



**COLORADO**  
**Energy & Carbon Management  
Commission**  
Department of Natural Resources

1120 Lincoln Street, Suite 801  
Denver, CO 80203

December 18, 2025

Bryan Maloney  
41476 Country Road 105  
Briggsdale, CO, 80611

RE: Water Well Sample  
DWR Water Well / Unregistered Water Well  
Latitude/ Longitude: 40.604064°, -104.068740°, Weld County

Dear Mr. Maloney,

On November 25, 2025, you contacted the Colorado Energy and Carbon Management Commission (ECMC), expressing concern about the quality of the water from your domestic water well and the potential impact on the groundwater and your water well. ECMC contacted you on November 25, 2025, to discuss your concerns and arranged to visit your property on Tuesday, December 5, 2025. This letter summarizes the ECMC's field visit and the laboratory analytical results for the sample that ECMC collected from your water well.

### **SAMPLE COLLECTION**

The water sample was collected from a faucet hydrant south of the house. This faucet is gravity-fed by water pumped from the well to the house and drains to the spigot. ECMC arrived at approximately 8:30 a.m. on December 5, 2025, and reviewed the water well system and potential sample locations with you. At approximately 8:35 a.m., ECMC Staff turned on the faucet to purge the system and activate the well pump. The system purged for approximately 15 minutes, and ECMC collected a sample from the faucet at 8:50 a.m. The purge water was clear, had no signs of odor, and no effervescence.



## **DISCUSSION OF ANALYTICAL RESULTS**

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) established *Domestic Water Supply - Human Health Standards* and *Domestic Water Supply - Secondary Drinking Water Standards* in Regulation 41 “The Basic Standards for Groundwater” (5 CCR 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 exceed these standards. The WQCC also established the *Groundwater Organic Chemical Standards* in Regulation 41, which are standards for organic groundwater contaminants statewide. The ECOM is an implementing agency of the groundwater standards for impacts associated with oil and gas exploration and production activities.

The sample collected from your water well was analyzed for a list of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), dissolved gas (methane, ethane, and propane), dissolved metals, major anions, and nuisance bacteria. Analytical data for the sample from your water well was compared to the CDPHE Regulation 41 standards in the table provided in Attachment 1. The complete laboratory analytical report is provided in Attachment 2.

### ***Volatile Organic Compounds***

The sample from your water well was analyzed for a list of volatile organic compounds, including petroleum hydrocarbons. No other VOCs were detected in the sample collected from your water well.

### ***Semi-Volatile Organic Compounds***

The sample from your water well was analyzed for a list of semi-volatile organic compounds (SVOCs), which includes additional hydrocarbons. No SVOCs were detected in the sample collected from your water well.

### ***Total Petroleum Hydrocarbons***

The laboratory analyzed the sample collected from your water well for total petroleum hydrocarbons. Total petroleum hydrocarbons (TPH) represent a collection of individual hydrocarbon compounds. There is no health-based standard for TPH in groundwater. However, the presence of TPH could indicate impacts from petroleum products such as crude oil, heating oil, or fuel oils, including diesel and gasoline. The sample collected from your water well did not contain TPH at a level above the laboratory reporting limit.

### ***Dissolved Gases***

Methane was not detected in the water sample collected from the water well. Methane gas is a colorless, odorless, and tasteless gas, which is present in some water wells in Colorado. The presence of methane in drinking water does not present a known health hazard to humans or other animals via ingestion. However, methane in domestic or commercial water supplies can be associated with undesirable and potentially serious side effects. Methane gas dissolved in water exsolves when exposed to the atmosphere and dissipates rapidly because it is lighter than air. This is often responsible for the effervescence observed in water wells that contain methane gas. If the methane occurs at a high enough concentration and if it is allowed to accumulate in a confined space, such as a well pit, crawl space, closet, etc., an explosion hazard can be established. In addition, if methane concentrations in a well water are high, bubbles of free gas form within the water and cause the well pump to cavitate and no longer bring water to the surface.

Methane occurs naturally and commonly comes from one of the sources listed below.

- **Biogenic Methane** is present in some aquifers in Colorado, such as the Laramie-Fox Hills in certain locations in Weld County, and other aquifers such as the Upper Pierre aquifer in northern Weld, Morgan and Logan Counties. This domestic water well was most likely completed in the deeper Fox Hills aquifer.
- **Biogenic Methane** is commonly found as a byproduct of the decay of organic matter. The presence of bacteria in water wells can provide conditions favorable for the production of methane either from the activity or decay of bacteria.
- **Thermogenic Methane** is formed by the thermal breakdown of organic material in rocks. This process occurs in rocks that have high temperatures associated with deep burial below the Earth's surface. The gas produced in the oil and gas fields of Weld County includes thermogenic methane, as well as ethane, propane, butane, pentane and hexane.

The stable isotope report from DIG shows that no methane was detected in the water sample. In addition, no ethane and propane were detected in the sample.

### ***Bacteria Occurrence***

The ECMC also collected samples of your water for Biological Activity Reaction Tests (BART™) to determine the presence of bacteria, as described below.

- **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 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 (H<sub>2</sub>S) gas as they grow. The H<sub>2</sub>S 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 not detected in the water sample collected from your 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 detected in the water sample collected from your water well.**

### ***General Water Quality***

Several inorganic (dissolved metals or anions) constituents in the water sample collected from your water well exceeded the CDPHE *Domestic Water Supply - Human Health Standards* including barium and uranium. Fluoride and nitrate were detected in the sample but at concentrations below the CDPHE *Domestic Water Supply - Human Health Standards*. Barium, fluoride, and uranium are naturally occurring elements. Arsenic, lead, nitrite, and selenium were not detected in the sample.

Barium was detected in the sample from your domestic well at a concentration of 13 ug/l. The CDPHE human health standard for barium is 2.0 mg/l. Barium is a highly poisonous metal and should be taken into consideration when used for drinking water.

ECMC compared additional inorganic constituents to the CDPHE *Domestic Water Supply -Drinking Water Standards*. These standards are not health-based but are designed to ensure a general water quality for drinking water.

Chloride was detected in the sample from your water well at a concentration of 20 milligrams per liter (mg/l), which does not exceed the CDPHE *Domestic Water Supply -Drinking Water Standard* of 250 mg/l. Chloride concentrations in excess of 250 mg/l usually produce a noticeable taste in drinking water. Excess chloride concentrations in rural areas can be attributed to the accumulated impacts on groundwater of septic leachate fields and road de-icing.

Total Dissolved Solids (TDS) were detected in the sample from your water well at a concentration of 960 milligrams per liter (mg/l). Although CDPHE has not applied a TDS standard for domestic drinking water, the United States Environmental Protection Agency (US EPA) has implemented a standard called the secondary maximum contaminant level (SMCL). The SCML for TDS is 500 mg/l and is based on the aesthetic quality of the water (such as taste and odor) and is intended as a guideline for public water supply systems and is not an enforceable standard. The total dissolved solids concentration of most groundwater in Colorado exceeds the SCML due to the interaction of the groundwater with naturally occurring minerals in the aquifers. Total dissolved solids concentrations are related to the presence of naturally occurring elements and chemical compounds. Your water well's TDS concentration is composed of chloride, sulfate, calcium, magnesium, potassium, sodium, and bicarbonate.

### **CONCLUSIONS**

There are no indications of impacts to your water well as a result of the plugged and abandoned oil and gas well southwest of your property. The water sample from your water well did not contain VOCs, SVOCs, or TPH.

TDS is a good indicator of overall inorganic water quality. The concentration of dissolved solids in your water well sample was 960 mg/l and does not exceed the secondary drinking water standards established by the US EPA. The secondary standard is an aesthetic standard. Chloride was detected in your water well sample at 20 mg/l, which is not above the CPDHE drinking water standard of 250 mg/l.

The ECMC maintains a water quality database where the results from your water well sample will be recorded.

The Colorado Energy and Carbon Management Commission has participated in the publication of a general information booklet on water supply wells. This booklet is entitled *How Well Do You Know Your Water Well*, and a copy of the booklet accompanies this letter. In addition, the National Groundwater Association has sponsored a website (<http://www.wellowner.org/>) with resources and information for water well owners. You

*Mr. Bryan Maloney*  
*December 18, 2025*  
*Page 6*

can view your water well permit and related documents at the Colorado Division of Water Resources website (<http://www.dwr.state.co.us/WellPermitSearch>).

The analytical results show there is no evidence of the plugged and abandoned oil and gas well (API No. 05-123-36703) impacting your water well at this time.

If you have any questions regarding the sampling results or information in this letter, please contact me at 303-817-5217.

Regards,

Krystal Heibel  
Environmental Protection Specialist - Northeast Colorado

Enclosures: Attachment 1: Table 1 Analytical Summary  
Attachment 2: Laboratory Analytical Reports  
Attachment 3: Water Well Booklet

cc: Kyle Waggoner, ECMC East Environmental Supervisor  
Audrey Blakeman, ECMC Environmental Manager

**TABLE 1 ANALYTICAL SUMMARY**  
 Water Well Sample - Bryan Maloney / DWR Water Well Permit No. (Unregistered)

Parameter	Water Well Sample Results		CDPHE Standards	
	December 2, 2025			
	Result	Domestic Water Supply - Human Health Standards	Agricultural Standards	Units
Arsenic	ND	0.01	0.1	mg/l
Barium	13	2.0	NS	mg/l
Cadmium	NA	0.005	0.01	mg/l
Chromium	NA	0.1	0.1	mg/l
Fluoride	0.7	4.0	2	mg/l
Lead	ND	0.05	0.1	mg/l
Nitrite	ND	1.0	10	mg/l
Nitrate	0.17	10.0	100	mg/l
Total Nitrite/Nitrate	ND	10.0	100	mg/l
Selenium	ND	0.05	0.02	mg/l
Silver	NA	0.05	NS	mg/l
Uranium	0.25	0.03	NS	mg/l
	Result	Domestic Water Supply - Drinking Water (Secondary) Standards	Agricultural Standards	Units
Chloride	20	250	NS	mg/l
Copper	1.7	1	0.2	mg/l
Iron	540	0.3	5	mg/l
Manganese	9.4	0.05	0.2	mg/l
pH	7.6	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	350	250	NS	mg/l
Total Dissolved Solids	960	NS	1.25 x background	mg/l
Calcium	89	NS	NS	mg/l
Magnesium	32	NS	NS	mg/l
Potassium	12	NS	NS	mg/l
Sodium	180	NS	NS	mg/l
Bromide	0.39	NS	NS	mg/l
Carbonate	ND	NS	NS	mg/l
Bicarbonate	450	NS	NS	mg/l
Total Alkalinity	450	NS	NS	mg/l
Conductivity	1.5	NS	NS	mmhos/cm
Sodium Adsorption Ratio	NA	NS	NS	No units
Methane	ND	NS	NS	mg/l

**Notes**

**CDPHE Standards**      Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards For Groundwater.

**mg/l**                      Milligrams per liter (equals parts per million).

**mmhos/cm**              millimhos per centimeer

**NA**                        Not analyzed.

**ND**                        Not detected.

**NS**                        No Standard.

**\*\***                         Health Advisory.

Human health standard.

Secondary standard.



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# ANALYTICAL REPORT

## PREPARED FOR

Attn: Krystal Heibel  
Colorado Energy & Carbon Management Commission  
1120 Lincoln St.  
Suite 801  
Denver, Colorado 80203

Generated 12/17/2025 4:14:32 PM

## JOB DESCRIPTION

KH Split-Sampling

## JOB NUMBER

280-217937-1

# Eurofins Denver

## Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins TestAmerica Project Manager.

## Authorization



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# Case Narrative

Client: Colorado Energy & Carbon Management Commission  
Project: KH Split-Sampling

Job ID: 280-217937-1

**Job ID: 280-217937-1**

**Eurofins Denver**

## Job Narrative 280-217937-1

The analytical test results presented in this report meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page, unless otherwise noted. Data qualifiers and/or narrative comments are included to explain any exceptions, if applicable. Regulated compliance samples (e.g. SDWA, NPDES) must comply with associated agency requirements/permits.

- Matrix-specific batch QC (e.g., MS, MSD, SD) may not be reported when insufficient sample volume is available or when site-specific QC samples are not submitted. In such cases, a Laboratory Control Sample Duplicate (LCSD) may be analyzed to provide precision data for the batch.
- For samples analyzed using surrogate and/or isotope dilution analytes, any recoveries falling outside of established acceptance criteria are re-prepared and/or re-analyzed to confirm results, unless the deviation is due to sample dilution or otherwise explained in the case narrative.

### Receipt

The samples were received on 12/2/2025 11:07 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperatures of the 2 coolers at receipt time were 6.2°C and 6.4°C.

### Receipt Exceptions

The following samples were received at the laboratory outside the required temperature criteria: Sample 1 (280-217937-1) and TB (280-217937-2). The sample(s) is considered acceptable since it was collected and submitted to the laboratory on the same day and there is evidence that the chilling process has begun. The lab will continue with the analysis unless instructed otherwise,

A trip blank was submitted for analysis with these samples; however, it was not listed on the Chain of Custody (COC).

Sterile containers received have no labels or Identification Sample 1 (280-217937-1)

### GC/MS VOA

Method 8260D: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with analytical batch 280-725866. The laboratory control sample (LCS) was performed in duplicate (LCSD) to provide precision data for this batch. Sample 1 (280-217937-1) and TB (280-217937-2)

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

### GC/MS Semi VOA

Method 8270E: The continuing calibration verification (CCV) associated with batch 280-725462 recovered above the upper control limit for Caprolactam. The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated samples are: Sample 1 (280-217937-1) and (CCV 280-725462/5).

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

### Gasoline Range Organics

Method 8015D\_GRO: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with analytical batch 280-726098. The laboratory control sample (LCS) was performed in duplicate (LCSD) to provide precision data for this batch. Sample 1 (280-217937-1).

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

### GC VOA

Method RSK\_175: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with analytical batch 280-725407. The laboratory control sample (LCS) was performed in duplicate (LCSD) to provide precision data for this batch. Sample 1 (280-217937-1) and (280-217937-T-1 DU)

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

### Diesel Range Organics

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

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## Case Narrative

Client: Colorado Energy & Carbon Management Commission  
Project: KH Split-Sampling

Job ID: 280-217937-1

**Job ID: 280-217937-1 (Continued)**

**Eurofins Denver**

### Metals

Method 200.7 - Dissolved: The interference check standard solution (ICSA) associated with batch 280-725725 had results for one or more elements at a level greater than the Reporting Limit. The following are the affected analytes: Cr. The vendor acknowledges that these elements are trace impurities in the ICSA standard. These results are not indicative of a matrix interference.

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

### General Chemistry

Method 9056A\_48HR: The following sample has chromatographic interferences that could adversely impact the identification and quantitation of target analytes: Sample 1 (280-217937-1) These interferences impact nitrate and may cause the value to have a low bias.

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

### Biology

Method BART\_IRB: The following sample was received outside of holding time: Sample 1 (280-217937-1).

Method BART\_SLYM: The following sample was received outside of holding time: Sample 1 (280-217937-1).

Method BART\_SRB: Sample Sample 1 (280-217937-1) was/were received outside of holding time.

