

# 2017 COLORADO RULE 608 COMPLIANCE REPORT

## RATON BASIN, COLORADO



DECEMBER 2017



Prepared for:

TIMBER CREEK OPERATING, LLC



*Advancing Opportunity*



# **2017 COLORADO RULE 608 COMPLIANCE REPORT**

## **RATON BASIN, COLORADO**

**DECEMBER 2017**

**Prepared for:**

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## 2017 Rule 608 Compliance Report

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Date



## EXECUTIVE SUMMARY

LT Environmental, Inc. (LTE) completed the tasks for the 2017 Colorado Rule 608 Compliance Program on behalf of Timber Creek Operating LLC. (TCO) with respect to TCO operations in Las Animas County, Colorado (Project Area). In October 2017, TCO purchased the XTO Energy, Inc. (XTO) assets in the project area. LTE completed the tasks in accordance with the Colorado Oil and Gas Conservation Commission (COGCC)-approved *Work Plan*, dated May 5, 2010, per the following subsections of the COGCC Rule 608:

- 608(a) – Assessment and monitoring of plugged and abandoned (P&A) production wells within one-quarter (¼) mile of proposed coalbed methane (CBM) wells;
- 608(b) – Water well sampling; and
- 608(c) – Coal outcrop and coal mine monitoring.

The 2017 Colorado Rule 608 Compliance Program meets the requirements of subsections a, b, and c of the COGCC Rule 608.

The 2017 Project Area was determined by a 2-mile buffer around the 2010 and 2011 proposed XTO CBM production wells and the CBM production wells XTO installed in 2010 and 2011. Neither XTO or TCO have not drilled any new CBM production wells in the Raton Basin since 2011 and, as a result, the 2017 Project Area is identical to the 2011 Project Area. Due to the absence of any proposed 2017 CBM wells, tasks 1, 2, and subtasks of task 3, and 4 were omitted from the 2017 Rule 608 Compliance Program.

LTE identified, through previous investigations, three mapping areas for surveying in 2017. Based on the findings from 2016 and a review of historical flux surveys at these three mapping areas, areas L-1021, 32 & L-1049, and L-1030, appear to be active seep areas.

Two natural springs were sampled for water quality analysis (Chavez 01 and Chavez 02). The water types appear to be predominately calcium and sodium+potassium in cationic composition and chloride and bicarbonate in anionic composition. In addition to collecting water samples, methane flux measurements were collected in the vicinity of the natural springs. Reportable methane flux was not detected at either of the measurement locations.

LTE recommends continued compliance with Rule 608 in Las Animas County in accordance with the COGCC-approved *Work Plan* as TCO development activities continue and/or expand. Based on the findings from 2017 and a review of historical flux surveys at the three mapping areas, areas L-1021, 32 & L-1049, and L-1030 appear to be active seep areas, and LTE recommends areas L-1021, 32 & L-1049, and L-1030 be included in the 2018 flux survey.



## 1.0 INTRODUCTION

LT Environmental, Inc. (LTE) has prepared this 2017 Colorado Rule 608 Compliance Report for Timber Creek Operating LLC (TCO) to summarize the tasks completed with respect to TCO operations in Las Animas County, Colorado (Project Area, Figure 1). In October 2017, TCO purchased the XTO Energy, Inc. (XTO) assets in the project area. Compliance activities were conducted in accordance with the Colorado Oil and Gas Conservation Commission (COGCC)-approved *Work Plan* (LTE, May 2010) previously submitted on May 5, 2010. This is the eighth annual event conducted in accordance with this compliance program.

### 1.1 OBJECTIVE

The objective of the Colorado Rule 608 Compliance Program is to meet compliance requirements, as discussed in the May 2010 *Work Plan*, associated with the drilling and installation of coalbed methane (CBM) production wells, specifically in Las Animas County, Colorado, which applies to the following subsections of Rule 608 of the COGCC 600 Series Safety Regulations, as amended on March 30, 2009:

- 608(a) – Assessment and monitoring of plugged and abandoned (P&A) production wells within one-quarter ( $\frac{1}{4}$ ) mile of proposed CBM wells;
- 608(b) – Water well sampling; and
- 608(c) – Coal outcrop and coal mine monitoring.

### 1.2 PROJECT AREA

The Project Area is located in the Raton Basin in southern Colorado. The Raton Basin is a geologic structural basin in southern Colorado and northern New Mexico. The basin is situated in Huerfano and Las Animas counties, Colorado, and Colfax County, New Mexico. The basin has long been a source of coal production and more recently a source of CBM. Much of the regional geology presented herein was derived from the report, *A Geologic Assessment of Natural Gas from Coal Seams in the Raton and Vermejo Formations, Raton Basin* (Stevens, et.al. 1992).

The Raton Basin is an asymmetric synclinal basin with the axis of the La Veta syncline oriented roughly north-south and passing through Weston, Colorado, which is immediately east of the area formerly defined by XTO for development of CBM. The Raton Formation outcrop is exposed over approximately 50 percent of the Project Area. The discontinuous nature of the coal beds both in the subsurface and on the surface makes it difficult to identify and/or correlate individual continuous coal beds from the subsurface producing zone to the surface coal outcrop. The area originally proposed for drilling by XTO is located on the western side of the La Veta syncline suggesting that the formations encountered within the Project Area are dipping to the east.

The Vermejo Formation consists of sandstone, interbedded siltstone, shale, carbonaceous shale, and coal accumulated above the fluvial-deltaic sequences of the Trinidad Sandstone (Stevens, et





al. 1992). The Vermejo Formation outcrops along the western edge of the Raton Basin syncline basin, which is on the west side of the Project Area. Of the more than 90,000-acre Project Area, the Vermejo Formation outcrop covers approximately two percent of the overall Project Area. The Raton and Vermejo formation outcrops are depicted on Figure 1.

### **1.3 SCOPE OF WORK**

XTO originally proposed to drill CBM production wells in the Project Area of the Raton Basin over the next several years (red outline on Figure 1), drilling began in 2010. However XTO did not install any CBM production wells in the Project Area in 2012, 2013, 2014, 2015, 2016, or 2017 and sold their assets in the project area to TCO in late 2017. As a result, the 2017 Project Area was determined by a 2-mile buffer around the 2010 and 2011 proposed XTO CBM production wells and CBM production wells XTO installed in 2010 and 2011. The 2017 Project Area (green outline on Figure 2), proposed 2010 and 2011 CBM production well locations, recorded P&A production well locations, water well locations, topography, and mine features are illustrated on Figure 2.

The scope of work for the Colorado Rule 608 Compliance Program includes the following tasks:

- Task 1: Assessment of applicable P&A production wells;
- Task 2: Assessment of applicable water wells;
- Task 3: Detailed mapping of known and diminishing methane seep areas;
- Task 4: Assessment of applicable natural springs; and
- Task 5: Preparation of this report.

### **1.4 DEVIATIONS**

Neither XTO or TCO proposed or installed any new CBM production wells in 2017. As a result, some tasks and subtasks were omitted from the 2017 Colorado Rule 608 Compliance Program as described below. Historical procedures and findings for these tasks are described in previous annual reports.

There were no new P&A production wells within the 2017 Project Area to assess in 2017, and as a result, Task 1 was not conducted for the 2017 Colorado Rule 608 Compliance Program.

A review of water wells within the 2017 Project Area meeting the requirements set forth in Rule 608(b) identified one water well (Permit Number 39685). However, the two proposed XTO CBM production wells (New Elk 22-13 and New Elk 22-14) nearest to the water well were not installed during 2017. As a result, Task 2 was not conducted during the 2017 Colorado Rule 608 Compliance Program. Water well #39685 will be sampled prior to the drilling of New Elk 22-13 and New Elk 22-14.



Ground surveys to locate suspect methane seeps on the Raton Formation outcrop and color infrared (CIR) aerial imagery and field verification of suspect areas along the Vermejo Formation and at the Quinto, Tercio, and Vega mines were not conducted as part of Task 3 since no new CBM production wells were proposed for 2017.

While conducting detailed mapping of methane seeps areas during 2010, 2011, 2012, and 2013, (Task 3), gas samples were collected for isotopic analysis from those areas with reportable methane flux and where existing isotopic information from the 2007 *COGCC Phase II Seep Investigation* (LTE, 2007) did not exist. During the 2007 Phase II seep investigation conducted for the COGCC, gas samples were collected from many of the known and suspect seep areas in the Raton Basin. Each methane seep area currently has isotopic analysis associated with it. As a result, re-sampling for isotopic analysis of these seep areas was not necessary in 2017.

The COGCC informed XTO and LTE that those natural springs that overlap with other oil and gas industry companies conducting similar activities to comply with Rule 608 did not need to be sampled. As a result, Task 4 was reduced from the original work plan by not sampling Spring 05 (Vega Canyon), Spring 07 (Spring Canyon), or Spring 08 (Middle Lorencito). LTE was not granted property access for Spring 02, Spring 03 (Quiet Spring), Spring 04, Spring 06, Spring 09, or Spring 10. As a result, natural spring water samples from these six springs were not collected in 2017.

## **1.5 REPORT ORGANIZATION**

This report is organized into five sections including this introduction (Section 1.0), which presents the objectives and scope of work related to the project. The field methods are described in Section 2.0. The 2017 results are summarized in Section 3.0. The conclusions of the 2017 work are in Section 4.0. The report references are included in Section 5.0. Figures, tables, and appendices follow the text.



## **2.0 FIELD METHODS**

### **2.1 2017 PROJECT AREA**

The 2017 Project Area was determined by a 2-mile buffer around the 2010 and 2011 proposed XTO CBM production wells and the CBM production wells XTO installed in 2010 and 2011. The 2017 Project Area is outlined in green on Figure 2. The overall Project Area is outlined in red on Figure 2.

### **2.2 PROPERTY ACCESS**

Prior to conducting 2017 field activities, LTE acquired landowner information from the Las Animas County Assessor's office. LTE cross-referenced parcel data to identify owners of parcels located in the 2017 Project Area. LTE requested to gain access to all properties where field work was proposed, but one property owner did not respond to our access request; as a result, no investigation activities were conducted on that property. The 2017 property owner and access information is presented in Table 1.

### **2.3 FLUX SURVEY**

Flux surveys of mapping areas consists of utilizing a West Systems® portable gas flux meter (flux meter) to measure the magnitude and extent of methane seepage, if detected, within the survey area. Measurements are typically collected using a sampling grid approach.

Grids for detailed mapping areas consisted of varying numbers of squares, with grid nodes spaced 50 feet to 100 feet apart, depending on historical data for previously identified methane seep areas. The smaller grid spacing is typically used to map methane seep areas of relatively small extent. A flux measurement is collected at the corner of each grid square. When methane is detected along the outer edges of the mapping area, additional grid points are developed and measured to determine the extent of methane seepage. Where appropriate, photographs of vegetative conditions, visible seeps, and sensitive receptors are collected.

The portable flux meter measures the flux of methane, hydrogen sulfide, and carbon dioxide by employing individual gas-specific sensors that record the increases, if any, of gas concentrations over time for a given surface area. These increases in concentration over time are proportional to the flux of each gas. For this flux survey, only methane flux rates are reported.

The flux meter components include an accumulation chamber connected by circulation tubes to the gas detector unit. At each sampling point, the accumulation chamber is placed on the ground surface to capture gas seeping from the ground. A fan in the chamber continuously mixes the gases in the chamber during the measurement process. A pump moves gases in the accumulation chamber to the detector unit. After passing through the detector unit, gases are returned to the chamber. This closed-loop process allows soil gases discharging to the chamber to increase in concentration over time. Increases in concentrations are measured and recorded automatically. No gas is allowed to escape the system nor is a vacuum created during the process. This enables







measurement of natural gas seep conditions, if present. The result for each gas is reported as a mass flux in units of moles per square meter per day ( $\text{mol}/\text{m}^2\cdot\text{day}$ ).

Flux measurement accuracy can be limited by surface conditions. One of the most important factors is the quality of the seal between the accumulation chamber base and the ground surface. To ensure a proper seal between the ground surface and the chamber, field personnel choose relatively flat surfaces where possible and place loose soil surrounding the base of the chamber to reduce the potential for gas loss at the base of the chamber. In addition, ground disturbance is minimized during the measurement process in order to maintain the natural seep conditions. In areas with heterogeneous surfaces, the seal is sometimes difficult to achieve. This scenario is evident at locations with poorly developed soil or where the soil surface is obscured by decayed organic matter on the forest floor.

The accuracy of the total flux estimation within the Project Area is influenced by the ability of the grid spacing system to represent the actual flux on a detailed level relative to the subsurface fracture system, coal quality, and stratigraphy within the Raton Formation.

The methane sensor within the flux meter unit has a range of 60 parts per million (ppm) to 50,000 ppm. The flux meter methane measurement range is  $0.0 \text{ mol}/\text{m}^2\cdot\text{day}$  to  $300 \text{ mol}/\text{m}^2\cdot\text{day}$ . Methane fluxes below  $0.2 \text{ mol}/\text{m}^2\cdot\text{day}$  are detectable with decreased accuracy. As a result, reporting of methane fluxes will not include values less than  $0.2 \text{ mol}/\text{m}^2\cdot\text{day}$ . Information on the flux meter is provided in Appendix A.

During the measurement process, gas concentrations are recorded at 1-second intervals and directly downloaded via Bluetooth<sup>®</sup> connection to a portable digital assistant (PDA) integrated with the Global Positioning System (GPS) unit. Other measurements recorded include barometric pressure, temperature, date, and time.

Integrated West Systems Flux Manager<sup>®</sup> software on the GPS unit recorded the gas measurement data. The software plots the curve of gas concentration versus time for each measurement collected. The best-fit line for the curve generated is selected. The slope of the best-fit line is proportional to the flux at the measurement point.

Full color spectrum aerial photographs were used as base maps for field use and figures for reporting. The geologic contacts depicted on the aerial photographic maps were derived from geologic maps prepared by the Colorado Geological Survey (CGS) and digitized. Accuracy of the formation contact is reduced when aerial photographs are viewed at a smaller scale.

### **2.3.1 Global Positioning System Data Management**

Each sample location is recorded using a GPS unit. Soil gas sampling grids are created in ArcView<sup>®</sup> and pre-loaded into the GPS unit so field personnel can quickly and accurately position detection equipment along the Project Area. Soil gas measurements and other relevant field data are then stored as attributes in the GPS unit along with the associated position data. The data stored in the GPS unit are downloaded later for processing and reporting.



The GPS unit position data are collected in the World Geodetic System 1984 (WGS 84) and projected in Universal Transverse Mercator (UTM) Zone 13 South, North American Datum 1983 (NAD 83) for use in an ArcView® project file. On average, 25 GPS log points are collected for each point feature in order to obtain more accurate positioning.

Readings collected with the GPS unit can be located with 1-meter accuracy. However, the terrain and forest canopy can adversely affect GPS unit accuracy. North-facing slopes and heavily wooded areas can distort or block satellite signals. When satellite signals are limited, positioning accuracy decreases. In locations where the GPS unit cannot obtain a signal, field personnel will note measurement data on their field reference maps. Specifications of the GPS unit are included in Appendix A.

### 2.3.2 Flux Volume Estimations

LTE estimated the volumetric flux of methane for each mapping area where sufficient reportable methane flux data points are available. Flux data were interpolated and gridded, then contoured and processed to estimate total volumetric flux.

The results were converted to volumetric flux rates common to the natural gas production industry in units of thousand cubic feet per day (MCFD). For a better perspective of the methane flux rates, LTE converted the mass flux values into volumetric flux units of cubic feet per day (CFD), assuming equal areas. The unit conversion is based on the molecular weight of the gas and the density of the gas at approximately 6,900 feet above mean sea level.

For methane flux, the calculation is as follows:

$$\frac{\text{mol CH}_4}{\text{day}} \times \frac{16.04276 \text{ g CH}_4}{\text{mol CH}_4} \times \frac{0.0698 \text{ ft}^3 \text{ CH}_4}{\text{g CH}_4} = \frac{\text{ft}^3 \text{ CH}_4}{\text{day}}$$

For example,

$$1.0 \text{ mol/day CH}_4 = 1.12 \text{ CFD CH}_4$$

**Notes:**

ft<sup>3</sup> – cubic feet

CH<sub>4</sub> – methane

g – gram

CFD – cubic feet per day

mol - mole

The volumetric flux values calculated are estimates and may not represent actual values for the specific areas. Interpolation calculation techniques are highly sensitive to data skewness and can result in large changes in calculated flux values based on measurements made at only a few locations.



## 2.4 NATURAL SPRING MONITORING

Surveys of natural springs are conducted on a well-by-well basis. Only natural springs identified on United States Geological Survey (USGS) topographic maps within the 2017 Project Area were surveyed.

Once a natural spring was identified, collection of water samples was attempted, barring any property access restrictions or lack of flow. At each natural spring, field personnel located the position and elevation using a GPS. A discharge rate was estimated, when possible, using a graduated cylinder and stopwatch. Water quality measurements, including pH, total dissolved solids (TDS), specific conductance (SC), oxidation-reduction potential (ORP), and temperature were collected using a SMARTROLL<sup>®</sup> meter. The equipment specifications for the water quality field meter are provided in Attachment A.

Water samples from the natural spring were collected and analyzed for the following:

- Major Cations [dissolved sodium (Na), calcium (Ca), magnesium (Mg), potassium (K), and iron (Fe)] by Environmental Protection Agency (EPA) Method 200.7;
- Dissolved Metals [selenium (Se), manganese (Mn)] by EPA Method 200.8;
- Alkalinity (carbonate/bicarbonate) by Method SM 2320B-2011;
- Major Anions [chloride (Cl), sulfate (SO<sub>4</sub>), bromide (Br), and fluoride (F)] by EPA Method 300;
- SC by Method SM 2510B-2011;
- Nitrate/Nitrite as Nitrogen (N) by EPA Method 300;
- TDS by Method SM2540C;
- Methane by Method RSK175 Modified;
- pH by Method SM 4500HB;
- Hydrogen Sulfide field analysis using Hach<sup>®</sup> test kit;
- Sodium Adsorption Ratio (SAR) by United States Department of Agriculture (USDA) Handbook 60; and
- Bacteria by Iron Reducing Bacteria (IRB) / Sulfate Reducing Bacteria (SRB) / Slime Forming Bacteria (SLYM).



Laboratory-provided sample bottles were filled with water for analysis of the parameters identified above. All water samples collected were submitted in a cooler under strict chain-of-custody documentation to Accutest Mountain States Laboratories (Accutest) in Wheat Ridge, Colorado.

LTE sampled natural springs Chavez 01 and Chavez 02 during the sampling event in 2017. Water samples were not collected from Spring 01 due to stagnation of the water from the natural springs, Chavez 03 was found to be dry at the time of the sampling event, and water samples were not collected from Spring 03 (also known as Quiet Spring) due to lack of access.



## **3.0 RESULTS**

### **3.1 FLUX SURVEY**

As a result of the 2016 Colorado Rule 608 Compliance Program, LTE identified three mapping areas for surveying in 2017. Reportable methane flux were detected in all three mapping areas:

- L-1021;
- 32 & L-1049; and
- L-1030.

Total reportable volumetric methane flux was calculated as 7.5 MCFD for area L-1021, 19.4 MCFD for area L-1030, and 74.3 MCFD for area 32 & L-1049. Since 2011, each of the three mapping areas have had reportable methane flux detected and have been considered active seep areas.

Methane flux measurements are presented on Figures 3 through 5. Summaries of the mapping areas are included in Table 2. Flux data is included in Appendix B. Volumetric flux calculations are included in Appendix C.

### **3.2 NATURAL SPRING SURVEY**

LTE identified 13 natural springs within the 2017 Project Area (Figure 2). Natural springs Spring 05 (Vega Canyon), Spring 07 (Spring Canyon), and Spring 08 (Middle Lorencito) were excluded from the sampling list as approved by the COGCC. Six natural springs were located on private property with no access granted. Two natural springs (Chavez 01, and Chavez 02) were sampled on September 6, 2017. Chavez 03 and Spring 01 were stagnant at the time of sampling, and as a result, no water samples were collected.

#### **3.2.1 Field Observations**

LTE collected field measurements from the Chavez 01 and Chavez 02 natural springs, which were documented in a field logbook. The 2017 field observations and measurements for the natural springs are consistent with previous years sampling events. Field observations and measurements are summarized in Table 3.

#### **3.2.2 Sampling and Analysis**

By plotting the major anions and major cations that are dissolved in the natural spring water samples on a Stiff diagram, the water type can be presented graphically. The water types appear to be predominately calcium and sodium+potassium in cationic composition and chloride and bicarbonate in anionic composition.



Laboratory analytical results for the natural spring samples are summarized in Table 4. A Stiff diagram illustrating the water type is depicted on Figure 6. Natural spring analytical results are presented in Appendix D.

### **3.2.3 Flux Measurements**

During the 2017 natural spring sampling event, flux measurements were collected near each natural spring location. Reportable methane flux was not detected in any of the flux measurement locations near the two natural springs.





## 4.0 CONCLUSIONS

The 2017 Colorado Rule 608 Compliance Program meets the requirements of subsections a, b, and c of the COGCC Rule 608.

LTE identified, through previous investigations, three mapping areas for surveying in 2017. Based on the findings from 2017 and a review of historical flux surveys at these three mapping areas, areas L-1021, 32 & L-1049, and L-1030 continue to be active seep areas.

Two natural springs were sampled for water quality analysis (Chavez 01 and Chavez 02). The water types appear to be predominately calcium and sodium+potassium in cationic composition and chloride and bicarbonate in anionic composition. In addition to collecting water samples, flux measurements were collected in the vicinity of the natural springs. Reportable methane flux was not detected at any of the measurement locations.

LTE recommends continued compliance with Rule 608 in Las Animas County in accordance with the COGCC-approved *Work Plan*. Based on the findings from 2017 and a review of historical flux surveys at the three previously identified mapping areas, areas L-1021, 32 & L-1049, and L-1030 appear to be active seep areas, and LTE recommends areas L-1021, 32 & L-1049, and L-1030 be included in the 2018 flux survey.



