3	37
Pyrene	80.0	65.3		ug/L		82	65 - 135	4	30

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
2,4,6-Tribromophenol	86		48 - 135
2-Fluorobiphenyl	79		48 - 135
2-Fluorophenol	79		41 - 135
Nitrobenzene-d5	82		42 - 135
Phenol-d5	81		46 - 135
Terphenyl-d14	81		20 - 135

Method: 8015B - Gasoline Range Organics - (GC)

Lab Sample ID: MB 280-315213/3

Matrix: Water

Analysis Batch: 315213

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics (GRO) -C6-C10	ND		25	ug/L			02/29/16 10:51	1

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8015B - Gasoline Range Organics - (GC) (Continued)

Lab Sample ID: MB 280-315213/3

Matrix: Water

Analysis Batch: 315213

Client Sample ID: Method Blank

Prep Type: Total/NA

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
a,a,a-Trifluorotoluene	103		82 - 110		02/29/16 10:51	1

Lab Sample ID: LCS 280-315213/5

Matrix: Water

Analysis Batch: 315213

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Gasoline Range Organics (GRO) -C6-C10	101	94.3		ug/L		94	79 - 149
Surrogate	LCS %Recovery	LCS Qualifier	Limits				
a,a,a-Trifluorotoluene	101		82 - 110				

Lab Sample ID: LCSD 280-315213/6

Matrix: Water

Analysis Batch: 315213

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Gasoline Range Organics (GRO) -C6-C10	101	97.7		ug/L		97	79 - 149	4	27
Surrogate	LCSD %Recovery	LCSD Qualifier	Limits						
a,a,a-Trifluorotoluene	103		82 - 110						

Method: 8021B - Volatile Organic Compounds (GC)

Lab Sample ID: MB 280-315066/5

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Method Blank

Prep Type: Total/NA

	MB	MB						
Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		0.50	ug/L			02/26/16 14:05	1
Ethylbenzene	ND		0.50	ug/L			02/26/16 14:05	1
Toluene	ND		0.50	ug/L			02/26/16 14:05	1
m-Xylene & p-Xylene	ND		0.50	ug/L			02/26/16 14:05	1
o-Xylene	ND		0.50	ug/L			02/26/16 14:05	1
	MB	MB						
Surrogate	%Recovery	Qualifier	Limits			Prepared	Analyzed	Dil Fac
a,a,a-Trifluorotoluene	99		85 - 115				02/26/16 14:05	1

Lab Sample ID: LCS 280-315066/6

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzene	20.0	20.6		ug/L		103	75 - 117
Ethylbenzene	20.0	21.3		ug/L		107	79 - 115

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8021B - Volatile Organic Compounds (GC) (Continued)

Lab Sample ID: LCS 280-315066/6

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Toluene	20.0	21.2		ug/L		106	77 - 115
m-Xylene & p-Xylene	40.0	42.1		ug/L		105	79 - 116
o-Xylene	20.0	20.5		ug/L		102	79 - 116

Surrogate	LCS %Recovery	LCS Qualifier	Limits
a,a,a-Trifluorotoluene	103		85 - 115

Lab Sample ID: LCSD 280-315066/7

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene	20.0	19.5		ug/L		98	75 - 117	5	45
Ethylbenzene	20.0	20.6		ug/L		103	79 - 115	4	46
Toluene	20.0	20.4		ug/L		102	77 - 115	4	45
m-Xylene & p-Xylene	40.0	40.3		ug/L		101	79 - 116	4	46
o-Xylene	20.0	19.5		ug/L		98	79 - 116	5	46

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
a,a,a-Trifluorotoluene	99		85 - 115

Lab Sample ID: 280-79907-B-1 MS

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Benzene	ND		20.0	20.4		ug/L		102	75 - 117
Ethylbenzene	0.75		20.0	21.4		ug/L		103	79 - 115
Toluene	2.5		20.0	23.2		ug/L		103	77 - 115
m-Xylene & p-Xylene	6.6		40.0	47.5		ug/L		102	79 - 116
o-Xylene	2.0		20.0	22.2		ug/L		101	79 - 116

Surrogate	MS %Recovery	MS Qualifier	Limits
a,a,a-Trifluorotoluene	97		85 - 115

Lab Sample ID: 280-79907-B-1 MSD

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Benzene	ND		20.0	20.2		ug/L		101	75 - 117	1	45
Ethylbenzene	0.75		20.0	21.1		ug/L		102	79 - 115	1	46
Toluene	2.5		20.0	22.7		ug/L		101	77 - 115	2	45
m-Xylene & p-Xylene	6.6		40.0	46.8		ug/L		101	79 - 116	1	46
o-Xylene	2.0		20.0	21.8		ug/L		99	79 - 116	2	46

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 8021B - Volatile Organic Compounds (GC) (Continued)

Lab Sample ID: 280-79907-B-1 MSD

Matrix: Water

Analysis Batch: 315066

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Surrogate	MSD %Recovery	MSD Qualifier	Limits
a,a,a-Trifluorotoluene	98		85 - 115

Method: RSK-175 - Dissolved Gases in Water

Lab Sample ID: MB 280-315046/9

Matrix: Water

Analysis Batch: 315046

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Ethane	ND		5.0	ug/L			02/29/16 17:33	1
Methane	ND		5.0	ug/L			02/29/16 17:33	1
Propane	ND		5.0	ug/L			02/29/16 17:33	1

Lab Sample ID: LCS 280-315046/10

Matrix: Water

Analysis Batch: 315046

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Ethane	274	284		ug/L		104	75 - 125
Methane	146	156		ug/L		107	75 - 125
Propane	401	405		ug/L		101	75 - 125

Lab Sample ID: 280-80176-Y-4 MS

Matrix: Water

Analysis Batch: 315046

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Ethane	ND		274	302		ug/L		111	75 - 125
Methane	ND		146	156		ug/L		107	52 - 145
Propane	ND		401	417		ug/L		104	50 - 150

Lab Sample ID: 280-80176-Y-4 MSD

Matrix: Water

Analysis Batch: 315046

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Ethane	ND		274	279		ug/L		102	75 - 125	8	20
Methane	ND		146	147		ug/L		101	52 - 145	6	20
Propane	ND		401	391		ug/L		97	50 - 150	6	20

Lab Sample ID: 280-80176-V-4 DU

Matrix: Water

Analysis Batch: 315046

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Ethane	ND		ND		ug/L		NC	20
Methane	ND		ND		ug/L		NC	20
Propane	ND		ND		ug/L		NC	20

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

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

Lab Sample ID: MB 280-314015/1-A

Matrix: Water

Analysis Batch: 314515

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 314015

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C10-C36	ND		0.50	mg/L		02/18/16 21:54	02/23/16 14:36	1
Surrogate	MB %Recovery	MB Qualifier	Limits			Prepared	Analyzed	Dil Fac
o-Terphenyl	93		50 - 115			02/18/16 21:54	02/23/16 14:36	1

Lab Sample ID: LCS 280-314015/2-A

Matrix: Water

Analysis Batch: 314515

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 314015

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	Limits	
C10-C36	2.00	1.88		mg/L		94	57 - 115	
Surrogate	LCS %Recovery	LCS Qualifier	Limits					
o-Terphenyl	96		50 - 115					

Lab Sample ID: LCSD 280-314015/3-A

Matrix: Water

Analysis Batch: 314515

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 314015

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	Limits	RPD	Limit
C10-C36	2.00	1.81		mg/L		91	57 - 115	4	31
Surrogate	LCSD %Recovery	LCSD Qualifier	Limits						
o-Terphenyl	97		50 - 115						

Method: 20B - Sodium Adsorption Ratio

Lab Sample ID: MB 280-315853/1

Matrix: Water

Analysis Batch: 315853

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Sodium Adsorption Ratio	ND		0.40	No Unit			03/03/16 15:26	1

Lab Sample ID: 280-79843-1 DU

Matrix: Water

Analysis Batch: 315853

Client Sample ID: PETRAS WATER WELL

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	Limit
Sodium Adsorption Ratio	15		14.9		No Unit		2	20

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 280-314112/1-D

Matrix: Water

Analysis Batch: 315500

Client Sample ID: Method Blank

Prep Type: Dissolved

Prep Batch: 314423

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Calcium	ND		200	ug/L		02/23/16 14:40	03/02/16 01:10	1
Iron	ND		100	ug/L		02/23/16 14:40	03/02/16 01:10	1
Potassium	ND		3000	ug/L		02/23/16 14:40	03/02/16 01:10	1
Barium	ND		10	ug/L		02/23/16 14:40	03/02/16 01:10	1
Arsenic	ND		15	ug/L		02/23/16 14:40	03/02/16 01:10	1
Lead	ND		9.0	ug/L		02/23/16 14:40	03/02/16 01:10	1
Selenium	ND		15	ug/L		02/23/16 14:40	03/02/16 01:10	1
Chromium	ND		10	ug/L		02/23/16 14:40	03/02/16 01:10	1

Lab Sample ID: MB 280-314112/1-D

Matrix: Water

Analysis Batch: 315820

Client Sample ID: Method Blank

Prep Type: Dissolved

Prep Batch: 314423

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Magnesium	ND		200	ug/L		02/23/16 14:40	03/03/16 21:05	1
Manganese	ND		10	ug/L		02/23/16 14:40	03/03/16 21:05	1

Lab Sample ID: MB 280-314112/1-D

Matrix: Water

Analysis Batch: 316079

Client Sample ID: Method Blank

Prep Type: Dissolved

Prep Batch: 314423

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Sodium	ND		1000	ug/L		02/23/16 14:40	03/07/16 20:28	1

Lab Sample ID: LCS 280-314112/2-D

Matrix: Water

Analysis Batch: 315500

Client Sample ID: Lab Control Sample

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Calcium	50000	47100		ug/L		94	90 - 111
Iron	1000	961		ug/L		96	89 - 115
Potassium	50000	50700		ug/L		101	89 - 114
Barium	2000	1930		ug/L		97	90 - 112
Arsenic	1000	1020		ug/L		102	88 - 110
Lead	500	510		ug/L		102	89 - 110
Selenium	2000	2050		ug/L		103	85 - 112
Chromium	200	207		ug/L		104	90 - 113

Lab Sample ID: LCS 280-314112/2-D

Matrix: Water

Analysis Batch: 315820

Client Sample ID: Lab Control Sample

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Magnesium	50000	49500		ug/L		99	90 - 113
Manganese	500	463		ug/L		93	90 - 110

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: LCS 280-314112/2-D

Matrix: Water

Analysis Batch: 316079

Client Sample ID: Lab Control Sample

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Sodium	50000	50800		ug/L		102	90 - 115

Lab Sample ID: 280-79843-1 MS

Matrix: Water

Analysis Batch: 315500

Client Sample ID: PETRAS WATER WELL

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Calcium	200000		50000	257000		ug/L		119	48 - 153
Iron	ND		1000	956		ug/L		96	52 - 155
Potassium	11000		50000	67900		ug/L		113	76 - 132
Barium	13		2000	1950		ug/L		97	85 - 120
Arsenic	ND		1000	1040		ug/L		104	84 - 124
Lead	ND		500	469		ug/L		94	89 - 121
Selenium	ND		2000	2070		ug/L		104	71 - 140
Chromium	ND		200	198		ug/L		99	73 - 135

Lab Sample ID: 280-79843-1 MS

Matrix: Water

Analysis Batch: 315820

Client Sample ID: PETRAS WATER WELL

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Magnesium	56000		50000	103000		ug/L		96	62 - 146
Manganese	79		500	539		ug/L		92	79 - 121

Lab Sample ID: 280-79843-1 MS

Matrix: Water

Analysis Batch: 316079

Client Sample ID: PETRAS WATER WELL

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Sodium	950000		50000	1010000	4	ug/L		121	70 - 203

Lab Sample ID: 280-79843-1 MSD

Matrix: Water

Analysis Batch: 315500

Client Sample ID: PETRAS WATER WELL

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	Limit
Calcium	200000		50000	255000		ug/L		114	48 - 153	1	20
Iron	ND		1000	964		ug/L		96	52 - 155	1	20
Potassium	11000		50000	68400		ug/L		114	76 - 132	1	20
Barium	13		2000	1950		ug/L		97	85 - 120	0	20
Arsenic	ND		1000	1030		ug/L		103	84 - 124	0	20
Lead	ND		500	465		ug/L		93	89 - 121	1	20
Selenium	ND		2000	2060		ug/L		103	71 - 140	1	20
Chromium	ND		200	198		ug/L		99	73 - 135	0	20

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 280-79843-1 MSD

Matrix: Water

Analysis Batch: 315820

Client Sample ID: PETRAS WATER WELL

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	Limit
Magnesium	56000		50000	102000		ug/L		92	62 - 146	2	20
Manganese	79		500	532		ug/L		91	79 - 121	1	20

Lab Sample ID: 280-79843-1 MSD

Matrix: Water

Analysis Batch: 316079

Client Sample ID: PETRAS WATER WELL

Prep Type: Dissolved

Prep Batch: 314423

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	Limit
Sodium	950000		50000	1010000	4	ug/L		122	70 - 203	0	20

Method: 300.0 - Anions, Ion Chromatography

Lab Sample ID: MB 280-313725/53

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate as N	ND		0.50	mg/L			02/18/16 02:50	1
Nitrite as N	ND		0.50	mg/L			02/18/16 02:50	1
Nitrate Nitrite as N	ND		0.50	mg/L			02/18/16 02:50	1

Lab Sample ID: MB 280-313725/6

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate as N	ND		0.50	mg/L			02/17/16 12:01	1
Nitrite as N	ND		0.50	mg/L			02/17/16 12:01	1
Nitrate Nitrite as N	ND		0.50	mg/L			02/17/16 12:01	1

Lab Sample ID: LCS 280-313725/4

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate as N	5.00	4.98		mg/L		100	90 - 110
Nitrite as N	5.00	5.05		mg/L		101	90 - 110
Nitrate Nitrite as N	10.0	10.0		mg/L		100	90 - 110

Lab Sample ID: LCS 280-313725/49

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate as N	5.00	5.02		mg/L		100	90 - 110
Nitrite as N	5.00	5.07		mg/L		101	90 - 110
Nitrate Nitrite as N	10.0	10.1		mg/L		101	90 - 110

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 300.0 - Anions, Ion Chromatography (Continued)

Lab Sample ID: LCSD 280-313725/5

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Nitrate as N	5.00	4.99		mg/L		100	90 - 110	0	10
Nitrite as N	5.00	5.07		mg/L		101	90 - 110	0	10
Nitrate Nitrite as N	10.0	10.1		mg/L		101	90 - 110	0	10

Lab Sample ID: LCSD 280-313725/50

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Nitrate as N	5.00	5.00		mg/L		100	90 - 110	1	10
Nitrite as N	5.00	5.08		mg/L		102	90 - 110	0	10
Nitrate Nitrite as N	10.0	10.1		mg/L		101	90 - 110	0	10

Lab Sample ID: MRL 280-313725/3

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec. Limits		
Nitrate as N	0.200	ND		mg/L		102	50 - 150		
Nitrite as N	0.200	ND		mg/L		87	50 - 150		

Lab Sample ID: 280-79846-A-1 MS

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Nitrate as N	ND		5.00	5.41		mg/L		108	80 - 120		
Nitrite as N	ND		5.00	5.09		mg/L		102	80 - 120		
Nitrate Nitrite as N	ND		10.0	10.5		mg/L		105	80 - 120		