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

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# Definitions/Glossary

Client: Colorado Energy & Carbon Management Commission  
Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Qualifiers

### Metals

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

### General Chemistry

Qualifier	Qualifier Description
HF	Parameter with a holding time of 15 minutes. Test performed by laboratory at client's request. Sample was analyzed outside of hold time.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

### Biology

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time. This does not meet regulatory requirements.

## Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
☼	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
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)
TNTC	Too Numerous To Count

# Detection Summary

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

**Client Sample ID: Sample 1**

**Lab Sample ID: 280-217937-1**

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	410		50	15	ug/L	1		200.7 Rev 4.4	Dissolved
Calcium	89000		200	60	ug/L	1		200.7 Rev 4.4	Dissolved
Potassium	12000		1500	500	ug/L	1		200.7 Rev 4.4	Dissolved
Magnesium	32000		200	50	ug/L	1		200.7 Rev 4.4	Dissolved
Sodium	180000		1000	450	ug/L	1		200.7 Rev 4.4	Dissolved
Strontium	2000		5.0	1.5	ug/L	1		200.7 Rev 4.4	Dissolved
Barium	13		2.0	0.55	ug/L	1		200.8	Dissolved
Copper	1.7	J	2.0	1.0	ug/L	1		200.8	Dissolved
Iron	540		200	50	ug/L	1		200.8	Dissolved
Manganese	9.4		3.0	1.5	ug/L	1		200.8	Dissolved
Uranium	0.25	J	1.0	0.25	ug/L	1		200.8	Dissolved
Bromide	0.39	J	0.50	0.20	mg/L	1		9056A	Total/NA
Nitrate as N	0.17	J	0.50	0.10	mg/L	1		9056A	Total/NA
Chloride	20		3.0	1.3	mg/L	1		9056A	Total/NA
Fluoride	0.70		0.50	0.20	mg/L	1		9056A	Total/NA
Sulfate	350		15	6.5	mg/L	5		9056A	Total/NA
Alkalinity	450		10	7.0	mg/L	1		SM 2320B	Total/NA
Bicarbonate Alkalinity as CaCO3	450		10	7.0	mg/L	1		SM 2320B	Total/NA
Specific Conductance (25C)	1500		2.0	2.0	umhos/cm	1		SM 2510B	Total/NA
Total Dissolved Solids (TDS)	960		20	12	mg/L	1		SM 2540C	Total/NA
pH adj. to 25 deg C	7.6	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Temperature	19.7	HF	1.0	1.0	Degrees C	1		SM 4500 H+ B	Total/NA
Iron Related Bacteria	25	H	1.0	1.0	CFU/mL	1		IRB	Total/NA
Slime Forming Bacteria	13000	H	20	20	CFU/mL	1		SLYM	Total/NA

**Client Sample ID: TB**

**Lab Sample ID: 280-217937-2**

No Detections.

This Detection Summary does not include radiochemical test results.

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# Method Summary

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

Method	Method Description	Protocol	Laboratory
8260D	Volatile Organic Compounds by GC/MS	SW846	EET DEN
8270E	Semivolatile Organic Compounds (GC/MS)	SW846	EET DEN
8015D	Gasoline Range Organics (GRO) (GC)	SW846	EET DEN
RSK-175	Dissolved Gases (GC)	RSK	EET DEN
8015D	Diesel Range Organics (DRO) (GC)	SW846	EET DEN
200.7 Rev 4.4	Metals (ICP)	EPA	EET DEN
200.8	Metals (ICP/MS)	EPA	EET DEN
365.1	Phosphorus, Ortho	EPA	EET DEN
9056A	Anions, Ion Chromatography	SW846	EET DEN
SM 2320B	Alkalinity	SM	EET DEN
SM 2510B	Conductivity, Specific Conductance	SM	EET DEN
SM 2540C	Solids, Total Dissolved (TDS)	SM	EET DEN
SM 4500 H+ B	pH	SM	EET DEN
IRB	Iron Reducing Bacteria	BART	EET DAL
SLYM	Slime Forming Bacteria	BART	EET DAL
SRB	Sulfate Reducing Bacteria	BART	EET DAL
200.7	Preparation, Total Recoverable Metals	EPA	EET DEN
200.8	Preparation, Total Recoverable Metals	EPA	EET DEN
3510C	Liquid-Liquid Extraction (Separatory Funnel)	SW846	EET DEN
5030B	Purge and Trap	SW846	EET DEN

#### Protocol References:

BART = Biological Activity Reaction Test

EPA = US Environmental Protection Agency

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.

#### Laboratory References:

EET DAL = Eurofins Dallas, 9701 Harry Hines Blvd, Dallas, TX 75220, TEL (214)902-0300

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

# Sample Summary

Client: Colorado Energy & Carbon Management Commission  
Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Sample Origin
280-217937-1	Sample 1	Water	12/02/25 08:45	12/02/25 11:07	Colorado
280-217937-2	TB	Water	12/02/25 00:00	12/02/25 11:07	Colorado

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# Client Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: SW846 8260D - Volatile Organic Compounds by GC/MS

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		1.0	0.25	ug/L			12/06/25 09:19	1
Ethylbenzene	ND		1.0	0.25	ug/L			12/06/25 09:19	1
Toluene	ND		1.0	0.25	ug/L			12/06/25 09:19	1
Xylenes, Total	ND		1.0	0.25	ug/L			12/06/25 09:19	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
1,2-Dichloroethane-d4 (Surr)	104		80 - 120					12/06/25 09:19	1
Toluene-d8 (Surr)	105		80 - 120					12/06/25 09:19	1
4-Bromofluorobenzene (Surr)	107		80 - 120					12/06/25 09:19	1
Dibromofluoromethane (Surr)	99		80 - 120					12/06/25 09:19	1

**Client Sample ID: TB**  
**Date Collected: 12/02/25 00:00**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-2**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		1.0	0.25	ug/L			12/06/25 08:58	1
Ethylbenzene	ND		1.0	0.25	ug/L			12/06/25 08:58	1
Toluene	ND		1.0	0.25	ug/L			12/06/25 08:58	1
Xylenes, Total	ND		1.0	0.25	ug/L			12/06/25 08:58	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
1,2-Dichloroethane-d4 (Surr)	106		80 - 120					12/06/25 08:58	1
Toluene-d8 (Surr)	105		80 - 120					12/06/25 08:58	1
4-Bromofluorobenzene (Surr)	105		80 - 120					12/06/25 08:58	1
Dibromofluoromethane (Surr)	99		80 - 120					12/06/25 08:58	1

## Method: SW846 8270E - Semivolatile Organic Compounds (GC/MS)

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1'-Biphenyl	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,2'-oxybis[1-chloropropane]	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,4,5-Trichlorophenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,4,6-Trichlorophenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,4-Dichlorophenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,4-Dimethylphenol	ND		9.4	4.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,4-Dinitrophenol	ND		28	9.4	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,4-Dinitrotoluene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2,6-Dinitrotoluene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2-Chloronaphthalene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
2-Chlorophenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2-Methylnaphthalene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
2-Methylphenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2-Nitroaniline	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
2-Nitrophenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
3 & 4 Methylphenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
3,3'-Dichlorobenzidine	ND		28	9.4	ug/L		12/03/25 10:49	12/03/25 18:32	1
3-Nitroaniline	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
4,6-Dinitro-2-methylphenol	ND		47	19	ug/L		12/03/25 10:49	12/03/25 18:32	1

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# Client Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: SW846 8270E - Semivolatile Organic Compounds (GC/MS) (Continued)

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
4-Bromophenyl phenyl ether	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
4-Chloro-3-methylphenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
4-Chloroaniline	ND		19	4.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
4-Chlorophenyl phenyl ether	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
4-Nitroaniline	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
4-Nitrophenol	ND		23	7.5	ug/L		12/03/25 10:49	12/03/25 18:32	1
Acenaphthene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Acenaphthylene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Acetophenone	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Anthracene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Atrazine	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Benzaldehyde	ND		3.7	1.9	ug/L		12/03/25 10:49	12/03/25 18:32	1
Benzo[a]anthracene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Benzo[a]pyrene	ND		3.7	1.9	ug/L		12/03/25 10:49	12/03/25 18:32	1
Benzo[b]fluoranthene	ND		3.7	1.9	ug/L		12/03/25 10:49	12/03/25 18:32	1
Benzo[g,h,i]perylene	ND		3.7	1.9	ug/L		12/03/25 10:49	12/03/25 18:32	1
Benzo[k]fluoranthene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Bis(2-chloroethoxy)methane	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Bis(2-chloroethyl)ether	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Bis(2-ethylhexyl) phthalate	ND		9.4	4.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Butyl benzyl phthalate	ND		3.7	1.9	ug/L		12/03/25 10:49	12/03/25 18:32	1
Caprolactam	ND		19	7.5	ug/L		12/03/25 10:49	12/03/25 18:32	1
Carbazole	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Chrysene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Dibenz(a,h)anthracene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Dibenzofuran	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Diethyl phthalate	ND		3.7	1.9	ug/L		12/03/25 10:49	12/03/25 18:32	1
Dimethyl phthalate	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Di-n-butyl phthalate	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Di-n-octyl phthalate	ND		9.4	4.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Fluoranthene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Fluorene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Hexachlorobenzene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Hexachlorobutadiene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Hexachlorocyclopentadiene	ND		47	19	ug/L		12/03/25 10:49	12/03/25 18:32	1
Hexachloroethane	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Indeno[1,2,3-cd]pyrene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Isophorone	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Naphthalene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Nitrobenzene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
N-Nitrosodi-n-propylamine	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
N-Nitrosodiphenylamine	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Pentachlorophenol	ND		47	19	ug/L		12/03/25 10:49	12/03/25 18:32	1
Phenanthrene	ND		3.7	0.94	ug/L		12/03/25 10:49	12/03/25 18:32	1
Phenol	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1
Pyrene	ND		9.4	3.7	ug/L		12/03/25 10:49	12/03/25 18:32	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
2,4,6-Tribromophenol (Surr)	90		41 - 134	12/03/25 10:49	12/03/25 18:32	1
2-Fluorobiphenyl (Surr)	64		22 - 120	12/03/25 10:49	12/03/25 18:32	1

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# Client Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: SW846 8270E - Semivolatile Organic Compounds (GC/MS) (Continued)

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
2-Fluorophenol (Surr)	52		23 - 120	12/03/25 10:49	12/03/25 18:32	1
Nitrobenzene-d5 (Surr)	79		36 - 120	12/03/25 10:49	12/03/25 18:32	1
Phenol-d5 (Surr)	36		15 - 120	12/03/25 10:49	12/03/25 18:32	1
Terphenyl-d14 (Surr)	91		54 - 127	12/03/25 10:49	12/03/25 18:32	1

## Method: SW846 8015D - Gasoline Range Organics (GRO) (GC)

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
GRO (C6-C10)	ND		25	10	ug/L			12/08/25 19:05	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	97		69 - 133		12/08/25 19:05	1

## Method: RSK-175 - Dissolved Gases (GC)

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ethane	ND		5.0	1.5	ug/L			12/03/25 12:53	1
Methane	ND		5.0	1.5	ug/L			12/03/25 12:53	1
Propane	ND		5.0	1.5	ug/L			12/04/25 15:17	1

## Method: SW846 8015D - Diesel Range Organics (DRO) (GC)

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C28)	ND		0.24	0.095	mg/L		12/03/25 10:52	12/05/25 02:50	1
ORO (C20-C38)	ND		0.24	0.095	mg/L		12/03/25 10:52	12/05/25 02:50	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
o-Terphenyl	76		56 - 150	12/03/25 10:52	12/05/25 02:50	1
n-Octacosane	85		45 - 150	12/03/25 10:52	12/05/25 02:50	1

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

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	410		50	15	ug/L		12/03/25 09:59	12/04/25 22:25	1
Calcium	89000		200	60	ug/L		12/03/25 09:59	12/04/25 22:25	1
Potassium	12000		1500	500	ug/L		12/03/25 09:59	12/04/25 22:25	1
Magnesium	32000		200	50	ug/L		12/03/25 09:59	12/04/25 22:25	1
Sodium	180000		1000	450	ug/L		12/03/25 09:59	12/04/25 22:25	1
Strontium	2000		5.0	1.5	ug/L		12/03/25 09:59	12/04/25 22:25	1

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# Client Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		2.0	0.50	ug/L		12/03/25 09:59	12/04/25 18:42	1
Barium	13		2.0	0.55	ug/L		12/03/25 09:59	12/04/25 18:42	1
Copper	1.7	J	2.0	1.0	ug/L		12/03/25 09:59	12/04/25 18:42	1
Iron	540		200	50	ug/L		12/03/25 09:59	12/04/25 18:42	1
Lead	ND		1.0	0.50	ug/L		12/03/25 09:59	12/04/25 18:42	1
Manganese	9.4		3.0	1.5	ug/L		12/03/25 09:59	12/04/25 18:42	1
Nickel	ND		3.0	1.0	ug/L		12/03/25 09:59	12/04/25 18:42	1
Selenium	ND		2.0	0.50	ug/L		12/03/25 09:59	12/04/25 18:42	1
Uranium	0.25	J	1.0	0.25	ug/L		12/03/25 09:59	12/04/25 18:42	1

## General Chemistry

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Orthophosphate (EPA 365.1)	ND		0.10	0.035	mg/L			12/03/25 19:53	1
Bromide (SW846 9056A)	0.39	J	0.50	0.20	mg/L			12/02/25 16:47	1
Nitrate as N (SW846 9056A)	0.17	J	0.50	0.10	mg/L			12/02/25 16:47	1
Chloride (SW846 9056A)	20		3.0	1.3	mg/L			12/02/25 16:47	1
Nitrite as N (SW846 9056A)	ND		0.50	0.10	mg/L			12/02/25 16:47	1
Fluoride (SW846 9056A)	0.70		0.50	0.20	mg/L			12/02/25 16:47	1
Sulfate (SW846 9056A)	350		15	6.5	mg/L			12/02/25 17:01	5
Alkalinity (SM 2320B)	450		10	7.0	mg/L			12/04/25 22:44	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	450		10	7.0	mg/L			12/04/25 22:44	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	ND		10	7.0	mg/L			12/04/25 22:44	1
Specific Conductance (25C) (SM 2510B)	1500		2.0	2.0	umhos/cm			12/05/25 20:20	1
Total Dissolved Solids (TDS) (SM 2540C)	960		20	12	mg/L			12/03/25 08:58	1
pH adj. to 25 deg C (SM 4500 H+ B)	7.6	HF	0.1	0.1	SU			12/04/25 15:04	1
Temperature (SM 4500 H+ B)	19.7	HF	1.0	1.0	Degrees C			12/04/25 15:04	1

## Method: BART IRB - Iron Reducing Bacteria

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Iron Related Bacteria	25	H	1.0	1.0	CFU/mL			12/04/25 15:46	1

## Method: BART SLYM - Slime Forming Bacteria

**Client Sample ID: Sample 1**  
**Date Collected: 12/02/25 08:45**  
**Date Received: 12/02/25 11:07**

**Lab Sample ID: 280-217937-1**  
**Matrix: Water**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Slime Forming Bacteria	13000	H	20	20	CFU/mL			12/04/25 15:47	1

# Client Sample Results

Client: Colorado Energy & Carbon Management Commission  
Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: BART SRB - Sulfate Reducing Bacteria

Client Sample ID: Sample 1  
Date Collected: 12/02/25 08:45  
Date Received: 12/02/25 11:07