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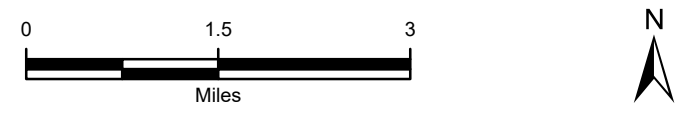
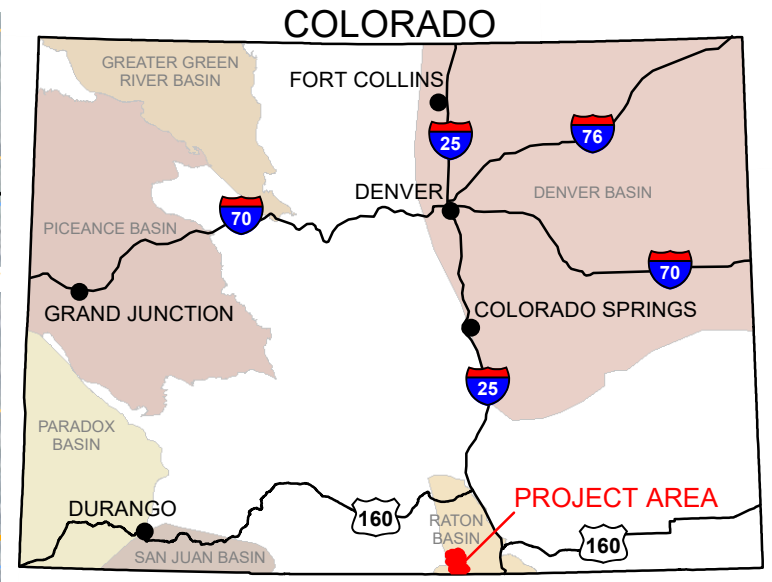
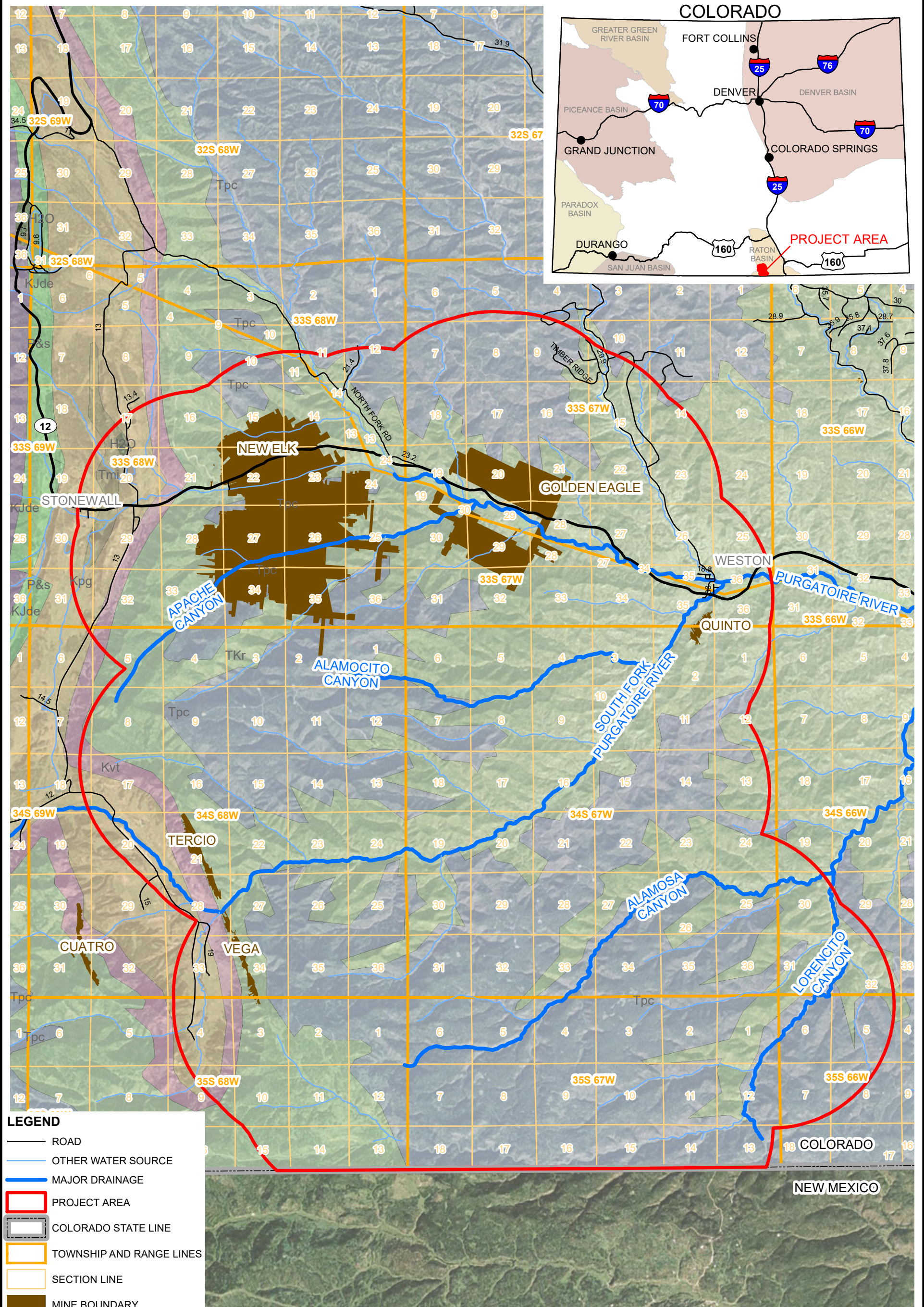
Zheng Zhou, Chris J. Ballentine, Rolf Kipfer, Martin Schoell, and Steve Thibodeaux. 2005. *Noble gas tracing of groundwater/coalbed methane interaction in the San Juan Basin*. USA.



## FIGURES







**FIGURE 1**  
**PROJECT AREA MAP**  
**2017 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**

**TIMBER CREEK OPERATING, LLC**





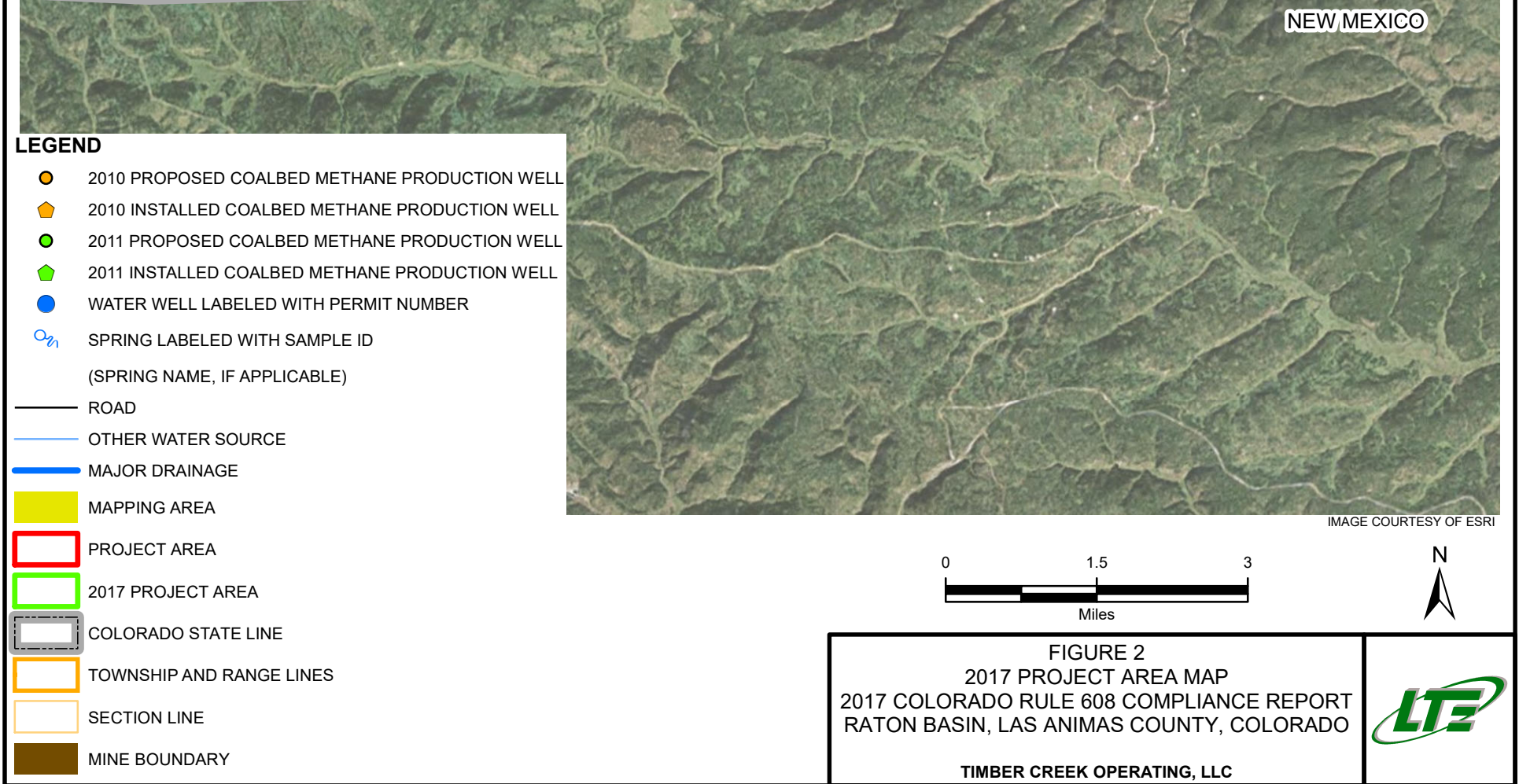
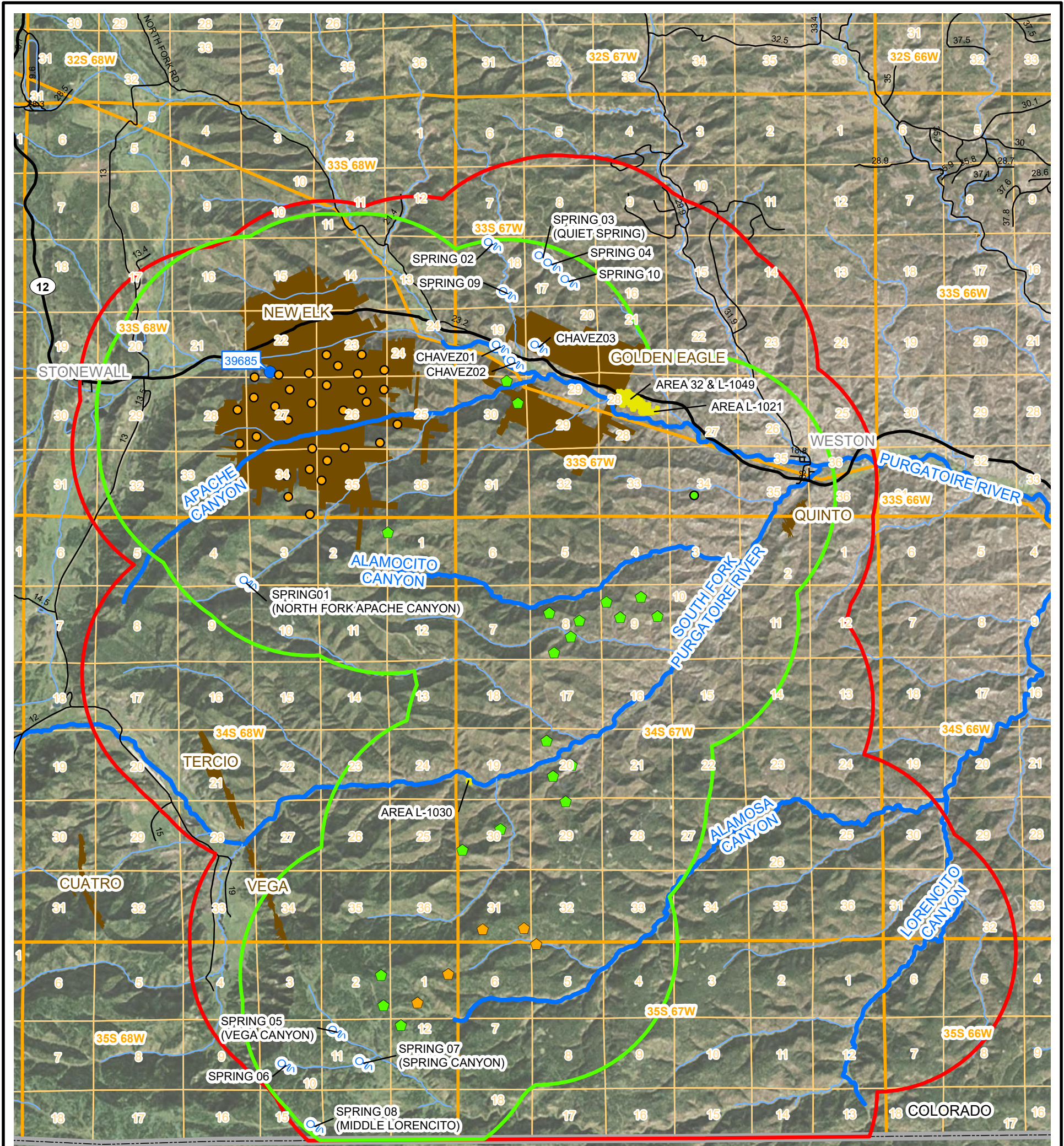






IMAGE COURTESY OF ESRI

**LEGEND**

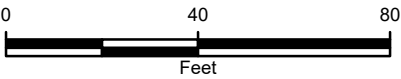
**2017 METHANE FLUX MEASUREMENT**  
(mol/m<sup>2</sup> • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 75.0000

**2011 SUSPECT METHANE SEEP (ID LABELED IN GREEN)**

— METHANE FLUX CONTOUR (mol/m<sup>2</sup> day)

mol/m<sup>2</sup> • day: MOLES PER SQUARE METER PER DAY  
ONLY METHANE FLUX MEASUREMENTS GREATER  
THAN OR EQUAL TO 0.2 mol/m<sup>2</sup> • day ARE LABELED



**FIGURE 3**  
**METHANE FLUX CONTOURS**  
**MAPPING AREA L-1021**  
**2017 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**TIMBER CREEK OPERATING, LLC**







IMAGE COURTESY OF ESRI

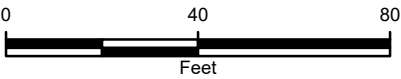
**LEGEND**

**2017 METHANE FLUX MEASUREMENT**  
(mol/m<sup>2</sup> • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 75.0000

**2011 SUSPECT METHANE SEEP (ID LABELED IN GREEN)**

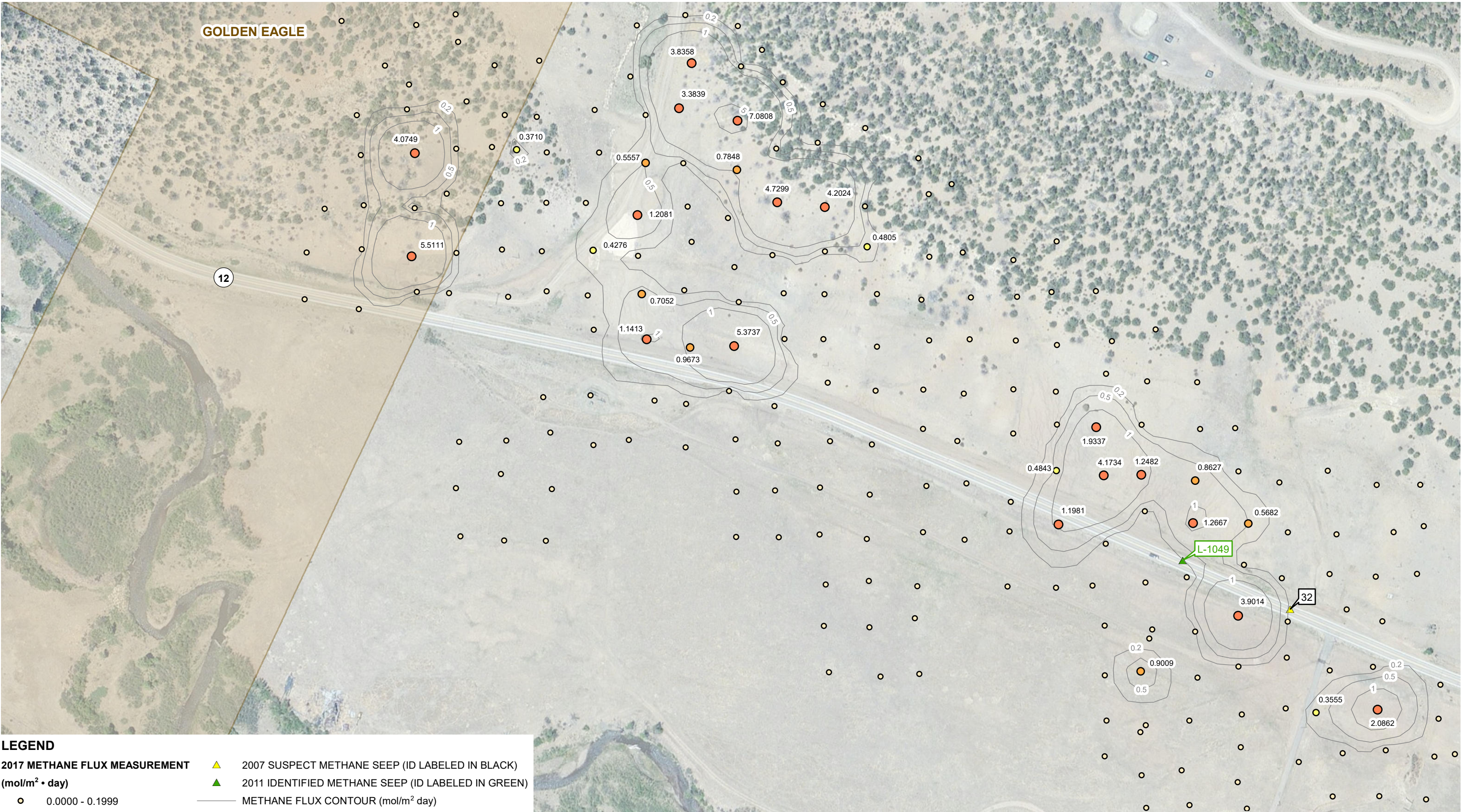
— METHANE FLUX CONTOUR (mol/m<sup>2</sup> day)  
mol/m<sup>2</sup> • day: MOLES PER SQUARE METER PER DAY  
ONLY METHANE FLUX MEASUREMENTS GREATER  
THAN OR EQUAL TO 0.2 mol/m<sup>2</sup> • day ARE LABELED



**FIGURE 4**  
**METHANE FLUX CONTOURS**  
**MAPPING AREA L-1030**  
**2017 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**TIMBER CREEK OPERATING, LLC**







**LEGEND**

**2017 METHANE FLUX MEASUREMENT**  
(mol/m<sup>2</sup> • day)

○

0.0000 - 0.1999

○

0.2000 - 0.5000

○

0.5001 - 1.0000

○

1.0001 - 10.0000

○

10.0001 - 75.0000

▲

2007 SUSPECT METHANE SEEP (ID LABELED IN BLACK)

▲

2011 IDENTIFIED METHANE SEEP (ID LABELED IN GREEN)

—

METHANE FLUX CONTOUR (mol/m<sup>2</sup> day)

CONTOUR INTERVAL VARIES

mol/m<sup>2</sup> • day: MOLES PER SQUARE METER PER DAY

ONLY METHANE FLUX MEASUREMENTS GREATER THAN OR EQUAL TO 0.2 mol/m<sup>2</sup> • day ARE LABELED

LEWICKI MINE BOUNDARY

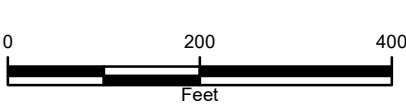
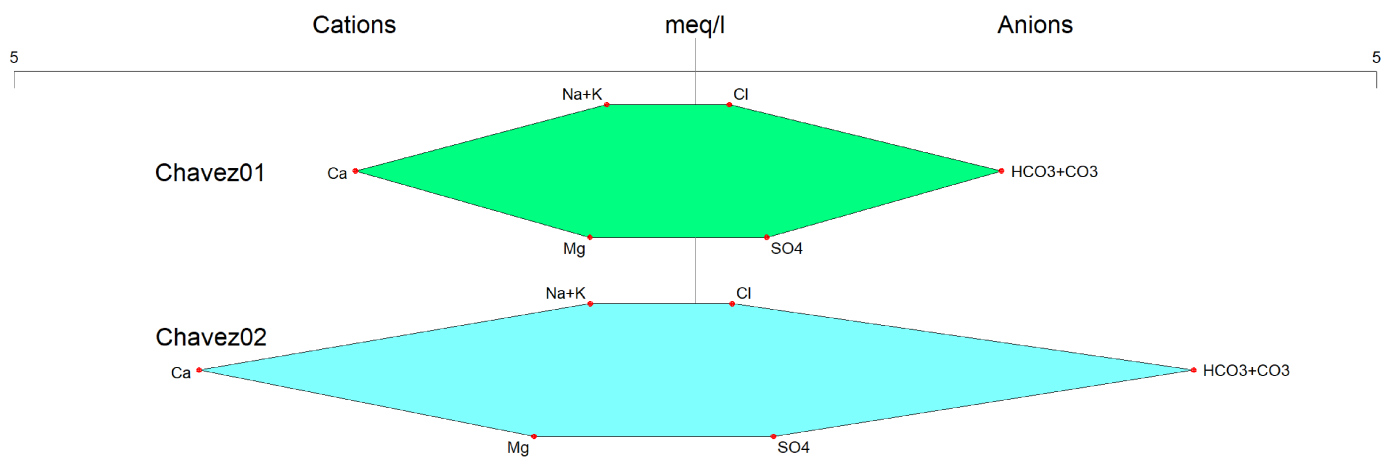