Lab Sample ID: 280-79846-A-1 MSD

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Nitrate as N	ND		5.00	5.45		mg/L		109	80 - 120	1	20
Nitrite as N	ND		5.00	5.13		mg/L		103	80 - 120	1	20
Nitrate Nitrite as N	ND		10.0	10.6		mg/L		106	80 - 120	1	20

Lab Sample ID: 280-79846-A-2 MSD

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Nitrate as N	ND		5.00	5.30		mg/L		106	80 - 120	1	20
Nitrite as N	ND		5.00	4.98		mg/L		100	80 - 120	2	20
Nitrate Nitrite as N	ND		10.0	10.3		mg/L		103	80 - 120	1	20

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 300.0 - Anions, Ion Chromatography (Continued)

Lab Sample ID: 280-79846-A-1 DU

Matrix: Water

Analysis Batch: 313725

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	Limit
Nitrate as N	ND		ND		mg/L		NC	15
Nitrite as N	ND		ND		mg/L		NC	15
Nitrate Nitrite as N	ND		ND		mg/L		NC	15

Lab Sample ID: MB 280-313726/53

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromide	ND		0.20	mg/L			02/18/16 02:50	1
Chloride	ND		3.0	mg/L			02/18/16 02:50	1
Fluoride	ND		0.50	mg/L			02/18/16 02:50	1
Sulfate	ND		5.0	mg/L			02/18/16 02:50	1

Lab Sample ID: MB 280-313726/6

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Bromide	ND		0.20	mg/L			02/17/16 12:01	1
Chloride	ND		3.0	mg/L			02/17/16 12:01	1
Fluoride	ND		0.50	mg/L			02/17/16 12:01	1
Sulfate	ND		5.0	mg/L			02/17/16 12:01	1

Lab Sample ID: LCS 280-313726/4

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	5.00	5.01		mg/L		100	90 - 110
Chloride	100	101		mg/L		101	90 - 110
Fluoride	5.00	5.14		mg/L		103	90 - 110
Sulfate	100	100		mg/L		100	90 - 110

Lab Sample ID: LCS 280-313726/49

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	5.00	5.05		mg/L		101	90 - 110
Chloride	100	102		mg/L		102	90 - 110
Fluoride	5.00	5.14		mg/L		103	90 - 110
Sulfate	100	101		mg/L		101	90 - 110

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 300.0 - Anions, Ion Chromatography (Continued)

Lab Sample ID: LCSD 280-313726/5

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Bromide	5.00	5.02		mg/L		100	90 - 110	0	10
Chloride	100	101		mg/L		101	90 - 110	0	10
Fluoride	5.00	5.18		mg/L		104	90 - 110	1	10
Sulfate	100	101		mg/L		101	90 - 110	0	10

Lab Sample ID: LCSD 280-313726/50

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Bromide	5.00	5.02		mg/L		100	90 - 110	0	10
Chloride	100	101		mg/L		101	90 - 110	1	10
Fluoride	5.00	5.16		mg/L		103	90 - 110	1	10
Sulfate	100	101		mg/L		101	90 - 110	0	10

Lab Sample ID: MRL 280-313726/3

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	0.200	0.204		mg/L		102	50 - 150
Chloride	2.50	ND		mg/L		100	50 - 150
Fluoride	0.200	ND		mg/L		85	50 - 150
Sulfate	2.50	ND		mg/L		99	50 - 150

Lab Sample ID: 280-79846-A-1 MS

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	ND		5.00	5.31		mg/L		106	80 - 120
Chloride	12		25.0	39.6		mg/L		110	80 - 120
Fluoride	ND		5.00	5.16		mg/L		102	80 - 120
Sulfate	ND		25.0	27.5		mg/L		110	80 - 120

Lab Sample ID: 280-79846-A-1 MSD

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Bromide	ND		5.00	5.35		mg/L		107	80 - 120	1	20
Chloride	12		25.0	39.8		mg/L		110	80 - 120	0	20
Fluoride	ND		5.00	5.33		mg/L		105	80 - 120	3	20
Sulfate	ND		25.0	27.7		mg/L		111	80 - 120	1	20

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: 300.0 - Anions, Ion Chromatography (Continued)

Lab Sample ID: 280-79846-A-2 MSD

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Bromide	ND		5.00	5.19		mg/L		104	80 - 120	1	20
Chloride	ND		25.0	29.5		mg/L		107	80 - 120	1	20
Fluoride	ND		5.00	5.09		mg/L		102	80 - 120	2	20
Sulfate	54		25.0	80.2		mg/L		105	80 - 120	0	20

Lab Sample ID: 280-79846-A-1 DU

Matrix: Water

Analysis Batch: 313726

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Bromide	ND		ND		mg/L		NC	15
Chloride	12		12.2		mg/L		0.1	15
Fluoride	ND		ND		mg/L		NC	15
Sulfate	ND		ND		mg/L		NC	15

Method: SM 1030E - Cation Anion Balance

Lab Sample ID: MB 280-315883/1

Matrix: Water

Analysis Batch: 315883

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Anions	0.000			meq/L			03/04/16 14:58	1
Total Cations	0.000			meq/L			03/04/16 14:58	1
Percent Difference	0.000			%			03/04/16 14:58	1
Anion/Cation Balance	0.000			%			03/04/16 14:58	1

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 280-313827/31

Matrix: Water

Analysis Batch: 313827

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Alkalinity	ND		5.0	mg/L			02/17/16 16:07	1
Bicarbonate Alkalinity as CaCO3	ND		5.0	mg/L			02/17/16 16:07	1
Carbonate Alkalinity as CaCO3	ND		5.0	mg/L			02/17/16 16:07	1
Hydroxide Alkalinity	ND		5.0	mg/L			02/17/16 16:07	1

Lab Sample ID: LCS 280-313827/30

Matrix: Water

Analysis Batch: 313827

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Alkalinity	200	199		mg/L		99	90 - 110

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commission
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: SM 2320B - Alkalinity (Continued)

Lab Sample ID: 280-79841-F-10 DU

Matrix: Water

Analysis Batch: 313827

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	Limit
Total Alkalinity	ND		ND		mg/L		NC	10

Method: SM 2510B - Conductivity, Specific Conductance

Lab Sample ID: MB 280-314254/30

Matrix: Water

Analysis Batch: 314254

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Specific Conductance	ND		2.0	umhos/cm			02/21/16 11:38	1

Lab Sample ID: LCS 280-314254/29

Matrix: Water

Analysis Batch: 314254

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Specific Conductance	1410	1420		umhos/cm		101	90 - 110

Lab Sample ID: 280-79684-B-1 DU

Matrix: Water

Analysis Batch: 314254

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	Limit
Specific Conductance	ND		ND		umhos/cm		NC	10

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 280-313791/1

Matrix: Water

Analysis Batch: 313791

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	ND		10	mg/L			02/17/16 15:10	1

Lab Sample ID: LCS 280-313791/2

Matrix: Water

Analysis Batch: 313791

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Dissolved Solids	500	493		mg/L		99	86 - 110

Lab Sample ID: 280-79855-A-1 DU

Matrix: Water

Analysis Batch: 313791

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	Limit
Total Dissolved Solids	1000		1050		mg/L		0.2	10

TestAmerica Denver

QC Sample Results

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 280-314005/4

Matrix: Water

Analysis Batch: 314005

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
pH	7.00	7.030		SU	-	100	99 - 101

Lab Sample ID: 280-79896-G-1 DU

Matrix: Water

Analysis Batch: 314005

Client Sample ID: Duplicate

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
pH	8.01		8.060		SU	-	0.6	5

Lab Chronicle

Client: Colorado Oil&Gas Conservation Commision
Project/Site: COGCC - Petras WW #200438711

TestAmerica Job ID: 280-79843-1

Client Sample ID: PETRAS WATER WELL

Date Collected: 02/16/16 12:20

Date Received: 02/16/16 14:26

Lab Sample ID: 280-79843-1

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3520C			1059 mL	1 mL	314238	02/21/16 10:50	JDW	TAL DEN
Total/NA	Analysis	8270C		1	1059 mL	1 mL	315694	03/03/16 15:46	DCK	TAL DEN
Total/NA	Analysis	8015B		1	5 mL	5 mL	315213	02/29/16 21:43	EER	TAL DEN
Total/NA	Analysis	8021B		1	5 mL	5 mL	315066	02/26/16 19:31	TEM	TAL DEN
Total/NA	Analysis	RSK-175		1	18 mL	18 mL	315046	02/29/16 19:28	MPS	TAL DEN
Total/NA	Prep	3510C			1056.8 mL	1 mL	314015	02/18/16 21:54	EJP	TAL DEN
Total/NA	Analysis	8015B		1	1056.8 mL	1 mL	314515	02/23/16 21:57	TEM	TAL DEN
Total/NA	Analysis	20B		1			315853	03/03/16 15:29	SJS	TAL DEN
Dissolved	Filtration	FILTRATION			200 mL	200 mL	314112	02/19/16 12:30	TEB	TAL DEN
Dissolved	Prep	3005A			50 mL	50 mL	314423	02/23/16 14:40	SEJ	TAL DEN
Dissolved	Analysis	6010B		1	50 mL	50 mL	316079	03/07/16 20:33	CMK	TAL DEN
Dissolved	Filtration	FILTRATION			200 mL	200 mL	314112	02/19/16 12:30	TEB	TAL DEN
Dissolved	Prep	3005A			50 mL	50 mL	314423	02/23/16 14:40	SEJ	TAL DEN
Dissolved	Analysis	6010B		1	50 mL	50 mL	315500	03/02/16 01:15	SJS	TAL DEN
Dissolved	Filtration	FILTRATION			200 mL	200 mL	314112	02/19/16 12:30	TEB	TAL DEN
Dissolved	Prep	3005A			50 mL	50 mL	314423	02/23/16 14:40	SEJ	TAL DEN
Dissolved	Analysis	6010B		1	50 mL	50 mL	315820	03/03/16 21:10	SJS	TAL DEN
Total/NA	Analysis	300.0		2	5 mL	5 mL	313725	02/17/16 14:46	TLP	TAL DEN
Total/NA	Analysis	300.0		2	5 mL	5 mL	313726	02/17/16 14:46	TLP	TAL DEN
Total/NA	Analysis	300.0		20	5 mL	5 mL	313726	02/18/16 05:29	TLP	TAL DEN
Total/NA	Analysis	SM 1030E		1			315883	03/04/16 14:58	CML	TAL DEN
Total/NA	Analysis	SM 2320B		1			313827	02/17/16 17:14	NAS	TAL DEN
Total/NA	Analysis	SM 2510B		1		25 mL	314254	02/21/16 11:39	WTW	TAL DEN
Total/NA	Analysis	SM 2540C		1	50 mL	100 mL	313791	02/17/16 15:10	RSM	TAL DEN
Total/NA	Analysis	SM 4500 H+ B		1			314005	02/18/16 19:15	MAS	TAL DEN

Laboratory References:

TAL DEN = TestAmerica Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

Login Sample Receipt Checklist

Client: Colorado Oil&Gas Conservation Commision

Job Number: 280-79843-1

Login Number: 79843

List Source: TestAmerica Denver

List Number: 1

Creator: Muniz, Ashley T

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Photos for BART test of Petras water well related to COGCC Complaint #200438711.

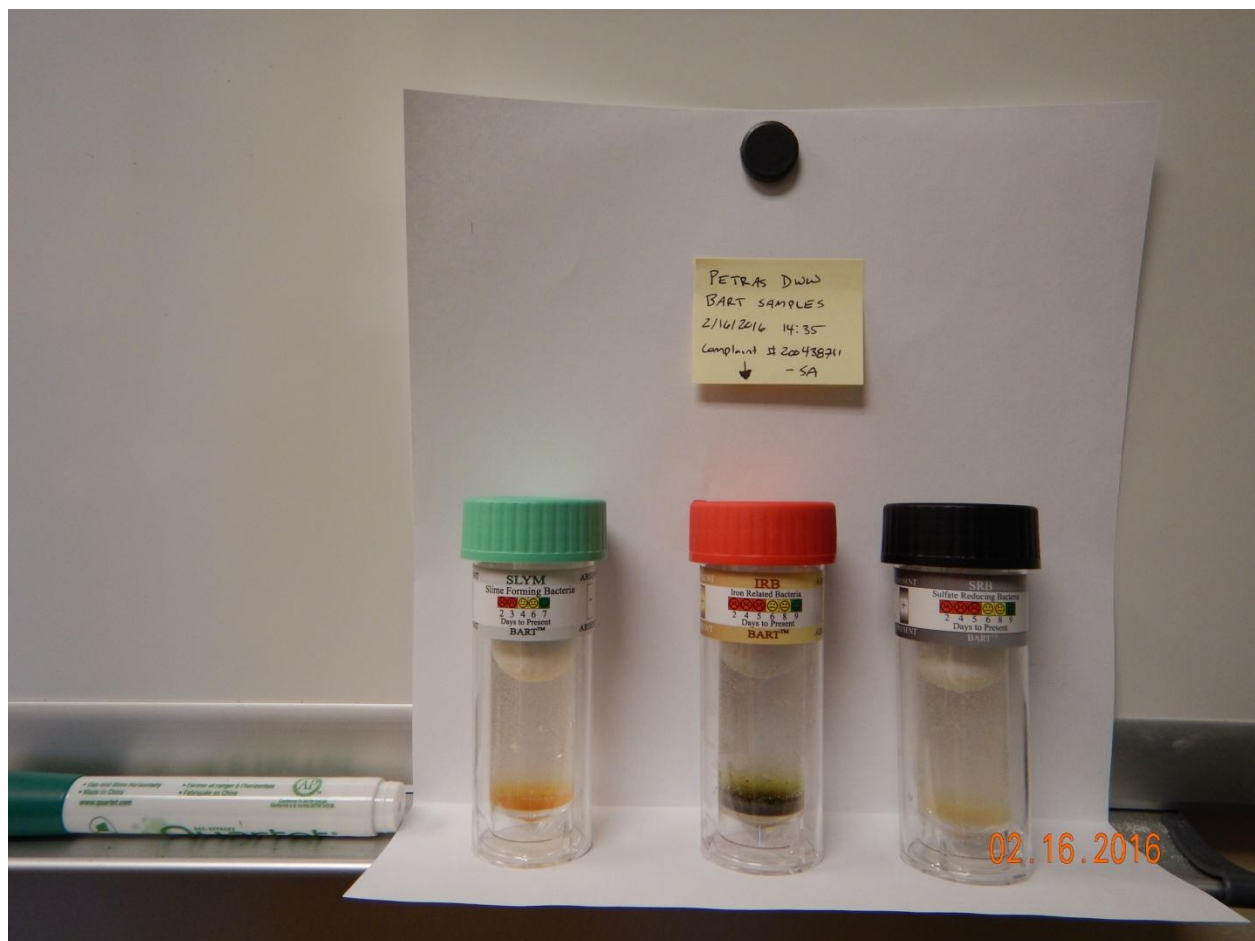


Figure 1 - Biological Activity Reaction Test (BART) - initial conditions.