Lab Sample ID: 280-217937-1  
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate Reducing Bacteria	ND	H	1.0	1.0	CFU/mL			12/04/25 15:48	1

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14

# Surrogate Summary

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)			
		DCA (80-120)	TOL (80-120)	BFB (80-120)	DBFM (80-120)
280-217937-1	Sample 1	104	105	107	99
280-217937-2	TB	106	105	105	99
LCS 280-725866/4	Lab Control Sample	108	104	103	102
LCSD 280-725866/5	Lab Control Sample Dup	108	104	104	103
MB 280-725866/10	Method Blank	103	105	107	99

### Surrogate Legend

DCA = 1,2-Dichloroethane-d4 (Surr)  
 TOL = Toluene-d8 (Surr)  
 BFB = 4-Bromofluorobenzene (Surr)  
 DBFM = Dibromofluoromethane (Surr)

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

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)					
		TBP (41-134)	FBP (22-120)	2FP (23-120)	NBZ (36-120)	PHL (15-120)	TPHL (54-127)
280-217937-1	Sample 1	90	64	52	79	36	91
LCS 280-725362/2-A	Lab Control Sample	106	78	57	88	39	92
LCSD 280-725362/3-A	Lab Control Sample Dup	98	59	42	67	28	89
MB 280-725362/1-A	Method Blank	90	62	52	83	35	96

### Surrogate Legend

TBP = 2,4,6-Tribromophenol (Surr)  
 FBP = 2-Fluorobiphenyl (Surr)  
 2FP = 2-Fluorophenol (Surr)  
 NBZ = Nitrobenzene-d5 (Surr)  
 PHL = Phenol-d5 (Surr)  
 TPHL = Terphenyl-d14 (Surr)

## Method: 8015D - Gasoline Range Organics (GRO) (GC)

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)
		BFB1 (69-133)
280-217937-1	Sample 1	97
LCS 280-726098/3	Lab Control Sample	101
LCSD 280-726098/4	Lab Control Sample Dup	102
MB 280-726098/6	Method Blank	101

### Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)

## Method: 8015D - Diesel Range Organics (DRO) (GC)

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)	
		OTPH (56-150)	OTCN (45-150)
280-217937-1	Sample 1	76	85

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# Surrogate Summary

Client: Colorado Energy & Carbon Management Commission  
Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

**Matrix: Water**

**Prep Type: Total/NA**

## Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	OTPH (56-150)	OTCN (45-150)
LCS 280-725363/2-A	Lab Control Sample	84	86
LCS 280-725363/4-A	Lab Control Sample	70	88
LCSD 280-725363/3-A	Lab Control Sample Dup	86	87
LCSD 280-725363/5-A	Lab Control Sample Dup	71	92
MB 280-725363/1-A	Method Blank	69	84

### Surrogate Legend

OTPH = o-Terphenyl

OTCN = n-Octacosane

# QC Association Summary

Client: Colorado Energy & Carbon Management Commission  
Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## GC/MS VOA

### Analysis Batch: 725866

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	8260D	
280-217937-2	TB	Total/NA	Water	8260D	
MB 280-725866/10	Method Blank	Total/NA	Water	8260D	
LCS 280-725866/4	Lab Control Sample	Total/NA	Water	8260D	
LCSD 280-725866/5	Lab Control Sample Dup	Total/NA	Water	8260D	

## GC/MS Semi VOA

### Prep Batch: 725362

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	3510C	
MB 280-725362/1-A	Method Blank	Total/NA	Water	3510C	
LCS 280-725362/2-A	Lab Control Sample	Total/NA	Water	3510C	
LCSD 280-725362/3-A	Lab Control Sample Dup	Total/NA	Water	3510C	

### Analysis Batch: 725462

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	8270E	725362
MB 280-725362/1-A	Method Blank	Total/NA	Water	8270E	725362
LCS 280-725362/2-A	Lab Control Sample	Total/NA	Water	8270E	725362
LCSD 280-725362/3-A	Lab Control Sample Dup	Total/NA	Water	8270E	725362

## GC VOA

### Analysis Batch: 725407

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	RSK-175	
MB 280-725407/5	Method Blank	Total/NA	Water	RSK-175	
LCS 280-725407/3	Lab Control Sample	Total/NA	Water	RSK-175	
LCSD 280-725407/4	Lab Control Sample Dup	Total/NA	Water	RSK-175	
280-217937-1 DU	Sample 1	Total/NA	Water	RSK-175	

### Analysis Batch: 725664

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	RSK-175	
MB 280-725664/5	Method Blank	Total/NA	Water	RSK-175	
LCS 280-725664/3	Lab Control Sample	Total/NA	Water	RSK-175	
LCSD 280-725664/4	Lab Control Sample Dup	Total/NA	Water	RSK-175	

### Analysis Batch: 726098

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	8015D	
MB 280-726098/6	Method Blank	Total/NA	Water	8015D	
LCS 280-726098/3	Lab Control Sample	Total/NA	Water	8015D	
LCSD 280-726098/4	Lab Control Sample Dup	Total/NA	Water	8015D	

## GC Semi VOA

### Prep Batch: 725363

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	3510C	
MB 280-725363/1-A	Method Blank	Total/NA	Water	3510C	

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# QC Association Summary

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## GC Semi VOA (Continued)

### Prep Batch: 725363 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 280-725363/2-A	Lab Control Sample	Total/NA	Water	3510C	
LCS 280-725363/4-A	Lab Control Sample	Total/NA	Water	3510C	
LCSD 280-725363/3-A	Lab Control Sample Dup	Total/NA	Water	3510C	
LCSD 280-725363/5-A	Lab Control Sample Dup	Total/NA	Water	3510C	

### Analysis Batch: 725679

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	8015D	725363
MB 280-725363/1-A	Method Blank	Total/NA	Water	8015D	725363
LCS 280-725363/2-A	Lab Control Sample	Total/NA	Water	8015D	725363
LCS 280-725363/4-A	Lab Control Sample	Total/NA	Water	8015D	725363
LCSD 280-725363/3-A	Lab Control Sample Dup	Total/NA	Water	8015D	725363
LCSD 280-725363/5-A	Lab Control Sample Dup	Total/NA	Water	8015D	725363

## Metals

### Prep Batch: 725366

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Dissolved	Water	200.8	
MB 280-725366/1-A	Method Blank	Total Recoverable	Water	200.8	
LCS 280-725366/15-A	Lab Control Sample	Total Recoverable	Water	200.8	
LCS 280-725366/2-A	Lab Control Sample	Total Recoverable	Water	200.8	

### Analysis Batch: 725703

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Dissolved	Water	200.8	725366
MB 280-725366/1-A	Method Blank	Total Recoverable	Water	200.8	725366
LCS 280-725366/15-A	Lab Control Sample	Total Recoverable	Water	200.8	725366

### Analysis Batch: 725725

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Dissolved	Water	200.7 Rev 4.4	725366
MB 280-725366/1-A	Method Blank	Total Recoverable	Water	200.7 Rev 4.4	725366
LCS 280-725366/2-A	Lab Control Sample	Total Recoverable	Water	200.7 Rev 4.4	725366

## General Chemistry

### Analysis Batch: 725206

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	9056A	
MB 280-725206/6	Method Blank	Total/NA	Water	9056A	
LCS 280-725206/4	Lab Control Sample	Total/NA	Water	9056A	
LCSD 280-725206/5	Lab Control Sample Dup	Total/NA	Water	9056A	
MRL 280-725206/3	Lab Control Sample	Total/NA	Water	9056A	

### Analysis Batch: 725207

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	9056A	
280-217937-1	Sample 1	Total/NA	Water	9056A	
MB 280-725207/6	Method Blank	Total/NA	Water	9056A	
LCS 280-725207/4	Lab Control Sample	Total/NA	Water	9056A	
LCSD 280-725207/5	Lab Control Sample Dup	Total/NA	Water	9056A	

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# QC Association Summary

Client: Colorado Energy & Carbon Management Commission  
Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## General Chemistry (Continued)

### Analysis Batch: 725207 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MRL 280-725207/3	Lab Control Sample	Total/NA	Water	9056A	

### Analysis Batch: 725349

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	SM 2540C	
MB 280-725349/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 280-725349/2	Lab Control Sample	Total/NA	Water	SM 2540C	

### Analysis Batch: 725488

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	365.1	
MB 280-725488/11	Method Blank	Total/NA	Water	365.1	
LCS 280-725488/10	Lab Control Sample	Total/NA	Water	365.1	

### Analysis Batch: 725802

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	SM 2320B	
MB 280-725802/34	Method Blank	Total/NA	Water	SM 2320B	
LCS 280-725802/32	Lab Control Sample	Total/NA	Water	SM 2320B	
LCSD 280-725802/33	Lab Control Sample Dup	Total/NA	Water	SM 2320B	

### Analysis Batch: 725803

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	SM 4500 H+ B	
LCS 280-725803/4	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	

### Analysis Batch: 726021

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	SM 2510B	
MB 280-726021/4	Method Blank	Total/NA	Water	SM 2510B	
LCS 280-726021/3	Lab Control Sample	Total/NA	Water	SM 2510B	

## Biology

### Analysis Batch: 34011

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	IRB	

### Analysis Batch: 34012

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	SLYM	

### Analysis Batch: 34013

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-217937-1	Sample 1	Total/NA	Water	SRB	

# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 8260D - Volatile Organic Compounds by GC/MS

**Lab Sample ID: MB 280-725866/10**  
**Matrix: Water**  
**Analysis Batch: 725866**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	ND		1.0	0.25	ug/L			12/06/25 06:31	1
Ethylbenzene	ND		1.0	0.25	ug/L			12/06/25 06:31	1
Toluene	ND		1.0	0.25	ug/L			12/06/25 06:31	1
Xylenes, Total	ND		1.0	0.25	ug/L			12/06/25 06:31	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane-d4 (Surr)	108		/ 0 - 120		12/05/29 05:81	1
Toluene-d/ (Surr)	109		/ 0 - 120		12/05/29 05:81	1
4-mrof obfuorozen7ene (Surr)	10B		/ 0 - 120		12/05/29 05:81	1
Dizrof obfuorof ethane (Surr)	pp		/ 0 - 120		12/05/29 05:81	1

**Lab Sample ID: LCS 280-725866/4**  
**Matrix: Water**  
**Analysis Batch: 725866**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	50.0	49.3		ug/L		99	80 - 121
Ethylbenzene	50.0	49.5		ug/L		99	80 - 120
Toluene	50.0	47.5		ug/L		95	80 - 120
Xylenes, Total	100	98.9		ug/L		99	80 - 120

Surrogate	LCS %Recovery	LCS Qualifier	Limits
1,2-Dichloroethane-d4 (Surr)	10/		/ 0 - 120
Toluene-d/ (Surr)	104		/ 0 - 120
4-mrof obfuorozen7ene (Surr)	108		/ 0 - 120
Dizrof obfuorof ethane (Surr)	102		/ 0 - 120

**Lab Sample ID: LCSD 280-725866/5**  
**Matrix: Water**  
**Analysis Batch: 725866**

**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	50.0	50.7		ug/L		101	80 - 121	3	20
Ethylbenzene	50.0	51.7		ug/L		103	80 - 120	4	20
Toluene	50.0	49.6		ug/L		99	80 - 120	4	20
Xylenes, Total	100	102		ug/L		102	80 - 120	3	20

Surrogate	LCSD %Recovery	LCSD Qualifier	Limits
1,2-Dichloroethane-d4 (Surr)	10/		/ 0 - 120
Toluene-d/ (Surr)	104		/ 0 - 120
4-mrof obfuorozen7ene (Surr)	104		/ 0 - 120
Dizrof obfuorof ethane (Surr)	108		/ 0 - 120

# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

Lab Sample ID: MB 280-725362/1-A

Matrix: Water

Analysis Batch: 725462

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 725362

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
1,1'-Biphenyl	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,2'-oxybis[1-chloropropane]	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,4,5-Trichlorophenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,4,6-Trichlorophenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,4-Dichlorophenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,4-Dimethylphenol	ND		10	5.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,4-Dinitrophenol	ND		30	10	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,4-Dinitrotoluene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2,6-Dinitrotoluene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2-Chloronaphthalene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2-Chlorophenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2-Methylnaphthalene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2-Methylphenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2-Nitroaniline	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
2-Nitrophenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
3 & 4 Methylphenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
3,3'-Dichlorobenzidine	ND		30	10	ug/L		12/03/25 10:49	12/03/25 17:26	1
3-Nitroaniline	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
4,6-Dinitro-2-methylphenol	ND		50	20	ug/L		12/03/25 10:49	12/03/25 17:26	1
4-Bromophenyl phenyl ether	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
4-Chloro-3-methylphenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
4-Chloroaniline	ND		20	5.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
4-Chlorophenyl phenyl ether	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
4-Nitroaniline	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
4-Nitrophenol	ND		25	8.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Acenaphthene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Acenaphthylene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Acetophenone	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Anthracene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Atrazine	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Benzaldehyde	ND		4.0	2.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Benzo[a]anthracene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Benzo[a]pyrene	ND		4.0	2.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Benzo[b]fluoranthene	ND		4.0	2.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Benzo[g,h,i]perylene	ND		4.0	2.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Benzo[k]fluoranthene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Bis(2-chloroethoxy)methane	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Bis(2-chloroethyl)ether	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Bis(2-ethylhexyl) phthalate	ND		10	5.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Butyl benzyl phthalate	ND		4.0	2.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Caprolactam	ND		20	8.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Carbazole	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Chrysene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Dibenz(a,h)anthracene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Dibenzofuran	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Diethyl phthalate	ND		4.0	2.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Dimethyl phthalate	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Di-n-butyl phthalate	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

**Lab Sample ID: MB 280-725362/1-A**  
**Matrix: Water**  
**Analysis Batch: 725462**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**  
**Prep Batch: 725362**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Di-n-octyl phthalate	ND		10	5.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Fluoranthene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Fluorene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Hexachlorobenzene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Hexachlorobutadiene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Hexachlorocyclopentadiene	ND		50	20	ug/L		12/03/25 10:49	12/03/25 17:26	1
Hexachloroethane	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Indeno[1,2,3-cd]pyrene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Isophorone	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Naphthalene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Nitrobenzene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
N-Nitrosodi-n-propylamine	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
N-Nitrosodiphenylamine	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Pentachlorophenol	ND		50	20	ug/L		12/03/25 10:49	12/03/25 17:26	1
Phenanthrene	ND		4.0	1.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Phenol	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1
Pyrene	ND		10	4.0	ug/L		12/03/25 10:49	12/03/25 17:26	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
2,4,5-Trizrof o3henol (Surr)	p0		41 - 184	12/08/29 10:4p	12/08/29 1B:25	1
2-Fluorozi3henyl (Surr)	52		22 - 120	12/08/29 10:4p	12/08/29 1B:25	1
2-Fluoro3henol (Surr)	92		28 - 120	12/08/29 10:4p	12/08/29 1B:25	1
Nitrozen7ene-d9 (Surr)	/ 8		85 - 120	12/08/29 10:4p	12/08/29 1B:25	1
Phenol-d9 (Surr)	89		19 - 120	12/08/29 10:4p	12/08/29 1B:25	1
Ter3henyl-d14 (Surr)	p5		94 - 12B	12/08/29 10:4p	12/08/29 1B:25	1