FIGURE 5  
METHANE FLUX CONTOURS  
MAPPING AREAS 32 & L-1049  
2017 COLORADO RULE 608 COMPLIANCE REPORT  
RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
TIMBER CREEK OPERATING, LLC







## LEGEND

Ca: CALCIUM  
 Cl: CHLORIDE  
 CO3: CARBONATE  
 HCO3: BICARBONATE  
 K: POTASSIUM  
 Mg: MAGNESIUM  
 Na: SODIUM  
 SO4: SULFATE  
 meq/l: MILLIEQUIVALENTS PER LITER

FIGURE 12  
 STIFF DIAGRAMS  
 SEPTEMBER 6, 2017  
 2017 COLORADO RULE 608 COMPLIANCE REPORT  
 RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
 TIMBER CREEK OPERATING, LLC



## TABLES



**TABLE 1**  
**PROPERTY OWNER AND ACCESS INFORMATION**

**2017 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**TIMBER CREEK OPERATING, LLC**

| LANDOWNER   | PARCEL ID            | SECTION                        | TOWNSHIP | RANGE | PERMISSION GRANTED |
|---|----------------------|--------------------------------|----------|-------|--------------------|
| XTO Energy, Inc.  | 14533300             | 28                             | 33       | 67    | Yes                |
|   | 14533405             | 27, 28                         | 33       | 67    |                    |
|   | 14533200             | 27                             | 33       | 67    |                    |
| Hill Ranch LTD and Kozad Properties LTD                               | 12220713             | 4, 5, 6, 7, 10                 | 35       | 67    | Yes                |
|   | 12220714             | 1,2, 3, 10, 11, 12, 13, 14, 15 | 35       | 68    |                    |
|   | 11071110             | 21, 22, 28                     | 34       | 67    |                    |
|   | 13432508             | 2, 31, 32, 33                  | 34       | 67    |                    |
|   | 14533003             | 28                             | 33       | 67    |                    |
|   | 13297000             | 27, 35                         | 33       | 67    |                    |
| Department of Natural Resources<br>(care of mibe.truillo@state.co.us) | 10877304<br>10877303 | 30                             | 33       | 67    | Yes                |
|   |                      | 2, 3, 13, 23, 24, 25, 26       | 34       | 68    |                    |
|   |                      | 19                             | 34       | 67    |                    |
|   |                      | 25                             | 33       | 68    |                    |
|   |                      | 35                             | 33       | 68    |                    |
| Bill R. and Rossana T. Chavez   | 13940200             | 19                             | 33       | 67    | Yes                |
| Donald Mounier  | NA                   | 17                             | 33       | 67    | No Response        |
| Bill Toupal   | NA                   | 28                             | 33       | 67    | Yes                |
|   |                      | 27, 28                         | 33       | 67    |                    |
|   |                      | 27                             | 33       | 67    |                    |
| Veronica Law  | NA                   | 19                             | 33       | 67    | Yes                |



TABLE 2  
MAPPING AREA SUMMARIES

2017 COLORADO RULE 608 COMPLIANCE REPORT  
RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
TIMBER CREEK OPERATING, LLC

| Area IDs    | Ground Survey Conducted |      |      |      |      |      |      |      | 2007                            | 2011                          |   |                                     | 2012                          |   |                                     | 2013                          |   |                                     | 2014                          |   |                                     | 2015                          |   |                                     | 2016                          |   |                                     | 2017                          |   |                                     |
|-------------|-------------------------|------|------|------|------|------|------|------|---------------------------------|-------------------------------|---|-------------------------------------|-------------------------------|---|-------------------------------------|-------------------------------|---|-------------------------------------|-------------------------------|---|-------------------------------------|-------------------------------|---|-------------------------------------|-------------------------------|---|-------------------------------------|-------------------------------|---|-------------------------------------|
|             | 2007                    | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Subsurface Methane Gas Detected | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** | Total Number of Sample Points | Reportable CH <sub>4</sub> Flux Points* | Total CH <sub>4</sub> Flux (MCFD)** |
| L-1021      |                         |      | x    | x    | x    | x    | x    | x    |                                 | 44                            | 10                                      | 129.71                              | 47                            | 6                                       | 6.7                                 | 46                            | 2                                       | NA                                  | 51                            | 4                                       | 1.9                                 | 35                            | 4                                       | 6.8                                 | 35                            | 6                                       | 14.1                                | 35                            | 2                                       | 7.5                                 |
| L-1030      |                         |      | x    | x    | x    | x    | x    | x    |                                 | 17                            | 3                                       | 2.19                                | 17                            | 3                                       | 2.2                                 | 18                            | 1                                       | NA                                  | 18                            | 4                                       | 56.9                                | 18                            | 2                                       | NA                                  | 18                            | 3                                       | 5.4                                 | 22                            | 7                                       | 19.4                                |
| 32 & L-1049 | x                       |      | x    | x    | x    | x    | x    | x    | x                               | 372                           | 146                                     | 304.12                              | 217                           | 55                                      | 720.4                               | 234                           | 37                                      | 332.4                               | 233                           | 33                                      | 150.7                               | 239                           | 25                                      | 668.4                               | 238                           | 32                                      | 204.3                               | 239                           | 29                                      | 74.3                                |

Notes:

- CH<sub>4</sub> - methane
- moles/m<sup>2</sup>·day - moles per meter squared per day
- MCFD - thousand cubic feet per day
- NA - not applicable
- \*\* - volume includes only gridded values > 0.2 moles/m<sup>2</sup>·day
- \* - only points where flux values were above the reporting limit of 0.2 moles/m<sup>2</sup>·day



**TABLE 3**  
**NATURAL SPRING WATER QUALITY MEASUREMENTS**

**2017 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**TIMBER CREEK OPERATING, LLC**

| Natural Spring          | Location                 | Latitude       | Longitude    | Inspection Date | Specific Electrical Conductance (µS/cm) | pH (Units) | ORP (mV) | Temperature (°C) | TDS (mg/l) |
|-------------------------|--------------------------|----------------|--------------|-----------------|---|------------|----------|------------------|------------|
| Spring01                | North Fork Apache Canyon | -104.991708    | 37.108089    | 8/13/2010       | 381.0                                   | 9.2        | 140.5    | 22.4             | 247.0      |
|                         |                          |                |              | 8/19/2011       | 408.0                                   | 7.1        | -99.5    | 13.3             | 432.0      |
|                         |                          |                |              | 9/4/2012        | DRY - NOT MEASURED                      |            |          |                  |            |
|                         |                          |                |              | 8/15/2013       | DRY - NOT MEASURED                      |            |          |                  |            |
|                         |                          |                |              | 8/21/2014       | 515.9                                   | 9.1        | -61.8    | 12.4             | 337.2      |
|                         |                          |                |              | 8/13/2015       | 562.4                                   | 8.8        | -38.9    | 11.0             | 368.8      |
|                         |                          |                |              | 8/25/2016       | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
|                         |                          |                |              | 9/6/2017        | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
| Chavez01                | Rancho Escondido         | -104.9265768   | 37.15615866  | 9/4/2012        | 391.0                                   | 6.8        | 106.5    | 15.7             | 200.7      |
|                         |                          |                |              | 8/15/2013       | 356.0                                   | 7.0        | 12.0     | 14.9             | NM         |
|                         |                          |                |              | 8/21/2014       | 329.0                                   | 7.7        | 200.9    | 16.3             | 579.0      |
|                         |                          |                |              | 8/12/2015       | 420.8                                   | 6.8        | 279.5    | 14.7             | 275.4      |
|                         |                          |                |              | 8/25/2016       | 284.6                                   | 7.1        | 25.5     | 14.1             | 233.4      |
|                         |                          |                |              | 9/6/2017        | 383.6                                   | 7.6        | 610      | 16.15            | 249.2      |
| Chavez02                | Rancho Escondido         | -104.922814480 | 37.152863914 | 9/4/2012        | 414.0                                   | 6.5        | 105.5    | 16.0             | 207.7      |
|                         |                          |                |              | 8/15/2013       | 417.0                                   | 6.9        | NM       | 14.1             | NM         |
|                         |                          |                |              | 8/21/2014       | 399.3                                   | 7.5        | 169.7    | 14.4             | 260.2      |
|                         |                          |                |              | 8/12/2015       | 550.6                                   | 7.1        | 323.4    | 14.1             | 361.2      |
|                         |                          |                |              | 8/25/2016       | 381.4                                   | 7.6        | 44.8     | 17.5             | 291.7      |
|                         |                          |                |              | 9/6/2017        | 554.9                                   | 7.04       | 544      | 16.1             | 358.75     |
| Chavez03                | Rancho Escondido         | -104.916708750 | 37.156096546 | 9/4/2012        | 1,864.0                                 | 7.0        | 104.7    | 14.1             | 921.9      |
|                         |                          |                |              | 8/15/2013       | 1,464.0                                 | 7.3        | 47.3     | 14.7             | NM         |
|                         |                          |                |              | 8/21/2014       | 1,922.9                                 | 7.6        | -40.1    | 16.3             | 1,255.3    |
|                         |                          |                |              | 8/12/2015       | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
|                         |                          |                |              | 8/25/2016       | DRY - NOT MEASURED                      |            |          |                  |            |
|                         |                          |                |              | 9/6/2017        | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
| Spring03 - Quiet Spring | Rancho Escondido         | -104.915474    | 37.174474    | 8/21/2014       | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
|                         |                          |                |              | 8/13/2015       | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
|                         |                          |                |              | 8/25/2016       | STAGNANT WATER - NOT MEASURED           |            |          |                  |            |
|                         |                          |                |              | 9/6/2017        | NO ACCESS GRANTED - NOT MEASURED        |            |          |                  |            |

**Notes:**

°C - degrees Celsius  
mg/l - milligrams per liter  
mV - millivolts  
NM - Not Measured  
ORP - oxidation reduction potential  
TDS - total dissolved solids  
µS/cm - microSiemens per centimeter

| TABLE 4<br>NATURAL SPRING ANALYTICAL RESULTS<br><br>2017 COLORADO RULE 608 COMPLIANCE REPORT<br>RATON BASIN, LAS ANIMAS COUNTY, COLORADO<br>TIMBER CREEK OPERATING, LLC |                             |                                 |                              |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|---|-----------------------------|---------------------------------|------------------------------|---------------------|------------------|---------------------|---------------------|--------------------|-------------------|----------------|-------------------------------|---------------------|-----------------------|---------------|--|-------|-------------------|--------------------|-------------------|--------------------|----------------------------|----------------------------------|-------------------------------|------------------------------------|------------------------------------|--|
| Natural Spring  | Location                    | Sample Date                     | Calcium<br>(mg/l)            | Magnesium<br>(mg/l) | Sodium<br>(mg/l) | Potassium<br>(mg/l) | Manganese<br>(mg/l) | Selenium<br>(mg/l) | Methane<br>(mg/l) | Iron<br>(mg/l) | Sodium<br>Adsorption<br>Ratio | Carbonate<br>(mg/l) | Bicarbonate<br>(mg/l) | TDS<br>(mg/l) | Specific<br>Conductivity<br>(umhos/cm) | pH    | Sulfate<br>(mg/l) | Chloride<br>(mg/l) | Bromide<br>(mg/l) | Fluoride<br>(mg/l) | Hydrogen Sulfide<br>(mg/l) | Nitrogen as<br>Nitrate<br>(mg/l) | Nitrogen as<br>Nitrite (mg/l) | Iron Reducing<br>Bacteria (cfu/ml) | Slime Forming<br>Bacteria (cfu/ml) | Sulfate Reducing<br>Bacteria<br>(cfu/ml) |
| Spring01  | North Fork Apache<br>Canyon | 8/13/2010                       | 3.4                          | 0.65                | 97.7             | 1.41                | 0.0210              | <0.00080           | 0.10900           | 1.59           | 11.4                          | <5.0                | 205                   | 280           | 364                                    | 10.13 | 2.9               | 3.3                | <0.20             | 0.74               | <0.50                      | <0.23                            | <0.061                        | 500                                | >350,000                           | 700,000                                  |
|   |                             | 8/15/2011                       | 2.2                          | 0.52                | 136.0            | 1.64                | 0.1260              | <0.00080           | 0.277             | 3.660          | 22.2                          | <5.0                | 332                   | 420           | 428                                    | 8.16  | 2.7               | 3.7                | <0.20             | 1.40               | NA                         | <0.045                           | <0.011                        | 9,000                              | 350,000                            | 700,000                                  |
|   |                             | 9/4/2012                        | DRY - NOT SAMPLED            |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 8/15/2013                       | DRY - NOT SAMPLED            |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 8/21/2014                       | 1.4                          | 0.35                | 129.0            | <1.0                | 0.0063              | <0.00080           | 1.00              | <0.010         | 25.0                          | <5.0                | 251                   | 338           | 406                                    | NA    | 3.5               | 3.7                | <0.050            | 1.00               | 0.5                        | <0.010                           | <0.0040                       | <25                                | <500                               | <200                                     |
|   |                             | 8/13/2015                       | 1.8                          | 0.47                | 128.0            |                     | 0.0111              | <0.00080           | 1.09000           | 0.0212         | 20.1                          | 10.9                | 227                   | 304           | 402                                    | 8.64  | 7.4               | 3.9                | <0.050            | 0.97               | <0.50                      | <0.020                           | <0.0080                       | <25                                | <500                               | <200                                     |
|   |                             | 8/25/2016                       | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
| Chavez01  | Rancho Escondido            | 9/6/2017                        | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 9/4/2012                        | 44.5                         | 8.12                | 20.4             | <1.0                | <0.0050             | <0.0020            | 0.0012            | <0.070         | 0.738                         | <5.0                | 157                   | 194           | 323                                    | 7.28  | 19.3              | 3.4                | <0.050            | 0.27               | 0.0                        | 0.011                            | <0.0040                       | 74,500                             | 350,000                            | 359,000                                  |
|   |                             | 8/15/2013                       | 50.2                         | 8.59                | 20.8             | 1.07                | NA                  | <0.0020            | NA                | <0.070         | 0.755                         | <5.0                | 171                   | 224           | 358                                    | 7.4   | 28.7              | 5.8                | <0.050            | 0.27               | NA                         | 0.012                            | <0.0040                       | 74,500                             | 66,500                             | 1,200                                    |
|   |                             | 8/21/2014                       | 49.8                         | 8.92                | 15.0             | 1.23                | <0.0050             | <0.00080           | 0.0035            | <0.010         | 0.490                         | <5.0                | 141                   | 210           | 278                                    | NA    | 21.6              | 5.1                | <0.050            | 0.23               | 0.0                        | <0.010                           | <0.0040                       | 9,000                              | 66,500                             | 700                                      |
|   |                             | 8/12/2015                       | 53.6                         | 9.92                | 15.4             | <1.0                | <0.0050             | <0.00080           | 0.00250           | 0.0147         | 0.507                         | <5.0                | 139                   | 220           | 285                                    | 7.19  | 27.5              | 15.7               | <0.050            | 0.23               | <0.50                      | <0.010                           | <0.0040                       | 74,500                             | 350,000                            | <200                                     |
|   |                             | 8/25/2016                       | 41.7                         | 8.09                | 13.4             | <1.000              | 8.090               | 0.0011             | 0.0022            | <0.010         | 0.519                         | <5.0                | 141                   | 200           | 291                                    | 7.13  | 24.6              | 6.7                | <0.050            | 0.21               | 0.0                        | <0.050                           | <0.0054                       | 74,500                             | 66,500                             | 1,200                                    |
|   |                             | 9/6/2017                        | 50.0                         | 9.42                | 15.0             | <1.000              | 0.0023              | <0.00080           | 0.00260           | <0.010         | 0.510                         | <5.0                | 137                   | 202           | 325                                    | 7.80  | 25.1              | 8.8                | <0.050            | 0.22               | 0.0                        | <0.010                           | <0.0040                       | 74,500                             | 350,000                            | 5,000                                    |
| Chavez02  | Rancho Escondido            | 9/4/2012                        | 49.3                         | 9.56                | 18.2             | 1.43                | <0.0050             | <0.0020            | 0.00030           | <0.070         | 0.621                         | <5.0                | 163                   | 206           | 330                                    | 7.17  | 20.3              | 4.0                | <0.050            | 0.30               | 0.0                        | 0.088                            | <0.0040                       | 74,500                             | 350,000                            | 359,000                                  |
|   |                             | 8/15/2013                       | 59.7                         | 11.00               | 20.2             | 1.51                | 0.0055              | <0.0020            | NA                | <0.070         | 0.670                         | <5.0                | 201                   | 264           | 428                                    | 7.28  | 31.3              | 8.1                | <0.050            | 0.29               | NA                         | 1.800                            | 1.800                         | 75,500                             | 12,500                             | 5,000                                    |
|   |                             | 8/21/2014                       | 57.7                         | 11.20               | 15.9             | 1.77                | <0.0050             | <0.00080           | 0.00054           | 0.264          | 0.489                         | <5.0                | 167                   | 242           | 318                                    | NA    | 24.0              | 5.8                | <0.050            | 0.29               | 0.0                        | 0.400                            | <0.0040                       | 9,000                              | <500                               | 5,000                                    |
|   |                             | 8/12/2015                       | 71.7                         | 13.30               | 14.9             | 1.61                | <0.0020             | <0.00080           | <0.00080          | 0.0473         | 0.472                         | <5.0                | 196                   | 291           | 405                                    | 7.45  | 29.8              | 14.5               | <0.050            | 0.27               | <0.50                      | 0.940                            | 0.940                         | 74,500                             | 350,000                            | 5,000                                    |
|   |                             | 8/25/2016                       | 56.6                         | 11.80               | 13.2             | 15.4                | <0.0050             | <0.00080           | <0.00080          | 0.0329         | 0.447                         | <5.0                | 195                   | 262           | 382                                    | 7.26  | 26.7              | 9.6                | <0.050            | 0.25               | 0.0                        | 0.42                             | 0.42                          | 74,500                             | 66,500                             | 18,000                                   |
|   |                             | 9/6/2017                        | 73.0                         | 14.4                | 16.8             | 1.620               | 0.0041              | <0.00080           | 0.00052           | 0.022          | 0.470                         | <5.0                | 223                   | 290           | 471                                    | 7.51  | 27.5              | 9.5                | <0.050            | 0.27               | 0.0                        | 0.16                             | <0.0040                       | 74,500                             | 350,000                            | 700                                      |
|   |                             | 8/12/2015                       | 117.0                        | 43.20               | 20.8             | 6.25                | <0.0050             | <0.0020            | 0.0119            | 0.235          | 4.17                          | <5.0                | 495                   | 990           | 160                                    | 7.44  | 63.7              | 254.0              | 2.0               | 0.35               | 0.0                        | 0.083                            | 0.024                         | 74,500                             | 66,500                             | 359,000                                  |
| Chavez03  | Rancho Escondido            | 8/15/2013                       | 113.0                        | 48.20               | 22.3             | 5.50                | <0.0050             | <0.0020            | NA                | 0.200          | 3.91                          | <5.0                | 536                   | 1,090         | 1,850                                  | 7.38  | 47.4              | 324.0              | 2.6               | 0.72               | NA                         | 0.260                            | 0.260                         | 9,000                              | 350,000                            | 359,000                                  |
|   |                             | 8/21/2014                       | 117.0                        | 53.30               | 241.0            | 5.81                | 0.3730              | <0.00080           | 0.0285            | 0.122          | 4.22                          | <5.0                | 539                   | 1,160         | 1,660                                  | NA    | 42.5              | 342.0              | 2.7               | <0.50              | 0.0                        | 0.063                            | <0.020                        | 2,300                              | 66,500                             | 359,000                                  |
|   |                             | 8/12/2015                       | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 8/25/2016                       | DRY - NOT SAMPLED            |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 9/6/2017                        | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
| Spring03 - Quiet<br>Spring  | Rancho Escondido            | 8/21/2014                       | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 8/12/2015                       | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 8/25/2016                       | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | 9/6/2017                        | STAGNANT WATER - NOT SAMPLED |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |
|   |                             | NO ACCESS GRANTED - NOT SAMPLED |                              |                     |                  |                     |                     |                    |                   |                |                               |                     |                       |               |  |       |                   |                    |                   |                    |                            |                                  |                               |                                    |                                    |  |

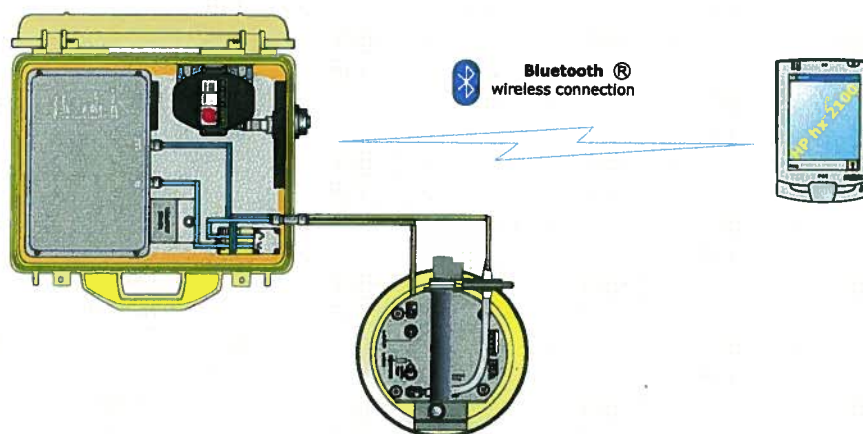
**Notes:**  
< - less than the laboratory reporting limit  
> - greater than  
cfu/ml - coliform units per milliliter  
mg/l - milligrams per liter  
NA - not analyzed  
TDS - total dissolved solids  
umhos/cm - microhms per centimeter

**APPENDIX A**  
**EQUIPMENT SPECIFICATIONS**



# WEST Systems portable soil flux meter for Carbon dioxide, Methane and Hydrogen sulfide fluxes

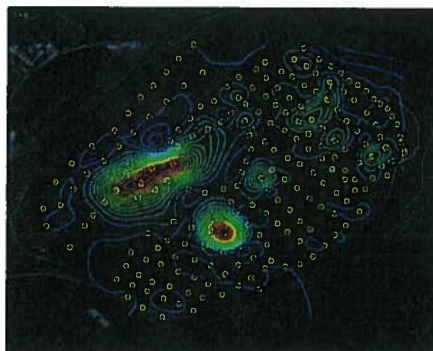
The WEST Systems Fluxmeter is a portable instrument for the measurement of soil gas diffuse degassing phenomena that uses the accumulation chamber method.