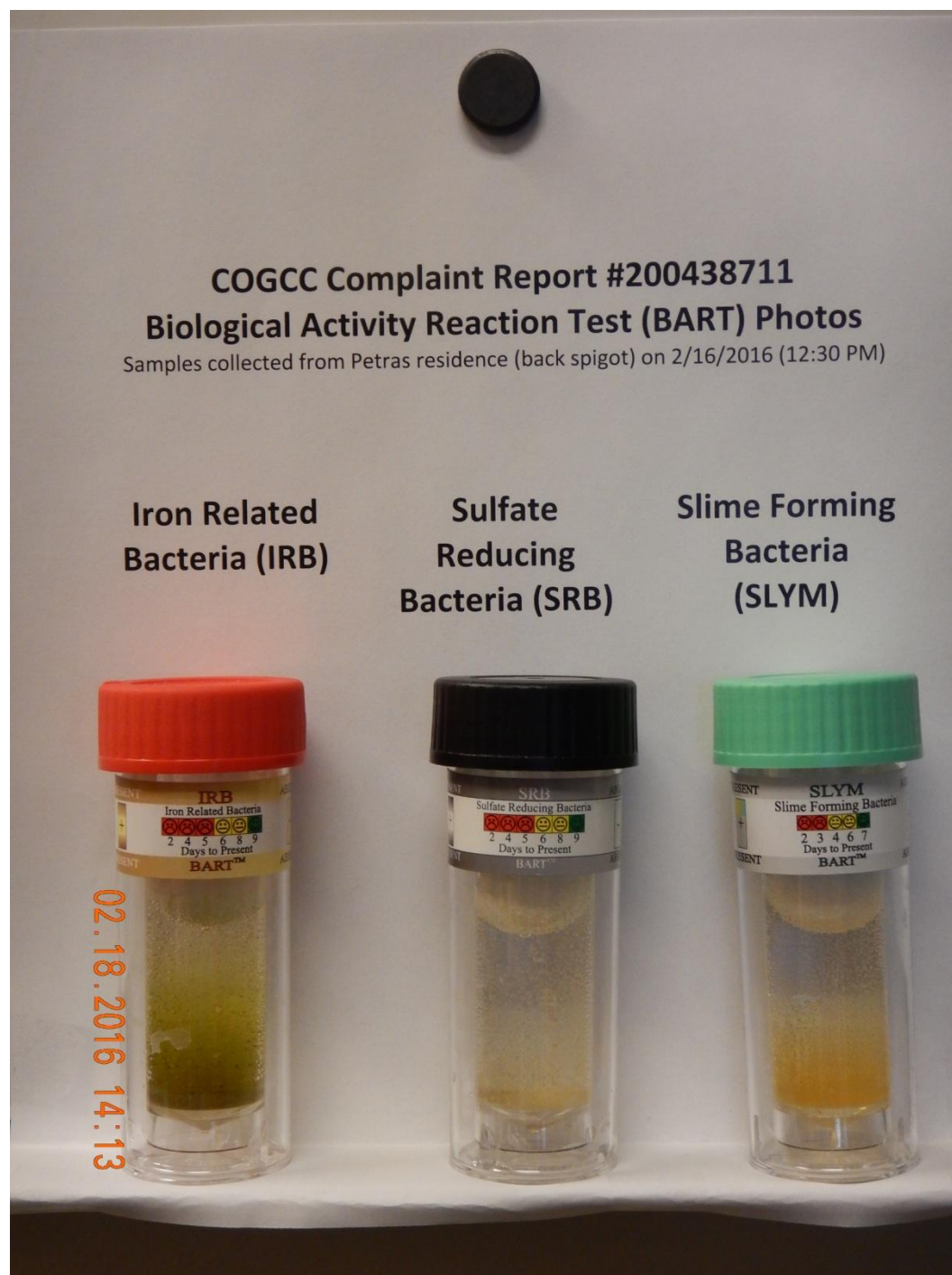


Figure 2 - BART Day 2: Activity observed for Iron-Related Bacteria (green, cloudy water).

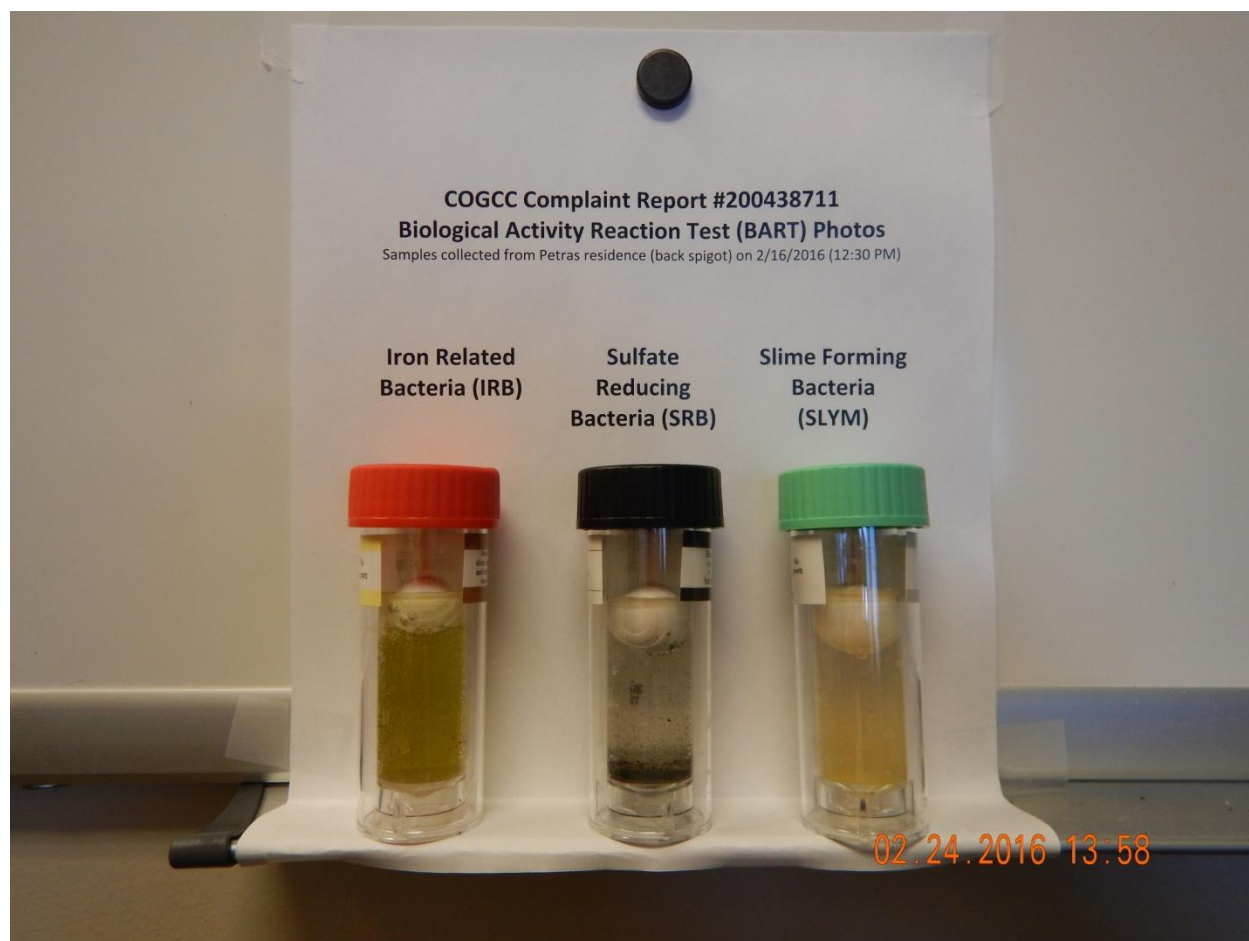


Figure 3 - BART Day 8: Black slime observed on the ball and at the base of the Sulfate-Reducing Bacteria container.

How Well Do You Know Your Water Well?

Groundwater and Water Wells in Colorado



Prepared by:

Michael Matheson, P.G.; Plateau Environmental Services, Inc.
Joe Bowden, PhD; CDS Environmental Services, LLC

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In cooperation with the following agencies:

Colorado Division of Water Resources

Colorado Department of Public Health and Environment

Colorado Oil & Gas Conservation Commission

Agency Contacts

Colorado Division of Water Resources (CDWR)

303-866-3585

<http://water.state.co.us/>

Colorado Department of Public Health & Environment (CDPHE)

303-692-2000 or 1-800-886-7689 (in-state)

<http://www.cdphe.state.co.us/>

Colorado Oil & Gas Conservation Commission (COGCC)

303-894-2100

<http://cogcc.state.co.us/>

US EPA Safe Drinking Water

<http://water.epa.gov/drink/>

Information considered accurate as of October 2011

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Introduction

Due to the rural nature of much of Colorado, individual domestic water wells are a way of life for many of us. This informative booklet has been prepared as a reference guide for private water well owners throughout the state. In it you will find basic information concerning the groundwater that is supplied to you from your private water well. It includes information about:

- the occurrence of groundwater and different types of aquifers;
- how recharge and use of groundwater can affect the amount and quality of water available to you;
- water well permitting and water testing;
- contamination sources and setbacks;
- typical components of a water well and distribution system;
- water quality standards and test result interpretation;
- methane in groundwater;
- information concerning well maintenance and disinfection.

Also included are some handy tools such as a water well troubleshooting guide, a water treatment decision guide, a glossary of terms, and links to helpful internet web sites that deal with water issues.

Finally, the guide also contains contact information for various government agencies that can help an-



swer questions that this document does not cover. People at these agencies have a great deal of very specific information about water and wells. They may be able to help you investigate and resolve problems or concerns that you may have.

It is our hope that you will keep this guide handy and use it to record information about your well and answer basic questions about groundwater and your water well for years to come.

Aquifers and Water Use Basics

Aquifers are porous and permeable sediment or rock. Water is stored in the small spaces between sediment or rock grains and particles and moves very slowly through these interconnected “pore spaces”. Groundwater can also be stored and move through small, interconnected and naturally occurring fractures found in some rocks like sandstone, granite, or shale. There is generally no such thing as “underground rivers or lakes” except in rare and special geologic conditions involving rocks known as limestone. Limestone aquifers are relatively rare in Colorado; however, Glenwood Springs is a example of groundwater discharged from a limestone aquifer.

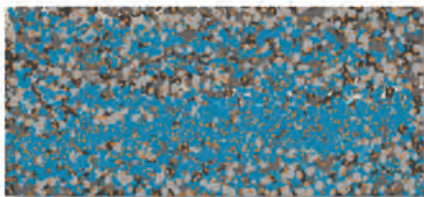
Aquifers are replenished through a process called “recharge.” Rain, snowmelt and even irrigation water all soak into the ground and slowly move and accumulate to saturate

pore spaces. Rivers, streams and irrigation ditches can also recharge aquifers. When drought occurs, or irrigation water is removed, recharge is diminished. Shallow river valley aquifers can be recharged quickly, but recharge water may take many years to reach deep bedrock aquifers.

Pumping groundwater from a well always causes a decline in groundwater levels at and near the well. This decline in groundwater level near the well also always causes a diversion of groundwater from its natural, possibly distant area of discharge. Pumping of a single well typically has a local effect on the groundwater-flow system. Pumping of many wells (sometimes hundreds or thousands of wells) in large areas can have regionally significant effects on groundwater systems. Too much groundwater pumping can

exceed the recharge rate and groundwater levels in a given area will decline. This is called “Groundwater Mining.”

The figures below give an idea of how groundwater is found in different types of rock. Sand and gravel can hold lots of water because pore spaces are large and well connected. Sandstone has smaller pores that are less well connected so it often yields less water. Shale has very small pores that are not interconnected; therefore, shales normally yield very little water. Coal can yield large amounts of water, but will often contain some methane gas and hydrogen sulfide. In some areas, such as the Raton Basin near Trinidad, Colorado, coal seams found in shallow aquifers may be the same coal seams where natural gas production occurs. However, in other areas, such as the San Juan Basin near Durango, Colorado, the natural gas industry removes methane from the thick coal seams, sandstone and shale that are usually several thousand feet deeper than shallow aquifers. Crystalline rock (such as granite and limestone) has no pores and water must be drawn from interconnected naturally occurring fractures.



Sand and Gravel



Sandstone



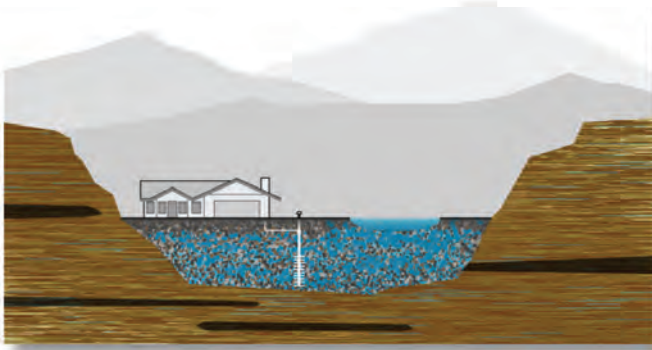
Shale and Coal



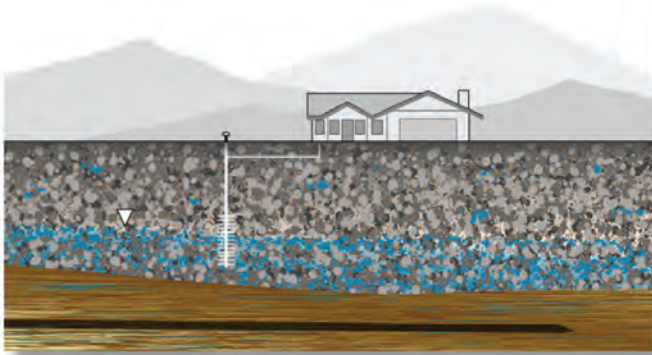
Crystalline Rock

Aquifers and Water Use Basics

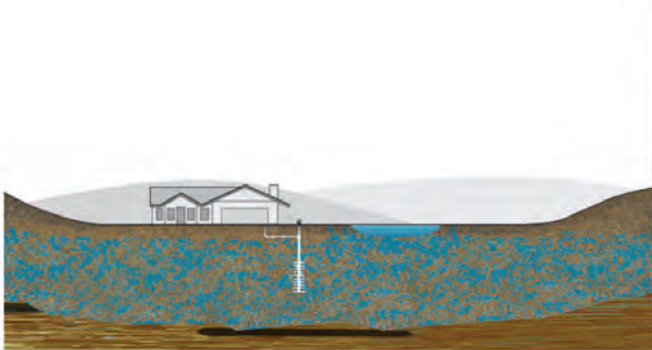
Colorado water wells typically tap into five different kinds of aquifers.



River Valley Aquifer



Glacial Outwash Aquifer



Dune Field Aquifer

River Valley Aquifer

River valley aquifers are found in shallow loose sediments like gravel and sand next to rivers, streams and lakes. They are usually of limited extent within the immediate river or stream valley. These aquifers are recharged by the river flow and usually have good water quality and sustained yield because of the regular recharge from the river or lake. However, the groundwater is often close to the ground surface and is therefore very susceptible to pollution from adverse surface conditions or septic systems.

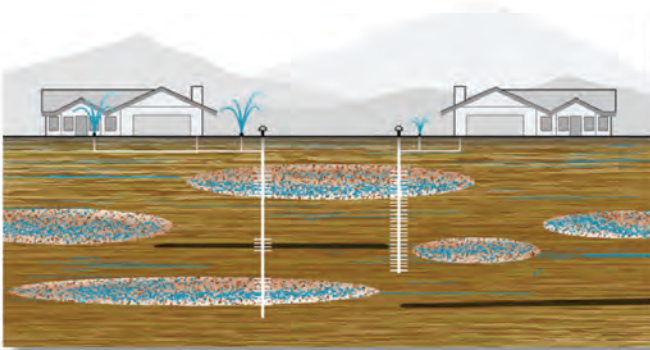
Glacial Outwash Aquifer

Glacial outwash aquifers are thick accumulations of unconsolidated sand and gravel deposited over large areas by alpine glaciers when they retreated many thousand years ago. Many high terraces in valleys and plains adjacent to or near the mountains are covered with these deposits. They are often developed areas for residences and agriculture. Recharge to this aquifer type is primarily from snowmelt, small mountain streams crossing to larger rivers or irrigation water used on farms and ranches. This aquifer type typically has good water quality and yield. However, as more water wells are drilled and fewer farms are irrigated, the aquifer can become depleted in certain areas.