**Lab Sample ID: LCS 280-725362/2-A**  
**Matrix: Water**  
**Analysis Batch: 725462**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 725362**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
1,1'-Biphenyl	80.0	56.5		ug/L		71	32 - 120
2,2'-oxybis[1-chloropropane]	80.0	66.4		ug/L		83	31 - 120
2,4,5-Trichlorophenol	80.0	75.0		ug/L		94	57 - 121
2,4,6-Trichlorophenol	80.0	73.9		ug/L		92	53 - 122
2,4-Dichlorophenol	80.0	73.7		ug/L		92	49 - 120
2,4-Dimethylphenol	80.0	71.3		ug/L		89	31 - 120
2,4-Dinitrophenol	160	131		ug/L		82	57 - 131
2,4-Dinitrotoluene	80.0	75.6		ug/L		95	67 - 122
2,6-Dinitrotoluene	80.0	72.7		ug/L		91	65 - 120
2-Chloronaphthalene	80.0	59.1		ug/L		74	33 - 120
2-Chlorophenol	80.0	63.6		ug/L		79	39 - 120
2-Methylnaphthalene	80.0	50.3		ug/L		63	28 - 120
2-Methylphenol	80.0	62.5		ug/L		78	39 - 120
2-Nitroaniline	80.0	74.0		ug/L		93	61 - 120
2-Nitrophenol	80.0	68.9		ug/L		86	46 - 120
3 & 4 Methylphenol	80.0	58.8		ug/L		73	37 - 120
3,3'-Dichlorobenzidine	160	155		ug/L		97	48 - 132

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

**Lab Sample ID: LCS 280-725362/2-A**  
**Matrix: Water**  
**Analysis Batch: 725462**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 725362**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
3-Nitroaniline	80.0	75.5		ug/L		94	56 - 120
4,6-Dinitro-2-methylphenol	160	141		ug/L		88	67 - 129
4-Bromophenyl phenyl ether	80.0	71.2		ug/L		89	57 - 120
4-Chloro-3-methylphenol	80.0	72.4		ug/L		90	56 - 120
4-Chloroaniline	80.0	66.1		ug/L		83	38 - 120
4-Chlorophenyl phenyl ether	80.0	64.2		ug/L		80	47 - 120
4-Nitroaniline	80.0	70.7		ug/L		88	63 - 127
4-Nitrophenol	160	56.3		ug/L		35	25 - 120
Acenaphthene	80.0	59.9		ug/L		75	41 - 120
Acenaphthylene	80.0	61.3		ug/L		77	41 - 120
Acetophenone	80.0	67.2		ug/L		84	49 - 120
Anthracene	80.0	74.6		ug/L		93	65 - 120
Atrazine	80.0	76.0		ug/L		95	55 - 122
Benzaldehyde	80.0	64.5		ug/L		81	29 - 120
Benzo[a]anthracene	80.0	76.5		ug/L		96	67 - 124
Benzo[a]pyrene	80.0	75.9		ug/L		95	65 - 124
Benzo[b]fluoranthene	80.0	79.6		ug/L		100	69 - 136
Benzo[g,h,i]perylene	80.0	81.1		ug/L		101	64 - 126
Benzo[k]fluoranthene	80.0	71.2		ug/L		89	63 - 124
Bis(2-chloroethoxy)methane	80.0	72.0		ug/L		90	47 - 120
Bis(2-chloroethyl)ether	80.0	69.2		ug/L		87	40 - 120
Bis(2-ethylhexyl) phthalate	80.0	70.5		ug/L		88	65 - 129
Butyl benzyl phthalate	80.0	75.5		ug/L		94	66 - 127
Caprolactam	80.0	26.7		ug/L		33	18 - 120
Carbazole	80.0	76.1		ug/L		95	66 - 123
Chrysene	80.0	71.5		ug/L		89	65 - 120
Dibenz(a,h)anthracene	80.0	80.8		ug/L		101	63 - 125
Dibenzofuran	80.0	64.2		ug/L		80	45 - 120
Diethyl phthalate	80.0	73.2		ug/L		92	65 - 120
Dimethyl phthalate	80.0	72.4		ug/L		91	60 - 120
Di-n-butyl phthalate	80.0	78.2		ug/L		98	69 - 129
Di-n-octyl phthalate	80.0	68.8		ug/L		86	60 - 130
Fluoranthene	80.0	77.2		ug/L		96	67 - 122
Fluorene	80.0	66.3		ug/L		83	51 - 120
Hexachlorobenzene	80.0	76.1		ug/L		95	61 - 120
Hexachlorobutadiene	80.0	42.4		ug/L		53	10 - 120
Hexachlorocyclopentadiene	160	78.5		ug/L		49	10 - 126
Hexachloroethane	80.0	41.8		ug/L		52	10 - 120
Indeno[1,2,3-cd]pyrene	80.0	83.4		ug/L		104	62 - 124
Isophorone	80.0	71.2		ug/L		89	49 - 120
Naphthalene	80.0	51.8		ug/L		65	29 - 120
Nitrobenzene	80.0	69.2		ug/L		86	38 - 120
N-Nitrosodi-n-propylamine	80.0	69.8		ug/L		87	48 - 120
N-Nitrosodiphenylamine	80.0	70.5		ug/L		88	61 - 120
Pentachlorophenol	160	130		ug/L		81	48 - 140
Phenanthrene	80.0	73.3		ug/L		92	63 - 120
Phenol	80.0	33.0		ug/L		41	19 - 120
Pyrene	80.0	72.3		ug/L		90	62 - 124

# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

**Lab Sample ID: LCS 280-725362/2-A**  
**Matrix: Water**  
**Analysis Batch: 725462**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 725362**

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
2,4,5-Trizrof o3henol (Surr)	105		41 - 184
2-Fluorozi3henyl (Surr)	B/		22 - 120
2-Fluoro3henol (Surr)	9B		28 - 120
Nitrozen7ene-d9 (Surr)	//		85 - 120
Phenol-d9 (Surr)	8p		19 - 120
Ter3henyl-d14 (Surr)	p2		94 - 12B

**Lab Sample ID: LCSD 280-725362/3-A**  
**Matrix: Water**  
**Analysis Batch: 725462**

**Client Sample ID: Lab Control Sample Dup**  
**Prep Type: Total/NA**  
**Prep Batch: 725362**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec		RPD	RPD Limit
							Limits	RPD		
1,1'-Biphenyl	80.0	43.9		ug/L		55	32 - 120	25	44	
2,2'-oxybis[1-chloropropane]	80.0	49.2		ug/L		61	31 - 120	30	41	
2,4,5-Trichlorophenol	80.0	61.2		ug/L		76	57 - 121	20	30	
2,4,6-Trichlorophenol	80.0	58.0		ug/L		73	53 - 122	24	30	
2,4-Dichlorophenol	80.0	55.6		ug/L		70	49 - 120	28	30	
2,4-Dimethylphenol	80.0	54.4		ug/L		68	31 - 120	27	32	
2,4-Dinitrophenol	160	124		ug/L		78	57 - 131	5	30	
2,4-Dinitrotoluene	80.0	69.5		ug/L		87	67 - 122	8	30	
2,6-Dinitrotoluene	80.0	63.4		ug/L		79	65 - 120	14	30	
2-Chloronaphthalene	80.0	45.8		ug/L		57	33 - 120	25	44	
2-Chlorophenol	80.0	46.8		ug/L		59	39 - 120	30	32	
2-Methylnaphthalene	80.0	39.3		ug/L		49	28 - 120	25	52	
2-Methylphenol	80.0	47.0		ug/L		59	39 - 120	28	33	
2-Nitroaniline	80.0	62.3		ug/L		78	61 - 120	17	30	
2-Nitrophenol	80.0	51.6		ug/L		64	46 - 120	29	31	
3 & 4 Methylphenol	80.0	45.3		ug/L		57	37 - 120	26	33	
3,3'-Dichlorobenzidine	160	152		ug/L		95	48 - 132	2	30	
3-Nitroaniline	80.0	67.4		ug/L		84	56 - 120	11	30	
4,6-Dinitro-2-methylphenol	160	136		ug/L		85	67 - 129	4	30	
4-Bromophenyl phenyl ether	80.0	62.1		ug/L		78	57 - 120	14	31	
4-Chloro-3-methylphenol	80.0	58.1		ug/L		73	56 - 120	22	30	
4-Chloroaniline	80.0	49.6		ug/L		62	38 - 120	29	33	
4-Chlorophenyl phenyl ether	80.0	53.4		ug/L		67	47 - 120	18	34	
4-Nitroaniline	80.0	67.1		ug/L		84	63 - 127	5	30	
4-Nitrophenol	160	57.9		ug/L		36	25 - 120	3	32	
Acenaphthene	80.0	47.3		ug/L		59	41 - 120	23	37	
Acenaphthylene	80.0	48.4		ug/L		61	41 - 120	23	37	
Acetophenone	80.0	50.9		ug/L		64	49 - 120	28	31	
Anthracene	80.0	69.0		ug/L		86	65 - 120	8	30	
Atrazine	80.0	70.3		ug/L		88	55 - 122	8	30	
Benzaldehyde	80.0	56.1		ug/L		70	29 - 120	14	39	
Benzo[a]anthracene	80.0	73.5		ug/L		92	67 - 124	4	30	
Benzo[a]pyrene	80.0	73.3		ug/L		92	65 - 124	4	30	
Benzo[b]fluoranthene	80.0	78.2		ug/L		98	69 - 136	2	30	
Benzo[g,h,i]perylene	80.0	76.0		ug/L		95	64 - 126	6	31	
Benzo[k]fluoranthene	80.0	71.2		ug/L		89	63 - 124	0	30	

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

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

Lab Sample ID: LCSD 280-725362/3-A

Matrix: Water

Analysis Batch: 725462

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 725362

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Bis(2-chloroethoxy)methane	80.0	53.6		ug/L		67	47 - 120	29	32
Bis(2-chloroethyl)ether	80.0	51.2		ug/L		64	40 - 120	30	32
Bis(2-ethylhexyl) phthalate	80.0	72.6		ug/L		91	65 - 129	3	30
Butyl benzyl phthalate	80.0	73.8		ug/L		92	66 - 127	2	30
Caprolactam	80.0	23.3		ug/L		29	18 - 120	13	30
Carbazole	80.0	73.4		ug/L		92	66 - 123	4	30
Chrysene	80.0	69.1		ug/L		86	65 - 120	3	30
Dibenz(a,h)anthracene	80.0	78.7		ug/L		98	63 - 125	3	32
Dibenzofuran	80.0	51.6		ug/L		65	45 - 120	22	35
Diethyl phthalate	80.0	66.1		ug/L		83	65 - 120	10	30
Dimethyl phthalate	80.0	63.0		ug/L		79	60 - 120	14	30
Di-n-butyl phthalate	80.0	76.6		ug/L		96	69 - 129	2	30
Di-n-octyl phthalate	80.0	69.8		ug/L		87	60 - 130	1	30
Fluoranthene	80.0	74.5		ug/L		93	67 - 122	4	30
Fluorene	80.0	55.4		ug/L		69	51 - 120	18	33
Hexachlorobenzene	80.0	69.2		ug/L		87	61 - 120	9	30
Hexachlorobutadiene	80.0	34.8		ug/L		44	10 - 120	20	94
Hexachlorocyclopentadiene	160	62.9		ug/L		39	10 - 126	22	87
Hexachloroethane	80.0	33.3		ug/L		42	10 - 120	23	88
Indeno[1,2,3-cd]pyrene	80.0	79.8		ug/L		100	62 - 124	4	31
Isophorone	80.0	54.0		ug/L		67	49 - 120	28	31
Naphthalene	80.0	40.3		ug/L		50	29 - 120	25	48
Nitrobenzene	80.0	53.0		ug/L		66	38 - 120	26	32
N-Nitrosodi-n-propylamine	80.0	52.0		ug/L		65	48 - 120	29	32
N-Nitrosodiphenylamine	80.0	62.9		ug/L		79	61 - 120	11	30
Pentachlorophenol	160	127		ug/L		79	48 - 140	2	30
Phenanthrene	80.0	68.3		ug/L		85	63 - 120	7	30
Phenol	80.0	24.8		ug/L		31	19 - 120	28	34
Pyrene	80.0	70.2		ug/L		88	62 - 124	3	30

Surrogate	LCSD		Limits
	%Recovery	Qualifier	
2,4,5-Trizrofl o3henol (Surr)	p/		41 - 184
2-Fluorozi3henyl (Surr)	9p		22 - 120
2-Fluoro3henol (Surr)	42		28 - 120
Nitrozen7ene-d9 (Surr)	5B		85 - 120
Phenol-d9 (Surr)	2/		19 - 120
Ter3henyl-d14 (Surr)	/ p		94 - 12B

## Method: 8015D - Gasoline Range Organics (GRO) (GC)

Lab Sample ID: MB 280-726098/6

Matrix: Water

Analysis Batch: 726098

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
GRO (C6-C10)	ND		25	10	ug/L			12/08/25 15:44	1

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 8015D - Gasoline Range Organics (GRO) (GC) (Continued)

**Lab Sample ID: MB 280-726098/6**  
**Matrix: Water**  
**Analysis Batch: 726098**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**

Surrogate	%Recovery	MB MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-mrof obuorozen7ene (Surr)	101		5p - 188		12/03/25 19:44	1

**Lab Sample ID: LCS 280-726098/3**  
**Matrix: Water**  
**Analysis Batch: 726098**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**

Analyte	Spike Added	LCS LCS Result Qualifier	Unit	D	%Rec	%Rec Limits
GRO (C6-C10)	937	1040	ug/L		111	66 - 123

Surrogate	%Recovery	LCS LCS Qualifier	Limits
4-mrof obuorozen7ene (Surr)	101		5p - 188

**Lab Sample ID: LCSD 280-726098/4**  
**Matrix: Water**  
**Analysis Batch: 726098**

**Client Sample ID: Lab Control Sample Dup**  
**Prep Type: Total/NA**

Analyte	Spike Added	LCSD LCSD Result Qualifier	Unit	D	%Rec	%Rec Limits	RPD	Limit
GRO (C6-C10)	937	1130	ug/L		121	66 - 123	8	30

Surrogate	%Recovery	LCSD LCSD Qualifier	Limits
4-mrof obuorozen7ene (Surr)	102		5p - 188

## Method: RSK-175 - Dissolved Gases (GC)

**Lab Sample ID: MB 280-725407/5**  
**Matrix: Water**  
**Analysis Batch: 725407**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**

Analyte	MB MB Result Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ethane	ND	5.0	1.5	ug/L			12/03/25 11:15	1
Methane	ND	5.0	1.5	ug/L			12/03/25 11:15	1
Propane	ND	5.0	1.5	ug/L			12/03/25 11:15	1

**Lab Sample ID: LCS 280-725407/3**  
**Matrix: Water**  
**Analysis Batch: 725407**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**

Analyte	Spike Added	LCS LCS Result Qualifier	Unit	D	%Rec	%Rec Limits
Ethane	123	105	ug/L		86	80 - 120
Methane	65.7	61.7	ug/L		94	80 - 120
Propane	181	150	ug/L		83	80 - 120