This method studied for soil respiration in agronomy (Parkinson) and for soil degassing in volcanic areas (R. Cioni et al.), has been designed by WEST Systems to obtain a portable instrument that allows the performance of measurements with very good accuracy in a short time. The instrument allows a wide range evaluation of the amount of soil gas flux and can be utilized for the evaluation of biogas degassing (landfills), for the survey of non visible degassing phenomena in volcanic and geothermal areas as well as soil respiration rate in agronomy. In the picture below, the results of the degassing survey of a landfill.



Portable fluxmeter



Methane flux contour lines



a group of researchers during a flux mapping fieldwork, using the WS-LI820 flux meter  
Courtesy of United States Geological Survey

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**WEST**  
Systems



# Portable soil flux meter

## Common physical characteristics:

Total Weight = 8.3 Kg/16 lbs. to be carried on the back using the backpack-like support vest. The field operator will also have to carry one of the accumulation chambers and the palmtop:

## Warm Up

Only at instrument cold start-up a warm-up time of 20 minutes is required. The typical measurement time ranges from 2 to 4 minutes and the autonomy of the instrument is about 4 hours with a single NiMH 14.4 Volts, 2.6 A/h battery. The instrument comes with two interchangeable batteries.

## Accumulation Chamber specifications:

- Accumulation chamber A diameter : 200 mm / Height: 100 mm / weight: 1.5 Kg/3.3 lbs
- Accumulation chamber B diameter : 200 mm / Height: 200mm / weight : 2.2 Kg/4.84 lbs

**Palm top computer:** PocketPC Color Display based on Windows Mobile operating system.

- PalmTop with cables, 0.3 Kg/0.7 lbs.
- Size 125mm (4.8") x 82mm (3.2") \* 25 mm (1").

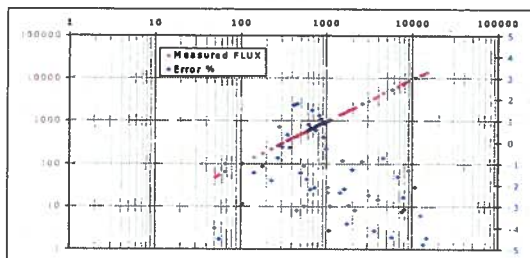
**Software** The instrument is supplied with a custom software, FluxManager, which allows recording and visualization of the increase in concentration of the target gas in the accumulation chamber, and then the flux calculations. The obtained measurements can be saved on the palmtop computer and then transferred to a desktop PC with a USB connection or using a SD card.

## The instrument is supplied complete with:

- backpack-like support vest
- Carrying case for transport and storage
- 2 batteries NiMH 14.4 Volts 2.6 A/h and 1 NiMH battery charger
- Accumulation chamber A and B
- Palmtop Pocket PC
- User Manual, in English
- FLUX Manager Software for Windows Mobile, in English

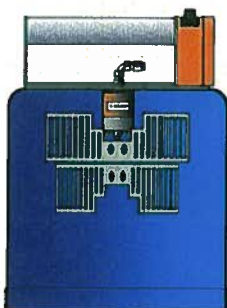
The standard flux meter configuration is supplied with a single gas detector, normally the carbon dioxide detector. The fluxmeter can host two sensors by the way special releases, based on specific customer request, it can be supplied with a maximum of 3 sensors.

Finally we improved the connection between the instrument and the palmtop that now is based on Bluetooth wireless embedded device.



The measured carbon dioxide flux vs imposed flux (grams  $m^{-2} day^{-1}$ );  
The error % vs imposed flux (in blue).

The instrument is extremely versatile and allows measurement of flux in 2/4 minutes. In the picture: Soil bio-gas flux monitoring in a landfill.

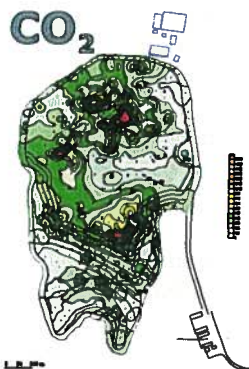


Accumulation Chamber Type B

## The accumulation chambers

In the normal use of instrument only the chamber B is used. To extend the instrument sensitivity to very low fluxes the accumulation chamber A is supplied.

|                  | Type A | Type B |
|------------------|--------|--------|
| net area $m^2$   | 0.0314 |        |
| net volume $m^3$ | 0.003  | 0.006  |



## CO<sub>2</sub> - LI820

### LI820 based Carbon dioxide fluxmeter

The CO<sub>2</sub> Fluxmeter is equipped with the LICOR LI-820 the most accurate and reliable portable carbon dioxide detector. The LI-820 is a double beam infrared sensor compensated for temperature variation in the range from -10 to 45°C and for atmospheric pressure variation in the range 660-1060 HPa. Accuracy 2% repeatability  $\pm 5$  ppm. The full scale range can be set to 1000, 2000, 5000 or 20000 ppmV of carbon dioxide. The characteristics of precision refer to the sensor set to a full scale range of 20000 ppmV. If a very high sensitivity is required, the detector can be set to 1000 or 2000 ppm full scale value to measure with very high precision fluxes in the range from 0 to 10 moles m<sup>-2</sup> day<sup>-1</sup>

#### CO<sub>2</sub> FLUX Measurement range:

from 0 up 600 moles m<sup>-2</sup> day<sup>-1</sup>

The accuracy depends on the measured flux:

|  |                     |
|--|---------------------|
| 0 to 0.5 moles m <sup>-2</sup> day <sup>-1</sup>   | 25% (Acc.ch.A)      |
| 0.5 to 1 moles m <sup>-2</sup> day <sup>-1</sup>   | 15% (Acc.ch.A or B) |
| 1 to 150 moles m <sup>-2</sup> day <sup>-1</sup>   | 10% (Acc.ch.B)      |
| 150 to 300 moles m <sup>-2</sup> day <sup>-1</sup> | 10% (Acc.ch.B)      |
| 300 to 600 moles m <sup>-2</sup> day <sup>-1</sup> | 20% (Acc.ch.B)      |

### WS-DRAGER: CO<sub>2</sub> Flux measurement:

A double beam infrared sensor compensated for temperature variation in the range from -20 to 65°C. Accuracy 3%. The full scale value can be set from 2,000 to 300,000 ppm of carbon dioxide. Carbon Dioxide flux measurement range from 0.5 to 1500 moles/m<sup>2</sup> per day.

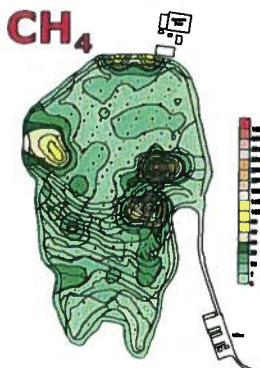
The precision depends on the measured flux:

range: 0.5 – 5 moles/m<sup>2</sup> per day 25% (Acc. chamber A)

5-350 moles/m<sup>2</sup>/day 10% (Acc. chamber B)

350-600 moles/m<sup>2</sup>/day 25% (Acc. chamber B)

600-1500 moles/m<sup>2</sup>/day 25% (Acc.Ch.B / F.S.=10%)



## WS-HC CH<sub>4</sub>

### Methane fluxmeter

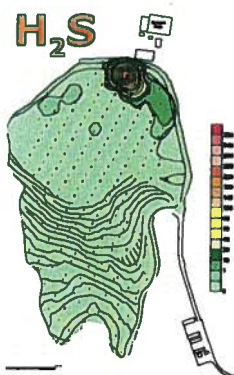
The methane sensor is an IR spectrometer. The full-scale range is 50000ppm, accuracy of 5% of reading, and repeatability is 2% of span. Detection limit 60 ppm, resolution 22 ppm. The detector was designed to measure the not controlled emissions of landfill, but it can be used to detect methane emission from coal or wherever the 0.2 moles/m<sup>2</sup>/day detection limit is acceptable.

#### Methane Flux measurement range

from 0.2 up 300 moles m<sup>-2</sup> day<sup>-1</sup>

The fluxmeter is provided with 2 accumulation chambers and the accuracy depends on the measured flux:

|  |                |
|--|----------------|
| 0.2 to 10 moles m <sup>-2</sup> day <sup>-1</sup>  | 25% (Acc.Ch.A) |
| 10 to 150 moles m <sup>-2</sup> day <sup>-1</sup>  | 15% (Acc.Ch.A) |
| 150 to 300 moles m <sup>-2</sup> day <sup>-1</sup> | 20% (Acc.Ch.B) |



## H<sub>2</sub>S - WEST

### Hydrogen sulfide

The hydrogen sulphide detector is a electrochemical cell with the following specifications:

The full-scale range is 20ppm, with a precision of 3% of reading, and the repeatability is 1.5% of span with a zero offset of 0.3%.

H<sub>2</sub>S Flux measurement range: from 0.0025 to 0.5 moles/m<sup>2</sup> per day.

The precision depends on the measured flux:

|  |                             |
|--|-----------------------------|
| 0.0025 – 0.05 moles/m <sup>2</sup> per day | $\pm 25\%$ (Acc. Chamber A) |
| 0.05 – 0.5 moles/m <sup>2</sup> per day    | $\pm 10\%$ (Acc. Chamber B) |

NOTE: The hydrogen sulphide flux evaluation can be affected by the presence of large quantities of water in both liquid and vapour phases.

We thanks to N.Lima et al. for the maps.

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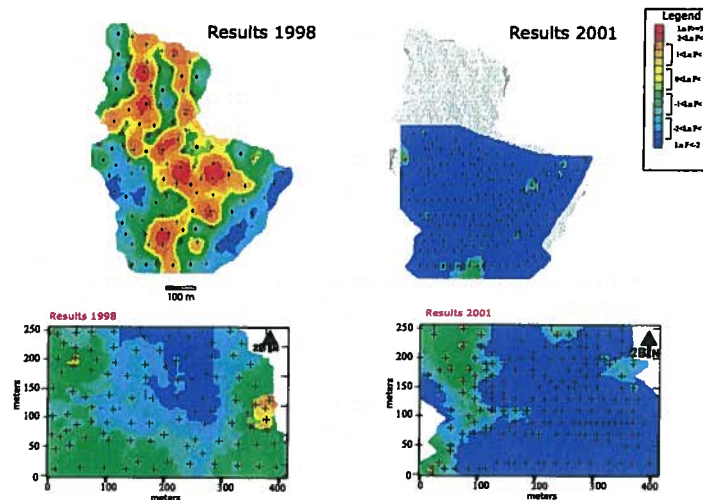
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## Application on a landfill: mapping the biogas non controlled emissions.

The figure shows the compare between the results of the measurement regime of a land/fill undertaken in 1998 and 2001: the mapping performed in 1998 gave clear indications of the areas which required intervention to improve the cover and the capture system.

The interventions were performed only where necessary with a significant economic savings.

The measurement regime of 2001 indicates without any doubt that the interventions were efficient and state-of-the-art.



The obtained results:

- Minor atmospheric emissions;
- Higher quantity and better quality of biogas for cogeneration;
- Optimisation of management costs.

## Continuous soil flux monitoring

WEST Systems produces a soil gas station for the continuous monitoring of carbon dioxide and hydrogen sulfide flux, soil temperature, soil water content, soil pressure gradient, soil heat flux and meteorological parameters.

For more information contact your local representative, visit our web site or e-mail to: [g.virgili@westsystems.com](mailto:g.virgili@westsystems.com)

### Local sales representative

H.Q.

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Japan

#### SHOKO CO., LTD.

7-13,1-chome, Shibakoen, Minato-ku Tokyo

105-8432, Japan

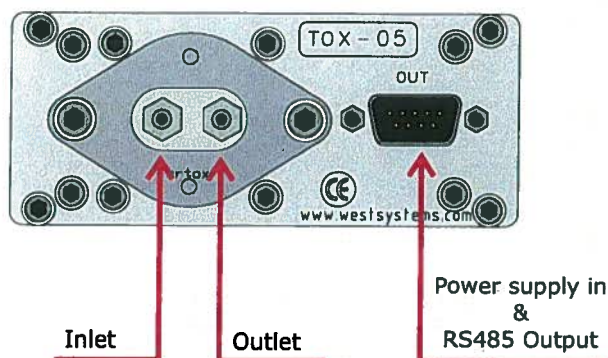
TEL : 03-3459-5106 FAX : 03-3459-5081

WEB SITE <http://www.shoko.co.jp>

e-mail [s-isotope@shoko.co.jp](mailto:s-isotope@shoko.co.jp)



# Hydrogen Sulfide Detector



| Pin | Signal  |
|-----|---------|
| 1   | Gnd     |
| 2   | +VDC    |
| 3   | Gnd     |
| 4   | RS485-B |
| 5   | RS485-A |
| 6   | Gnd     |
| 7   | +12V    |
| 8   | Gnd     |
| 9   | RS485-B |

## Legenda

**Gnd:** Ground reference for power supply and RS485

**+VDC:** 10-28 Volts Power supply input

**RS485-A:** Digital signal output A

**RS485-B:** Digital signal output B

## Sensor specifications

Ambient conditions:

Air temperature -40°C to 65 °C

Air pressure 700 hPa to 1300 hPa

Air RH 5% - 95% non condensating.

Expected sensor life > 24 months.

Chemical cell order code: WEST H2S-BH

Detector order code: WEST TOX-05-H2S-BH

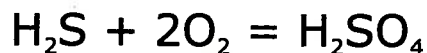
Factory calibration : 20 ppm

RMS Noise <= 0.02 ppm

Zero Offset <= 0.2 ppm

Max Overrange >= 200 ppm

The chemical cell reaction is:



the gas sample specific consumption is very low:

$$2.5 \times 10^{-10} \text{ moles/Sec per ppm}$$

Due to this consumption the H<sub>2</sub>S flux is methodically underestimated by a -10% with the AccumulationChamber A and by a -5% when using the accumulation chamber B. Then we advise to use the accumulation chamber B except when the flux is very very low.

## Appendix M

### WS-HC detector

#### WS-HC Hydrocarbon Flux measurement:

The HydroCarbon detector is based on a double beam infrared spectrometer able to detect methane, hexane, propane and other molecules with HC linkages. The instrument comes calibrated for the methane. *The instrument requires a frequent **zero base-line** calibration that will be done using atmospheric air. The calibration requires 20 second.*

#### Detector specifications:

Accuracy 5%

Repeatability 2%

Resolution 22 ppm (Methane equivalent)

Full scale range is 50000 ppm of methane.

Detection limit 60 ppm.

Methane flux measurement range from 0.1 to 150 moles/m<sup>2</sup> per day.  
The precision depends on the measured flux:

|       |     |     |                               |      |
|-------|-----|-----|-------------------------------|------|
| range | 0.1 | 5   | moles/ m <sup>2</sup> per day | ±25% |
|       | 5   | 150 | moles/ m <sup>2</sup> per day | ±10% |

The measurement of very low fluxes (< 0.1 moles/m<sup>2</sup>/day) is possible but the error will increase due to the low detector sensitivity.



**RS485 Connector DB9 Male panel**

|       |               |
|-------|---------------|
| Pin 1 | Gnd           |
| Pin 2 | +Power supply |
| Pin 3 | Gnd           |
| Pin 4 | RS485 B       |
| Pin 5 | RS485 A       |
| Pin 6 | Gnd           |
| Pin 7 | +Power supply |
| Pin 8 | Gnd           |
| Pin 9 | RS485 B       |

The gas fittings can be used with rilsan 6x4 mm tubes or silicon 5x3.2 tubes. Please respect inlet and outlet ports.

# LI-820 Specifications

## CO<sub>2</sub> Specifications

**Measurement Range:** 0-1000 ppm, 0-2000 ppm with 14 cm bench; 0-5000 ppm, 0-20000 ppm with 5 cm bench

**Accuracy:** < 2.5% of reading with 14 cm bench; 4% of reading with 5 cm bench

### Calibration Drift

<sup>1</sup>**Zero Drift:** < 0.15 ppm / °C

<sup>2</sup>**Span Drift at 370 ppm:** < 0.03% / °C

<sup>3</sup>**Total Drift at 370 ppm:** < 0.4 ppm / °C

**RMS Noise at 370 ppm with 1 sec Signal Filtering:** < 1 ppm

<sup>1</sup> Zero drift is the change with temperature at 0 concentration

<sup>2</sup> Span drift is the change after re-zeroing following a temperature change

<sup>3</sup> Total drift is the change with temperature without re-zeroing or re-spanning

**Measurement Principle:** Non-Dispersive Infrared

**Traceability:** Traceable gases to WMO standards from 0-3000 ppm. Traceable gases to EPA protocol gases from 3000 to 20000 ppm

**Pressure Compensation Range:** 15 kPa-115 kPa

**Maximum Gas Flow Rate:** 1 liter/minute

**Output Signals:** Two Analog Voltage (0-2.5 V or 0-5 V) and Two Current (4-20 mA)  
Digital: TTL (0-5 V) or Open Collector

**DAC Resolution:** 14-bits across user-specified range

**Source Life:** 18000 hours

**Power Requirements:** Input Voltage 12-30 VDC  
1.2A @ 12V (14 W) maximum during warm-up with heaters on  
0.3 A @ 12 V (3.6 W) average after warm-up with heaters on

**Supply Operating Range:** 12-30 VDC

**Operating Temperature Range:** -20 to 45 °C

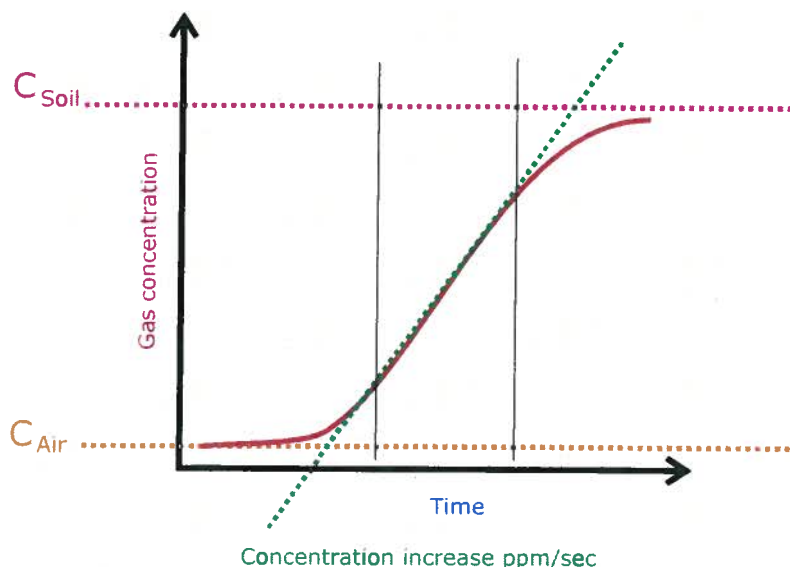
**Relative Humidity Range:** 0 to 95% RH, Non-Condensing

**Dimensions:** 8.75" x 6" x 3" (22.23 x 15.25 x 7.62 cm)

**Weight:** 2.2 lbs (1 kg)

## Quantifying the flux

How explained in the chapter 3 the flux is proportional to the concentration increase ratio ppm/sec. The proportionality factor depends on the chamber volume/surface ratio as well as the barometric pressure and the air temperature inside the accumulation chamber.



There are two methods to carry out the field work, in both cases for each measurement you have to record the type of accumulation chamber used, the barometric pressure, and the air temperature.

The variation of few mBar of the pressure and or few degrees of temperature do not affect the evaluation of flux very much, then you can use a mean value for both parameters. Of course that depends on the accuracy you want to reach for the evaluation of flux.

The instrument measures the barometric pressure, using the embedded pressure sensor of the LICOR, with a good accuracy. A platinum Pt100 or a thermo-couple thermometer can be used to measure the air temperature as well as the soil temperature.

### Choosing the flux measurement unit

The first measurements made, 10 years ago, with the accumulation chamber was expressed in cm/sec which is a speed, the speed of carbon dioxide flowing out from the soil. During the last ten years several units have been used by volcanologist and by geochemistry researchers. The most common unit is grams/squaremeter per day, but using the same instrument for two gas species to express the flux using this unit means to have two different conversion factors. Actually we use the unit **moles/squaremeter per day** that has two advantages: A single conversion factor for every gas specie and an easy conversion of the flux in grams/sm per day simply multiplying the result expressed in moles/sm per day for the molecular weight of the target gas.

From the [tools][settings] menu you can set the accumulation chamber factor in the "A.c.K." field.

If this factor is set to 1 the instrument will give you results expressed in ppm/sec, that's simply the slope of the curve in the selected interval.

If you set the A.c.K to a value different from 1 the instrument will give you the results expressed in moles per square meter per day.

Please see next page.

## Quantifying the flux

### Method 1: Measuring the slope

Set the Accumulation Chamber factor to 1 in order to have the flux measurement expressed in the slope unit "ppm/sec" and translate it in the desired unit with a post processing.

Using this method you can focus only on the accumulation chamber interfacing with the soil, the flux curve shape and the other aspects of the measurement, putting off choosing the correct accumulation chamber factor.