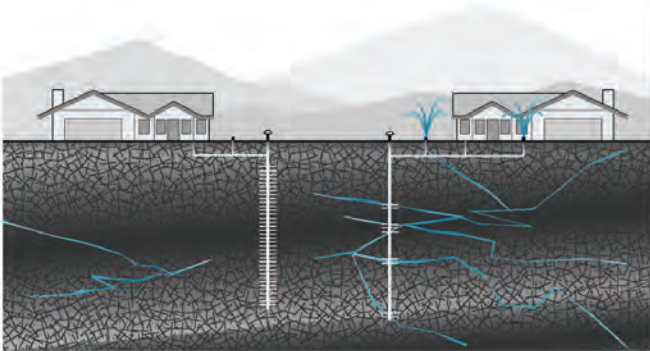
Dune Field Aquifer

Large areas of the eastern plains of Colorado are covered with wind deposited sand dunes that have been stabilized by vegetation. They are often called "Sand Hills." Rain, snowmelt and irrigation water have percolated into these large accumulations of unconsolidated sand and silt. The Sand Hills serve as an important shallow aquifer on the eastern plains. Water quality and yield from this aquifer type can be good, but they are susceptible to drought and groundwater mining.

Aquifers and Water Use Basics



Bedrock Shale and Sandstone Aquifer



Crystalline Fractured Aquifer

Bedrock Shale and Sandstone Aquifer

Bedrock shale and sandstone aquifers are often tapped in Colorado as these are the most common rock types in developable areas outside the high mountains. Most of these aquifers are made up of interbedded layers of sandstone and shale. More groundwater is generally found in sandstone than in shale. The yield and quality of water removed from bedrock aquifers can vary widely. In some areas dominated by shale it may not be possible to develop a well with good yield and water quality. And because recharge into bedrock aquifers is usually very slow, bedrock aquifers can easily suffer from the effects of groundwater mining.

Crystalline Fractured Aquifer

Crystalline fractured aquifers are most commonly found in mountain areas and include rocks such as granite, metamorphic quartzite and volcanic rocks. Fractured aquifers can also be found in areas with thick sandstone or limestone deposits. While these types of rocks have little or no pore spaces, groundwater can be stored and transported in interconnected naturally occurring fractures among the rock. Wells that are drilled into a network of fractures can yield water. However, a nearby well that does not intercept fractures may yield no water at all.

Water Well Permitting, Construction and Recordkeeping

The early stage of planning a new or replacement water well includes several steps. These steps include selecting a licensed drilling and pump contractor, selecting a well location that avoids contamination hazards, and obtaining a well permit. The Colorado Division of Water Resources requires that every new or replacement well be permitted before it is drilled, and that water wells must be drilled and constructed pursuant to Colorado Water Well Construction Rules (2 CCR 402-2). <http://water.state.co.us/DWRIPub/Documents/constructionrules05.pdf>

In general, the well permit application asks for ownership and proposed well location information, proposed construction details, water use and septic system information and the well driller's license number. <http://water.state.co.us/groundwater/wellpermit/Pages/default.aspx>

The Division of Water Resources (DWR) has several different types of possible well permits that can be issued. DWR form GWS-44 is used for most residential and livestock water wells. Based on certain water rights criteria the DWR may limit water to indoor use only for parcels of less than 35 acres, and to outdoor use of no more than 1 irrigated acre for parcels larger than 35 acres. In water critical areas (where water rights are over appropriated) the DWR may deny a new well permit

altogether unless a landowner obtains appropriate replacement water rights. There are several areas in Colorado that are designated as water critical areas. Persons interested in purchasing undeveloped

land should always contact DWR before purchasing the property to determine if a well permit can be issued for that particular parcel. It is also a good idea to contact a local geologist to assist in evaluating the

Sample Well Construction Report

FORM NO. GWS-31 09/2011		WELL CONSTRUCTION AND TEST REPORT STATE OF COLORADO, OFFICE OF THE STATE ENGINEER 1313 Sherman St., Room 821, Denver, CO 80203 Main (303) 866-3561 Fax (303) 866-3569		For Office Use Only	
1. WELL PERMIT NUMBER: XXXXXXX					
2. WELL OWNER INFORMATION					
NAME OF WELL OWNER: John Doe					
MAILING ADDRESS: 123 Easy St.					
CITY: Durango STATE: CO ZIP CODE: 81301					
TELEPHONE NUMBER: (970) 123-4567					
3. WELL LOCATION AS DRILLED: NE 1/4, NE 1/4, Sec. 9 Twp. 34 N or S, Range 9 E or W					
DISTANCES FROM SEC. LINES: 100 ft. from N or S section line and 100 ft. from E or W section line.					
SUBDIVISION: Paradise LOT 1 BLOCK 2 FILING (UNIT)					
Optional GPS Location: GPS Unit must use the following settings: Format must be UTM. Units must be meters, Datum must be NAD83. Unit must be set to true N. Zone 12 or Zone 13					
STREET ADDRESS AT WELL LOCATION: 123 Easy St., Durango					
4. GROUND SURFACE ELEVATION: 6,547 feet					
DATE COMPLETED: 6/1/11 TOTAL DEPTH: 200 feet					
5. GEOLOGIC LOG:					
Depth	Type	Grain Size	Color	Water Loc.	
0 - 30	Silty sand	SM	brown		
30 - 40	Gravel	GP	grey	yes	
40 - 60	Shale		yellow		
60 - 90	Sandstone	fine	brown	yes	
90 - 100	Shale		green		
100 - 135	Sandstone	fine	brown	yes	
135 - 200	Shale		green		
6. HOLE DIAM. (in.)					
From (ft) To (ft)					
12" 0 25					
8" 25 200					
7. PLAIN CASING:					
OD (in.)	Kind	Wall Size (in.)	From (ft)	To (ft)	
9"	Steel	0.25	+1	24	
5.5"	PVC	Sch 40	+1	54	
5.5"	PVC	Sch 40	139	189	
PERFORATED CASING: Screen Slot Size (in): 0.020					
5.5"	PVC	Sch 40	54	139	
8. FILTER PACK:					
Material: Sand					
Size: 0.25"					
Interval: 50 - 200					
9. PACKER PLACEMENT:					
Type: None					
Depth:					
10. GROUTING RECORD					
Material: cement					
Amount: 0-25					
Density: 1.25					
Interval: 0-50					
Placement: tremie					
Remarks: Water in gravel and sandstones					
11. DISINFECTION: Type: Bleach Amt. Used: 1.25 gal. 48 hrs.					
12. WELL TEST DATA: Check box if Test data is submitted on Form Number GWS 39 Supplemental Well Test.					
TESTING METHOD: Temporary sub pump					
Static Level: 32 ft. Date/Time measured: 6/10/11 0800 Production Rate: 16 gpm.					
Pumping Level: 54 ft. Date/Time measured: 6/10/11 1400 Test Length (hrs): 6					
Remarks: Pumped until clear and stable flow with stable conductivity					
13. I have read the statements made herein and know the contents thereof, and they are true to my knowledge. This document is signed and certified in accordance with Rule 17.4 of the Water Well Construction Rules, 2 CCR 402-2. [The filing of a document that contains false statements is a violation of section 37-91-108(1)(e), C.R.S., and is punishable by fines up to \$5000 and/or revocation of the contracting license.]					
Company Name: Acme Drilling Phone: (970) 765-4321 License Number: 1234					
Mailing Address: PO 1					
Signature: Print Name and Title: Tom Digger, Driller Date: 6/15/11					

Water Well Permitting, Construction and Recordkeeping

probability of developing a good well on the parcel.

Another early step in the well drilling process is planning for your water analysis and treatment. In Colorado, private well owners are responsible for the quality and quantity of their water supply. They are also responsible for determining what treatment equipment may be necessary for their well water. Before drilling a new well or sampling your existing well, you should contact a qualified analytical laboratory to discuss the appropriate analytical testing to be performed on your well water. You can obtain a list of qualified laboratories by contacting the Colorado Department of Public Health and Environment (CDPHE).

(<http://www.cdphe.state.co.us/wq/drinkingwater/PrivateWellInformation.html>).

Also, you should obtain the necessary bottles and instruction on how to collect and preserve the water sample. Then, after the well is drilled, fully developed and disinfected you will be ready to collect your water sample and deliver it to the laboratory. Based on the analytical results, you can select appropriate treatment equipment (see Water Treatment Decision Guide on page 18).

As part of the well drilling process, the driller must record certain data that will be reported to DWR. This includes a record of the geologic formations penetrated (the well log), an as-built well construction record and diagram, and an accurate water level and well yield test. It is very important that the driller collects and records this information accurately. You may wish to ask the driller to collect and save samples of all the different soil and rock formations that were penetrated so that they can be examined later by a geologist. You will also want the licensed driller and pump installer to provide you with copies of all the diagrams and reports that must be submitted to DWR.

Keep these records in a safe place. You will need to refer to these documents in the future when performing well maintenance or while evaluating well problems. Always keep detailed records of any maintenance or testing that is performed on the well.

A section is provided in the back of this booklet that lets you record some of the basic construction and permit information for your well for your easy future reference.

Have the water from your new well tested by a qualified analytical laboratory. Record the results for future reference.

If you have an existing well with no records, DWR can provide you with copies of the reports that were submitted by the driller when the well was drilled. You can find permit and basic construction information about the well at the DWR web site Well Permit Search function (<http://www.dwr.state.co.us/WellPermitSearch/default.aspx>). This web site will have all of the available scanned documents that have been submitted for your well.

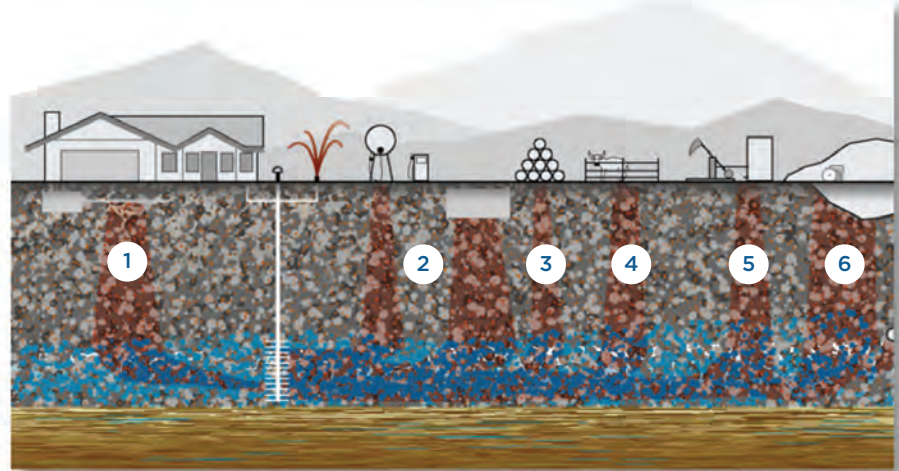
Water Well Protection and Pollution Sources

Man-Made Pollutants

Groundwater pollution occurs when man-made products such as gasoline, oil, road salts, fertilizer, and chemicals get into the groundwater and cause it to become unsafe or unfit for human use. Some of the most common sources of pollutants are leaking fuel storage tanks, septic systems, animal holding pens (corrals), inappropriate chemical storage sites, landfills, and the widespread use of road salts and agricultural chemicals. In general, keep these facilities and materials as far away from your water well as possible. If possible, your well should be placed uphill of any potential contaminant source.

A domestic well can easily be polluted if it is not properly constructed or if unsafe materials are released into the well. Toxic materials spilled or dumped near a well can leach into the aquifer and pollute the groundwater drawn from that well, making polluted wells used for drinking water very dangerous.

Individual septic systems, or those not connected to a city sewer system, can also be a serious pollution source. Septic systems are designed to slowly drain away human waste underground at a harmless rate. An improperly designed, located, constructed, or maintained septic system can leak bacteria, viruses, or household chemicals into



Common Man-Made Pollutants

groundwater causing serious problems. A permit is required to install, alter or repair a septic system in Colorado (5 CCR 1003-6), and the property owner is responsible for proper installation and maintenance of the system and for abatement of any nuisance arising from its failure. Contact your local or regional health department for more information on local septic system rules (including design and setbacks).

Landfills are another source of pollution. When properly constructed, contemporary landfills have a protective bottom layer to prevent pollutants from getting into our groundwater. But, if this protective layer fails, pollutants from the landfill can make their way down into the groundwater.

Finally, chemicals including fertilizers, insecticides and pesticides are washed into the ground by irrigation and precipitation and eventually end

up in the groundwater if they are improperly applied.

1. Septic systems leach household waste into soil and neutralize many types of contaminants. However, a septic system should be at least 100 feet from a water well and chemicals should not be poured down the drain as these may not be effectively neutralized by the soil.
2. Fuel tanks and fueling operations can be a source of contamination of groundwater if there are leaks or spills. This can happen with both above-ground and underground tanks and pipelines. Do not store fuel or transfer fuel near a water well. Fix leaks and cleanup spills immediately.
3. Chemical storage, leaks or spills and improper chemical use can all be sources of groundwater contamination. Typical chemi-

Water Well Protection and Pollution Sources

cals stored in a household may include paint, solvents, fertilizer, herbicides, pesticides, cleaners and oil. Always use chemicals as instructed on the label. Do not store or use chemicals near (or in the same building as) your water well. Fix leaks and cleanup spills immediately.

4. Animal holding pens (corrals) tend to become areas of concentrated animal waste. Rain water and snowmelt can carry these wastes into groundwater. Do not situate animal holding pens near your water well. Use a minimum 100 foot offset as you should with your septic system. Also, do not bury a dead animal within 150 feet of a water well (preferably further).
5. Oil and gas production facilities can be a source of contaminants such as oil, condensate and produced water. Oil and gas facilities must be sited a minimum of 150 feet from residences and other occupied structures. Keep your water well at least that far from an oil & gas production facility. Also, if you notice anything leaking from an oil & gas facility immediately call the operator of the facility (there should be a sign at the facility with an emergency contact number) so that

trained professionals can respond to correct the problem.

6. Landfills can be a source of contaminants that can leach into groundwater. All current municipal and county landfills must meet stringent requirements for construction and monitoring. However, historic landfills and private “ranch” landfills can be an unmonitored source of contaminants. If you have a private landfill then only place inert materials in it. Do not dispose of chemicals, petroleum products and other potential contaminants in private landfills. Information concerning disposing of your own solid waste on your own property is available from CDPHE at:
<http://www.cdphe.state.co.us/hm/onesownwaste.pdf>

Natural Contaminants

Contamination of groundwater is not always a result of the introduction of pollutants by human activities. Possible natural contaminants include trace elements such as arsenic and selenium, dissolved gases like methane and radon, and high concentrations of commonly occurring dissolved salts.

In Colorado, many groundwaters naturally contain arsenic, chloride, dissolved salts, fluoride, iron, magnesium, manganese, selenium, sulfate, radon, uranium, and other trace metals in concentrations exceeding recommended or mandatory standards for public drinking water established by the CDPHE, the U.S. EPA and the U.S. Public Health Service.