**Lab Sample ID: LCSD 280-725407/4**  
**Matrix: Water**  
**Analysis Batch: 725407**

**Client Sample ID: Lab Control Sample Dup**  
**Prep Type: Total/NA**

Analyte	Spike Added	LCSD LCSD Result Qualifier	Unit	D	%Rec	%Rec Limits	RPD	Limit
Ethane	123	98.9	ug/L		80	80 - 120	6	10
Methane	65.7	56.5	ug/L		86	80 - 120	9	10

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: RSK-175 - Dissolved Gases (GC) (Continued)

Lab Sample ID: LCSD 280-725407/4  
 Matrix: Water  
 Analysis Batch: 725407

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
Propane	181	146		ug/L		81	80 - 120	3	10

Lab Sample ID: 280-217937-1 DU  
 Matrix: Water  
 Analysis Batch: 725407

Client Sample ID: Sample 1  
 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

Lab Sample ID: MB 280-725664/5  
 Matrix: Water  
 Analysis Batch: 725664

Client Sample ID: Method Blank  
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ethane	ND		5.0	1.5	ug/L			12/04/25 10:53	1
Methane	ND		5.0	1.5	ug/L			12/04/25 10:53	1
Propane	ND		5.0	1.5	ug/L			12/04/25 10:53	1

Lab Sample ID: LCS 280-725664/3  
 Matrix: Water  
 Analysis Batch: 725664

Client Sample ID: Lab Control Sample  
 Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Ethane	123	110		ug/L		89	80 - 120
Methane	65.7	62.6		ug/L		95	80 - 120
Propane	181	165		ug/L		91	80 - 120

Lab Sample ID: LCSD 280-725664/4  
 Matrix: Water  
 Analysis Batch: 725664

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
Ethane	123	113		ug/L		92	80 - 120	3	10
Methane	65.7	63.0		ug/L		96	80 - 120	1	10
Propane	181	172		ug/L		95	80 - 120	4	10

## Method: 8015D - Diesel Range Organics (DRO) (GC)

Lab Sample ID: MB 280-725363/1-A  
 Matrix: Water  
 Analysis Batch: 725679

Client Sample ID: Method Blank  
 Prep Type: Total/NA  
 Prep Batch: 725363

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C28)	ND		0.25	0.10	mg/L		12/03/25 10:52	12/04/25 22:04	1
ORO (C20-C38)	ND		0.25	0.10	mg/L		12/03/25 10:52	12/04/25 22:04	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
<i>o</i> -Ter3henyl	5p		95 - 190	12/08/29 10:92	12/04/29 22:04	1
<i>n</i> -Octacosane	/ 4		49 - 190	12/08/29 10:92	12/04/29 22:04	1

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 8015D - Diesel Range Organics (DRO) (GC)

**Lab Sample ID: LCS 280-725363/2-A**  
**Matrix: Water**  
**Analysis Batch: 725679**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 725363**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
DRO (C10-C28)	2.00	1.34		mg/L		67	35 - 120
<b>Surrogate</b>							
	<b>%Recovery</b>	<b>LCS</b>	<b>Qualifier</b>	<b>Limits</b>			
<i>o-Ter3henyl</i>	/ 4			95 - 190			
<i>n-Octacosane</i>	/ 5			49 - 190			

**Lab Sample ID: LCS 280-725363/4-A**  
**Matrix: Water**  
**Analysis Batch: 725679**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 725363**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
ORO (C20-C38)	2.01	1.62		mg/L		81	58 - 120
<b>Surrogate</b>							
	<b>%Recovery</b>	<b>LCS</b>	<b>Qualifier</b>	<b>Limits</b>			
<i>o-Ter3henyl</i>	B0			95 - 190			
<i>n-Octacosane</i>	//			49 - 190			

**Lab Sample ID: LCSD 280-725363/3-A**  
**Matrix: Water**  
**Analysis Batch: 725679**

**Client Sample ID: Lab Control Sample Dup**  
**Prep Type: Total/NA**  
**Prep Batch: 725363**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
DRO (C10-C28)	2.00	1.35		mg/L		67	35 - 120	1	32
<b>Surrogate</b>									
	<b>%Recovery</b>	<b>LCSD</b>	<b>Qualifier</b>	<b>Limits</b>					
<i>o-Ter3henyl</i>	/ 5			95 - 190					
<i>n-Octacosane</i>	/ B			49 - 190					

**Lab Sample ID: LCSD 280-725363/5-A**  
**Matrix: Water**  
**Analysis Batch: 725679**

**Client Sample ID: Lab Control Sample Dup**  
**Prep Type: Total/NA**  
**Prep Batch: 725363**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
ORO (C20-C38)	2.01	1.66		mg/L		82	58 - 120	2	27
<b>Surrogate</b>									
	<b>%Recovery</b>	<b>LCSD</b>	<b>Qualifier</b>	<b>Limits</b>					
<i>o-Ter3henyl</i>	B1			95 - 190					
<i>n-Octacosane</i>	p2			49 - 190					

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

**Lab Sample ID: MB 280-725366/1-A**  
**Matrix: Water**  
**Analysis Batch: 725725**

**Client Sample ID: Method Blank**  
**Prep Type: Total Recoverable**  
**Prep Batch: 725366**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		50	15	ug/L		12/03/25 09:59	12/04/25 21:44	1
Calcium	ND		200	60	ug/L		12/03/25 09:59	12/04/25 21:44	1

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# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 200.7 Rev 4.4 - Metals (ICP) (Continued)

**Lab Sample ID: MB 280-725366/1-A**  
**Matrix: Water**  
**Analysis Batch: 725725**

**Client Sample ID: Method Blank**  
**Prep Type: Total Recoverable**  
**Prep Batch: 725366**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Potassium	ND		1500	500	ug/L		12/03/25 09:59	12/04/25 21:44	1
Magnesium	ND		200	50	ug/L		12/03/25 09:59	12/04/25 21:44	1
Sodium	ND		1000	450	ug/L		12/03/25 09:59	12/04/25 21:44	1
Strontium	ND		5.0	1.5	ug/L		12/03/25 09:59	12/04/25 21:44	1

**Lab Sample ID: LCS 280-725366/2-A**  
**Matrix: Water**  
**Analysis Batch: 725725**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total Recoverable**  
**Prep Batch: 725366**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Boron	2000	1890		ug/L		95	85 - 115
Calcium	50000	46700		ug/L		93	85 - 115
Potassium	50000	46600		ug/L		93	85 - 115
Magnesium	50000	45900		ug/L		92	85 - 115
Sodium	50000	47600		ug/L		95	85 - 115
Strontium	1000	941		ug/L		94	85 - 115

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

**Lab Sample ID: MB 280-725366/1-A**  
**Matrix: Water**  
**Analysis Batch: 725703**

**Client Sample ID: Method Blank**  
**Prep Type: Total Recoverable**  
**Prep Batch: 725366**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		2.0	0.50	ug/L		12/03/25 09:59	12/04/25 18:28	1
Barium	ND		2.0	0.55	ug/L		12/03/25 09:59	12/04/25 18:28	1
Copper	ND		2.0	1.0	ug/L		12/03/25 09:59	12/04/25 18:28	1
Iron	ND		200	50	ug/L		12/03/25 09:59	12/04/25 18:28	1
Lead	ND		1.0	0.50	ug/L		12/03/25 09:59	12/04/25 18:28	1
Manganese	ND		3.0	1.5	ug/L		12/03/25 09:59	12/04/25 18:28	1
Nickel	ND		3.0	1.0	ug/L		12/03/25 09:59	12/04/25 18:28	1
Selenium	ND		2.0	0.50	ug/L		12/03/25 09:59	12/04/25 18:28	1
Uranium	ND		1.0	0.25	ug/L		12/03/25 09:59	12/04/25 18:28	1

**Lab Sample ID: LCS 280-725366/15-A**  
**Matrix: Water**  
**Analysis Batch: 725703**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total Recoverable**  
**Prep Batch: 725366**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Arsenic	100	101		ug/L		101	85 - 115
Barium	100	102		ug/L		102	85 - 115
Copper	100	101		ug/L		101	85 - 115
Iron	2000	2040		ug/L		102	85 - 115
Lead	100	100		ug/L		100	85 - 115
Manganese	100	97.5		ug/L		98	85 - 115
Nickel	100	102		ug/L		102	85 - 115
Selenium	100	104		ug/L		104	85 - 115
Uranium	100	101		ug/L		101	85 - 115

# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 365.1 - Phosphorus, Ortho

Lab Sample ID: MB 280-725488/11  
 Matrix: Water  
 Analysis Batch: 725488

Client Sample ID: Method Blank  
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Orthophosphate	ND		0.10	0.035	mg/L			12/03/25 19:52	1

Lab Sample ID: LCS 280-725488/10  
 Matrix: Water  
 Analysis Batch: 725488

Client Sample ID: Lab Control Sample  
 Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Orthophosphate	0.500	0.488		mg/L		98	90 - 110

## Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 280-725206/6  
 Matrix: Water  
 Analysis Batch: 725206

Client Sample ID: Method Blank  
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate as N	ND		0.50	0.10	mg/L			12/02/25 12:51	1
Nitrite as N	ND		0.50	0.10	mg/L			12/02/25 12:51	1

Lab Sample ID: LCS 280-725206/4  
 Matrix: Water  
 Analysis Batch: 725206

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	4.81		mg/L		96	90 - 110
Nitrite as N	5.00	4.93		mg/L		99	90 - 110

Lab Sample ID: LCSD 280-725206/5  
 Matrix: Water  
 Analysis Batch: 725206

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	4.82		mg/L		96	90 - 110	0	10
Nitrite as N	5.00	4.94		mg/L		99	90 - 110	0	10

Lab Sample ID: MRL 280-725206/3  
 Matrix: Water  
 Analysis Batch: 725206

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	0.500	0.508		mg/L		102	50 - 150
Nitrite as N	0.500	0.466	J	mg/L		93	50 - 150

Lab Sample ID: MB 280-725207/6  
 Matrix: Water  
 Analysis Batch: 725207

Client Sample ID: Method Blank  
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromide	ND		0.50	0.20	mg/L			12/02/25 12:51	1
Chloride	ND		3.0	1.3	mg/L			12/02/25 12:51	1

Eurofins Denver

# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: 9056A - Anions, Ion Chromatography (Continued)

**Lab Sample ID: MB 280-725207/6**  
**Matrix: Water**  
**Analysis Batch: 725207**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		0.50	0.20	mg/L			12/02/25 12:51	1
Sulfate	ND		3.0	1.3	mg/L			12/02/25 12:51	1

**Lab Sample ID: LCS 280-725207/4**  
**Matrix: Water**  
**Analysis Batch: 725207**

**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	4.63		mg/L		93	90 - 110
Chloride	100	98.9		mg/L		99	90 - 110
Fluoride	5.00	4.93		mg/L		99	90 - 110
Sulfate	100	98.9		mg/L		99	90 - 110

**Lab Sample ID: LCSD 280-725207/5**  
**Matrix: Water**  
**Analysis Batch: 725207**

**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	4.62		mg/L		92	90 - 110	0	10
Chloride	100	98.9		mg/L		99	90 - 110	0	10
Fluoride	5.00	4.92		mg/L		98	90 - 110	0	10
Sulfate	100	99.0		mg/L		99	90 - 110	0	10

**Lab Sample ID: MRL 280-725207/3**  
**Matrix: Water**  
**Analysis Batch: 725207**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec Limits
Bromide	0.500	0.560		mg/L		112	50 - 150
Chloride	3.00	2.77	J	mg/L		92	50 - 150
Fluoride	0.500	0.497	J	mg/L		99	50 - 150
Sulfate	3.00	3.04		mg/L		101	50 - 150

## Method: SM 2320B - Alkalinity

**Lab Sample ID: MB 280-725802/34**  
**Matrix: Water**  
**Analysis Batch: 725802**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity	ND		10	7.0	mg/L			12/04/25 20:43	1
Bicarbonate Alkalinity as CaCO3	ND		10	7.0	mg/L			12/04/25 20:43	1
Carbonate Alkalinity as CaCO3	ND		10	7.0	mg/L			12/04/25 20:43	1

**Lab Sample ID: LCS 280-725802/32**  
**Matrix: Water**  
**Analysis Batch: 725802**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity	200	198		mg/L		99	89 - 110

Eurofins Denver

# QC Sample Results

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

## Method: SM 2320B - Alkalinity (Continued)

Lab Sample ID: LCSD 280-725802/33  
 Matrix: Water  
 Analysis Batch: 725802

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
Alkalinity	200	197		mg/L		99	89 - 110	0	10

## Method: SM 2510B - Conductivity, Specific Conductance

Lab Sample ID: MB 280-726021/4  
 Matrix: Water  
 Analysis Batch: 726021

Client Sample ID: Method Blank  
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Specific Conductance (25C)	ND		2.0	2.0	umhos/cm			12/05/25 20:20	1

Lab Sample ID: LCS 280-726021/3  
 Matrix: Water  
 Analysis Batch: 726021

Client Sample ID: Lab Control Sample  
 Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Specific Conductance (25C)	1410	1380		umhos/cm		98	90 - 110

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

Lab Sample ID: MB 280-725349/1  
 Matrix: Water  
 Analysis Batch: 725349

Client Sample ID: Method Blank  
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids (TDS)	ND		10	6.0	mg/L			12/03/25 08:58	1

Lab Sample ID: LCS 280-725349/2  
 Matrix: Water  
 Analysis Batch: 725349

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 (TDS)	501	499		mg/L		100	88 - 114

## Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 280-725803/4  
 Matrix: Water  
 Analysis Batch: 725803

Client Sample ID: Lab Control Sample  
 Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
pH adj. to 25 deg C	7.03	7.0		SU		100	99 - 101

# Lab Chronicle

Client: Colorado Energy & Carbon Management Commission  
 Project/Site: KH Split-Sampling

Job ID: 280-217937-1

**Client Sample ID: Sample 1**

**Lab Sample ID: 280-217937-1**

**Date Collected: 12/02/25 08:45**

**Matrix: Water**

**Date Received: 12/02/25 11:07**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D		1	5 mL	5 mL	725866	12/06/25 09:19	MD	EET DEN
Total/NA	Prep	3510C			266.9 mL	1 mL	725362	12/03/25 10:49	EDW	EET DEN
Total/NA	Analysis	8270E		1			725462	12/03/25 18:32	PW	EET DEN
Total/NA	Analysis	8015D		1	5 mL	5 mL	726098	12/08/25 19:05	AES	EET DEN
Total/NA	Analysis	RSK-175		1	20 mL	20 mL	725407	12/03/25 12:53	AES	EET DEN
Total/NA	Analysis	RSK-175		1	20 mL	20 mL	725664	12/04/25 15:17	AES	EET DEN
Total/NA	Prep	3510C			1049.2 mL	1 mL	725363	12/03/25 10:52	EDW	EET DEN
Total/NA	Analysis	8015D		1			725679	12/05/25 02:50	DCL	EET DEN
Dissolved	Prep	200.8			50 mL	50 mL	725366	12/03/25 09:59	AR	EET DEN
Dissolved	Analysis	200.7 Rev 4.4		1			725725	12/04/25 22:25	ADL	EET DEN
Dissolved	Prep	200.8			50 mL	50 mL	725366	12/03/25 09:59	AR	EET DEN
Dissolved	Analysis	200.8		1			725703	12/04/25 18:42	LMT	EET DEN
Total/NA	Analysis	365.1		1	2 mL	2 mL	725488	12/03/25 19:53	LBR	EET DEN
Total/NA	Analysis	9056A		1	10 mL	10 mL	725206	12/02/25 16:47	IRC	EET DEN
Total/NA	Analysis	9056A		1	10 mL	10 mL	725207	12/02/25 16:47	IRC	EET DEN
Total/NA	Analysis	9056A		5	10 mL	10 mL	725207	12/02/25 17:01	IRC	EET DEN
Total/NA	Analysis	SM 2320B		1			725802	12/04/25 22:44	EL	EET DEN
Total/NA	Analysis	SM 2510B		1			726021	12/05/25 20:20	EL	EET DEN
Total/NA	Analysis	SM 2540C		1	50 mL	100 mL	725349	12/03/25 08:58	YBF	EET DEN
Total/NA	Analysis	SM 4500 H+ B		1			725803	12/04/25 15:04	EL	EET DEN
Total/NA	Analysis	IRB		1			34011	12/04/25 15:46	OOE	EET DAL
Total/NA	Analysis	SLYM		1			34012	12/04/25 15:47	OOE	EET DAL
Total/NA	Analysis	SRB		1			34013	12/04/25 15:48	OOE	EET DAL