### Method 2: Measuring the flux directly in moles/sm/day.

To get the results directly in moles/sm/day you have to set the Accumulation Chamber factor to the correct value, taking it from the tables.

For each measurement, if there are variations in the air temperature, or of the barometric pressure, or if you changed the accumulation chamber you have to select the [tools][settings] menu and put the correct accumulation chamber factor in the "A.c.K." field. This operation can be "critical". In any case on the saved files you'll find the results of flux evaluation expressed in both units, the raw ppm/sec and the moles/sm/day computed with the A.c.K. you set.

### The accumulation chamber factors

Here following the formula used to compute the A.c.K.:

$$K = \frac{86400 \cdot P}{10^6 \cdot R \cdot T_k} \cdot \frac{V}{A}$$

Where

- **P** is the barometric pressure expressed in mBar (HPa)
- **R** is the gas constant 0.08314510 bar L K<sup>-1</sup> mol<sup>-1</sup>
- **T<sub>k</sub>** is the air temperature expressed in Kelvin degree
- **V** is the chamber net volume in cubic meters
- **A** is the chamber inlet net area in square meters.

The dimensions of the A.c.K. are

$$K = \frac{\text{moles} \cdot \text{meter}^{-2} \cdot \text{day}^{-1}}{\text{ppm} \cdot \text{sec}^{-1}}$$

In the table the conversion factors vs temperature and barometric pressure for the Accumulation Chamber Type A and B are reported.

### An example:

You're using the accumulation chamber B, the slope of the flux curve is 2.5 ppm/sec, the barometric pressure is 1008 mBar (HPa) and the air temperature is 22 °C.

From the table B get the value that correspond to the barometric pressure and temperature. In this case I get the value computed for 25°C and 1013 mBar : 0.696.

Then the flux is: 2.5 x 0.696 = 1.74 moles per square meter per day.



The Gasport Gas Tester is designed for gas utility workers to detect methane and certain toxic gases. It is a reliable, simple, versatile tool to help your service technicians get the job done quickly! With multiple ranges and sensing capabilities built into one rugged housing, the Gasport Tester simplifies your work by reducing the number of meters you have to carry on the job.



## Applications

The Gasport Tester's poison-tolerant methane sensor provides three measurement ranges for your daily service needs:

- Open air, safety sampling
- Small, in-home leak detection
- Street/outdoor service line leak detection

## Features and Benefits

- **Proven in field use—rugged and reliable**  
Less costly to maintain, less time in repair
- **Multiple functions in one instrument**  
No need to buy, carry & maintain multiple instruments
- **New, poison-tolerant combustible gas sensor**  
Reduces meter ownership costs
- **User-selectable, "silent" operation mode**  
Reduces customer disturbances and worries
- **Fast warm up time**  
Fastest warm up time in industry saves time
- **Can monitor up to four gases at a time**  
Fewer instruments to carry
- **Show all gas concentrations simultaneously**  
Eliminates guesswork on what reading is displayed
- **Autoranging methane sensor**  
Automatically switches between 0-5% and 5-100% methane ranges
- **Gas readings recorded for later retrieval**  
Can double check readings after job is done
- **Simple manual or automated calibration options**  
Reduces training time and helps ensure accuracy
- **Intrinsically safe**  
Meets safety standards for work in hazardous areas
- **Lifetime warranty on case and electronics**  
Reduced maintenance and lifetime costs



## Specifications

| Gas              | Range                                 | Resolution                         |
|------------------|---------------------------------------|------------------------------------|
| Methane          | 0-5000 ppm                            | 50 ppm                             |
| Methane          | 0-100% LEL or<br>0-5% CH <sub>4</sub> | 1 % LEL or<br>0.1% CH <sub>4</sub> |
| Methane          | 5-100% CH <sub>4</sub>                | 1% CH <sub>4</sub>                 |
| Oxygen           | 0-25%                                 | 0.1%                               |
| Carbon Monoxide  | 0-1000 ppm                            | 1 ppm                              |
| Hydrogen Sulfide | 0-100 ppm                             | 1 ppm                              |

|                               |  |
|-------------------------------|--|
| <b>Battery types:</b>         | NiCd and Alkaline  |
| <b>Case material:</b>         | Impact resistant, stainless-steel-fiber-filled polycarbonate                               |
| <b>Operating temperature:</b> | normal -10 to 40°C;<br>extended -20 to 50°C  |
| <b>Operating humidity:</b>    | Continuous: 15-95% RH,<br>non-condensing<br>Intermittent duty: 5-95% RH,<br>non condensing |
| <b>Warm up time:</b>          | Less than 20 seconds to initial readings   |
| <b>Datalog capacity:</b>      | 12 hours   |
| <b>Input:</b>                 | 3 clearly marked, metal domed keys   |
| <b>Warranty:</b>              | Case and Electronics: Lifetime<br>Sensors and consumable parts: 1 year                     |

**The answer for gas utilities' gas detection needs**

# Gasport® Gas Tester

## Ordering Information

### Battery Chargers

| Part No. | Description                           |
|----------|---------------------------------------|
| 494716   | Omega 120 VAC 50/60Hz                 |
| 495965   | Omega 220 VAC 50/60Hz                 |
| 801759   | Omega 110/220 VAC, Five Unit, 50/60Hz |
| 800525   | Omega 8 - 24VDC for vehicle use       |

### Battery Packs

| Part No. | Description                  |
|----------|------------------------------|
| 496990   | Standard NiCd Rechargeable   |
| 800526   | Alkaline, Type C             |
| 711041   | Alkaline, with Thumbscrews   |
| 800527   | Heavy Duty NiCd Rechargeable |

### Sensors

| Part No. | Description      |
|----------|------------------|
| 813693   | Combustible Gas  |
| 480566   | O <sub>2</sub>   |
| 812389   | CO               |
| 812390   | H <sub>2</sub> S |

### Protective Boots

| Part No. | Description                                   |
|----------|---|
| 804955   | Black, for NiCd Battery Packs                 |
| 802806   | Orange, for NiCd Battery Packs                |
| 806751   | Black, for Alkaline Battery Packs             |
| 806750   | Orange, for Alkaline Battery Packs            |
| 806749   | Black, for HD NiCd Battery Packs              |
| 806748   | Orange, for HD NiCd Battery Packs             |
| 812833   | Yellow Soft Carrying Case with Harness        |
| 711022   | Black padded Vinyl Carrying Case with Harness |

### Sampling Equipment

| Part No. | Description   |
|----------|---|
| 800332   | Probe - 1 ft., plastic                                      |
| 800333   | Probe - 3 ft., plastic                                      |
| 803561   | Probe - 3 ft., plastic (holes 2" from end) (bar hole probe) |
| 803962   | Probe - 3 ft., plastic (holes 2" from handle) (solid probe) |
| 803848   | Probe - Hot Gas Sampler                                     |
| 710465   | Sampling Line - 5 ft., coiled                               |
| 497333   | Sampling Line - 10 ft.                                      |
| 497334   | Sampling Line - 15 ft.                                      |
| 497335   | Sampling Line - 25 ft.                                      |

### Sampling Accessories

| Part No. | Description                                     |
|----------|---|
| 801582   | Replacement Filter, Probe, pkg. of 10           |
| 801291   | External Filter Holder                          |
| 014318   | Charcoal Filter                                 |
| 711039   | Line Scrubber Filter Holder                     |
| 711059   | Line Scrubber Replacement Cartridges, Box of 12 |
| 808935   | Dust Filter, Pump Module                        |
| 802897   | Water Trap (Teflon) Filter, Pump Module         |

### Calibration Check Equipment

| Part No. | Description  |
|----------|--|
| 477149   | Calibration Kit Model RP with 0.25 lpm Regulator                               |
| 491041   | Calibration Gas - methane, 2.5%  |
| 473180   | Calibration Gas - 300 ppm CO   |
| 813718   | Calibration Gas - methane, 2.5% oxygen, 15% 60 ppm CO                          |
| 813720   | Calibration Gas - methane, 2.5% oxygen, 15% 300 ppm CO 10 ppm H <sub>2</sub> S |
| 710288   | Gasmiser™ Demand Regulator 0 - 3.0 lpm   |

### Accessories

| Part No. | Description   |
|----------|---|
| 804679   | Data Docking Module Kit. Includes the Data Docking Module, MSA Link Software and Instruction Manual |

## Approvals

The Gasport Gas Tester has been designed to meet intrinsic safety testing requirements in certain hazardous atmospheres.

The Gasport Gas Tester is approved by MET (an OSHA Nationally Recognized Testing Laboratory [NRTL]) for use in Class I, Division I, Groups A, B, C, D; Class II, Division I, Groups E, F, G; and Class III Hazardous locations. Gasport Gas Testers sold in Canada are approved by CSA for use in Class I, Division I, Groups A, B, C, and D locations.

Contact MSA at 1-800-MSA-2222 for more information or with questions regarding the status of approvals.

### Gasport Gas Tester Kits

|                             | LEL Display | O <sub>2</sub> | CO | H <sub>2</sub> S | Alarms Always | Alarms Optional | Leak Detect Page | Peak | Alkaline Battery | NiCd Battery | 5ft Coiled Line | 1ft Probe | Part No. |
|-----------------------------|-------------|----------------|----|------------------|---------------|-----------------|------------------|------|------------------|--------------|-----------------|-----------|----------|
| 4-Gas, Selectable, NiCd     | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711489   |
| 4-Gas, Selectable, Alkaline | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711490   |
| 3-Gas, Selectable, NiCd     | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711493   |
| 3-Gas, Selectable, Alkaline | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711494   |
| 2-Gas, Selectable, NiCd     | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711495   |
| 2-Gas, Selectable, Alkaline | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711496   |
| 4-Gas, Alarms On, NiCd      | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711491   |
| 4-Gas, Alarms On, Alkaline  | •           | •              | •  | •                | •             | •               | •                | •    | •                | •            | •               | •         | 711492   |

### Assemble-to-Order (ATO) System: You Make the Choices

The ATO System makes it easy to "custom order" the Gasport Gas Tester, configured exactly the way you want it. You can choose from an extensive line of base instrument components and accessories. To obtain a copy of the "ATO System and Price Information for the Gasport Gas Tester," call toll-free 1-800-MSA-2222, and request Bulletin 0804-28. To obtain a copy of the ATO via FAX, call MSA QuickLit Information Service at 1-800-672-9010. At the prompt, request QuickLit Document #2345 (ATO for Gasport Gas Tester).

**Note:** This Data Sheet contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products.

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# QRAE II User's Guide



**Covers QRAE II Diffusion & Pump Models  
with Firmware Version 3.60 or higher**



# QRAE II User Guide

## 1.2 Specifications

### QRAE II Specifications

|   |   |            |                |
|---|---|------------|----------------|
| <b>Configuration</b>                          | Pumped or diffusion 4-gas with datalogging  |            |                |
| <b>Dimensions:</b>                            | Diffusion: 5" L x 2.8" W x 1.5" H (125mm x 72mm x 38mm)   |            |                |
|   | Pump: 5" L x 2.8" W x 1.5" H (125mm x 72mm x 38mm)  |            |                |
| <b>Weight:</b>                                | Diffusion: 9 oz (250g)  |            |                |
|   | Pump: 12 oz (350 g) with battery  |            |                |
| <b>Detectors:</b>                             | 2 Electrochemical toxic gases sensors   |            |                |
|   | 1 Solid Polymer Electrolyte oxygen sensor   |            |                |
|   | 1 Catalytic sensor for combustible level organics   |            |                |
| <b>Battery:</b>                               | Rechargeable 3.7V Li-ion battery pack (6-hour charge time) or a 3 AA alkaline battery adapter.  |            |                |
| <b>Operating Time:</b>                        | Up to 10 hours continuous w/ Li-ion battery pack  |            |                |
| <b>Display:</b>                               | 4-line graphical LCD with automatic LED backlight for dim lighting conditions   |            |                |
| <b>Keypad:</b>                                | 2 programming/operation keys  |            |                |
| <b>Direct Readout:</b>                        | Up to 4 simultaneous values with sensor name, battery charge, high and low values for all sensors, elapsed time, and datalogging on/off state |            |                |
| <b>Sampling Method:</b>                       | Diffusion or pumped (depending on model)  |            |                |
| <b>Range, Resolution &amp; Response Time:</b> | LEL   | 0-100%     | 1 % 15 sec     |
|   | O <sub>2</sub>  | 0-30%      | 0.1 % 20 sec   |
|   | CO  | 0-1000 ppm | 1 ppm 25 sec   |
|   | H <sub>2</sub> S  | 0-100 ppm  | 0.1 ppm 30 sec |
| <b>Alarm Settings:</b>                        | Separate limits for TWA, STEL, High, Low  |            |                |
| <b>Alarms:</b>                                | ≥95 dB @ 30 cm buzzer, flashing red LEDs, vibration alarm, LCD to indicate exceeded preset limits, low battery, or sensor failure             |            |                |
| <b>Calibration:</b>                           | Two-point field calibration for fresh air and standard reference gas  |            |                |
| <b>Protection:</b>                            | Password protected calibration settings, alarm limits, and data   |            |                |
| <b>Intrinsic Safety:</b>                      | CSA Class I, Division 1, Group A, B, C, D, T4 (US & Canada), SIRA ATEX II 2G Ex ia d II C T4 Gb (Europe), IECEx Ex d ia II C T4 Gb            |            |                |
| <b>EM Immunity:</b>                           | No effect when exposed to 0.43mW/cm <sup>2</sup> RF interference (5-watt transmitter at 12"/10cm).  |            |                |
| <b>Data Storage:</b>                          | 64,000 readings (64 hours, 4 channels at 1 minute interval) in non-volatile memory.   |            |                |
| <b>Datalog Interval:</b>                      | Programmable 1- to 3,600-second intervals   |            |                |
| <b>Alarm Settings:</b>                        | Separate alarm limit settings for TWA, STEL, Low and High alarm.  |            |                |
| <b>Communication:</b>                         | Download data to PC and upload monitor setup from PC through an RS-232 link to PC serial port   |            |                |
| <b>Temperature:</b>                           | -20° C to 50° C (-4° F to 122° F)   |            |                |
| <b>Humidity:</b>                              | 0% to 95% relative humidity (non-condensing)  |            |                |

#### Caution:

Refer to RAE Systems Technical Note TN-114 for sensor cross-sensitivities.  
Refer to RAE Systems Technical Note TN-144 for LEL sensor poisoning.

### KEY FEATURES

#### Trimble Floodlight satellite shadow reduction technology

More positions and increased accuracy in tough environments

#### Sunlight readable display

For unmatched clarity in bright sunlight

#### 3.5G cellular capability

High-speed Internet connectivity in the field

#### 5 megapixel autofocus camera

Capture high quality photographs and link directly to features

#### Field-swappable battery

All day operation and the convenience of swap-and-go battery replacement



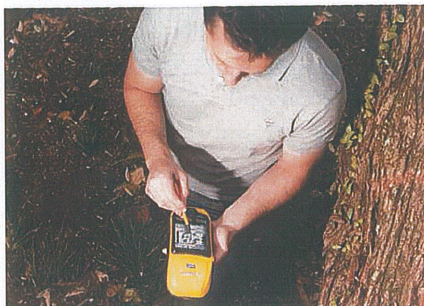
### THE ACCURACY YOU NEED ANYWHERE YOU NEED IT

Bringing together the essential functionality for productive GIS data collection in one device, the Trimble® GeoExplorer® 6000 series also delivers positioning accuracy in challenging GNSS situations such as under trees and near buildings with Trimble Floodlight™ technology. Wherever you work, it just works.

#### Accurate, productive, reliable data collection

Integrating both a GPS/GLONASS receiver and a dual frequency GNSS antenna, the Trimble GeoExplorer 6000 series delivers accuracy you can depend on to record new assets, or reliably navigate back to previously recorded locations.

Used with Trimble's range of powerful field and office software, GeoExplorer 6000 series handhelds allow you to work faster and in more places than ever before. The Trimble GeoExplorer series can deliver down to centimeter accuracy—either postprocessed or in real time for the confidence the job is done right while still on site.



Trees and buildings create "satellite shadows", limiting the areas where you can reliably collect high-accuracy GNSS data. Using Trimble Floodlight technology, the GeoExplorer 6000 series continues to deliver productive, usable data under tree canopy or in urban canyons. You can work with fewer disruptions, meaning better data, faster, at less cost.

#### Designed for work, wherever you work

The Trimble GeoExplorer series works for the way you work. The built-in 5 megapixel autofocus camera, with geotagging capability, gives you one of the best ways to capture information about an asset, event, or site. A sunlight-optimized display maintains exceptional clarity in all outdoor conditions for crisp on screen text and images. And you can stay connected with an optional integrated 3.5G cellular modem for continuous network and Internet access to real-time map data, web-based services, Trimble VRS™ corrections, and live update of field information.



With the Trimble GeoExplorer 6000 series you get it all.



# TRIMBLE GEOEXPLORER 6000 SERIES

## PRODUCT MODELS

|                | GeoXH                | GeoXT    |
|----------------|----------------------|----------|
| Accuracy       | Decimeter/Centimeter | Submeter |
| Floodlight     | Yes                  | Optional |
| Cellular modem | Optional             | Optional |
| Camera         | 5 MP                 | 5 MP     |

## GNSS

Receiver ..... Trimble Maxwell™ 6 GNSS chipset  
 Channels ..... 220 channels  
 Systems ..... GPS, GLONASS<sup>1</sup>  
 WAAS/EGNOS/MSAS/GAGAN  
 Update rate ..... 1 Hz  
 Time to first fix ..... 45 s (typical)  
 NMEA-0183 support ..... Optional  
 Trimble Floodlight technology ..... Optional  
 RTCM support ..... RTCM2.x/RTCM3.x  
 CMR support ..... CMR/CMR+/CMRx

## GeoXT handhelds

GPS ..... L1C/A  
 GLONASS ..... L1C/A, L1P

## GeoXH handhelds

GPS ..... L1C/A, L2C, L2E  
 GLONASS ..... L1C/A, L1P, L2C/A, L2P

## GNSS ACCURACY<sup>2</sup>

### GeoXH Centimeter Edition

#### Real-time Centimeter output

Horizontal (external antenna)<sup>3</sup> ..... 1 cm + 1 ppm  
 Vertical (external antenna) ..... 1.5 cm + 2 ppm  
 Horizontal (internal antenna) ..... 2.5 cm + 1.2 ppm  
 Vertical (internal antenna) ..... 4 cm + 2 ppm

#### Postprocessed Centimeter output

Horizontal (external antenna)<sup>3</sup> ..... 1 cm + 1 ppm  
 Vertical (external antenna) ..... 1.5 cm + 1 ppm  
 Horizontal (internal antenna) ..... 2.5 cm + 1.2 ppm  
 Vertical (internal antenna) ..... 4 cm + 1.5 ppm

## All GeoXH configurations

### Real-time and postprocessed H-Star (Horizontal RMS)

H-Star ..... 10 cm + 1 ppm

## All GeoXH and GeoXT configurations

### Real-time DGNSS (Horizontal RMS)

Code ..... 75 cm + 1 ppm  
 SBAS<sup>4</sup> (WAAS/EGNOS/MSAS) ..... typically < 1 m

### Postprocessed DGNSS (Horizontal RMS)

Code ..... 50 cm + 1 ppm  
 Carrier (after 45 minutes) ..... 1 cm + 2 ppm

## ENVIRONMENTAL (MIL-STD-810G)

Drop shock ..... 1.2 m (4 ft) to plywood over concrete  
 Functional shock ..... Method 516.6 Procedure I  
 Vibration ..... Method 514.6 Procedure I  
 Relative humidity ..... 95% non-condensing  
 Maximum operating altitude ..... 9,000 m (29,000 ft)  
 Maximum storage altitude ..... 12,000 m (40,000 ft)

## TEMPERATURE

Operation ..... -20 °C to +60 °C (-4 °F to +140 °F)  
 Storage ..... -30 °C to +70 °C (-22 °F to +158 °F)

## INGRESS PROTECTION

Water/Dust ..... IP65

## SIZE AND WEIGHT

Height ..... 234 mm (9.2 in)  
 Width ..... 99 mm (3.9 in)  
 Depth ..... 56 mm (2.2 in)  
 Weight (inc. battery) ..... 925 g (2.0 lb)

## BATTERY

Type ..... Rechargeable, removable Li-Ion  
 Capacity ..... 11.1 V 2.5 AH  
 Charge time ..... 4 hours (typical)

## BATTERY RUN TIME<sup>5</sup>

|                        | GeoXH     | GeoXT     |
|------------------------|-----------|-----------|
| GNSS                   | 9 hours   | 11 hours  |
| GNSS & Wi-Fi           | 8 hours   | 9.5 hours |
| GNSS & cellular        | 6.5 hours | 7 hours   |
| Standby time (typical) | 50 days   | 50 days   |

## CONNECTORS & INPUTS

- Internal microphone and speaker
- Mini USB connector
- DE-9 serial via optional USB to serial converter
- External power connector
- SIM socket
- SDHC card socket

## CAMERA

Still mode ..... Autofocus 5 MP  
 Still image format ..... JPG  
 Video mode ..... Up to VGA resolution  
 Video file format ..... WMV with audio

## CELLULAR<sup>6</sup> & WIRELESS<sup>7</sup>

UMTS/HSDPA ..... 850/900/2100 MHz  
 GPRS/EDGE ..... 850/900/1800/1900 MHz  
 Wi-Fi ..... 802.11 b/g  
 Bluetooth ..... Version 2.1 + EDR

## DISPLAY

Type ..... Transflective LED-backlit LCD  
 Size ..... 4.2" (diagonal)  
 Resolution ..... 480x640  
 Luminance ..... 280 cd/m2

## HARDWARE

Processor ..... TI OMAP 3503  
 RAM ..... 256 MB  
 Flash ..... 2 GB  
 External storage ..... SD/SDHC up to 32 GB

## LANGUAGES

- English, Spanish, French, German, Italian, Portuguese (Brazilian), Chinese (Simplified), Korean, Japanese, Russian

## IN THE BOX

GeoExplorer 6000 series handheld, rechargeable battery pack, pouch and strap, USB data cable, AC power adaptor, screen protector kit, spare stylus & tether, documentation

## OPTIONAL ACCESSORIES

- Trimble Zephyr™ Model 2 external GNSS antenna
- Trimble Tornado™ external GNSS antenna
- Trimble Tempest™ external GNSS antenna
- Vehicle power supply
- 1.5 m & 5 m external antenna cable
- Range pole kit for external antenna
- Carbon fiber monopole kit
- Backpack kit for external antenna
- Vehicle mount
- Hard carry case
- Null modem cable
- USB to serial converter cable

## SOFTWARE COMPATIBILITY

- Trimble TerraSync software
- Trimble GPS Pathfinder® Office software
- Trimble Positions™ software suite
- Trimble GPSCorrect™ extension for Esri ArcPad software
- Trimble GPS Analyst™ extension for Esri ArcGIS for Desktop software
- Trimble GPS Controller software
- Trimble GNSS Connector software
- Trimble TrimPix™ Pro system
- Custom applications built with a Mobile GIS Developer Community software development kit (SDK)
- Third party NMEA-based applications

<sup>1</sup> GLONASS is enabled on GeoXT and GeoXH handhelds with Floodlight technology enabled.