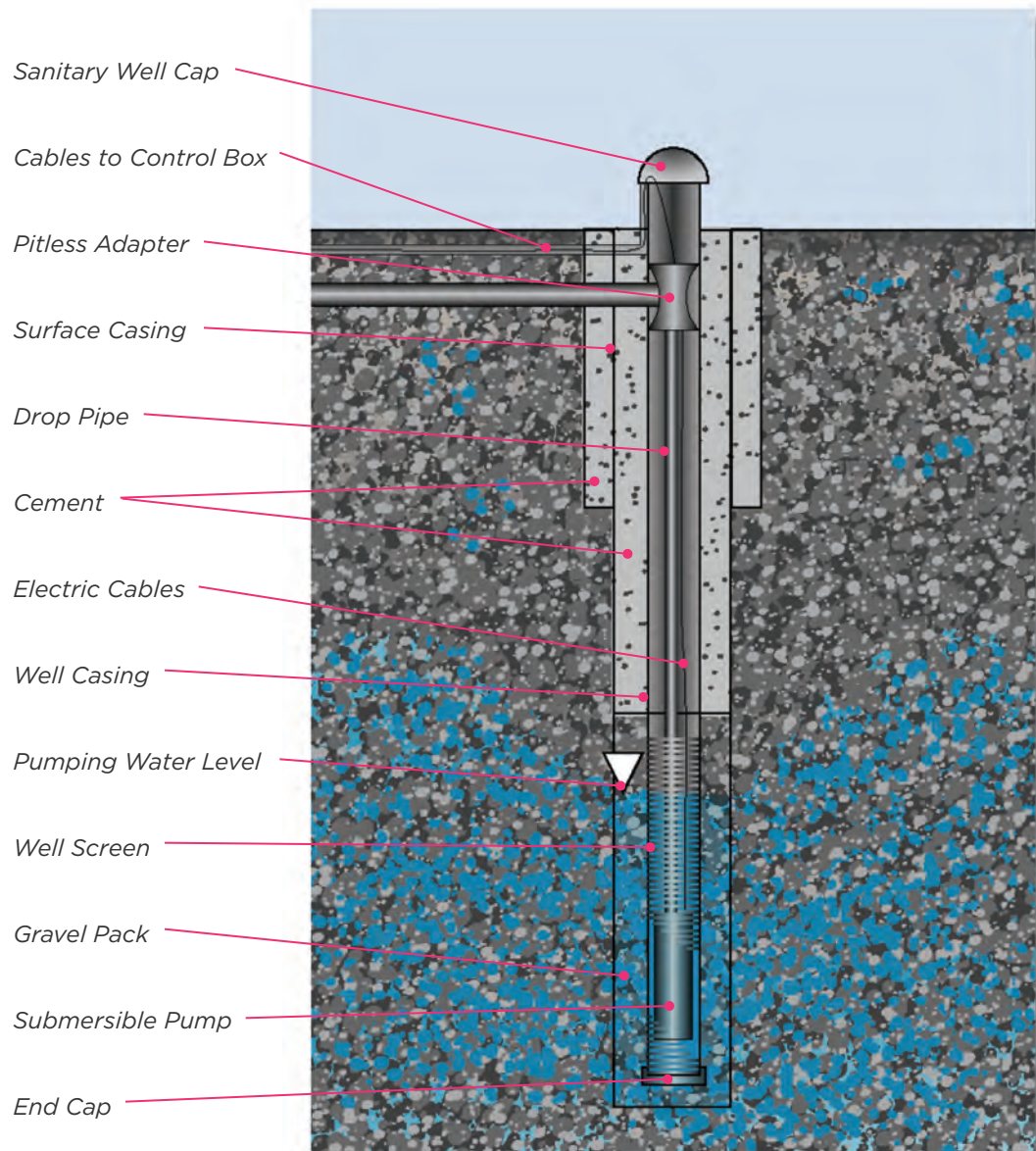
Anatomy of a Water Well

Typical Water Well Components

This schematic diagram represents a typical water well as constructed in a water table type aquifer. While most wells are much deeper than illustrated here, all of the individual

components are shown and labeled. The following list of water well terms helps explain the well components and other useful terms.

Knowing about the different components of a water well, and their function, will allow you to more effectively discuss your well with your licensed well driller or pump installer.



Anatomy of a Water Well

Typical Water System Terminology

Aquifer – A water bearing layer of sediment or rock with interconnected pore spaces or fractures that can store and deliver water to a well.

Borehole – The cylindrical hole drilled into the ground and aquifer.

Casing – Steel or PVC tubing placed in the borehole to keep the borehole open and to allow room to store water and install a pump.

Casing Stickup – The amount of casing that sticks up above the ground surface. This should be at least 1 foot.

Cement – Placed between the wall of the borehole and the casing and surface casing to prevent surface contamination from reaching the aquifer.

Cistern – A water holding tank, usually underground, used for storage or treatment of water before being delivered to the pressure tank and home. A cistern will usually be vented to allow gases such as methane and radon to escape.

Control Box – Electrical switch box that turns the well pump on and off.

Drop Pipe – Pipe placed in the casing to connect the pump to the surface.

Electrical Cable – Wiring from the pump control box to the pump that supplies power and command signals.

End Cap – Cap placed on the bottom of the casing to prevent sediment from flowing into the casing.

Gravel Pack – Gravel or sand placed between the borehole wall and the well screen to keep the borehole open and filter water before it enters the well.

Groundwater – Water stored beneath the surface of the earth that is transmitted through small, interconnected pores and fractures in sediment and rock.

Pitless Adapter – A device placed in the well casing that allows water to be diverted from the drop pipe to piping on the exterior of the well below the frost line.

Pressure Tank – A water holding tank equipped with an air bladder that regulates water pressure into the home and demand to the pump.

Pumping Water Level – The depth below the ground surface of the water level in the well when the pump is operating. This is always deeper than the static water level.

Sanitary Well Seal – A sealed cap on the top of the well casing that prevents surface contaminants from entering the inside of the well. It is also vented to allow gases such as methane and radon to escape the casing.

Submersible Pump – The most common type of water well pump includes the pump and pump motor placed at the bottom of the drop pipe below the pumping water level.

Static Water Level – The depth below ground surface of water when the pump is not operating. This level will vary seasonally and over longer time periods due to recharge, drought or groundwater mining.

Surface Casing – Steel casing at least 20 feet deep that is the first casing installed in a well that prevents surface contaminants from entering the well.

Treatment Equipment – Can include a variety of equipment designed to remove various water contaminants and purify groundwater before use.

Well Screen – Steel or PVC perforated pipe that water from the aquifer flows through to enter the well and pump.

Water Well Maintenance



Properly constructed private water supply systems require routine maintenance. These simple steps will help protect your system and investment.

1. Always use licensed water well drillers and pump installers when a well is constructed, a pump is installed, a cistern is installed, or the system is serviced. Always ask to have a copy of their license or certification and insurance before they start any work on your well or system or before you sign any contract. A reputable professional will gladly ask their insurance carrier to provide you a certificate of insurance at no charge.
2. An annual well maintenance check, including a water chemistry and bacterial test, a check of the static water level, and a well yield test is recommended. Any source of drinking water should be checked any time there is a change in taste, odor or appearance, or anytime a water supply system is serviced.
3. Keep livestock, hazardous chemicals, such as paint, solvents fertilizer, pesticides, herbicides, fuel and motor oil far away from your well and pump house.
4. Periodically check the well cover or well cap on top of the well casing to ensure it is in good repair and the vent is clear.
5. Always maintain proper separation between your well and buildings, waste systems, chemical storage facilities and livestock corrals.
6. Do not allow back-siphonage. When mixing pesticides, fertilizers or other chemicals, do not put the hose inside the tank or container.
7. When landscaping, keep the top of your well at least one foot above the ground. Slope the ground away from your well for proper drainage.
8. Take care in working or mowing around your well. A damaged casing could jeopardize the sanitary protection of your well. Do not pile snow, leaves, or other materials around the well.
9. Keep your well records in a safe place. These include the construction report, as well as annual water well system maintenance, water testing results, routine measurements of well yield and static water level. A section is provided in the back of this booklet where you may record basic information about your well.
10. Be aware of changes in your well, the area around your well, or the water it provides.
11. A licensed water well contractor or pump installer can periodically measure the water level in your well and its production rate. They can also clean your well screen if there are indications of it becoming plugged by mineralization or bacteria. The pump installer can also clean and maintain your cistern if you have one.
12. When your well has come to the end of its serviceable life (usually more than 20 years), have your licensed well driller properly plug and abandon your well.

Water Quality Standards and Interpretation

Interpreting Your Water Test Report

Obtaining a water analysis from a testing laboratory is a necessary first step toward solving household water quality problems. Before testing, you may have had concerns about the safety of the water used in the household. Or, you may have noticed objectionable symptoms when using the water for drinking, cooking, or other household purposes. Perhaps you have routinely monitored your household water quality through periodic testing and have recently noticed differing results between tests for one or more indicators. To identify the source of contamination problems, as well as to determine the type of corrective action to take, a properly interpreted water analysis report is essential.

Besides providing a laboratory report of the analysis for the

naturally occurring constituents and pollutants or contaminants (if present), most water testing laboratories provide little additional explanation of test results beyond the units used and possibly a

following glossary of water testing terms, may assist you in understanding a water analysis report for some common household water contaminants.

What Do the Numbers Mean?

Once a water testing laboratory has completed the analysis of your water, you will receive a report. It will contain a list of the natural constituents, possible contaminants and physical characteristics for which your water was tested and the measured concentration of each. The concentration is the amount of a given substance (weight) in a specific amount of water (volume). The most common concentration unit used is milligrams per liter (mg/L) which, is

approximately equal to one part per million (ppm), or one part contaminant to one million parts water.

ABC LABORATORIES ID# 12-258-120
Date received 12/05/2011
Date reported 12/18/2011
Date Sampled 12/04/2011


Well owner: Colorado Well Owner
Somewhere Road
Rural, Colorado 81111

Sample ID: Domestic well near the creek
Sample Matrix: water, unfiltered

Laboratory Report

Results

Parameter	Method	Report Limit	Result	Units	MCL
Alkalinity, Total	2320B	10	384	mg/L	
Alkalinity, Bicarbonate	2320B	10	384	mg/L	
Alkalinity, Carbonate	2320B	10	20	mg/L	
Alkalinity, Hydroxide	2320B	10	<10	mg/L	
Calcium	200.7	0.5	18.1	mg/L	
Chloride	4500CL	10	40	mg/L	
Conductivity	120.1	1	1040	µS/cm	
Fluoride	4500FC	0.2	0.4	mg/L	4.0
Hardness	Calc	14	50	mg/L	
Iron	200.7	0.05	<0.05	mg/L	
Magnesium	200.7	0.5	1.2	mg/L	
Methane	BLM	0.5	<0.5	mg/L	
Nitrate/Nitrite as N	353.2	0.05	0.5	mg/L	
pH	150.1	NA	8.05	Std Units	
Potassium	200.7	0.5	0.7	mg/L	
Selenium	3114B	0.001	0.005	mg/L	0.05
Sodium	200.7	0.5	237	mg/L	
TDS	160.1	10	800	mg/L	
Uranium	200.7	0.01	<0.01	mg/L	0.03

Report Approved By: 
Good Guy Ph.D.
Laboratory Manager
ABC LABORATORIES

Date: 12/18/2011

Sample Water Quality Analysis Report

footnote or similar comment in the event that a problem contaminant is identified. The information provided below, along with the

Water Quality Standards and Interpretation

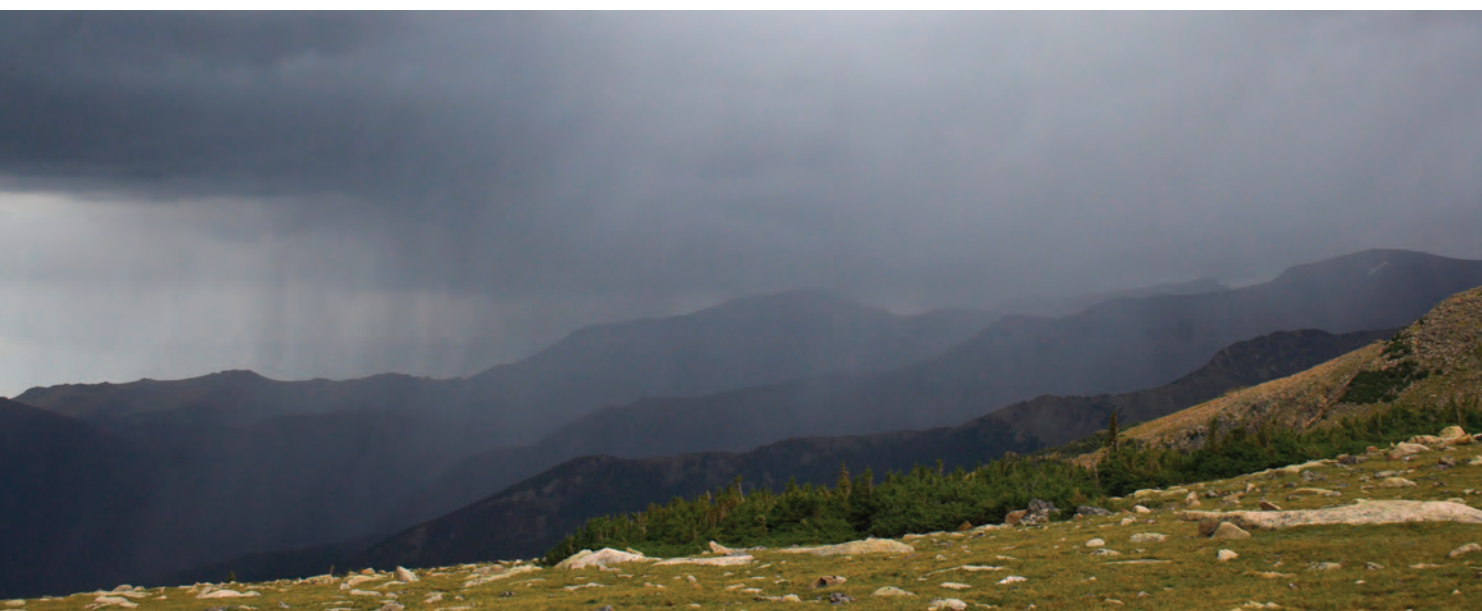
How Much is too Much?

"Pure" water does not exist in nature and all natural water contains some dissolved mineral and salt constituents. In most cases, the levels of these naturally occurring constituents are beneficial or minimal and of little consequence. However, when certain constituent levels in household water are excessive, they may affect household activities and/or be detrimental to human, animal and plant health. Evaluating what levels of constituents are acceptable and understanding the nature of problems caused when the concentration is excessive and would be considered a contaminant of concern are the basic considerations in interpreting a household water analysis report.

Acceptable limits for evaluating the suitability and safety of your well water are established for many contaminants. Some established standards are set by nuisance considerations (taste, odor, staining, etc.) while many are based on health implications and are legally enforceable with respect to public water systems. These acceptable limits should be used as guidelines for your own water supply when evaluating your well water test results.

Whether you have the results of tests that you specifically requested, or you simply instructed the laboratory to conduct general or routine household water quality tests, you can use the following tables as a general guideline for the most

common household water quality contaminants. These are divided into three categories: general indicators, nuisance impurities, and health contaminants. (Note: Some contaminants are evaluated on the basis of both nuisance and health criteria.)