**Client Sample ID: TB**

**Lab Sample ID: 280-217937-2**

**Date Collected: 12/02/25 00:00**

**Matrix: Water**

**Date Received: 12/02/25 11:07**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260D		1	5 mL	5 mL	725866	12/06/25 08:58	MD	EET DEN

**Laboratory References:**

EET DAL = Eurofins Dallas, 9701 Harry Hines Blvd, Dallas, TX 75220, TEL (214)902-0300

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

# Login Sample Receipt Checklist

Client: Colorado Energy & Carbon Management Commission

Job Number: 280-217937-1

**Login Number: 217937**

**List Source: Eurofins Denver**

**List Number: 1**

**Creator: Held, Wesley**

Question	Answer	Comment
Radioactivity wasn't checked or is <math>\leq</math> background as measured by a survey meter.	True	
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	Received same day of collection; chilling process has begun.
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.	False	Refer to Job Narrative for details.
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 <math><6\text{mm}</math> (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

## Login Sample Receipt Checklist

Client: Colorado Energy & Carbon Management Commission

Job Number: 280-217937-1

**Login Number: 217937**

**List Number: 2**

**Creator: Stoaks, Miya L**


**List Source: Eurofins Dallas**

**List Creation: 12/04/25 11:51 AM**

Question	Answer	Comment
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
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	0.2/-0.4 -0.6 027
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?	N/A	
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.	True	
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").	N/A	



# Chain of Custody Record

<b>Client Information</b>		<b>Sampler</b>		<b>Lab PM</b>		<b>Carrier Tracking No(s)</b>		<b>COC No:</b>	
Client Contact: <b>K. Heibel</b> Phone: <b>(303) 817-5217</b> Email: <b>Olivia.Braganza@et.eurofins.com</b>		State of Origin: <b>CO</b>		Page <b>1</b> of <b>1</b>		Job #:		Preservation Codes: N None D - HNO3 A - HCL R NaThioSO4 Other:	
<b>Company</b> Colorado Energy & Carbon Management Commission		<b>Due Date Requested</b> <b>30 DAYS</b>		<b>TAT Requested (days)</b> <b>30 DAYS</b>		<b>Analysis Requested</b>		<b>Total Number of Containers</b>	
<b>Address:</b> 1120 Lincoln St Suite 801 City: <b>Denver</b> State, Zip: <b>CO, 80203</b> Phone: <b>970-461-2970(Tel)</b> Email: <b>Krystal.heibel@state.co.us</b>		<b>Compliance Project:</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <b>PO #:</b> PHAA GAE 2025-02668 <b>WO #:</b> 075-ENVS-RA <b>Project #:</b> <b>KH Split-Sampling</b> <b>ECMC-Split-Samples/Complaints-RR</b> <b>SSOW#:</b> <b>28030074</b>		<b>Sample Date</b> <b>12/2/25</b>		<b>Sample Time</b> <b>8:45</b>		<b>Sample Type</b> <b>G=grab</b>	
<b>Site:</b> <b>Bryan Maloney</b>		<b>Matrix</b> (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air, DW=Drinking Water)		<b>Preservation Code:</b> <b>G W</b>		<b>Field Filtered Sample (Yes or No)</b> <b>N</b>		<b>Perform MS/MSD (Yes or No)</b> <b>N</b>	
<b>Sample Identification</b> <b>Sample 1</b>		<b>Sample Date</b> <b>12/2/25</b>		<b>Sample Time</b> <b>8:45</b>		<b>Sample Type</b> <b>G=grab</b>		<b>Preservation Code:</b> <b>G W</b>	
<b>Analysis Requested</b>		<b>200 T, 200.8 - Dissolved Metals (Field Filtered)</b>		<b>RSK_175 - Dissolved Gases</b>		<b>8015D GRO - GRO</b>		<b>8260D - VOCs</b>	
<b>220B, 2510B, SM4500_H+ - Alkalinity, Conductivity, pH</b>		<b>365_1 Ortho, 9056A_2BD, 9056A_48HR - Ortho Phosphorus, BCl, F, SO4, NO3, NO2</b>		<b>8015D DRD - DRD</b>		<b>2540C_Calcid - TDS</b>		<b>BART_IRB, BART_SLYM, BART_SRB - Iron Reducing Bacteria, Sime Forming Bacteria, Sulfate Reducing Bacteria</b>	
<b>Special Instructions/Note:</b>		<b>280-217937 Chain of Custody</b>							
<b>Possible Hazard Identification</b> <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown <input type="checkbox"/> Radiological		<b>Deliverable Requested</b> <input type="checkbox"/> I, II, III, IV, Other (specify)		<b>Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)</b> <input type="checkbox"/> Return To Client <input checked="" type="checkbox"/> Disposal By Lab <input type="checkbox"/> Archive For _____ Months		<b>Special Instructions/QC Requirements</b>			
<b>Empty Kit Relinquished by:</b>		<b>Date</b>		<b>Time</b>		<b>Method of Shipment:</b>			
<b>Relinquished by:</b> <b>Krystal Heibel</b>		<b>Date/Time:</b> <b>12/2/25 9:17</b>		<b>Company:</b> <b>ECMC</b>		<b>Received by:</b> <b>Kilian Collins</b>		<b>Date/Time:</b> <b>12/2/25 09:17</b>	
<b>Relinquished by:</b> <b>Kilian Collins</b>		<b>Date/Time:</b> <b>12/2/25 11:05</b>		<b>Company:</b> <b>ECMC</b>		<b>Received by:</b>		<b>Date/Time:</b>	
<b>Relinquished by:</b>									
<b>Custody Seals Intact:</b> <input type="checkbox"/> Yes <input type="checkbox"/> No		<b>Custody Seal No</b>							





**dig**  
Dolan Integration Group

Geochemistry for Energy

11025 Dover Street Unit 800  
Westminster, CO 80021  
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes  
Data and Interpretation**

**Job #:** 251214961  
**Lab #:** DIG-042330  
**Client:** Energy and Carbon Management Commission  
**Sample Name(s):** Sample 1

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#: 251214961  
 #: DIG-042330  
 ent: Energy and Carbon Management Commission  
 Sample Name: Sample 1  
 Date Sampled: 12/02/25  
 Time Sampled: 8:45  
 Sample Description: Isoflask  
 Sampling Notes:  
 Date Received: 12/02/25  
 Date Analyzed: Gas Composition: 12/04/25  $\delta^{13}\text{C}$ : 12/09/25  $\delta\text{D}$ :  
 Date Reported: 12/16/25  
 Comments:

Measured Values:	Measured ppm	Analyte mol % <sup>a</sup>	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	$\delta\text{D}$ ‰ VSMOW	Comments
Nitrogen (N <sub>2</sub> )	821195	81.51	-	-	-	
Nitrogen + Argon (O <sub>2</sub> +Ar)	164184	16.30	-	-	-	
Carbon Dioxide (CO <sub>2</sub> )	22136	2.20	-	-20.80	-	
Helium (He) <sup>b</sup>	nd	nd	-	-	-	
Hydrogen (H <sub>2</sub> )	nd	nd	-	-	-	
Methane (CH <sub>4</sub> )	nd	nd	nd	-	-	
Ethane (C <sub>2</sub> H <sub>6</sub> )	nd	nd	nd	-	-	
Ethane (C <sub>2</sub> H <sub>4</sub> )	nd	nd	nd	-	-	
Propane (C <sub>3</sub> H <sub>8</sub> )	nd	nd	nd	-	-	
Isobutane (C <sub>4</sub> H <sub>10</sub> )	nd	nd	nd	-	-	
Normal butane (C <sub>4</sub> H <sub>10</sub> )	nd	nd	nd	-	-	
Normal pentane (C <sub>5</sub> H <sub>12</sub> )	nd	nd	nd	-	-	
Normal pentane (C <sub>5</sub> H <sub>12</sub> )	nd	nd	nd	-	-	
Normal hexanes + (C <sub>6</sub> H <sub>14</sub> )	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Wetness (mol % C <sub>2</sub> +C <sub>1</sub> +) )	
(C <sub>2</sub> +C <sub>3</sub> ) (mol/mol)	
U	1.00
Specific Gravity	1.00

analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. % )

Condition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

Hydrocarbons

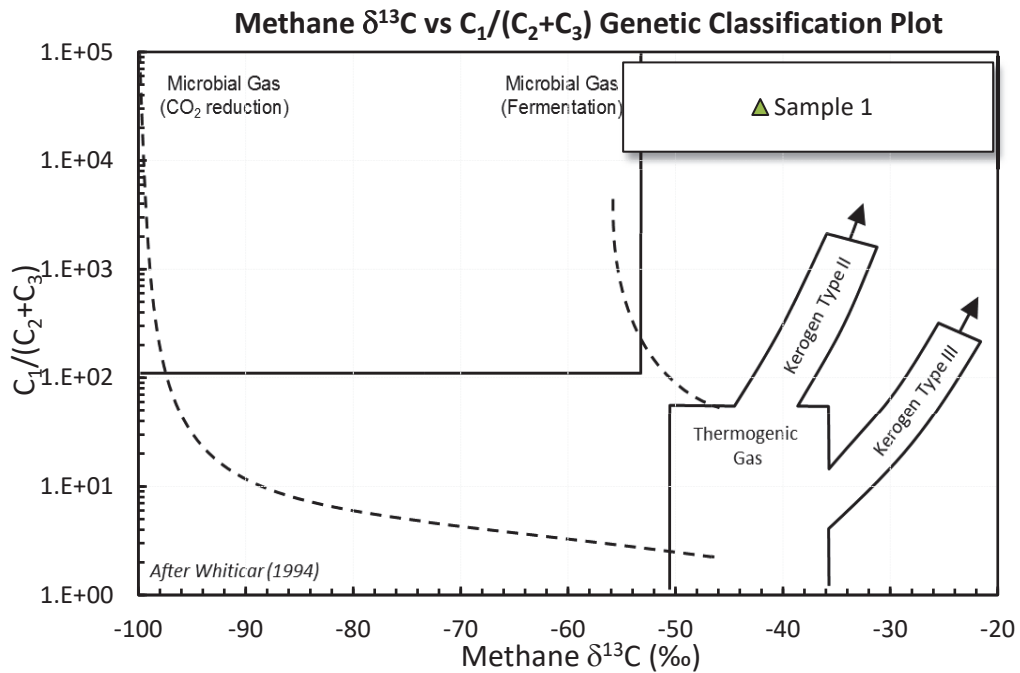
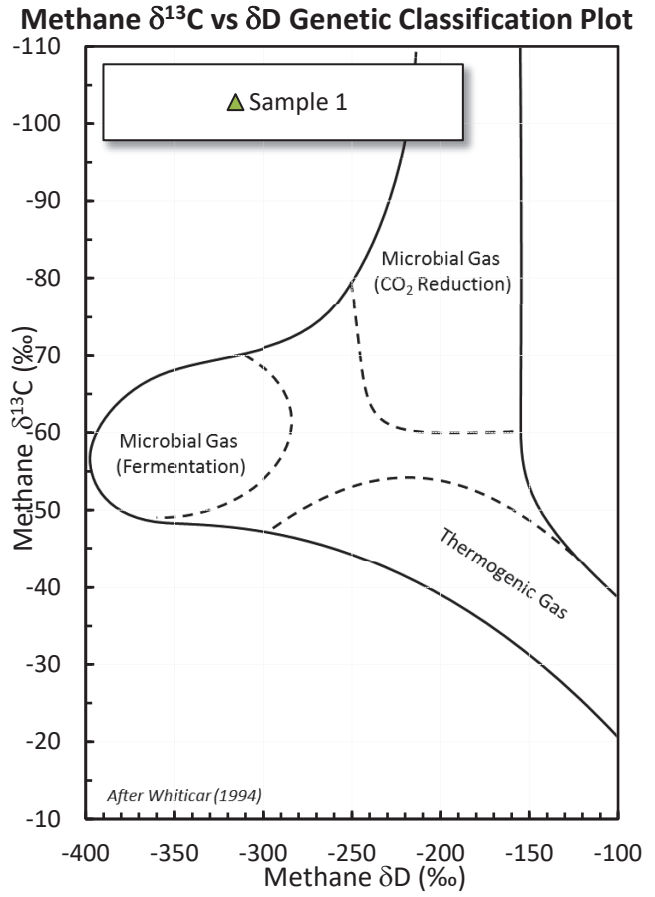
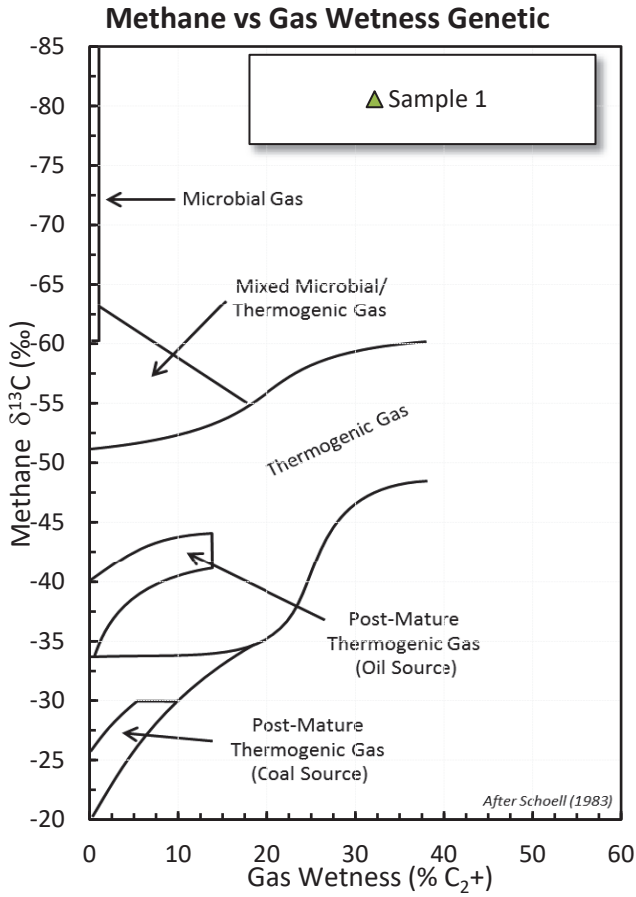
not detected

not analyzed

isotope results based on multi-point laboratory calibration

for  $\delta^{13}\text{C} < 0.5$  ‰

for  $\delta\text{D} < 5.0$  ‰



Energy and Carbon Management Commission Sample 1

251214961

DIG-042330

**INFORMATION**

**STABLE ISOTOPE ANALYSIS**

Client Sample ID	Lab Number	Sample Type	Sample Date	Sample Time	Date Received	$\delta^{13}\text{C}_{\text{DIC}}$
Sample 1	DIG-42332	Water	12/02/25	8:45	12/2/25	-12.5