<sup>2</sup> Accuracy and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. Always follow recommended GNSS data collection practices. Specified Centimeter accuracy can normally be achieved for baselines of 30 km or less. Specified H-Star accuracy can normally be achieved for baseline lengths of 100 km or less. Centimeter and H-Star accuracy is typically achieved within 2 minutes. Carrier postprocessed accuracy is limited to data collected within 10 km of the base station used for corrections.

<sup>3</sup> Stated accuracy is for the Zephyr Model 2 antenna.

<sup>4</sup> SBAS (Satellite Based Augmentation System). Includes WAAS; available in North America only; EGNOS; available in Europe only and MSAS; available in Japan only.

<sup>5</sup> Actual run time will vary with conditions and environment of use.

<sup>6</sup> Not available on all configurations. The GeoXH and GeoXT 3.5G edition handhelds are PTCRB certified and can operate on supported networks that do not require carrier certification. Consult with your local reseller for more information.

<sup>7</sup> Bluetooth and Wi-Fi type approvals are country specific. GeoExplorer 6000 series handhelds have Bluetooth and Wi-Fi approval in the U.S. and in most European countries. For further information please consult your local reseller.

Specifications subject to change without notice.



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 store.trimble.com



# Operator's Manual

## SMARTROLL™ MP Handheld Instrument

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## General Specifications

|                       |  |
|-----------------------|--|
| Operating temperature | -5 to 50° C (23 to 122° F)   |
| Storage temperature   | -40 to 65° C (-40 to 149° F)   |
| Dimensions            | 4.7 cm (1.85 in.) OD x 26.9 cm (10.6 in.) with restrictor installed (does not include connector)   |
| Weight                | 694 g (1.53 lbs)   |
| Wetted materials      | PVC, 316 stainless steel, titanium, Acetal, Viton®, PC/PMMA  |
| Environmental rating  | IP68 with all sensors and cable attached. IP67 with sensors removed and cable detached.  |
| Reading rate          | 1 reading every 10 seconds; data logged to smartphone.   |
| Power                 | 6 VDC from battery pack  |
| Interface             | iPhone® 4S, iPod touch® 5, or iPad® 3, 4, mini or later; iOS 6.0 or later. Bluetooth® Low Energy (BLE) radio. Purchase the iSitu™ App at the Apple® App Store.   |
| Cable                 | Black polyurethane. Standard lengths available: 1.5 m, 4.6 m, 9.1 m, 30.5 m (5 ft, 15 ft, 30 ft, 100 ft)   |
| Warranty              | 2-years  |
| Notes                 | Specifications are subject to change without notice. Apple, iPhone, iPod touch, and iPad are trademarks of Apple Inc. registered in U.S. and other countries. Bluetooth is a registered trademark of Bluetooth SIG, Inc. Viton is a registered trademark of DuPont Performance Elastomers L.L.C. |

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## Sensor Specifications

### Level, Depth, Pressure Sensor Specifications

|                  |   |
|------------------|---|
| Accuracy         | Typical $\pm 0.1\%$ FS @ 15° C; $\pm 0.3\%$ FS max. from 0 to 50° C |
| Range            | 76 m (250 ft); absolute (non-vented)                                |
| Resolution       | $\pm 0.01\%$ FS or better   |
| Sensor Type      | Fixed   |
| Response Time    | Instantaneous in thermal equilibrium                                |
| Units of Measure | Pressure: psi, kPa, bar, mbar, mmHg, inHg Level: mm, cm, m, in, ft  |
| Methodology      | Piezoresistive; ceramic   |

### Barometric Pressure Sensor Specifications (Battery Pack)

|                  |  |
|------------------|--|
| Accuracy         | $\pm 3$ mbar max.                          |
| Range            | 300 to 1100 mbar                           |
| Resolution       | 0.01 mbar                                  |
| Sensor Type      | Fixed                                      |
| Response Time    | Instantaneous in thermal equilibrium       |
| Units of Measure | psi, kPa, bar, mbar, mmHg, inHg, Torr, atm |
| Methodology      | Piezoresistive pressure sensor             |



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## Conductivity Sensor Specifications

|                  |  |
|------------------|--|
| Accuracy         | Typical $\pm 0.5\%$ + 1 $\mu\text{S/cm}$ ; $\pm 1\%$ max.  |
| Range            | 5 to 100,000 $\mu\text{S/cm}$  |
| Resolution       | 0.1 $\mu\text{S/cm}$   |
| Sensor Type      | Fixed  |
| Response Time    | Instantaneous in thermal equilibrium   |
| Units of Measure | Actual conductivity ( $\mu\text{S/cm}$ , $\text{mS/cm}$ ) Specific conductivity ( $\mu\text{S/cm}$ , $\text{mS/cm}$ ) Salinity (PSU) Total dissolved solids (ppt, ppm) Resistivity (Ohms-cm) Density ( $\text{g/cm}^3$ ) |
| Methodology      | Std. Methods 2510 EPA 120.1  |

## Dissolved Oxygen RDO Fast Cap (Optical Sensor) Specifications

|                  |  |
|------------------|--|
| Accuracy         | $\pm 0.1$ mg/L; $\pm 0.2$ mg/L; $\pm 10\%$ of reading                        |
| Range            | 0 to 8 mg/L; 8 to 20 mg/L; 20 to 50 mg/L; Full operating range: 0 to 50 mg/L |
| Resolution       | 0.01 mg/L  |
| Sensor Type      | Fixed with replaceable RDO Fast Cap (life: 1 year typical)                   |
| Response Time    | T90: <30 sec. T95: <45 sec.  |
| Units of Measure | mg/L, % saturation, ppm  |
| Methodology      | EPA-approved In-Situ Methods 1002-8-2009 1003-8-2009 1004-8-2009             |

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## ORP Sensor Specifications

|                  |                                 |
|------------------|---------------------------------|
| Accuracy         | ±5.0 mV                         |
| Range            | ±1400 mV                        |
| Resolution       | 0.1 mV                          |
| Sensor Type      | Replaceable pH/ORP combo sensor |
| Response Time    | <15 sec.                        |
| Units of Measure | mV                              |
| Methodology      | Std. Methods 2580               |

## pH Sensor Specifications

|                  |                                    |
|------------------|------------------------------------|
| Accuracy         | ±0.1 pH unit from 0 to 12 pH units |
| Range            | 0 to 14 pH units                   |
| Resolution       | 0.01 pH unit                       |
| Sensor Type      | Replaceable pH/ORP combo sensor    |
| Response Time    | <15 sec., pH 7 to pH 4             |
| Units of Measure | pH units                           |
| Methodology      | Std. Methods 4500-H+ EPA 150.2     |

## Air Temperature Sensor Specifications (Battery Pack)

|                  |                             |
|------------------|-----------------------------|
| Accuracy         | ±2° C                       |
| Range            | -20 to 70° C (-4 to 158° F) |
| Resolution       | 0.1° C                      |
| Sensor Type      | Fixed                       |
| Response Time    | <30 sec.                    |
| Units of Measure | Celsius, Fahrenheit         |
| Methodology      | EPA 170.1                   |

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## Sample Temperature Sensor Specifications (Probe)

|                  |                            |
|------------------|----------------------------|
| Accuracy         | ±0.1° C                    |
| Range            | -5 to 50° C (23 to 122° F) |
| Resolution       | 0.01° C or better          |
| Sensor Type      | Fixed                      |
| Response Time    | <30 sec.                   |
| Units of Measure | Celsius, Fahrenheit        |
| Methodology      | EPA 170.1                  |



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## Battery Pack Specifications

| Battery Type             | Four 1.5V AA lithium or alkaline batteries                                      |
|--------------------------|---|
| Operating temperature    | -5 to 50° C (23 to 122° F); 95% relative humidity, non-condensing               |
| Storage temperature      | -40 to 65° C (-40 to 149° F); 95% relative humidity, non-condensing             |
| Dimensions & weight      | 9.5 x 7.6 x 5.7 cm (3.75 x 3 x 2.25 in.) (H x D x W).<br>Weight: 165 g (5.8 oz) |
| Materials                | PC/ABS  |
| Environmental rating     | IP67 with battery cover closed  |
| Output options           | BLE radio   |
| Battery type             | 4 AA Lithium or Alkaline  |
| Warranty on battery pack | 1-year  |
| Warranty on cable        | 1-year  |

**APPENDIX B**  
**FLUX METER DATA**



## APPENDIX B FLUX DATA

| Site Point ID           | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|-------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepAreaL-1030090517_06 | 1146109  | 3164860 | A             | 782.8          | 34.3        | 9/5/2017 | 0         | -0.001    | 1.232     | 0.2381373  | 0.000000                 | 0.000000                 | 0.293385                 |
| SeepAreaL-1030090517_02 | 1146201  | 3164668 | A             | 783.2          | 31.5        | 9/5/2017 | -0.942    | -0.003    | 0.167     | 0.2404488  | 0.000000                 | 0.000000                 | 0.040155                 |
| SeepAreaL-1030090517_05 | 1146205  | 3164820 | A             | 782.8          | 33.6        | 9/5/2017 | -0.445    | 0.002     | 0.488     | 0.2386807  | 0.000000                 | 0.000477                 | 0.116476                 |
| SeepAreaL-1030090517_04 | 1146210  | 3164776 | A             | 783.2          | 32.9        | 9/5/2017 | -0.085    | 0.004     | 0.805     | 0.2393489  | 0.000000                 | 0.000957                 | 0.192676                 |
| SeepAreaL-1030090517_03 | 1146220  | 3164707 | A             | 783.2          | 32.1        | 9/5/2017 | -0.835    | -0.001    | 1.315     | 0.2399762  | 0.000000                 | 0.000000                 | 0.315569                 |
| SeepAreaL-1030090517_18 | 1146255  | 3164755 | A             | 783.0          | 39.1        | 9/5/2017 | 118.388   | 0.002     | 2.99      | 0.2345365  | 27.766310                | 0.000469                 | 0.701264                 |
| SeepAreaL-1030090517_16 | 1146259  | 3164625 | A             | 783.0          | 38.5        | 9/5/2017 | -1.739    | 0.009     | 1.218     | 0.234988   | 0.000000                 | 0.002115                 | 0.286215                 |
| SeepAreaL-1030090517_17 | 1146261  | 3164721 | A             | 783.0          | 38.8        | 9/5/2017 | 3.061     | 0.018     | 5.994     | 0.234762   | 0.718607                 | 0.004226                 | 1.407164                 |
| SeepAreaL-1030090517_07 | 1146262  | 3164822 | A             | 782.8          | 35.1        | 9/5/2017 | -0.391    | 0         | 0.406     | 0.2375193  | 0.000000                 | 0.000000                 | 0.096433                 |
| SeepAreaL-1030090517_01 | 1146267  | 3164667 | A             | 783.0          | 30.3        | 9/5/2017 | -2.101    | -0.002    | 2.609     | 0.241338   | 0.000000                 | 0.000000                 | 0.629651                 |
| SeepAreaL-1030090517_19 | 1146278  | 3164755 | A             | 783.0          | 39.6        | 9/5/2017 | 309.901   | 0         | 6.29      | 0.2341615  | 72.566900                | 0.000000                 | 1.472876                 |
| SeepAreaL-1030090517_22 | 1146299  | 3164697 | A             | 783.3          | 40.8        | 9/5/2017 | 7.25      | 0         | 0.385     | 0.2333559  | 1.691830                 | 0.000000                 | 0.089842                 |
| SeepAreaL-1030090517_20 | 1146305  | 3164771 | A             | 783.3          | 40.2        | 9/5/2017 | 21.386    | 0.005     | 10.68     | 0.2338027  | 5.000104                 | 0.001169                 | 2.497013                 |
| SeepAreaL-1030090517_08 | 1146309  | 3164808 | A             | 783.3          | 35.7        | 9/5/2017 | -0.348    | 0.007     | 2.605     | 0.2372093  | 0.000000                 | 0.001660                 | 0.617930                 |
| SeepAreaL-1030090517_15 | 1146312  | 3164613 | A             | 783.0          | 38.4        | 9/5/2017 | -0.347    | 0.003     | 0.845     | 0.2350635  | 0.000000                 | 0.000705                 | 0.198629                 |
| SeepAreaL-1030090517_21 | 1146315  | 3164732 | A             | 783.2          | 40.6        | 9/5/2017 | 4.871     | 0.001     | 0.809     | 0.2334748  | 1.137256                 | 0.000233                 | 0.188881                 |