Water Quality Standards and Interpretation

General Indicators

General water quality indicators are parameters used to indicate the possible presence of harmful contaminants. Testing for indicators may eliminate the need for costly tests for specific contaminants. Generally, if an indicator is excessive, the water supply may contain other contaminants as well, and further testing is recommended. For example, you are probably familiar with coliform bacteria. These harmless bacteria are present in the air, soil,

vegetation, and all warm-blooded animals. A positive total coliform bacteria test result may be followed by tests for fecal coliform or E. coli bacteria which, if present, would confirm that sewage or animal waste is contaminating the water. Total dissolved solids (TDS) and pH are considered general water quality indicators, and may vary over time depending on well recharge characteristics. The tests listed in Table 1, along with a test for nitrate/nitrite (see Table 4), provide a good rou-

tine analysis (as often as once a year) for most rural water supplies, unless there is a reason to suspect other contaminants.

Table 1: General Water Quality Indicators

Indicator	Acceptable Limit	Indication
Bacteria	None Present	Possible bacterial or viral contamination from human sewage, animal waste, surface water or any one of a number of bacteria such as sulfate reducing, slime formers, iron, methanogenic, etc..
pH Value	6.5 to 8.5	An important overall measure of water quality, pH can alter corrosivity and solubility of contaminants. Low pH will cause pitting of pipes and fixtures and/or metallic taste. This may indicate that metals are being dissolved. At a high pH, the water will have a slippery feel or soda taste.
Total Dissolved Solids (TDS)	500 mg/L*	Dissolved minerals, like sodium, calcium, magnesium, iron or manganese. High TDS also may indicate excessive hardness (scaly deposits) and cause iron or mineral staining, or a salty, bitter taste.
Odor/Color		Can be indicative of high mineral content such as iron (red staining) or manganese (black staining). Rotten egg odor is indicative of hydrogen sulfide. Both color and odor indicate that your water should be tested.
Gas Bubbles		Can be indicative of dissolved gas such as methane. Sometimes is indicative of low water levels and air being trapped by the pump.

* TDS levels greater than 500 mg/l are found naturally in many water wells and public drinking water systems in the western states. Water with higher than 500 mg/l may cause mild and transient gastric upset and still be safe to drink. In many cases it is the only source of water.

Water Quality Standards and Interpretation

Nuisance Impurities

Nuisance impurities are another category of contaminants. While these have no adverse health effects at low levels, they may make water unsuitable for many household pur-

poses. Nuisance impurities may include iron, bacteria, chloride, and hardness. Table 2 lists some typical nuisance impurities you may see on your water analysis report. Acceptable limits for nuisance impurities

come from the EPA Secondary Drinking Water Standards for public drinking water systems.

Table 2: Common Nuisance Impurities and Their Effects

Contaminant	Acceptable Limit	Effects
Chlorides	250 mg/L	Salty or brackish taste; corrosive; blackens and pits stainless steel and can cause green plants to yellow.
Copper (Cu)	1.3 mg/L	Blue-green stains on plumbing fixtures; bitter, metallic .
Iron (Fe)	0.3 mg/L	Metallic taste; discolored beverages; yellowish stains on laundry, reddish brown stains on fixtures.
Manganese (Mn)	0.05 mg/L	Black specks on fixtures; bitter taste.
Sulfates (SO ₄)	250 mg/L	Bitter, medicinal taste; corrosive; may cause gastric upset and diarrhea.
Iron Bacteria		Orange to brown-colored slime in water, can cause an oil-like film on standing water, black-brown sludge in toilet tank.
Slime Bacteria		Jelly-like slime deposits in toilet tank, bottom of cisterns.
Sulfate Reducing Bacteria		Rotten egg or sewer-like like smell.
Zinc (Zn)	5 mg/L	Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful. Indication of galvanized pipe corrosion in older homes.

Water Quality Standards and Interpretation

Water Hardness

Hardness is one contaminant you will also commonly see on the report. Hard water causes white, scaly deposits on plumbing fixtures and cooking appliances and decreased cleaning action of soaps and detergents. Hardness is the sum of the calcium and magnesium levels found in your water. Hard water can also cause buildup in hot water heaters and reduce their effective lifetime. Table 3 will help you interpret your water hardness parameters.

Hardness may be expressed in either milligrams per liter (mg/L) or grains per gallon (gpg). A gpg is

used exclusively as a hardness unit and equals approximately 17 mg/L or ppm. Those water supplies falling in the hard-to-very hard categories may need to be softened. However, as with all water treatment, you should carefully consider the advantages and disadvantages of softening before making a decision on how to proceed.

Advantages and disadvantages of softening your water include:

- increased levels of sodium or potassium (depending on which type of salt is used in your softener system) in softened water;
- increased effectiveness of detergents and soaps;

- increased life of hot water heater elements;
- increased potential for pipe corrosion, and;
- negative impact on houseplants.

Since the levels of sodium and potassium can affect your health, consult your health professional about any impacts that softening your water may have on your health. If you have a heart condition or high blood pressure you must consult your health professional before drinking softened water.

Table 3: Hardness Classifications (Concentration of Hardness)

In Grains per Gallon	In Milligrams per Liter (mg/L)	Relative Hardness Level
Below 3.5	Below 60	Soft
3.5 to 7.0	60 to 120	Moderately Hard
7.0 to 10.5	120 to 180	Hard
10.5 and above	180 and above	Very Hard

Health Contaminants

The parameters outlined in Table 4 are some common contaminants that have known health effects. The table lists acceptable limits, potential health effects, and possible

sources of the contaminant in public water systems, these contaminants are regulated under the EPA Primary Drinking Water Standards. You may want to test for these contaminants in your private water well

to determine the quality of your water.

Water Quality Standards and Interpretation

Table 4: Standards, Sources, and Potential Health Effects of Common Regulated Contaminants

Contaminant	Acceptable Limit	Sources	Potential Health Affects at High Concentration
Fecal Coliform Bacteria	zero	Human sewage and animal waste leaking into well or from ground water contamination	Gastrointestinal distress, shock. Infants, elderly, individuals with a compromised immune system and the sick are especially susceptible.
Fluoride (F)	4.0 mg/L	Fluoride is leached from natural deposits.	Mottling of teeth and brittle bones. If less than 0.7 mg/L contact your doctor or dentist for recommendations about the need for additional fluoride for small children and the elderly.
Selenium (Se)	0.05 mg/L	Selenium is leached from natural deposits.	Dangerous to humans and animals alike. Horses are especially susceptible exhibiting hoof [nail] damage, hair loss, still born foals, weight loss and with long term exposure, death. Human and other animals share the same symptoms.
Lead (Pb)	0.015 mg/L	Used in batteries; may be leached from brass faucets, lead caulking, lead pipes and lead soldered joints. Is also leached from natural deposits	Nervous disorders and mental impairment especially in fetuses, infants, and young children. Also, kidney damage, blood disorders and hypertension, low birth weights.
Arsenic (As)	0.05 mg/L	Arsenic is leached from natural deposits.	Dangerous to humans and animals alike. May cause skin damage, circulatory system problems and an increased risk of cancer.
Nitrates and Nitrites	10 mg/L as nitrate-N [1.0 mg/l as nitrite-N]	Byproduct of agricultural fertilization, human and animal waste leaching to groundwater; also leached from natural deposits.	Serious health threat for infants (birth to 6 months). Symptoms include shortness of breath and blue-baby disease; lower health threat to children and adults.
Radon (Rn)	30 pCi/L	Naturally-occurring radioactive gas formed from uranium decay; can seep into well water from surrounding rocks and be released in the air as it leaves the faucet.	Continued breathing of radon gas increases chances of lung cancer; may increase risk of stomach, colon, and bladder cancers.
Uranium (U)	0.03 mg/L	Uranium is leached from natural deposits	High levels suggest the presence of Radon gas. Increased risk of cancer and kidney toxicity.

Water Quality Standards and Interpretation

Methane in Groundwater

Methane is a colorless, odorless and tasteless gas, which is produced by biological decay of organic materials or by high temperatures and pressures acting on organic materials. These materials include coals, organic rich shales, landfill materials, compost piles and other accumulations of organic materials both above and underground. Methane is also produced in the digestive system of humans and animals, and has no known direct health effect. The specific source of methane found in groundwater in Colorado, can generally be determined by detailed and relatively expensive laboratory analysis.

Methane in water wells becomes a problem when it is allowed to build up in confined spaces and become a potential safety hazard. These high concentrations of methane can displace oxygen, or in the presence of a spark, can explode. Extensive testing for methane in water wells in Colorado has been conducted during the past twenty years. As a result of this testing, many believe that methane concentrations below 1 mg/L are considered harmless. Methane levels up to 7 mg/L usually are not a concern but should be monitored for changes. Also, care should be taken to ventilate confined spaces where well water is used. Above 7 mg/L additional



monitoring and treatment should be considered and implemented. Treatment for removing or lowering the concentration of methane in the water delivered into a house is relatively simple and includes vented wellhead caps, cisterns, some form of aeration and ventilation to allow the methane to safely dissipate outdoors rather than accumulate within your home, well house or other confined space. When you find methane in your well water, additional regular testing and monitoring should be performed since methane levels can fluctuate over time.

Figures 1 and 2 on page 20 demonstrate two types of methane treatment, one a small cistern or tank method and the other a more detailed two chambered cistern. Details of operation are found with the figures. In addition, for lower levels of methane, a vented well cap may be a sufficient treatment. As a general rule, the higher the methane

level the more aggressive the removal system must be.

The system in Figure 1 is suitable for low-to-medium levels of methane, whereas Figure 2 describes a system for higher levels of methane.

Water Quality Standards and Interpretation

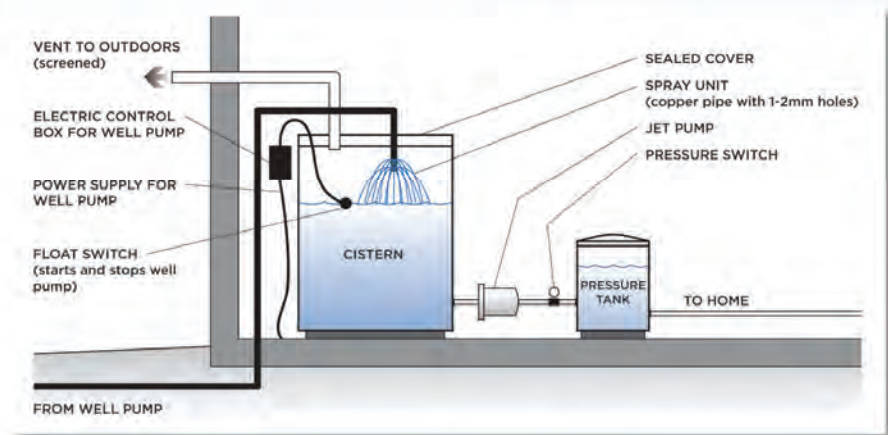


Figure 1: Small Cistern

Small Cistern

This small cistern system can be installed in a basement, garage, utility room or pump house. The active removal of methane is achieved by spraying the water into the open space of the cistern / tank and allowing the escaped gas to vent out.

Since methane is lighter than air it will rise to the top of the cistern and vent. The gas **must** be vented outside of any structure and never allowed to accumulate inside. Remember that this system should be installed by a licensed pump installer or plumber.

trapped methane to escape into the air. At the same time the aeration pump is blowing filtered air into the water further driving off any residual dissolved methane. When the pump refills the cistern (200 to 300 gallons) the air pump continues to blow for an additional 10 to 30 minutes to assure that all of the methane is removed. The methane free water moves into the passive (storage) side of the cistern which is also vented. The methane must be vented outside of any structure and never allowed to accumulate inside.

Because of the complexity of systems like this they should be installed by a licensed pump installer or plumber familiar with control systems.

Where Can I Get Additional Information?

Further assistance with interpretation of your household water quality test report is available. If you have any problems understanding the way the information is presented on the report, you should contact the testing laboratory directly for explanation. To assist you in evaluating the significance of your results, and any actions you should take to solve identified problems, or for further information on contaminants not discussed in this publication, you may want to contact your local Health Department or environmental professional. If you wish to

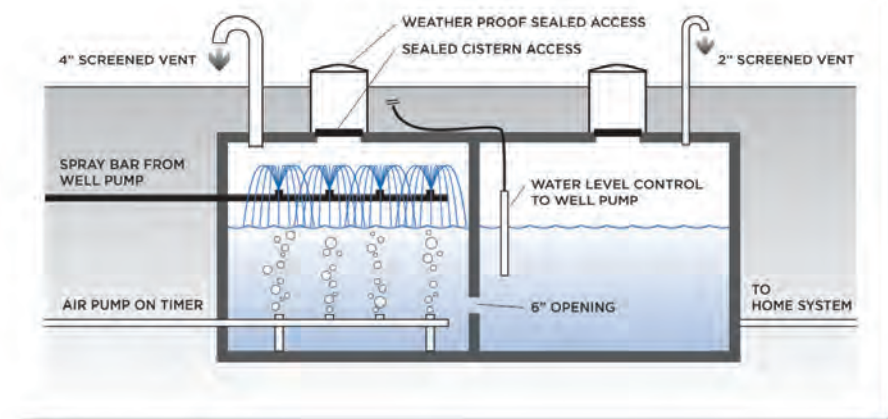


Figure 2: Large Cistern

Large Cistern

This system is an aggressive system and is usually installed outside and underground. In the active chamber one or two spray bars are installed about 15 - 20 inches below the top. One or two aeration bars

are set about 12 inches above the bottom.

When the water in the passive chamber is low enough the controls turn on the well pump and the air pump (Jacuzzi type). The water sprays upward allowing much of the

Water Quality Standards and Interpretation

obtain more background information about the occurrence of contaminants and their effects on household water quality, particularly as it pertains to established drinking water standards, call the EPA Safe Drinking Water Hotline at (800) 426-4791. Or you can explore sites on the internet starting with one or more of the web sites listed in this booklet.

Where Can I Get Additional Help For Water Treatment?

Sources for water treatment assistance are usually found in most Yellow Pages under the headings of "Water Purify & Filter Equipment" or "Water Treatment Equipment, Service and Supplies". Additional assistance can often be found by talking to the local Health Department and in some cases the laboratory that analyzed your water. Care should be taken when a professional offers to test your water or demonstrates in-home water quality tests. Many of these in-home tests are difficult to perform and can provide misleading information. If possible use an independent testing laboratory that is certified. A listing of certified laboratories can be found at: <http://www.cdphe.state.co.us/lr/pages/cert/SDWList.pdf>.