**RUN CALIBRATION DATA**

Internal checks	$\text{d}^{13}\text{C}$ per mil
1 SD	0.5

Name: Energy and Carbon Management Commission Sample 1  
 251214961  
 DIG-042330

**INFORMATION** **STABLE ISOTOPE ANALYSIS**

Client Sample ID	Lab Number	Sample Type	Sample Date	Sample Time	Date Received	$\delta^{18}\text{O}$ ‰ VSMOW	‰
Sample 1	DIG-042331	Water	12/02/25	8:45	12/2/25	-10.6	

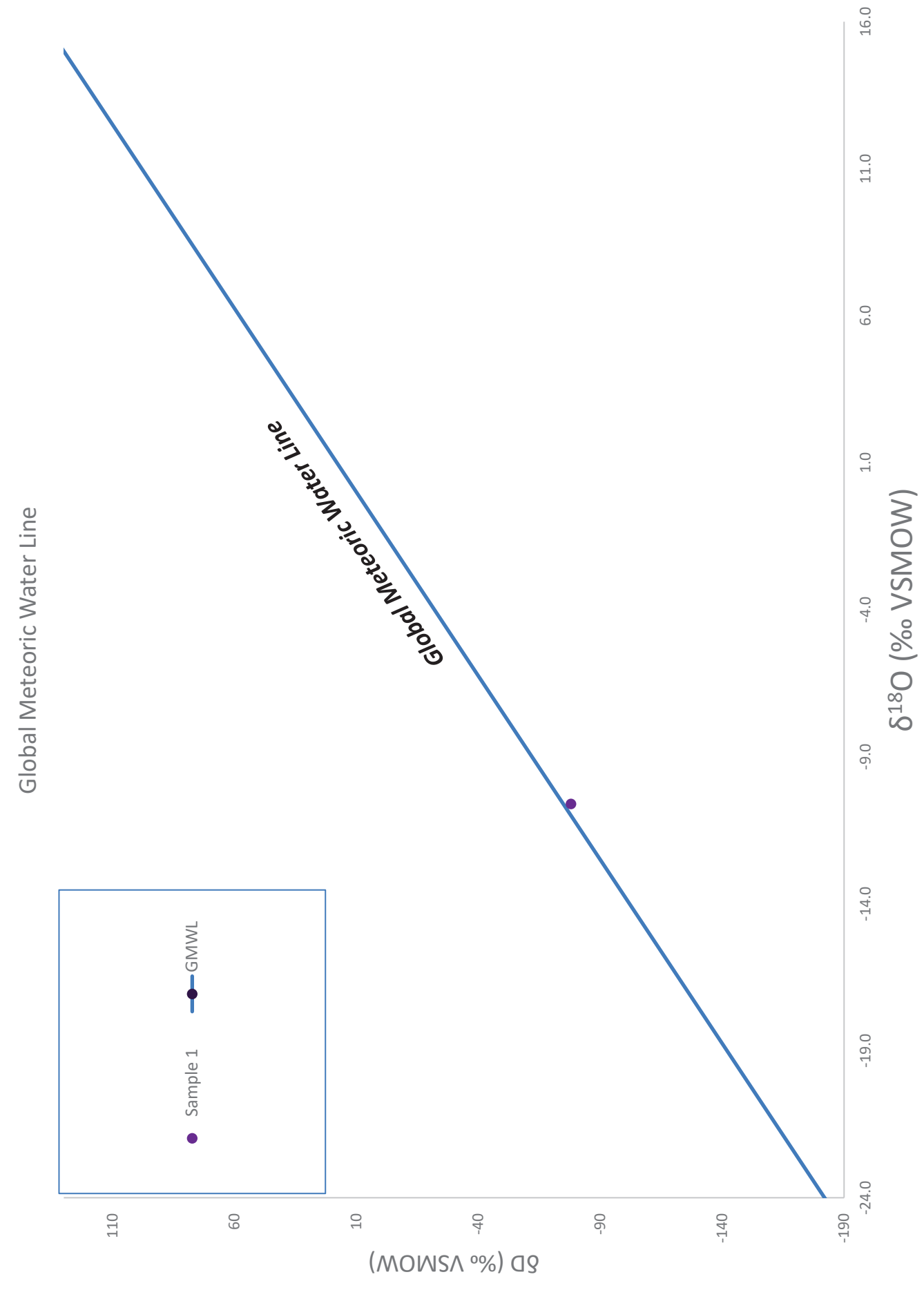
**RUN CALIBRATION DATA**

Internal checks	$\text{d}^2\text{H}$ per mil	$\text{d}^{18}\text{C}$
1 SD	1.00	

Standards					
USGS 46	USGS 47	USGS 48	USGS 50		
d18O	d18O	dD	d18O	dD	d18O
-29.77	-19.83	-150.77	-2.24	-2.41	4.97
0.27	0.15	0.46	0.21	0.85	0.24









# Chain of Custody Form



0



main 303.531.2030 • info@digforenergy.com • digforenergy.com  
Office and Lab 11025 Dover St • Ste 800 • Westminster, CO 80021

Send Data to:	Send Invoice to (if different):	Additional Information:
Name: <i>Krystal Heibel</i>	Name:	AFE #:
Company: <i>EMC</i>	Company: <i>Energy and Carbon Management Commission</i>	Project: <i>Bryan Maloney</i>
Address: <i>1120 Lincoln St. Suite 801</i>	Address: <i>1120 Lincoln St. Suite 801</i>	PO #: <i>GAE PHAA #0516</i>
City, State: <i>Denver, CO <del>80201</del> 80203</i>	City, State: <i>Denver, CO 80203</i>	Location: <i>41476 County Rd 105 Bridgegate CO</i>
Phone: <i>303-817-5217</i>	Phone:	Sampled By: <i>KHeibel</i>
Email: <i>Krystal.heibel@state.co.us</i>	Email:	API #:

Turnaround Time\*\*:  Standard (≤ 10 Business days)  Rush (≤ 5 Business days)  Expedited Rush (≤ 3 Business days)

Container Number	Sample Identification	Date Sampled	Time	Sample Type*	Gas Composition	d13C of Methane (C1)	d13C of Ethane (C2)	d13C of Propane+ (C3+)	d13C of Carbon Dioxide (CO2)	d13C of Methane (C1)	Whole Oil Gas Chromatography (with ASTM D1250)	ASTM D1250 (API Gravity)	d15O and dD Isotopes of Water	Gas Quantification	RSK 175 Dissolved Inorganic Carbon (DIC)	d13C of Dissolved Inorganic Carbon (DIC)	Other (Specify):
	<i>Sample 1</i>	<i>12/2/25</i>	<i>8:45</i>	<i>Other Water</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
				Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

0

Chain of Custody Record Comments:

Relinquished by Signature	Company	Date	Time	Received by Signature	Company	Date	Time
<i>Krystal</i>	<i>EMC</i>	<i>12/2/25</i>	<i>2:00</i>	<i>Earl W. Hill</i>	<i>DSG</i>	<i>12/2/25</i>	<i>14:00</i>

\*Gas composition vs RSK-175 - Gas composition is a basic analysis of the concentration (ppm) of gases within the headspace of the sample (headspace is created at the lab). RSK-175 is a specific analysis technique combined with calculations to give the total dissolved gas of each species in the water sample (mg/L). Why one or the other? Gas composition gives us a quick, general look at relative concentrations and ratios (e.g., gas wetness). RSK-175 gives us an exact total of gas present in the sample (headspace and dissolved in the water). Questions? Give us a call at 303-531-2030.

\*\* Rush and Expedited Rush turnaround time analysis will incur additional costs at 2x and 3x the standard turnaround time pricing.



# 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 an example of groundwater discharged from a limestone aquifer.

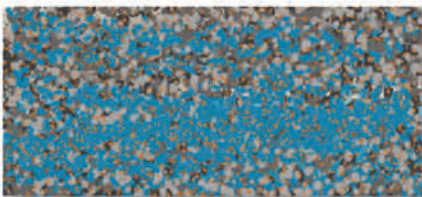
Aquifers are replenished through a process called “recharge.” Rain, snowmelt and even irrigation water all soak into the ground and slowly move and accumulate to saturate

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.



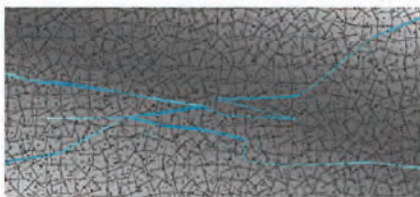
*Sand and Gravel*



*Sandstone*



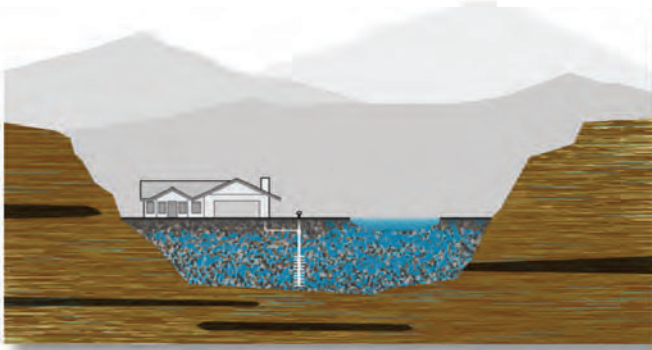
*Shale and Coal*



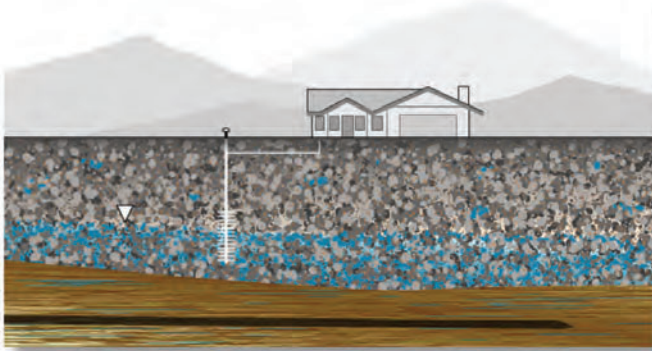
*Crystalline Rock*

## 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.

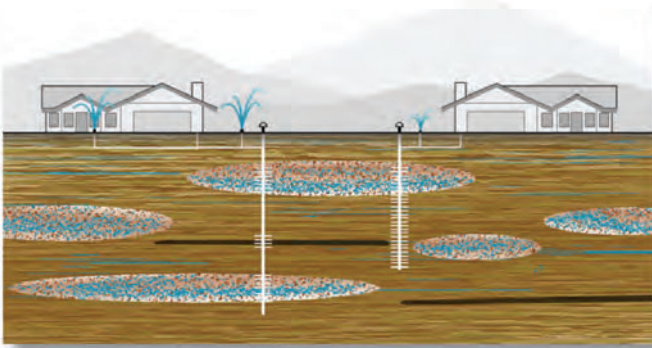
### **Glacial Outwash Aquifer**

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.

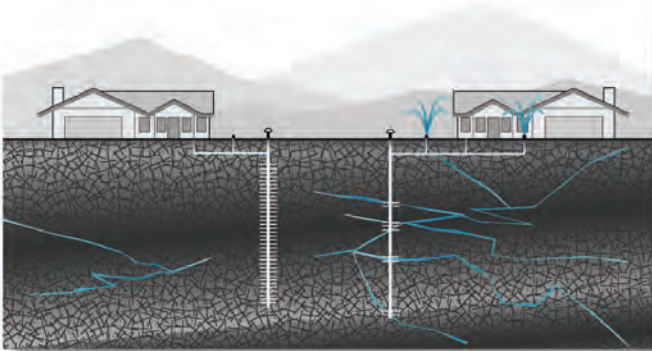
### **Dune Field Aquifer**

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 05/2011		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) 866-3562		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				DRILLING METHOD: Air Rotary			
DATE COMPLETED: 6/1/11				TOTAL DEPTH: 200 feet			
DATE COMPLETED: 6/1/11				DEPTH COMPLETED: 189 feet			
5. GEOLOGIC LOG:							
Depth	Type	Grain Size	Color	Water Loc.	6. HOLE DIAM. (in.)		
0 - 30	Silty sand	SM	brown		From (ft)	To (ft)	
30 - 40	Gravel	GP	grey	yes	12"	0	25
40 - 60	Shale		yellow		8"	25	200
60 - 90	Sandstone	fine	brown	yes	7. PLAIN CASING:		
90 - 100	Shale		green		OD (in)	Kind	Wall Size (in)
100 - 135	Sandstone	fine	brown	yes	9"	Steel	0.25
135 - 200	Shale		green		5.5"	PVC	Sch 40
					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	Amount	Density
					cement		0-25
					cement		0-50
							tremie
Remarks: Water in gravel and sandstones							
11. DISINFECTION: Type Bleach Amt. Used 1.25 gal. 48 hrs.							
12. WELL TEST DATA: <input type="checkbox"/> 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 37-91-106(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.

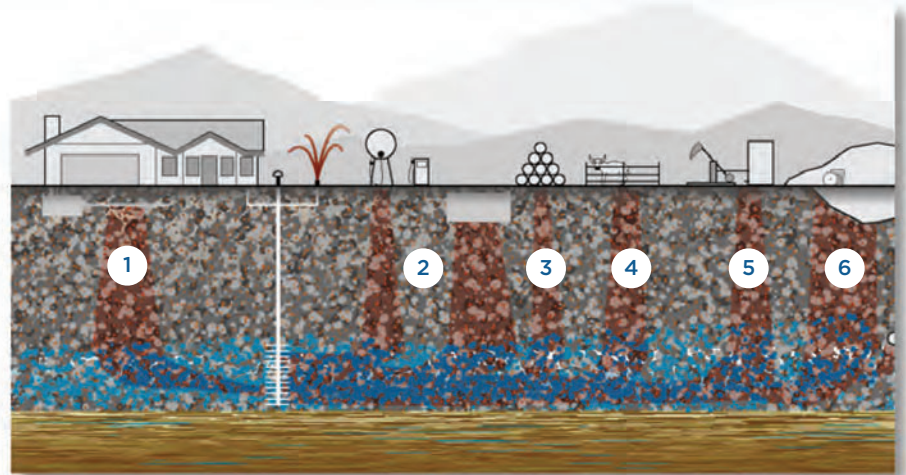
# Water Well Protection and Pollution Sources

## 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

icals 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.