As with the use of any technical service, care should be taken to assure yourself that the professional you have chosen has specific experience

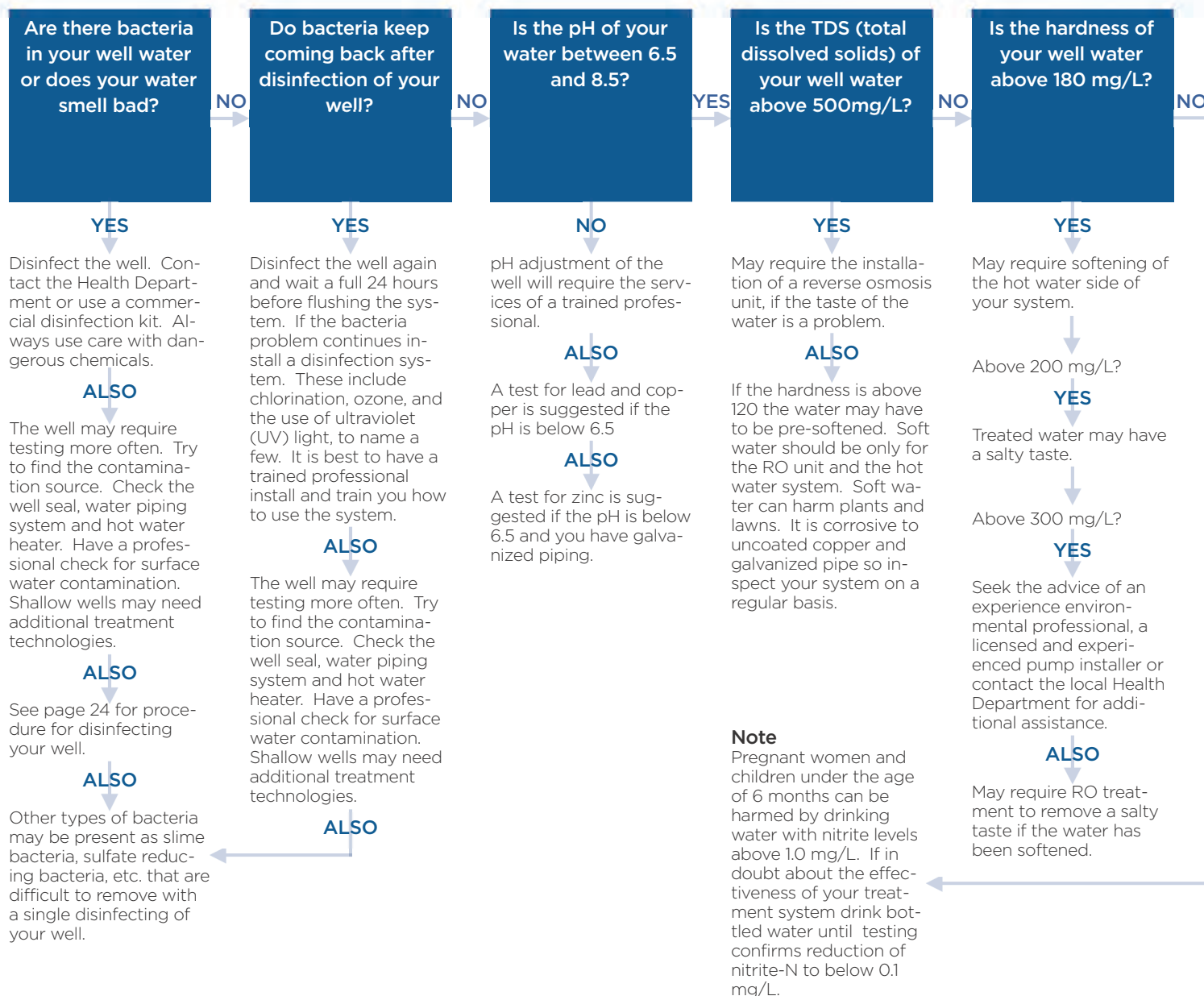
in the treatment of your water's problems. Ask for references, certifications, training credentials and the names of others who have used their services. Check with the Better Business Bureau for consumer complaints. Ask how long the professional has been performing his services. Don't be shy. Obtain recommendations and quotations from more than one professional. Verify the terms of warranty claims on both equipment and installation. Ask to see the technical information on your proposed system before signing any contract.

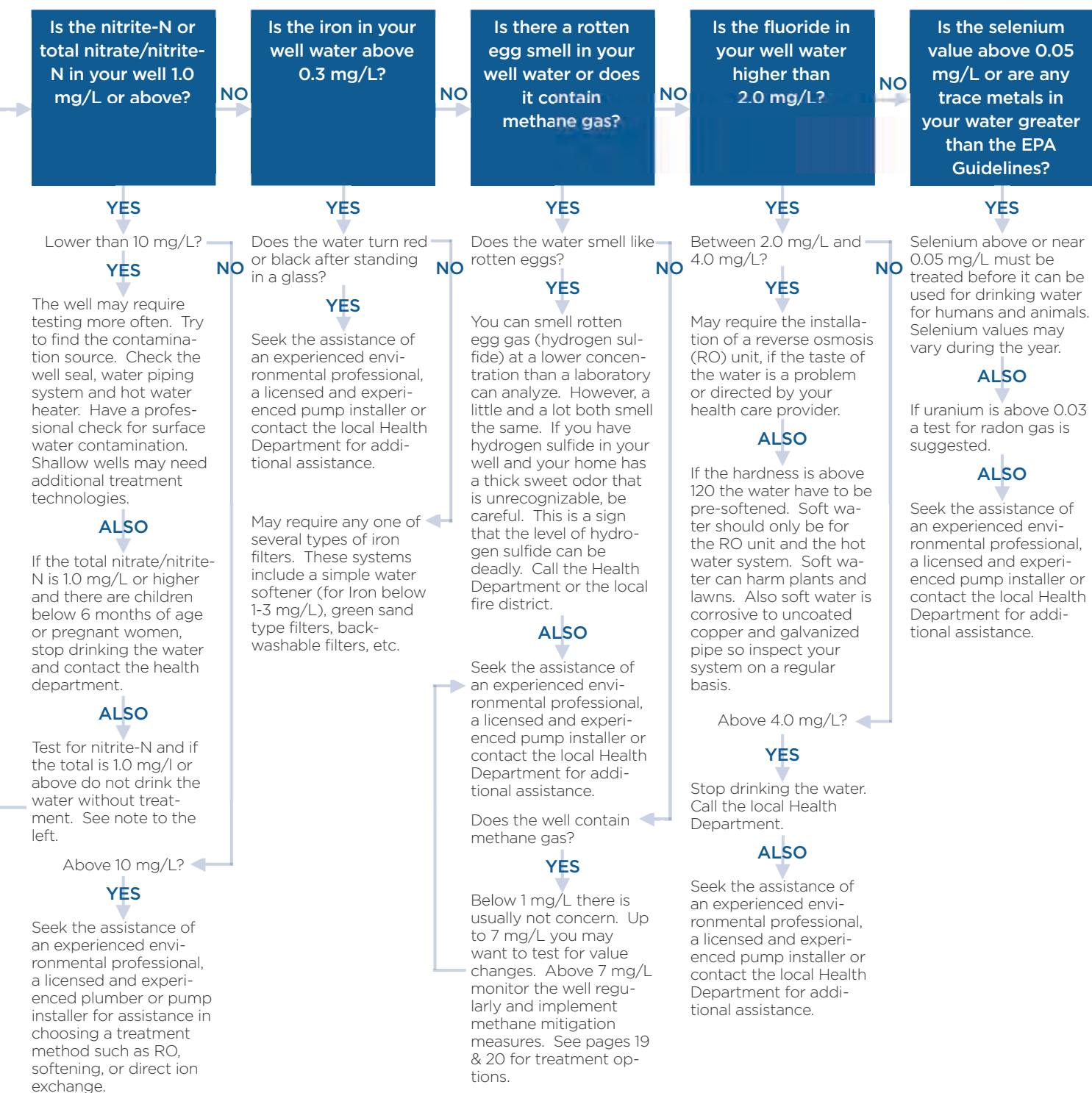
If you have any doubts about the contract drawn up by the professional, seek legal assistance **before** signing. Look up web sites on the specific types of equipment that your professional recommends, talk to your friends, ask a lot of questions, and if you don't get answers, don't buy until your questions are answered. If you can't afford the entire system ask for a recommendation on a basic system to treat the major problem(s) to start with, and make sure that it will be compatible with any upgrades in the future.

Remember that you are the owner of a small domestic water treatment system; essentially a small version of the public systems in cities and towns.

Consequently, it will need to be maintained on a regular basis. Make sure that you are provided with the technical manuals for your system and ask your professional to set up a regular maintenance schedule for you to follow, including follow-up and annual visits by your professional. Record all system maintenance in the Basic Well Data section at the end of this booklet.

Water Treatment Decision Guide





Chlorination Techniques

When to treat your well with chlorine?

You should disinfect your well if your test for bacteria is positive, or following any construction, installation, maintenance, or repair of your well and other water systems. Disinfecting is essential if there has been flooding or other obvious signs of contamination in or around or in your well. The disinfecting process most often recommended is “shock chlorination”. Shock chlorination is the process by which wells are sanitized using household chlorine bleach and is effective in home water systems such as wells, spring houses, and cisterns. Routine shock chlorination is NOT recommended for treating recurring bacteria problems. For these continuing chronic bacteria problems contact a reputable licensed water treatment expert who is familiar with your area.

What precautions should I take prior to chlorination?

Make sure that everyone in your home is warned not to use the water during the treatment process. Arrange for an alternative source of drinking water. Special care should be taken to ensure that children and older adults do not consume tap water during the treatment process. Unless you are familiar with water wells, and are comfortable working with chemicals, the well chlorination should be performed by a licensed

water well contractor, pump installer or licensed plumber. If you have water treatment devices, consult with your water treatment company before beginning the chlorination process. Always use rubber gloves as well as a splash apron and eye protection when handling bleach. Avoid contact with the bleach. If you should splash this solution on your person or clothing, immediately rinse thoroughly with water.

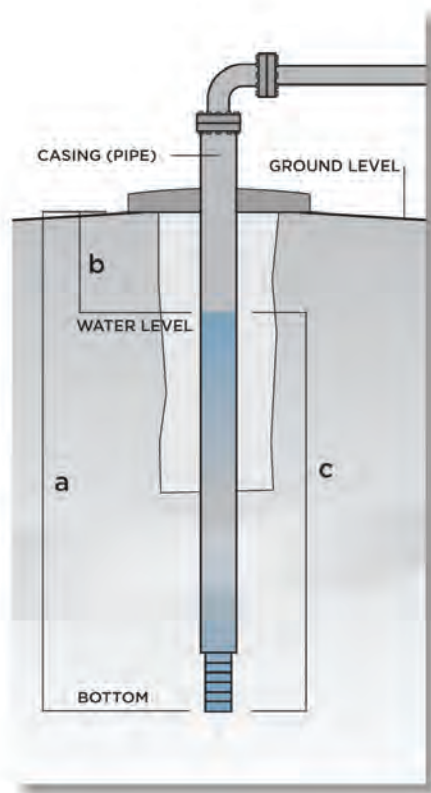


Figure 3: Well Capacity Calculation

How to determine the amount of Chlorine bleach to add to your well.

Use basic 5 % to 6% household laundry bleach (Sodium Hypochlorite). DO NOT USE any of the newer concentrated products, dry bleach or any of the “Fresh Scent,” “Lemon Scent” or similar forms of bleach. The cheapest or generic brand is usually free of added materials.

Three pints of bleach should be added for every 100 gallons of standing water in the well. To determine the amount of standing water in your well you need three measurements (see Figure 3 to the left):

1. The diameter of your well which can be found in your drill log or from a measurement that your driller or pump installer can provide.
2. The total depth of your well (a), which you can obtain from your well’s drill log or from a measurement provided by your driller or pump installer.
3. The depth from the top of your well to the top of the water (b). This measurement can also be provided by your driller or pump installer.

The depth of water in your well is calculated by subtracting measurement b from measurement a, which equals c (depth of water).

Chlorination Techniques

From the chart below determine how much standing water is in your well. Generally, there are two types of wells, drilled and bored. The inside diameter of the casing (well pipe) of a drilled well is typically from 4 to 8 inches. Bored wells are larger, ranging from 24 to 36 inches. Refer to the following table to determine your well's storage per foot of water. If you use a cistern, tank storage or have a hand dug well you will need to contact your local health department or pump installer for additional information and assistance to disinfect your system.

Table 5: Water storage per foot in various size boreholes.

Drilled Well Pipe	
Diameter (inches)	Storage per Foot of Water (gal/ft)
4"	0.653
6"	1.47
8"	2.61

Example: A drilled well with a 6" diameter has a storage per foot of water capacity of 1.47 gal/ft. Next multiply your total depth of water "c" times your storage per foot of water "s." For example if we will assume that "c" is 204 ft. The volume of water in your well is: 204 feet x 1.47 gal/ft = 300 gal. To disinfect your system (well and piping to and in your home) add 3 pints of bleach into your well for every 100 gallons of water, or in this case nine (9)

pints of household bleach. You will also need to add an extra three (3) pints to treat the household plumbing such as the pressure tank, hot water heater, and pipes. So for this example you will use a total of twelve (12) pints or 1.5 gallons of household bleach.

Basic Chlorination Technique

The following basic technique has been recommended by many Health Departments and other agencies. Many web sites have additional or more detailed instructions for the disinfection of domestic drinking water wells that have been deter-

mined to have bacterial contamination. There are three listed at the end of this section. If you use a commercially available disinfection kit follow the manufacturer's directions.

1. Before disinfection, inspect your water system (or have it inspected by a professional) to determine and correct any damage, faults or design problems that may exist. These problems may contribute to the

bacterial contamination found in your well. Inspect all areas and surfaces that may be a source of dust or other contamination in and around the system. After every possible contamination source has been eliminated, the water supply should be disinfected as outlined below:

2. Wearing rubber gloves, a splash apron and eye protection, dilute the amount of bleach you determined (see procedure above) to be adequate for your well's water volume by first adding 2 to 3 gallons of water in a 5 gallon bucket and mixing carefully.
3. Remove the well seal at the top of the well. Now carefully pour the bleach mixture into your well using a large funnel. Wait about 15 minutes and run an additional 15 or 20 gallons of fresh water from a nearby hose bib into the funnel to treat the well bore sides.
4. Now open a cold water faucet in the system and run the water until you can smell the chlorine bleach odor. Turn off the faucet. Now do the same for ALL cold water faucets on the system. Also flush the toilets. Turn off your hot water heater and run hot water until you smell chlorine. Now repeat for all hot water faucets, to allow the piping and the heater to be treated.

Chlorination Techniques

5. Allow the bleach to remain in the entire system for 24 hours (at least overnight). During this wait period do not use the water for any purpose. This is to allow the disinfectant to kill all the bacteria within the system. After the overnight or 24 hour wait, flush out the remaining chlorine by turning on outside faucets letting them run until the chlorine smell dissipates. Finally, run the indoor faucets until the smell of chlorine is gone. Minimize the amount of the water going into your septic

system, streams, rivers, ponds or lakes as the chlorine bleach may disrupt the operation of the septic system or kill wildlife.

6. Wells with excessive bacterial contamination or wells that contain slime, iron or sulfate reducing bacteria may require more than one treatment or the installation of a permanent disinfection system.
7. Two days after the system is flushed obtain a sterile sample bottle from your local Health Department or a certified laboratory and test for bacteria to assure that your treatment was effective. Take this sample as directed from a clean water tap that does not have an aeration head (a possible source of contamination) and take it back to the Health Department or laboratory as soon as possible (within 6 hours).

If your well does not respond to two or three treatments, as described above, contact a licensed pump installer, a water treatment specialist or a licensed plumber familiar with water treatment systems.

Helpful web sites:

Boulder County web site
<http://www.waterwell.cc/CHLORIN.HTM>

University of Georgia web site
www.fcs.uga.edu/pubs/PDF/HACE-858-4.pdf

Lake County Illinois web site
<http://www.lakecountyil.gov/Health/want/Documents/WellChlorination.pdf>



Trouble Shooting Guide

Q – Why does water not come from my well anymore?

A – There may be several reasons why water is not delivered from a well. First check your breaker box to see if the breaker is tripped. You should call a licensed pump installer to check the pump and pump control equipment, which may have failed. The pump installer can also check the water level in the well. Overuse of the aquifer may have dropped the static groundwater level below the depth of your well or pump. The pump may have to be reset at a lower level or the well replaced with a deeper well.

Q – Why does my well seem to pump less water than it used to?

A – Over time minerals or bacteria can constrict your water well screen or your water system pump or piping. Overuse or seasonal lack of recharge of the aquifer can also cause the static groundwater level to drop and thus decrease the amount of water that can enter the well. A licensed well driller or pump installer can clean your well screen and check your pump, piping and water level. They can also measure the yield of your well and compare it to the yield when the well was drilled. Keep good records of all of these checks and maintenance activities as they can be used in the future to help diagnose problems. Record these in the Data section at the end of this booklet.