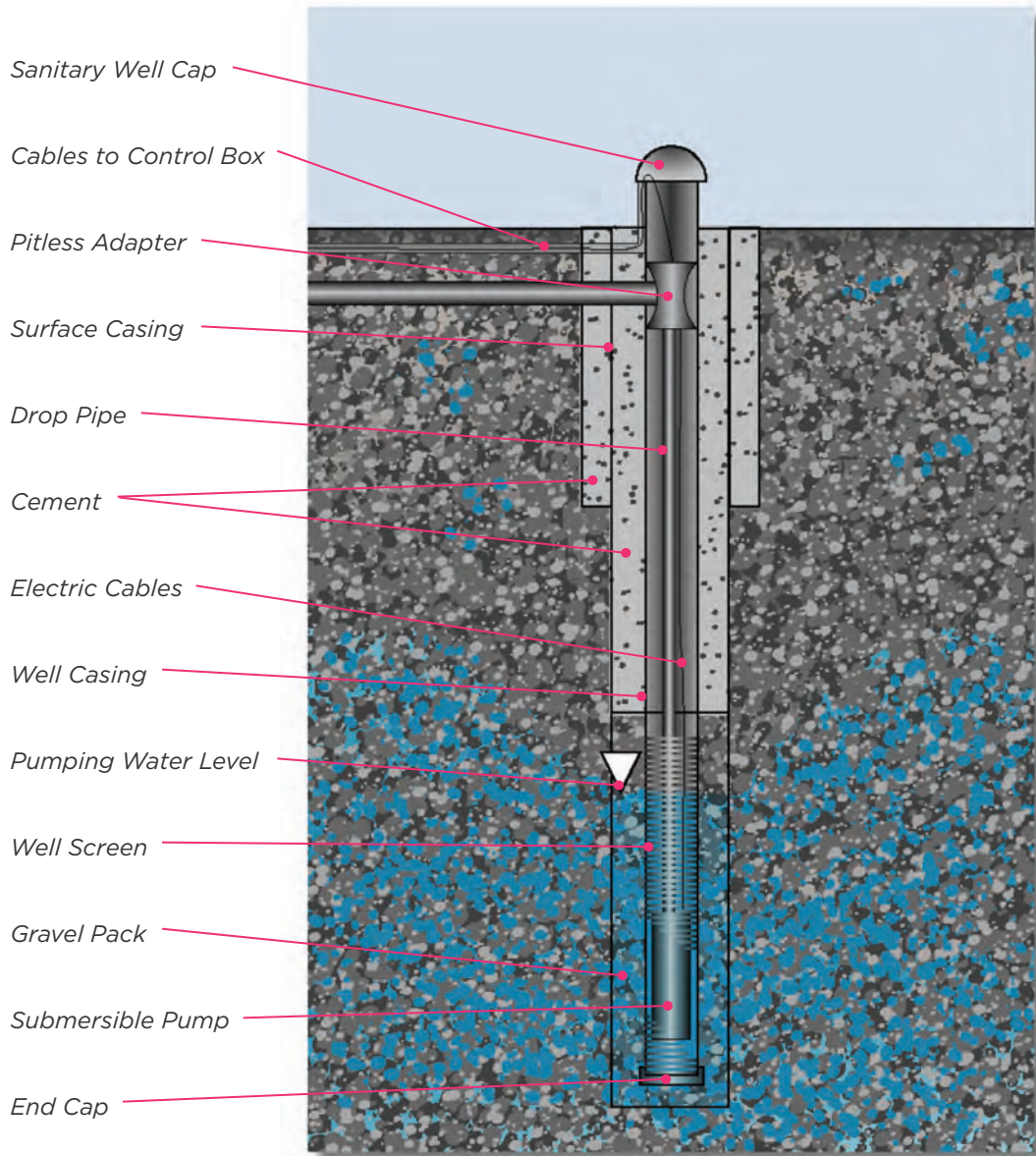
# Anatomy of a Water Well

## 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


**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

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	? S/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	180.1	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

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

## 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 <sub>4</sub> )	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

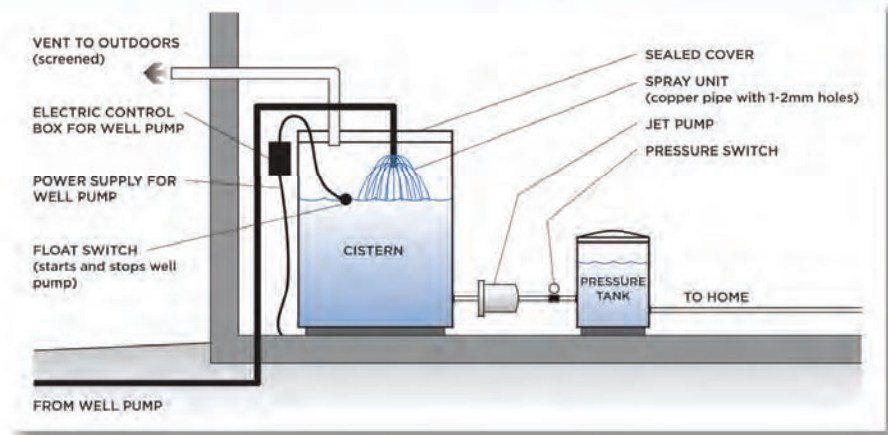


Figure 1: Small Cistern

### 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

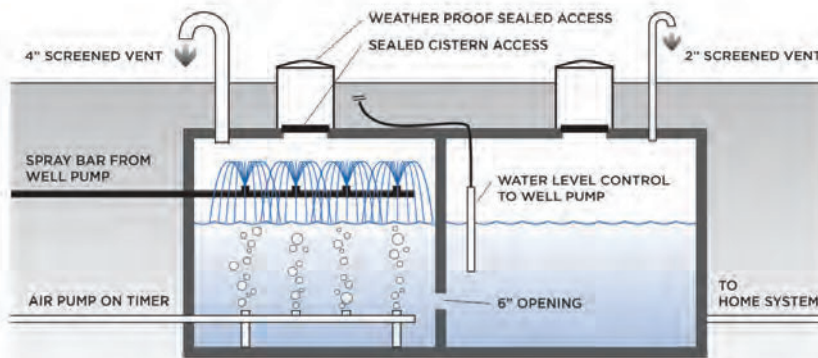


Figure 2: Large Cistern

### 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 exper-

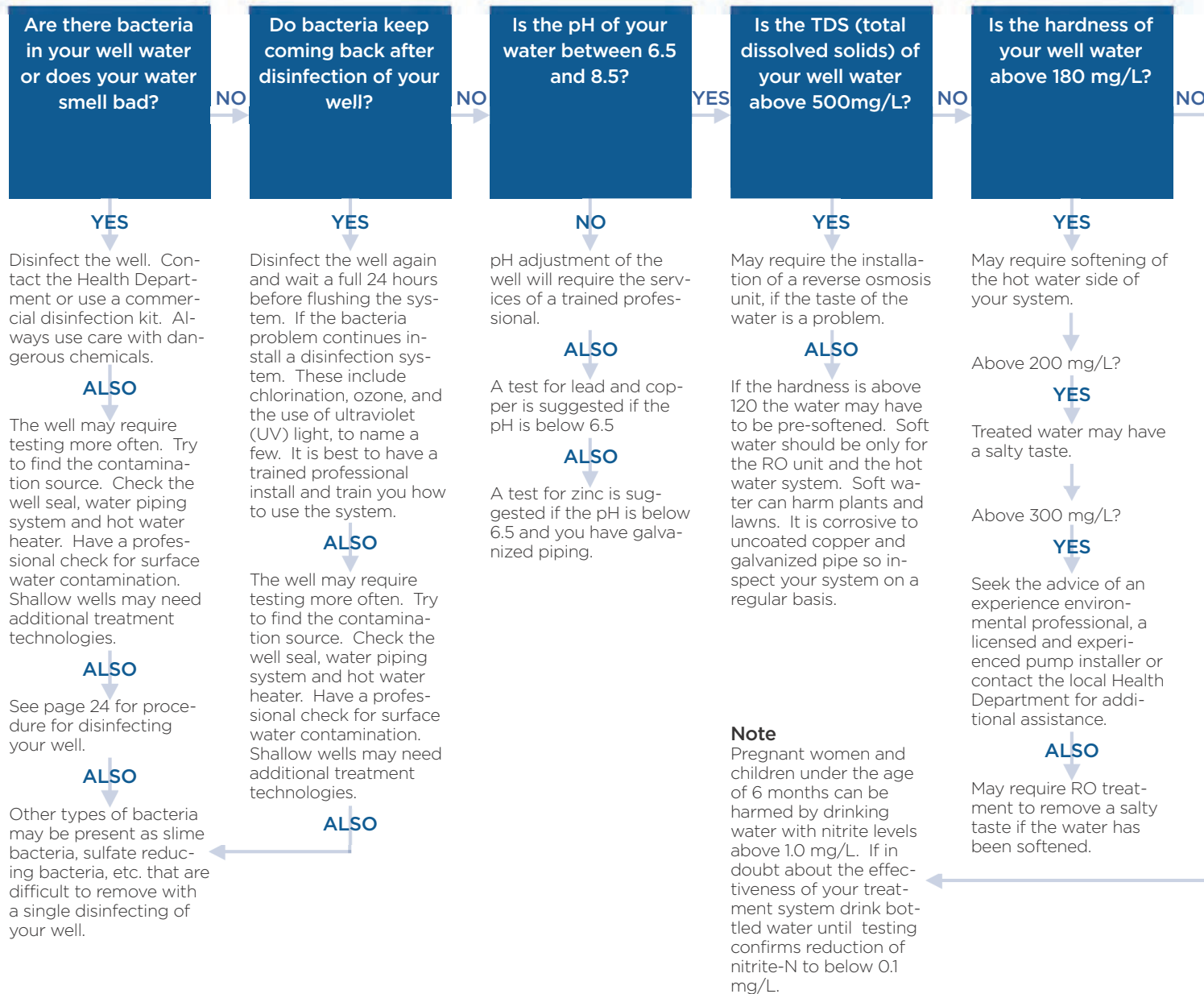
ience in the treatment of your water’s problems. Ask for references, certifications, training credentials and the names of others who have used their services. Check with the Better Business Bureau for consumer complaints. Ask how long the professional has been performing his services. Don’t be shy. 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.

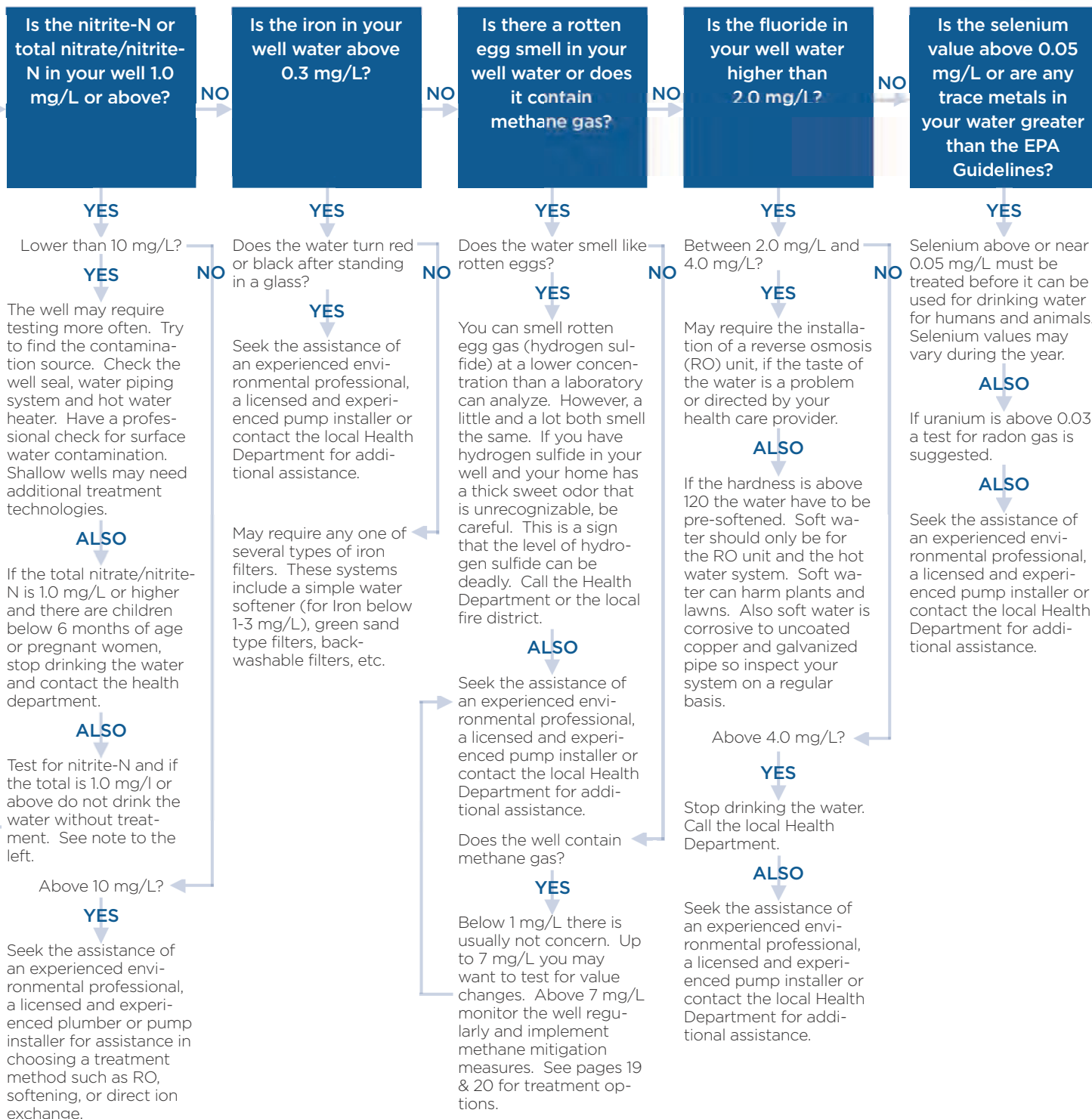
If you have any doubts about the contract drawn up by the professional, seek legal assistance **before** signing. Look up web sites on the specific types of equipment that your professional recommends, talk to your friends, ask a lot of questions, and if you don’t get answers, don’t buy until your questions 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.

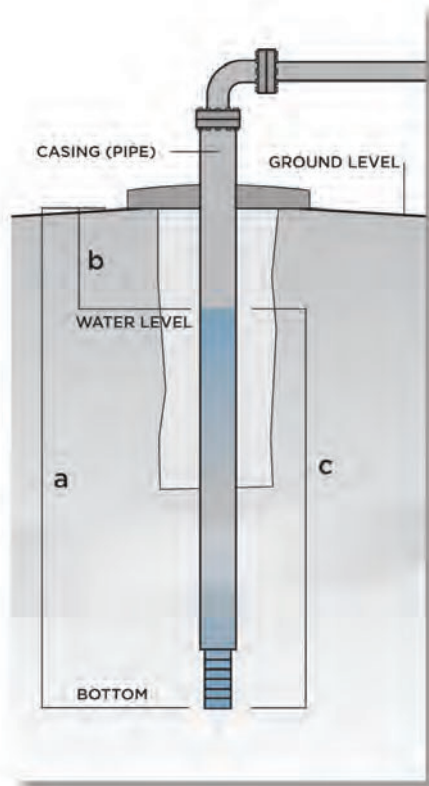


Figure 3: Well Capacity Calculation

### 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		Bored Well	
Diameter (inches)	Storage per Foot of Water (gal/ft)	Diameter (inches)	Storage per Foot of Water (gal/ft)
4"	0.653	24"	23.5
6"	1.47	36"	52.9
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-

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.

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

## 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](http://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.



## 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](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>