Q – Why does my pump seem to run every time I turn on the tap?

A – The pressure in your water system is regulated by a pressure tank so that the pump does not have to be run every time there is demand for water. The tank has an air bladder in it that can rupture. Have a licensed pump installer or plumber check the pressure tank and the pump control unit.

Q – Why does my water leave stains on fixtures and clothes?

A – Your water likely has lots of dissolved minerals in it. Have the water tested by a laboratory to determine its chemical composition. You can then use the Water Treatment Decision Guide in this booklet, or call a licensed pump installer to help you decide what treatment equipment may be appropriate for your well and water.

Q – Why is there a lot of sediment in my water?

A – Your well may have been improperly developed to remove excess drilling fluids and sediment when it was drilled. Or your well casing or well seals may have failed. Your cistern (if you have one) may also need cleaning or is damaged. Have a licensed well driller or pump installer inspect the system and determine the source of the sediment.



Q – Why does my water smell like sulfur or have sewer like smell.

A – Your well probably has bacteria in it. Have the water tested for bacteria immediately. The local Health Department or a licensed pump installer can help disinfect the well and find the source of the bacteria.

Q – Why does my water smell or taste like chemicals?

A – Your well may be polluted with chemicals. **Stop using the water immediately.** Call the Health Department to help you find out where the source of the chemical contamination may be and what to analyze your water for. Have the water tested by a laboratory for likely chemical pollutants.

Q – Why does my water fizz?

A – Your well water has gas dissolved in it. This gas may be harmless air or carbon dioxide. It may also be methane or radon. Have the water tested by a laboratory to determine what the gas is and whether or not a treatment system is necessary. A licensed pump installer can find air leaks in the water system if that is the indicated problem. The pump installer can also help with the appropriate treatment system.

Water Testing Glossary

Acidic – descriptive term used in reference to water having a pH of less than 7; pertains to the corrosiveness of water.

Acute Health Effects (acute toxicity) – Any poisonous effect with a sudden and/or severe onset produced within a short period of time after using contaminated water, resulting in mild to severe biological harm or illness. Acute symptoms include, but are not limited to, upset stomach, loose stool, bowel upset, and gastrointestinal difficulties. If symptoms occur as a result of drinking contaminated water, medical attention should be sought promptly.

Aesthetic Characteristics – The non-health related characteristics of water that make it desirable for human use. Generally taste, color, odor, and turbidity are considered to be aesthetic characteristics.

Alkaline – A water sample having a pH greater than 7 is alkaline (non-acidic).

Certified Testing Laboratory – A laboratory certified by the CDPHE as qualified to test drinking water. Information about local state-approved laboratories is available at the Health Department. See the web site list at the end of this booklet for a list of certified labs.

CDPHE – Colorado Department of Public Health and Environment is responsible for the enforcement of EPA public drinking water regulations within the State of Colorado. CDPHE works with EPA, local health departments and when needed with sovereign Indian Tribes, who often have their own environmental departments. See the web site list at the end of this booklet for a link to CDPHE.

Chronic Health Effects – Chronic means long-term. Chronic health effects occur and persist as a result of repeated or long term use of contaminated water. Often, it takes many months or years of exposure for chronic health effects to occur. Chronic health effects include irreversible damage to internal organs, and changes to our gene structure, which can result in cancer, birth defects, disabilities, and additional problems.

Coliform Bacteria – A type of bacteria that is found in the intestinal tract of all animals, including humans. These bacteria are used as an indicator of well cleanliness. If the coliform test is unacceptable, it is an indicator that your well is polluted and that additional tests or treatments are advisable. If the disinfection of your well does not remove the coliform bacteria seek the assistance of your local Health Department. Unacceptable coliform tests

are usually seen on your report as: TNTC (too numerous to count) and confluent growth. You may need to call your licensed pump installer or a water treatment professional to assist in treating chronic bacteria problems.

Concentration – The amount of a given substance (weight) in a specific amount of water (volume) and is often expressed as mg/L or ppm.

Contaminants – Naturally occurring substances when present in high enough levels make water unfit for drinking and/or other household uses. Some contaminants are man-made or come from human activities such as farming, mining, livestock, etc.

Corrosive Water – Water that is acidic or "soft" may be corrosive and may deteriorate plumbing and leach toxic metals such as lead, zinc and copper from pipes.

Corrosivity Index – One of the methods for assessing the scale dissolving (corrosive) or scale forming potential of water. A positive number indicates a tendency to deposit calcium and magnesium carbonates. If the result is negative, it is an indication that the water will dissolve carbonates and enhance corrosion.

Detection Limit – The minimum concentration of a substance that may be measured in the laboratory

Water Testing Glossary

and reported in the given testing method. Many laboratory reports will state what the detection limit is for each contaminant.

Disinfection – The destruction of all pathogenic organisms, with chlorine, ozone, ultraviolet light or heating.

EPA – The abbreviation for the Environmental Protection Agency, properly called, "the United States Environmental Protection Agency". This agency has the responsibility of developing and enforcing Primary Drinking Water Standards for public drinking water systems. EPA does not regulate private wells or cisterns. The EPA also develops, but does not enforce, Secondary Drinking Water Standards. See the web site list at the end of this booklet for a link to EPA.

Grains per Gallon (gpg) – Apothecaries' weight of a chemical substance in one gallon of water used in the water-conditioning trade to indicate hardness of water. One gpg equals approximately 17 mg/L of hardness.

Hardness – A water quality problem in many areas in Colorado. Hardness is a relative term. It describes the content of the dissolved minerals, calcium and magnesium, and is reported as grains per gallon or mg/l. Water with less than 3.5 grains per gallon (60 mg/l) is considered

"soft"; while hard water above 7 grains per gallon (120 mg/l) may affect the appearance of plumbing fixtures, the lifespan of water heaters, and the efficiency of detergents.

Health Risk – The risk or likelihood that a chemical will adversely affect a person's health. Estimating health risks of various chemicals is a complex and inexact science.

Heavy Metals – Elements with higher molecular weights, which are generally toxic in low concentrations to plant and animal life. Examples include mercury, chromium, cadmium, arsenic, selenium, and lead.

Hydrogen Sulfide – A hazardous, poison gas that smells like rotten eggs. It is sometimes produced by bacteria in well waters. It can be found in local water wells at concentrations that are a nuisance but are not poisonous. However in high concentrations the gas can accumulate in low areas and become toxic and/or explosive. Use caution when you smell hydrogen sulfide.

Iron Bacteria – Microorganisms that feed on iron in the water. They may appear as a slimy rust-colored coating on the interior surface of a toilet flush tank or as a dark colored glob of gelatinous material or sand-like lumps of black sediment in the water. Iron bacteria colonies will sometimes float on the surface of a

standing body of water and have an iridescent sheen that is often mistaken for an oil spill.

Maximum Contaminant Level

(MCL) – The maximum level of a contaminant which is permitted in public water supplies. Maximum contaminant levels are specified in the Primary Drinking Water Standards set by EPA and the CDPHE for contaminants that affect the safety of public drinking water.

Methane – A colorless, odorless, flammable, lighter-than-air gas that can be found in water wells which are completed in coal seams, or other zones that contain trapped gasses. Although methane is not a poison, if it is allowed to accumulate in confined spaces it can pose a risk for explosion or fire. Methane is easily removed by proper venting.

Milligrams per Liter (mg/L) – Metric weight of a substance in a liter of water. 1 mg/L = 1 ounce per 7,500 gallons. (1 mg/L = approximately 1 ppm in water)

Nitrate/nitrite-N – A salt form of the element nitrogen. The presence of nitrates and/or nitrites in a water supply generally indicates pollution by human or animal waste, and/or commercial fertilizer. These materials are very dangerous for children below the age of six months.

Water Testing Glossary

Nuisance Contaminants – Contaminants that affect aesthetic or functional aspects of water quality and have little or no impact on health. They are managed in public drinking water systems as Secondary Maximum Contaminant Level (MCL) Standards.

Organic Chemicals – Those chemicals that contain carbon. If not properly handled, stored, transported, and disposed, organic chemicals can pollute water supplies. These can include trihalomethanes, pesticides, volatile organic compounds such as benzene, toluene, ethylbenzene, and xylenes (constituents of crude oil, condensate, and gasoline) and in some areas pharmaceuticals.

Parts per Million (ppm) – Concentration of a substance on a weight basis in water. 1 ppm = 1 pound of a contaminant per million pounds of water (1 ppm in water = approximately 1 mg/L)

Pathogens – Live organisms that contaminate water. Examples include bacteria, viruses, and parasites such as Giardia.

pH – A factor used to measure the acidity and alkalinity of water. Values for pH fall on a scale ranging from 0 to 14. Water that has a pH of 7 is neutral; water that is acid has a pH lower than 7 and water that is

alkaline has a pH greater than 7. The secondary standard for drinking water is a pH between 6.5 and 8.5.

Pollutants – Man-made substances introduced to the environment that at high enough levels can make water unfit for human, animal, or plant consumption or use.

Potable Water – Water that is fit for drinking.

Primary Drinking Water Standards – The Primary Drinking Water Standards for public water supplies are published by the EPA and monitored, and enforced the CDPHE. Primary standards regulate contaminants which pose serious health risks to the water user. The primary standards are only enforceable in public water systems and should be used as a guide for your personal drinking water well. For a link to these standards see the web site list in this booklet for a link to CDPHE or the EPA.

Private Water Systems – Any systems which do not meet the definition of public water systems, for example, a private individual water source, such as a residential water well. Private water systems are not regulated by local health departments, the CDPHE or the EPA.

Public Water System – In Colorado, a public water system is one that serves at least 15 connections (for example households) or at least 25 individuals. CDPHE and EPA regulations apply to public water systems.

Pure – Without contaminants or pollutants.

Radon – A tasteless, odorless, colorless radioactive gas formed from decay of uranium in rocks. Radon has been found dissolved in some groundwater supplies. Activities that release radon as vapor from water include showering, bathing, and cooking. High concentrations of radon are known to be carcinogenic and are linked with increased risk of lung and other cancers. Radon is easily removed from water by purging with air and venting

Safe – The level of a contaminant or pollutant is low enough that no health problems will occur.

Scale – Mineral deposits which build up on the inside of water pipes and water-using appliances, like coffee pots and water heaters. It is made of calcium and magnesium carbonates and usually associated with hard water. Small amounts of scale are helpful in preventing leaching of metal from pipes.

Water Testing Glossary

Secondary Drinking Water Standards – The Secondary Drinking Water Standards are published by the EPA. Secondary Standards set desirable/acceptable levels for nuisance contaminants, which affect taste, odor, color, and other aesthetic and functional qualities of the water supply. These secondary standards are not enforced by law, but rather are guidelines for public water treatment plants and state governments. These guidelines are helpful as you read the laboratory results from your well. For a link to these standards see the web site list in this booklet for a link to CDPHE or the EPA.

Total Dissolved Solids (TDS) – A good general indicator of water quality, which measures the total amount of dissolved minerals, metals, and salts. Water with more than 500 milligrams per liter TDS is of marginal quality and may contain undesirable amounts of calcium, magnesium, sulfates, chlorides, or other salts for human consumption. Many wells produce water that has much higher levels of TDS and in many areas may be the only source of water. High levels of TDS are often safe to drink, but may cause transient gastric problems. These higher levels of TDS can be removed, but often at a higher cost than routine water treatment..

Toxic Metals – Arsenic, barium, chromium, mercury, selenium, lead, and other toxic metals are regulated by EPA Primary Drinking Water Standards. Toxic metals may be naturally occurring in rock and soil, or may pollute water as a result of runoff or leaching from industrial or agricultural sites, mining activities or hazardous waste disposal.

Toxicity – The toxicity (poisonous effect) of a water contaminant depends on the concentration of the contaminant in the water and the period of time the contaminated water is consumed. Any chemical can be toxic, if you swallow enough of it. Also, people react differently to different toxic substances; some people may be harmed more than others. Pregnant and nursing women, the elderly, infants, ill or malnourished people, and people taking medication or that have a compromised immune system may be especially vulnerable to certain contaminants.

Turbidity – A cloudy condition in water due to suspended clay or organic matter. Turbidity can be treated with filters.

Volatile Organic Chemicals (VOCs) – Hydrocarbon containing compounds which evaporate readily and are expensive to analyze. Primary Drinking Water Standards set limits for several volatile organic

chemicals, including the solvents such as trichloroethylene and carbon tetrachloride, and the gasoline component, benzene. Tests for VOC compounds are not routine and tend to be fairly expensive because of the difficult and precise laboratory work involved. Low levels of VOC's can be treated with activated charcoal filter systems. Treated water must be tested to assure that the treatment has reduced the VOC's to a safe level before using as drinking water. Filters must be replaced often.

Water Quality – In general is determined by these characteristics: safety, taste, color, smell, corrosivity, staining, pH, hardness, and chemical composition of dissolved solids.

Text and glossary are freely adapted from publications provided by various state and local agencies and the Colorado Department of Public Health & Environment.

Record of Basic Well Data

Use this form to help document the history of your well.

General Information

Owner's Name:

Owner's Address:

Permit #:

Well Location:

Driller Name:

Phone #:

Pump Installer Name:

Phone #:

Date Drilled:

Pump Installation Date:

Installation Data

Well Depth:

Surface Casing Depth:

Production Casing Diameter:

Cement Interval:

Well Screen Interval:

Pump Size & Type:

Pump Depth:

Water Levels

Initial Static Water Level (feet bgs):

Subsequent Static Water Levels

feet bgs:

Date:

feet bgs:

Date:

feet bgs:

Date:

feet bgs:

Date:

feet bgs:

Date:

feet bgs:

Date:

Yield Rates

Initial Yield Rate (gpm):

Subsequent Yield Rate

gpm

Date

gpm

Date

gpm

Date

gpm

Date

gpm

Date

gpm

Date

Well Maintenance – Record dates and descriptions of work performed.

Additional Notes:

Helpful Water Web Sites

US Environmental Protection Agency

<http://www.epa.gov>

<http://water.epa.gov/drink/>

<http://water.epa.gov/lawsregs/rulesregs/sdwa/currentregulations.cfm>

<http://water.epa.gov/learn/kids/drinkingwater/index.cfm> (stuff for kids to do)

<http://water.epa.gov/drink/info/well/index.cfm>

Radon

<http://www.epa.gov/radon/>

US Geological Survey

<http://www.usgs.gov/water/>

<http://water.usgs.gov/ogw/>

Colorado Department of Public Health & Environment

<http://www.cdphe.state.co.us/>

<http://www.cdphe.state.co.us/wq/drinkingwater/PrivateWellInformation.html>

Colorado Division of Water Resources

<http://water.state.co.us/Home/Pages/default.aspx>

<http://water.state.co.us/groundwater/Pages/default.aspx>

<http://water.state.co.us/groundwater/wellpermit/Pages/default.aspx>

<http://www.dwr.state.co.us/WellPermitSearch/default.aspx>

<http://water.state.co.us/DWRIPub/Documents/constructionrules05.pdf>

Colorado Oil & Gas Conservation Commission

<http://cogcc.state.co.us/>

Colorado State University Extension Service - Water Related Resources

http://www.ext.colostate.edu/pubs/water/water_related.html

The Groundwater Foundation

<http://www.groundwater.org/gi/gi.html>

National Groundwater Association

<http://www.ngwa.org/Fundamentals/Pages/default.aspx>

<http://www.wellowner2.org/2009/>

Water Quality Association

<http://www.wqa.org/landing.cfm?section=3>