## APPENDIX B FLUX DATA (Continued)

| Site Point ID             | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|---------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepAreaL-1030090517_13   | 1146324  | 3164663 | A             | 783.3          | 38.0        | 9/5/2017 | 42.72     | 0.001     | 6.896     | 0.2354558  | 10.058670                | 0.000235                 | 1.623703                 |
| SeepAreaL-1030090517_12   | 1146353  | 3164667 | A             | 783.3          | 37.8        | 9/5/2017 | 0         | 0.003     | 0.785     | 0.2356073  | 0.000000                 | 0.000707                 | 0.184952                 |
| SeepAreaL-1030090517_10   | 1146355  | 3164763 | A             | 783.5          | 36.9        | 9/5/2017 | -0.005    | 0.005     | 0.71      | 0.2363515  | 0.000000                 | 0.001182                 | 0.167810                 |
| SeepAreaL-1030090517_11   | 1146360  | 3164718 | A             | 783.5          | 37.4        | 9/5/2017 | 0         | 0.001     | 2.255     | 0.235971   | 0.000000                 | 0.000236                 | 0.532115                 |
| SeepAreaL-1030090517_14   | 1146365  | 3164624 | A             | 783.2          | 38.2        | 9/5/2017 | 0         | -0.004    | 0.217     | 0.2352745  | 0.000000                 | 0.000000                 | 0.051055                 |
| SeepAreaL-1030090517_09   | 1146366  | 3164822 | A             | 783.5          | 36.2        | 9/5/2017 | -0.001    | 0.003     | 4.476     | 0.2368863  | 0.000000                 | 0.000711                 | 1.060303                 |
| SeepArea32L-1049090617_12 | 1173755  | 3177866 | A             | 792.1          | 38.1        | 9/6/2017 | -0.421    | 0.001     | 0.567     | 0.2380246  | 0.000000                 | 0.000238                 | 0.134960                 |
| SeepArea32L-1049090617_14 | 1173757  | 3177648 | A             | 792.4          | 38.8        | 9/6/2017 | -0.8      | 0.004     | 2.269     | 0.2375804  | 0.000000                 | 0.000950                 | 0.539070                 |
| SeepArea32L-1049090617_13 | 1173763  | 3177742 | A             | 792.1          | 38.5        | 9/6/2017 | -1.612    | 0         | 0.486     | 0.2377191  | 0.000000                 | 0.000000                 | 0.115531                 |
| SeepArea32L-1049090617_87 | 1173775  | 3178254 | A             | 792.2          | 34.8        | 9/6/2017 | -1.815    | 0         | 0.522     | 0.2406056  | 0.000000                 | 0.000000                 | 0.125596                 |
| SeepArea32L-1049090617_85 | 1173782  | 3178052 | A             | 791.8          | 35.1        | 9/6/2017 | -0.402    | 0.001     | 2.312     | 0.2402501  | 0.000000                 | 0.000240                 | 0.555458                 |
| SeepArea32L-1049090617_86 | 1173782  | 3178153 | A             | 792.2          | 35.0        | 9/6/2017 | -0.741    | 0.005     | 2.574     | 0.2404494  | 0.000000                 | 0.001202                 | 0.618917                 |
| SeepArea32L-1049090617_88 | 1173793  | 3178348 | A             | 791.9          | 34.7        | 9/6/2017 | 0         | 0.002     | 0.66      | 0.2405926  | 0.000000                 | 0.000481                 | 0.158791                 |
| SeepAreaL-1021090717_31   | 1173797  | 3178414 | A             | 790.1          | 43.3        | 9/7/2017 | -0.871    |           | 1.195     | 0.2335221  | 0.000000                 |                          | 0.279059                 |
| SeepAreaL-1021090717_30   | 1173804  | 3178455 | A             | 790.1          | 43.4        | 9/7/2017 | 0         | 0.004     | 0.264     | 0.2334484  | 0.000000                 | 0.000934                 | 0.061630                 |
| SeepAreaL-1021090717_29   | 1173807  | 3178514 | A             | 790.1          | 43.4        | 9/7/2017 | -1.787    | 0.003     | 0.05      | 0.2334484  | 0.000000                 | 0.000700                 | 0.011672                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID             | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|---------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_11 | 1173813  | 3177846 | A             | 792.1          | 37.7        | 9/6/2017 | -0.746    | -0.001    | 0.647     | 0.2383308  | 0.000000                 | 0.000000                 | 0.154200                 |
| SeepArea32L-1049090617_15 | 1173828  | 3177638 | A             | 791.8          | 39.1        | 9/6/2017 | 0         | 0.001     | 0.725     | 0.2371724  | 0.000000                 | 0.000237                 | 0.171950                 |
| SeepAreaL-1021090717_32   | 1173836  | 3178421 | A             | 790.1          | 43.3        | 9/7/2017 | -2.553    | 0.007     | 0.626     | 0.2335221  | 0.000000                 | 0.001635                 | 0.146185                 |
| SeepArea32L-1049090617_16 | 1173838  | 3177725 | A             | 792.1          | 39.4        | 9/6/2017 | -1.039    | 0.001     | 1.251     | 0.2370345  | 0.000000                 | 0.000237                 | 0.296530                 |
| SeepArea32L-1049090617_89 | 1173839  | 3178359 | A             | 791.8          | 34.6        | 9/6/2017 | -1.134    | 0.002     | 1.708     | 0.2406404  | 0.000000                 | 0.000481                 | 0.411014                 |
| SeepAreaL-1021090717_33   | 1173851  | 3178444 | A             | 790.1          | 43.3        | 9/7/2017 | -0.792    | 0.005     | 4.283     | 0.2335221  | 0.000000                 | 0.001168                 | 1.000175                 |
| SeepArea32L-1049090617_03 | 1173856  | 3177979 | A             | 793.0          | 33.7        | 9/6/2017 | -5.141    | 0.012     | 1.684     | 0.241712   | 0.000000                 | 0.002901                 | 0.407043                 |
| SeepAreaL-1021090717_28   | 1173859  | 3178507 | A             | 790.1          | 43.3        | 9/7/2017 | -0.984    | 0.002     | 0.427     | 0.2335221  | 0.000000                 | 0.000467                 | 0.099714                 |
| SeepAreaL-1021090717_19   | 1173864  | 3178872 | A             | 790.6          | 42.6        | 9/7/2017 | -0.085    | 0         | 0.404     | 0.234188   | 0.000000                 | 0.000000                 | 0.094612                 |
| SeepArea32L-1049090617_92 | 1173868  | 3178272 | A             | 791.7          | 34.3        | 9/6/2017 | 0         | -0.002    | 1.026     | 0.2408448  | 0.000000                 | 0.000000                 | 0.247107                 |
| SeepArea32L-1049090617_32 | 1173869  | 3177558 | A             | 791.8          | 41.5        | 9/6/2017 | -1.555    | 0.01      | 0.953     | 0.2353634  | 0.000000                 | 0.002354                 | 0.224301                 |
| SeepAreaL-1021090717_20   | 1173871  | 3178831 | A             | 790.6          | 42.7        | 9/7/2017 | -0.352    | 0.005     | 0.444     | 0.2341138  | 0.000000                 | 0.001171                 | 0.103947                 |
| SeepArea32L-1049090617_91 | 1173873  | 3178316 | A             | 791.7          | 34.4        | 9/6/2017 | -1.132    | 0         | 0.834     | 0.2407665  | 0.000000                 | 0.000000                 | 0.200799                 |
| SeepArea32L-1049090617_84 | 1173875  | 3178074 | A             | 792.2          | 35.3        | 9/6/2017 | -0.479    | 0.002     | 0.93      | 0.2402156  | 0.000000                 | 0.000480                 | 0.223400                 |
| SeepArea32L-1049090617_83 | 1173882  | 3178167 | A             | 792.4          | 35.5        | 9/6/2017 | -2        | 0         | 2.595     | 0.2401205  | 0.000000                 | 0.000000                 | 0.623113                 |
| SeepAreaL-1021090717_21   | 1173883  | 3178783 | A             | 790.6          | 42.8        | 9/7/2017 | -0.436    | 0.019     | 2.094     | 0.2340397  | 0.000000                 | 0.004447                 | 0.490079                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID             | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|---------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_10 | 1173888  | 3177853 | A             | 791.9          | 37.3        | 9/6/2017 | -0.777    | 0.003     | 3.04      | 0.2385777  | 0.000000                 | 0.000716                 | 0.725276                 |
| SeepAreaL-1021090717_34   | 1173889  | 3178472 | A             | 790.1          | 43.3        | 9/7/2017 | -0.001    | 0.002     | 5.7       | 0.2335221  | 0.000000                 | 0.000467                 | 1.331076                 |
| SeepAreaL-1021090717_23   | 1173894  | 3178674 | A             | 790.5          | 43.1        | 9/7/2017 | 0         | -0.01     | -0.034    | 0.2337881  | 0.000000                 | 0.000000                 | 0.000000                 |
| SeepAreaL-1021090717_27   | 1173895  | 3178517 | A             | 790.1          | 43.3        | 9/7/2017 | -1.101    | 0.003     | 0.452     | 0.2335221  | 0.000000                 | 0.000701                 | 0.105552                 |
| SeepAreaL-1021090717_24   | 1173898  | 3178620 | A             | 790.5          | 43.2        | 9/7/2017 | -0.001    | 0.009     | 0.8       | 0.2337142  | 0.000000                 | 0.002103                 | 0.186971                 |
| SeepAreaL-1021090717_26   | 1173899  | 3178564 | A             | 790.2          | 43.3        | 9/7/2017 | -0.419    | 0.005     | 0.49      | 0.2335517  | 0.000000                 | 0.001168                 | 0.114440                 |
| SeepAreaL-1021090717_35   | 1173899  | 3178419 | A             | 790.1          | 43.3        | 9/7/2017 | -0.445    | 0.005     | 0.416     | 0.2335221  | 0.000000                 | 0.001168                 | 0.097145                 |
| SeepAreaL-1021090717_22   | 1173899  | 3178720 | A             | 790.6          | 42.9        | 9/7/2017 | -14.36    | 0.009     | 10.223    | 0.2339657  | 0.000000                 | 0.002106                 | 2.391831                 |
| SeepArea32L-1049090617_90 | 1173903  | 3178356 | A             | 791.7          | 34.5        | 9/6/2017 | 0         | 0.001     | 0.654     | 0.2406882  | 0.000000                 | 0.000241                 | 0.157410                 |
| SeepAreaL-1021090717_18   | 1173908  | 3178868 | A             | 790.0          | 42.4        | 9/7/2017 | -0.482    | -0.004    | 0.016     | 0.2341585  | 0.000000                 | 0.000000                 | 0.003747                 |
| SeepArea32L-1049090617_18 | 1173921  | 3177636 | A             | 791.7          | 40.2        | 9/6/2017 | -0.583    | 0.003     | 1.147     | 0.23631    | 0.000000                 | 0.000709                 | 0.271048                 |
| SeepAreaL-1021090717_25   | 1173926  | 3178572 | A             | 790.2          | 43.2        | 9/7/2017 | -0.002    | 0.007     | 1.167     | 0.2336255  | 0.000000                 | 0.001635                 | 0.272641                 |
| SeepAreaL-1021090717_14   | 1173935  | 3178822 | A             | 790.3          | 41.5        | 9/7/2017 | 128.286   | 0.002     | 9.012     | 0.2349175  | 30.136620                | 0.000470                 | 2.117076                 |
| SeepArea32L-1049090617_19 | 1173936  | 3177647 | A             | 791.7          | 40.4        | 9/6/2017 | -0.004    | 0.001     | 1.321     | 0.2361593  | 0.000000                 | 0.000236                 | 0.311966                 |
| SeepArea32L-1049090617_17 | 1173946  | 3177742 | A             | 791.5          | 39.9        | 9/6/2017 | -0.001    | 0         | 0.233     | 0.2364767  | 0.000000                 | 0.000000                 | 0.055099                 |
| SeepArea32L-1049090617_31 | 1173946  | 3177562 | A             | 791.4          | 41.5        | 9/6/2017 | -3.074    | 0.003     | 4.516     | 0.2352445  | 0.000000                 | 0.000706                 | 1.062364                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID             | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|---------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_93 | 1173950  | 3178281 | A             | 791.9          | 34.2        | 9/6/2017 | -1.116    | 0         | 1.723     | 0.240984   | 0.000000                 | 0.000000                 | 0.415215                 |
| SeepAreaL-1021090717_15   | 1173955  | 3178830 | A             | 790.6          | 41.7        | 9/7/2017 | 0         | 0         | 3.397     | 0.2348574  | 0.000000                 | 0.000000                 | 0.797811                 |
| SeepAreaL-1021090717_16   | 1173957  | 3178790 | A             | 790.2          | 41.9        | 9/7/2017 | -0.001    | 0.008     | 1.288     | 0.2345895  | 0.000000                 | 0.001877                 | 0.302151                 |
| SeepAreaL-1021090717_12   | 1173958  | 3178666 | A             | 790.5          | 41.0        | 9/7/2017 | -0.004    | 0.017     | 1.653     | 0.2353509  | 0.000000                 | 0.004001                 | 0.389035                 |
| SeepAreaL-1021090717_13   | 1173958  | 3178712 | A             | 790.5          | 41.2        | 9/7/2017 | 6.179     | 0.005     | 3.441     | 0.2352012  | 1.453308                 | 0.001176                 | 0.809327                 |
| SeepArea32L-1049090617_09 | 1173959  | 3177855 | A             | 791.5          | 36.9        | 9/6/2017 | -1.94     | 0.006     | 0.966     | 0.2387648  | 0.000000                 | 0.001433                 | 0.230647                 |
| SeepArea32L-1049090617_02 | 1173963  | 3178016 | A             | 791.1          | 33.0        | 9/6/2017 | 1.471     | 0.003     | 2.232     | 0.2416842  | 0.355517                 | 0.000725                 | 0.539439                 |
| SeepArea32L-1049090617_94 | 1173965  | 3178342 | A             | 791.9          | 34.1        | 9/6/2017 | -1.122    | 0         | 0.593     | 0.2410624  | 0.000000                 | 0.000000                 | 0.142950                 |
| SeepAreaL-1021090717_17   | 1173966  | 3178877 | A             | 791.0          | 42.1        | 9/7/2017 | -2.477    | -0.007    | 0.072     | 0.2346781  | 0.000000                 | 0.000000                 | 0.016897                 |
| SeepArea32L-1049090617_82 | 1173970  | 3178149 | A             | 791.3          | 35.7        | 9/6/2017 | 8.706     | 0         | 18.088    | 0.2396319  | 2.086236                 | 0.000000                 | 4.334462                 |
| SeepArea32L-1049090617_04 | 1173972  | 3177950 | A             | 792.6          | 34.4        | 9/6/2017 | 0         | 0         | 4.051     | 0.2410402  | 0.000000                 | 0.000000                 | 0.976454                 |
| SeepAreaL-1021090717_11   | 1173976  | 3178610 | A             | 790.1          | 40.9        | 9/7/2017 | 0         | 0.012     | 2.495     | 0.2353067  | 0.000000                 | 0.002824                 | 0.587090                 |
| SeepAreaL-1021090717_10   | 1173990  | 3178567 | A             | 790.1          | 40.8        | 9/7/2017 | 0         | 0.01      | 1.129     | 0.2353817  | 0.000000                 | 0.002354                 | 0.265746                 |
| SeepAreaL-1021090717_08   | 1174002  | 3178614 | A             | 790.0          | 40.7        | 9/7/2017 | 0         | 0.004     | 1.18      | 0.2354269  | 0.000000                 | 0.000942                 | 0.277804                 |
| SeepAreaL-1021090717_07   | 1174005  | 3178668 | A             | 789.8          | 40.7        | 9/7/2017 | 0         | 0         | 0.151     | 0.2353673  | 0.000000                 | 0.000000                 | 0.035540                 |
| SeepAreaL-1021090717_05   | 1174007  | 3178779 | A             | 789.7          | 40.8        | 9/7/2017 | -3.604    | -0.007    | 1.626     | 0.2352625  | 0.000000                 | 0.000000                 | 0.382537                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepAreaL-1021090717_06    | 1174008  | 3178730 | A             | 789.8          | 40.8        | 9/7/2017 | 0         | 0.001     | 0.286     | 0.2352923  | 0.000000                 | 0.000235                 | 0.067294                 |
| SeepAreaL-1021090717_09    | 1174008  | 3178561 | A             | 790.0          | 40.7        | 9/7/2017 | 0         | 0.005     | 0.896     | 0.2354269  | 0.000000                 | 0.001177                 | 0.210942                 |
| SeepAreaL-1021090717_04    | 1174018  | 3178823 | A             | 789.7          | 40.9        | 9/7/2017 | 0         | 0.011     | 1.573     | 0.2351876  | 0.000000                 | 0.002587                 | 0.369950                 |
| SeepArea32L-1049090617_95  | 1174024  | 3178285 | A             | 791.7          | 34.1        | 9/6/2017 | 0         | 0.002     | 0.773     | 0.2410016  | 0.000000                 | 0.000482                 | 0.186294                 |
| SeepAreaL-1021090717_03    | 1174034  | 3178874 | A             | 788.8          | 40.8        | 9/7/2017 | -0.373    | -0.001    | 0.888     | 0.2349944  | 0.000000                 | 0.000000                 | 0.208675                 |
| SeepArea32L-1049090617_21  | 1174039  | 3177759 | A             | 791.4          | 41.0        | 9/6/2017 | -1.075    | 0         | 0.833     | 0.2356189  | 0.000000                 | 0.000000                 | 0.196271                 |
| SeepArea32L-1049090617_45  | 1174041  | 3177073 | A             | 791.5          | 41.9        | 9/6/2017 | 0         | 0.007     | 1.206     | 0.2349755  | 0.000000                 | 0.001645                 | 0.283380                 |
| SeepArea32L-1049090617_30  | 1174044  | 3177558 | A             | 791.5          | 41.6        | 9/6/2017 | 0         | 0.004     | 1.01      | 0.2351995  | 0.000000                 | 0.000941                 | 0.237551                 |
| SeepArea32L-1049090617_44  | 1174047  | 3177157 | A             | 792.1          | 41.8        | 9/6/2017 | 0         | 0.004     | 1.302     | 0.2352283  | 0.000000                 | 0.000941                 | 0.306267                 |
| SeepArea32L-1049090617_46  | 1174051  | 3176961 | A             | 791.4          | 42.0        | 9/6/2017 | 0         | 0.004     | 0.73      | 0.2348712  | 0.000000                 | 0.000939                 | 0.171456                 |
| SeepArea32L-1049090617_20  | 1174053  | 3177636 | A             | 791.4          | 40.7        | 9/6/2017 | 3.82      | 0.001     | 6.14      | 0.2358441  | 0.900924                 | 0.000236                 | 1.448083                 |
| SeepArea32L-1049090617_01  | 1174055  | 3178045 | A             | 791.1          | 32.3        | 9/6/2017 | -1.206    | -0.008    | 0.363     | 0.2422381  | 0.000000                 | 0.000000                 | 0.087932                 |
| SeepArea32L-1049090617_81  | 1174062  | 3178139 | A             | 791.5          | 36.1        | 9/6/2017 | 0         | 0         | 5.211     | 0.2393825  | 0.000000                 | 0.000000                 | 1.247422                 |
| SeepArea32L-1049090617_08  | 1174063  | 3177848 | A             | 791.9          | 36.5        | 9/6/2017 | -2.132    | 0.002     | 5.357     | 0.2391941  | 0.000000                 | 0.000478                 | 1.281363                 |
| SeepArea32L-1049090717_239 | 1174068  | 3178366 | A             | 789.9          | 40.1        | 9/7/2017 | 0         | 0.001     | 0.662     | 0.235848   | 0.000000                 | 0.000236                 | 0.156131                 |
| SeepArea32L-1049090617_05  | 1174082  | 3177952 | A             | 791.3          | 34.9        | 9/6/2017 | -0.003    | 0         | 2.686     | 0.2402542  | 0.000000                 | 0.000000                 | 0.645323                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_23  | 1174124  | 3177655 | A             | 791.0          | 41.5        | 9/6/2017 | -0.404    | 0         | 4.923     | 0.2351256  | 0.000000                 | 0.000000                 | 1.157523                 |
| SeepArea32L-1049090617_22  | 1174139  | 3177754 | A             | 790.9          | 41.2        | 9/6/2017 | -0.083    | 0.001     | 1.298     | 0.2353202  | 0.000000                 | 0.000235                 | 0.305446                 |
| SeepArea32L-1049090617_24  | 1174143  | 3177661 | A             | 791.0          | 41.7        | 9/6/2017 | -1.068    | 0.003     | 0.18      | 0.2349762  | 0.000000                 | 0.000705                 | 0.042296                 |
| SeepArea32L-1049090617_48  | 1174148  | 3177049 | A             | 791.4          | 42.2        | 9/6/2017 | 0         | -0.001    | 2.223     | 0.2347223  | 0.000000                 | 0.000000                 | 0.521788                 |
| SeepArea32L-1049090617_47  | 1174151  | 3176950 | A             | 791.7          | 42.1        | 9/6/2017 | -1.799    | 0.003     | 0.873     | 0.2348858  | 0.000000                 | 0.000705                 | 0.205055                 |
| SeepArea32L-1049090617_29  | 1174152  | 3177558 | A             | 791.3          | 41.7        | 9/6/2017 | -1.929    | 0.007     | 0.363     | 0.2350653  | 0.000000                 | 0.001645                 | 0.085329                 |
| SeepArea32L-1049090617_06  | 1174160  | 3177954 | A             | 791.0          | 35.4        | 9/6/2017 | -0.001    | 0.01      | 0.712     | 0.239774   | 0.000000                 | 0.002398                 | 0.170719                 |
| SeepArea32L-1049090717_237 | 1174161  | 3178160 | A             | 789.8          | 39.8        | 9/7/2017 | 0         | -0.003    | 2.772     | 0.2360442  | 0.000000                 | 0.000000                 | 0.654314                 |
| SeepArea32L-1049090617_43  | 1174168  | 3177147 | A             | 791.9          | 41.7        | 9/6/2017 | 0         | 0.006     | 1.348     | 0.2352436  | 0.000000                 | 0.001411                 | 0.317108                 |
| SeepArea32L-1049090617_07  | 1174173  | 3177847 | A             | 791.0          | 36.0        | 9/6/2017 | 16.303    | 0.002     | 8.109     | 0.2393086  | 3.901448                 | 0.000479                 | 1.940554                 |
| SeepArea32L-1049090717_238 | 1174187  | 3178082 | A             | 789.8          | 39.9        | 9/7/2017 | -0.735    | 0.003     | 0.91      | 0.2359688  | 0.000000                 | 0.000708                 | 0.214732                 |
| SeepAreaL-1021090717_02    | 1174204  | 3178905 | A             | 789.5          | 40.6        | 9/7/2017 | 0.14      | 0.001     | 0.143     | 0.2353529  | 0.032949                 | 0.000235                 | 0.033655                 |
| SeepArea32L-1049090617_33  | 1174234  | 3177453 | A             | 792.1          | 41.5        | 9/6/2017 | -1.792    | 0         | 0.401     | 0.2354525  | 0.000000                 | 0.000000                 | 0.094416                 |
| SeepAreaL-1021090717_01    | 1174236  | 3178831 | A             | 790.1          | 40.4        | 9/7/2017 | -2.683    | -0.009    | 0.319     | 0.235682   | 0.000000                 | 0.000000                 | 0.075183                 |
| SeepArea32L-1049090617_37  | 1174236  | 3177348 | A             | 791.1          | 41.5        | 9/6/2017 | 0         | 0.002     | 0.212     | 0.2351553  | 0.000000                 | 0.000470                 | 0.049853                 |
| SeepArea32L-1049090617_42  | 1174237  | 3177152 | A             | 791.5          | 41.7        | 9/6/2017 | -4.93     | 0.004     | 0.996     | 0.2351247  | 0.000000                 | 0.000940                 | 0.234184                 |





## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_28  | 1174239  | 3177532 | A             | 791.0          | 41.8        | 9/6/2017 | -1.097    | 0.005     | 1.928     | 0.2349016  | 0.000000                 | 0.001175                 | 0.452890                 |
| SeepArea32L-1049090617_50  | 1174241  | 3176954 | A             | 791.4          | 42.2        | 9/6/2017 | -0.427    | 0.005     | 0.768     | 0.2347223  | 0.000000                 | 0.001174                 | 0.180267                 |
| SeepArea32L-1049090617_25  | 1174245  | 3177646 | A             | 790.7          | 41.8        | 9/6/2017 | -0.774    | 0         | 3.976     | 0.2348125  | 0.000000                 | 0.000000                 | 0.933615                 |
| SeepArea32L-1049090617_49  | 1174248  | 3177047 | A             | 791.6          | 42.2        | 9/6/2017 | 0         | 0.004     | 3.269     | 0.2347816  | 0.000000                 | 0.000939                 | 0.767501                 |
| SeepArea32L-1049090717_233 | 1174254  | 3177942 | A             | 789.5          | 39.4        | 9/7/2017 | -1.023    | 0.006     | 1.705     | 0.2362565  | 0.000000                 | 0.001418                 | 0.402817                 |
| SeepArea32L-1049090617_26  | 1174256  | 3177736 | A             | 790.7          | 41.8        | 9/6/2017 | -0.469    | -0.001    | 0.769     | 0.2348125  | 0.000000                 | 0.000000                 | 0.180571                 |
| SeepArea32L-1049090717_235 | 1174258  | 3178145 | A             | 789.6          | 39.6        | 9/7/2017 | -0.963    | 0         | 0.001     | 0.2361353  | 0.000000                 | 0.000000                 | 0.000236                 |
| SeepArea32L-1049090717_234 | 1174264  | 3178045 | A             | 789.5          | 39.5        | 9/7/2017 | -1.058    | 0.002     | 2.716     | 0.2361809  | 0.000000                 | 0.000472                 | 0.641467                 |
| SeepArea32L-1049090717_236 | 1174264  | 3178235 | A             | 789.5          | 39.6        | 9/7/2017 | -0.6      | 0.001     | 0.471     | 0.2361054  | 0.000000                 | 0.000236                 | 0.111206                 |
| SeepArea32L-1049090717_232 | 1174283  | 3177860 | A             | 789.3          | 39.3        | 9/7/2017 | 0         | 0         | 0.892     | 0.2362722  | 0.000000                 | 0.000000                 | 0.210755                 |
| SeepArea32L-1049090617_27  | 1174329  | 3177561 | A             | 798.7          | 41.8        | 9/6/2017 | -1.759    | 0.001     | 3.423     | 0.2371882  | 0.000000                 | 0.000237                 | 0.811895                 |
| SeepArea32L-1049090617_79  | 1174335  | 3176348 | A             | 791.0          | 36.8        | 9/6/2017 | -1.392    | 0.002     | 1.219     | 0.238691   | 0.000000                 | 0.000477                 | 0.290964                 |
| SeepArea32L-1049090617_78  | 1174336  | 3176258 | A             | 791.1          | 36.9        | 9/6/2017 | 0         | 0.002     | 0.427     | 0.2386441  | 0.000000                 | 0.000477                 | 0.101901                 |
| SeepArea32L-1049090617_38  | 1174338  | 3177255 | A             | 791.0          | 41.5        | 9/6/2017 | 0         | 0.005     | 0.841     | 0.2351256  | 0.000000                 | 0.001176                 | 0.197741                 |
| SeepArea32L-1049090617_51  | 1174339  | 3177043 | A             | 791.6          | 42.2        | 9/6/2017 | 0         | 0.002     | 1.689     | 0.2347816  | 0.000000                 | 0.000470                 | 0.396546                 |
| SeepArea32L-1049090617_57  | 1174343  | 3176853 | A             | 791.8          | 41.2        | 9/6/2017 | 0         | 0.003     | 0.234     | 0.235588   | 0.000000                 | 0.000707                 | 0.055128                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_58  | 1174344  | 3176760 | A             | 791.2          | 41.0        | 9/6/2017 | 0         | 0.004     | 0.361     | 0.2355593  | 0.000000                 | 0.000942                 | 0.085037                 |
| SeepArea32L-1049090617_77  | 1174345  | 3176163 | A             | 791.1          | 37.1        | 9/6/2017 | 0         | 0.003     | 2.746     | 0.2384903  | 0.000000                 | 0.000715                 | 0.654894                 |
| SeepArea32L-1049090617_56  | 1174349  | 3176941 | A             | 791.3          | 41.4        | 9/6/2017 | 0         | 0.004     | 0.932     | 0.2352895  | 0.000000                 | 0.000941                 | 0.219290                 |
| SeepArea32L-1049090717_229 | 1174349  | 3178060 | A             | 789.4          | 39.0        | 9/7/2017 | -0.454    | 0.003     | 0.765     | 0.2365293  | 0.000000                 | 0.000710                 | 0.180945                 |
| SeepArea32L-1049090717_230 | 1174354  | 3177955 | A             | 789.4          | 39.1        | 9/7/2017 | -1.231    | 0.009     | 1.15      | 0.2364535  | 0.000000                 | 0.002128                 | 0.271922                 |
| SeepArea32L-1049090617_41  | 1174354  | 3177165 | A             | 791.0          | 41.6        | 9/6/2017 | -3.547    | 0.008     | 0.88      | 0.2350509  | 0.000000                 | 0.001880                 | 0.206845                 |
| SeepArea32L-1049090717_228 | 1174354  | 3178184 | A             | 789.3          | 38.9        | 9/7/2017 | -0.747    | 0.003     | 3.591     | 0.2365751  | 0.000000                 | 0.000710                 | 0.849541                 |
| SeepArea32L-1049090617_36  | 1174356  | 3177352 | A             | 790.6          | 41.5        | 9/6/2017 | 0         | 0.005     | 0.633     | 0.2350067  | 0.000000                 | 0.001175                 | 0.148759                 |
| SeepArea32L-1049090717_227 | 1174367  | 3178249 | A             | 789.5          | 38.8        | 9/7/2017 | -0.498    | 0.006     | 1.218     | 0.2367109  | 0.000000                 | 0.001420                 | 0.288314                 |
| SeepArea32L-1049090617_34  | 1174371  | 3177458 | A             | 791.1          | 41.5        | 9/6/2017 | 5.095     | 0.009     | 13.462    | 0.2351553  | 1.198116                 | 0.002116                 | 3.165661                 |
| SeepArea32L-1049090717_231 | 1174373  | 3177869 | A             | 789.3          | 39.2        | 9/7/2017 | 2.404     | 0.01      | 1.616     | 0.2363479  | 0.568180                 | 0.002363                 | 0.381938                 |
| SeepArea32L-1049090717_218 | 1174374  | 3177750 | A             | 789.8          | 38.5        | 9/7/2017 | 5.344     | 0.002     | 17.465    | 0.2370288  | 1.266682                 | 0.000474                 | 4.139708                 |
| SeepArea32L-1049090717_217 | 1174399  | 3177645 | A             | 789.9          | 38.5        | 9/7/2017 | 0         | 0.005     | 3.354     | 0.2370588  | 0.000000                 | 0.001185                 | 0.795095                 |
| SeepArea32L-1049090617_35  | 1174420  | 3177355 | A             | 790.6          | 41.5        | 9/6/2017 | 0         | 0.003     | 1.83      | 0.2350067  | 0.000000                 | 0.000705                 | 0.430062                 |
| SeepArea32L-1049090617_52  | 1174435  | 3177049 | A             | 791.0          | 42.1        | 9/6/2017 | -0.001    | 0.003     | 0.326     | 0.2346781  | 0.000000                 | 0.000704                 | 0.076505                 |
| SeepArea32L-1049090617_59  | 1174442  | 3176761 | A             | 791.0          | 40.8        | 9/6/2017 | -1.849    | 0.004     | 1.058     | 0.2356498  | 0.000000                 | 0.000943                 | 0.249318                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_60  | 1174444  | 3176845 | A             | 791.1          | 40.6        | 9/6/2017 | -1.599    | 0.007     | 0.924     | 0.2358298  | 0.000000                 | 0.001651                 | 0.217907                 |
| SeepArea32L-1049090617_80  | 1174447  | 3176361 | A             | 790.9          | 36.6        | 9/6/2017 | -1.288    | 0.002     | 0.866     | 0.2388149  | 0.000000                 | 0.000478                 | 0.206814                 |
| SeepArea32L-1049090617_76  | 1174449  | 3176153 | A             | 791.0          | 37.2        | 9/6/2017 | -2.701    | 0.004     | 0.948     | 0.2383833  | 0.000000                 | 0.000954                 | 0.225987                 |
| SeepArea32L-1049090617_55  | 1174451  | 3176942 | A             | 790.9          | 41.6        | 9/6/2017 | 0         | 0.007     | 0.811     | 0.2350211  | 0.000000                 | 0.001645                 | 0.190602                 |
| SeepArea32L-1049090617_40  | 1174454  | 3177172 | A             | 790.9          | 41.6        | 9/6/2017 | 0         | 0.004     | 1.195     | 0.2350211  | 0.000000                 | 0.000940                 | 0.280850                 |
| SeepArea32L-1049090717_225 | 1174456  | 3178147 | A             | 789.1          | 38.7        | 9/7/2017 | -1.675    | 0.003     | 0.515     | 0.2366668  | 0.000000                 | 0.000710                 | 0.121883                 |
| SeepArea32L-1049090717_226 | 1174457  | 3178241 | A             | 788.8          | 38.7        | 9/7/2017 | -0.418    | 0.008     | 1.256     | 0.2365769  | 0.000000                 | 0.001893                 | 0.297141                 |
| SeepArea32L-1049090617_39  | 1174460  | 3177259 | A             | 791.0          | 41.5        | 9/6/2017 | 0         | 0.002     | 5.548     | 0.2351256  | 0.000000                 | 0.000470                 | 1.304477                 |
| SeepArea32L-1049090717_223 | 1174462  | 3177937 | A             | 789.4          | 38.6        | 9/7/2017 | -2.873    | 0.007     | 0.811     | 0.2368328  | 0.000000                 | 0.001658                 | 0.192071                 |
| SeepArea32L-1049090717_219 | 1174466  | 3177754 | A             | 789.5          | 38.5        | 9/7/2017 | 3.641     | 0.004     | 1.219     | 0.2369388  | 0.862694                 | 0.000948                 | 0.288828                 |
| SeepArea32L-1049090717_213 | 1174477  | 3177556 | A             | 789.9          | 38.5        | 9/7/2017 | 17.605    | 0.004     | 5.629     | 0.2370588  | 4.173420                 | 0.000948                 | 1.334404                 |
| SeepArea32L-1049090717_216 | 1174478  | 3177638 | A             | 789.8          | 38.5        | 9/7/2017 | 5.266     | 0.002     | 2.492     | 0.2370288  | 1.248194                 | 0.000474                 | 0.590676                 |
| SeepArea32L-1049090617_75  | 1174480  | 3176251 | A             | 791.1          | 37.4        | 9/6/2017 | 0         | 0.002     | 1.058     | 0.2382599  | 0.000000                 | 0.000477                 | 0.252079                 |
| SeepArea32L-1049090717_222 | 1174486  | 3177848 | A             | 789.3          | 38.5        | 9/7/2017 | -0.001    | 0.003     | 7.002     | 0.2368787  | 0.000000                 | 0.000711                 | 1.658625                 |
| SeepArea32L-1049090717_224 | 1174487  | 3178041 | A             | 789.1          | 38.6        | 9/7/2017 | -1.754    | 0.013     | 0.998     | 0.2367427  | 0.000000                 | 0.003078                 | 0.236269                 |
| SeepArea32L-1049090717_212 | 1174488  | 3177454 | A             | 790.3          | 38.5        | 9/7/2017 | 2.042     | 0.001     | 1.28      | 0.2371788  | 0.484319                 | 0.000237                 | 0.303589                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090617_65  | 1174538  | 3176651 | A             | 790.9          | 39.4        | 9/6/2017 | 0         | 0.007     | 0.606     | 0.2366754  | 0.000000                 | 0.001657                 | 0.143425                 |
| SeepArea32L-1049090617_69  | 1174543  | 3176451 | A             | 790.9          | 38.5        | 9/6/2017 | -1.125    | 0.003     | 0.815     | 0.2373589  | 0.000000                 | 0.000712                 | 0.193448                 |
| SeepArea32L-1049090617_53  | 1174544  | 3177054 | A             | 790.6          | 42.0        | 9/6/2017 | 0         | 0.007     | 6.893     | 0.2346338  | 0.000000                 | 0.001642                 | 1.617331                 |
| SeepArea32L-1049090617_61  | 1174546  | 3176850 | A             | 791.3          | 40.3        | 9/6/2017 | -1.581    | 0.008     | 1.296     | 0.2361152  | 0.000000                 | 0.001889                 | 0.306005                 |
| SeepArea32L-1049090617_74  | 1174550  | 3176161 | A             | 790.9          | 37.6        | 9/6/2017 | -1.379    | 0.001     | 0.454     | 0.2380464  | 0.000000                 | 0.000238                 | 0.108073                 |
| SeepArea32L-1049090617_54  | 1174551  | 3176963 | A             | 790.6          | 41.8        | 9/6/2017 | -1.528    | 0.006     | 1.036     | 0.2347828  | 0.000000                 | 0.001409                 | 0.243235                 |
| SeepArea32L-1049090717_199 | 1174551  | 3177239 | A             | 790.1          | 39.0        | 9/7/2017 | -1.469    | 0.002     | 0.056     | 0.236739   | 0.000000                 | 0.000473                 | 0.013257                 |
| SeepArea32L-1049090617_73  | 1174552  | 3176262 | A             | 790.9          | 37.7        | 9/6/2017 | -0.787    | 0.003     | 10.974    | 0.2379698  | 0.000000                 | 0.000714                 | 2.611480                 |
| SeepArea32L-1049090617_68  | 1174554  | 3176528 | A             | 790.9          | 38.7        | 9/6/2017 | 0         | 0.004     | 0.346     | 0.2372067  | 0.000000                 | 0.000949                 | 0.082074                 |
| SeepArea32L-1049090617_64  | 1174555  | 3176759 | A             | 791.0          | 39.6        | 9/6/2017 | -0.32     | 0.001     | 0.707     | 0.236554   | 0.000000                 | 0.000237                 | 0.167244                 |
| SeepArea32L-1049090717_210 | 1174568  | 3177360 | A             | 789.8          | 38.5        | 9/7/2017 | -1.738    | 0.002     | 0.631     | 0.2370288  | 0.000000                 | 0.000474                 | 0.149565                 |
| SeepArea32L-1049090617_72  | 1174570  | 3176358 | A             | 791.0          | 37.9        | 9/6/2017 | 0         | 0.002     | 0.659     | 0.2378468  | 0.000000                 | 0.000476                 | 0.156741                 |
| SeepArea32L-1049090717_220 | 1174578  | 3177765 | A             | 789.3          | 38.5        | 9/7/2017 | -0.582    | 0.002     | 1.01      | 0.2368787  | 0.000000                 | 0.000474                 | 0.239248                 |
| SeepArea32L-1049090717_198 | 1174578  | 3177165 | A             | 790.1          | 39.1        | 9/7/2017 | -0.205    | 0.002     | 0.682     | 0.2366632  | 0.000000                 | 0.000473                 | 0.161404                 |
| SeepArea32L-1049090717_221 | 1174579  | 3177841 | A             | 789.0          | 38.5        | 9/7/2017 | -1.359    | 0.005     | 0.626     | 0.2367887  | 0.000000                 | 0.001184                 | 0.148230                 |
| SeepArea32L-1049090717_214 | 1174581  | 3177540 | A             | 789.5          | 38.5        | 9/7/2017 | 8.161     | 0         | 3.608     | 0.2369388  | 1.933657                 | 0.000000                 | 0.854875                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_215 | 1174587  | 3177638 | A             | 789.3          | 38.5        | 9/7/2017 | 0         | 0.002     | 1.659     | 0.2368787  | 0.000000                 | 0.000474                 | 0.392982                 |
| SeepArea32L-1049090717_211 | 1174587  | 3177455 | A             | 789.6          | 38.5        | 9/7/2017 | -0.636    | 0.001     | 2.539     | 0.2369688  | 0.000000                 | 0.000237                 | 0.601664                 |
| SeepArea32L-1049090617_62  | 1174627  | 3176843 | A             | 790.7          | 40.1        | 9/6/2017 | -1.055    | 0.001     | 3.964     | 0.2360868  | 0.000000                 | 0.000236                 | 0.935848                 |
| SeepArea32L-1049090617_66  | 1174632  | 3176652 | A             | 790.6          | 39.2        | 9/6/2017 | -1.555    | 0.002     | 0.883     | 0.2367371  | 0.000000                 | 0.000473                 | 0.209039                 |
| SeepArea32L-1049090617_67  | 1174639  | 3176584 | A             | 790.6          | 38.9        | 9/6/2017 | -0.262    | 0.001     | 0.569     | 0.2369647  | 0.000000                 | 0.000237                 | 0.134833                 |
| SeepArea32L-1049090617_71  | 1174646  | 3176342 | A             | 791.0          | 38.1        | 9/6/2017 | 0         | 0.003     | 0.714     | 0.237694   | 0.000000                 | 0.000713                 | 0.169714                 |
| SeepArea32L-1049090617_70  | 1174650  | 3176445 | A             | 790.6          | 38.3        | 9/6/2017 | -0.853    | 0.006     | 0.358     | 0.2374212  | 0.000000                 | 0.001425                 | 0.084997                 |
| SeepArea32L-1049090717_200 | 1174654  | 3177253 | A             | 793.3          | 39.0        | 9/7/2017 | -0.432    | 0.004     | 1.816     | 0.2376978  | 0.000000                 | 0.000951                 | 0.431659                 |
| SeepArea32L-1049090717_209 | 1174658  | 3177453 | A             | 789.1          | 38.5        | 9/7/2017 | -0.321    | 0.004     | 0.756     | 0.2368187  | 0.000000                 | 0.000947                 | 0.179035                 |
| SeepArea32L-1049090617_63  | 1174660  | 3176745 | A             | 791.0          | 39.8        | 9/6/2017 | 0         | 0.003     | 2.957     | 0.2364028  | 0.000000                 | 0.000709                 | 0.699043                 |
| SeepArea32L-1049090717_196 | 1174660  | 3177062 | A             | 789.8          | 39.3        | 9/7/2017 | -0.76     | 0.003     | 1.928     | 0.2364219  | 0.000000                 | 0.000709                 | 0.455821                 |
| SeepArea32L-1049090717_197 | 1174663  | 3177166 | A             | 789.9          | 39.2        | 9/7/2017 | -0.633    | 0.004     | 2.347     | 0.2365275  | 0.000000                 | 0.000946                 | 0.555130                 |
| SeepArea32L-1049090717_201 | 1174663  | 3177361 | A             | 789.4          | 38.9        | 9/7/2017 | 0         | 0.005     | 1.147     | 0.2366051  | 0.000000                 | 0.001183                 | 0.271386                 |
| SeepArea32L-1049090717_195 | 1174678  | 3176959 | A             | 789.8          | 39.3        | 9/7/2017 | -0.814    | -0.001    | 0.228     | 0.2364219  | 0.000000                 | 0.000000                 | 0.053904                 |
| SeepArea32L-1049090717_206 | 1174679  | 3177759 | A             | 788.0          | 38.6        | 9/7/2017 | -0.942    | 0         | 0.875     | 0.2364127  | 0.000000                 | 0.000000                 | 0.206861                 |
| SeepArea32L-1049090717_207 | 1174681  | 3177650 | A             | 789.3          | 38.6        | 9/7/2017 | -1.767    | 0.002     | 0.951     | 0.2368028  | 0.000000                 | 0.000474                 | 0.225199                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_208 | 1174697  | 3177561 | A             | 788.8          | 38.5        | 9/7/2017 | 0         | 0.006     | 0.515     | 0.2367287  | 0.000000                 | 0.001420                 | 0.121915                 |
| SeepArea32L-1049090717_154 | 1174754  | 3176661 | A             | 790.2          | 38.9        | 9/7/2017 | 4.084     | 0.001     | 7.957     | 0.2368449  | 0.967274                 | 0.000237                 | 1.884574                 |
| SeepArea32L-1049090717_194 | 1174756  | 3177065 | A             | 789.5          | 39.4        | 9/7/2017 | -0.179    | 0.002     | 6.317     | 0.2362565  | 0.000000                 | 0.000473                 | 1.492432                 |
| SeepArea32L-1049090717_155 | 1174757  | 3176756 | A             | 789.9          | 39.1        | 9/7/2017 | 22.712    | 0.004     | 1.042     | 0.2366033  | 5.373734                 | 0.000946                 | 0.246541                 |
| SeepArea32L-1049090717_203 | 1174760  | 3177455 | A             | 789.3          | 38.8        | 9/7/2017 | -1.334    | 0.004     | 1.86      | 0.2366509  | 0.000000                 | 0.000947                 | 0.440171                 |
| SeepArea32L-1049090717_204 | 1174768  | 3177574 | A             | 788.8          | 38.7        | 9/7/2017 | -2.718    | 0.001     | 0.343     | 0.2365769  | 0.000000                 | 0.000237                 | 0.081146                 |
| SeepArea32L-1049090717_202 | 1174769  | 3177366 | A             | 789.3          | 38.8        | 9/7/2017 | -0.001    | 0.006     | 2.253     | 0.2366509  | 0.000000                 | 0.001420                 | 0.533175                 |
| SeepArea32L-1049090717_193 | 1174769  | 3177178 | A             | 789.4          | 39.5        | 9/7/2017 | -0.86     | 0.003     | 1.095     | 0.236151   | 0.000000                 | 0.000708                 | 0.258585                 |
| SeepArea32L-1049090717_192 | 1174772  | 3177266 | A             | 788.8          | 39.6        | 9/7/2017 | -1.32     | 0.001     | 0.934     | 0.2358961  | 0.000000                 | 0.000236                 | 0.220327                 |
| SeepArea32L-1049090717_139 | 1174772  | 3176567 | A             | 789.6          | 33.3        | 9/7/2017 | 4.736     | 0.003     | 2.009     | 0.2409898  | 1.141328                 | 0.000723                 | 0.484148                 |
| SeepArea32L-1049090717_180 | 1174772  | 3176949 | A             | 789.5          | 41.6        | 9/7/2017 | -1.054    | 0.005     | 1.562     | 0.2346051  | 0.000000                 | 0.001173                 | 0.366453                 |
| SeepArea32L-1049090717_179 | 1174772  | 3176865 | A             | 789.7          | 41.6        | 9/7/2017 | -0.304    | 0         | 0.156     | 0.2346646  | 0.000000                 | 0.000000                 | 0.036608                 |
| SeepArea32L-1049090717_138 | 1174792  | 3176452 | A             | 789.9          | 32.8        | 9/7/2017 | -1.087    | 0         | 1.674     | 0.2414753  | 0.000000                 | 0.000000                 | 0.404230                 |
| SeepArea32L-1049090717_205 | 1174793  | 3177668 | A             | 788.3          | 38.6        | 9/7/2017 | -2.472    | 0.006     | 0.768     | 0.2365027  | 0.000000                 | 0.001419                 | 0.181634                 |
| SeepArea32L-1049090717_98  | 1174837  | 3175943 | A             | 790.5          | 22.4        | 9/7/2017 | 0         | -0.001    | 0.878     | 0.2501624  | 0.000000                 | 0.000000                 | 0.219643                 |
| SeepArea32L-1049090717_156 | 1174852  | 3176766 | A             | 789.9          | 39.3        | 9/7/2017 | -6.453    | 0.002     | 0.291     | 0.2364518  | 0.000000                 | 0.000473                 | 0.068807                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_183 | 1174858  | 3177162 | A             | 789.3          | 41.6        | 9/7/2017 | -0.572    | 0.013     | 2.243     | 0.2345457  | 0.000000                 | 0.003049                 | 0.526086                 |
| SeepArea32L-1049090717_99  | 1174859  | 3175826 | A             | 790.5          | 22.5        | 9/7/2017 | 0         | 0         | 0.571     | 0.2500778  | 0.000000                 | 0.000000                 | 0.142794                 |
| SeepArea32L-1049090717_191 | 1174862  | 3177269 | A             | 788.7          | 39.7        | 9/7/2017 | -0.203    | 0.001     | 2.095     | 0.2357908  | 0.000000                 | 0.000236                 | 0.493982                 |
| SeepArea32L-1049090717_105 | 1174864  | 3176267 | A             | 790.1          | 23.2        | 9/7/2017 | 0         | 0.001     | 0.174     | 0.2493608  | 0.000000                 | 0.000249                 | 0.043389                 |
| SeepArea32L-1049090717_190 | 1174864  | 3177368 | A             | 788.3          | 39.8        | 9/7/2017 | -2.038    | 0.007     | 1.866     | 0.2355959  | 0.000000                 | 0.001649                 | 0.439622                 |
| SeepArea32L-1049090717_137 | 1174867  | 3176439 | A             | 789.9          | 32.4        | 9/7/2017 | 0         | 0.003     | 1.014     | 0.2417914  | 0.000000                 | 0.000725                 | 0.245177                 |
| SeepArea32L-1049090717_181 | 1174869  | 3176952 | A             | 789.3          | 41.6        | 9/7/2017 | 0         | 0.007     | 0.881     | 0.2345457  | 0.000000                 | 0.001642                 | 0.206635                 |
| SeepArea32L-1049090717_182 | 1174870  | 3177065 | A             | 789.3          | 41.6        | 9/7/2017 | -1.034    | 0.002     | 1.342     | 0.2345457  | 0.000000                 | 0.000469                 | 0.314760                 |
| SeepArea32L-1049090717_140 | 1174870  | 3176556 | A             | 789.9          | 33.8        | 9/7/2017 | 2.93      | 0.005     | 1.187     | 0.2406886  | 0.705218                 | 0.001203                 | 0.285697                 |
| SeepArea32L-1049090717_178 | 1174872  | 3176863 | A             | 789.8          | 41.5        | 9/7/2017 | -1.206    | 0.006     | 4.478     | 0.2347689  | 0.000000                 | 0.001409                 | 1.051295                 |
| SeepArea32L-1049090717_96  | 1174872  | 3176139 | A             | 790.1          | 21.8        | 9/7/2017 | -1.659    | -0.009    | 0.041     | 0.2505444  | 0.000000                 | 0.000000                 | 0.010272                 |
| SeepArea32L-1049090717_189 | 1174874  | 3177443 | A             | 787.4          | 39.9        | 9/7/2017 | -0.516    | 0         | -0.292    | 0.2352517  | 0.000000                 | 0.000000                 | 0.000000                 |
| SeepArea32L-1049090717_97  | 1174875  | 3176069 | A             | 790.2          | 22.1        | 9/7/2017 | 0         | -0.001    | 0.362     | 0.2503215  | 0.000000                 | 0.000000                 | 0.090616                 |
| SeepArea32L-1049090717_106 | 1174876  | 3176350 | A             | 790.2          | 23.3        | 9/7/2017 | -3.143    | -0.002    | 0.54      | 0.2493083  | 0.000000                 | 0.000000                 | 0.134626                 |
| SeepArea32L-1049090717_188 | 1174876  | 3177539 | A             | 787.2          | 40.0        | 9/7/2017 | -0.925    | -0.001    | 0.423     | 0.2351169  | 0.000000                 | 0.000000                 | 0.099454                 |
| SeepArea32L-1049090717_153 | 1174878  | 3176648 | A             | 789.4          | 38.6        | 9/7/2017 | -1.343    | 0.004     | 0.602     | 0.2368328  | 0.000000                 | 0.000947                 | 0.142573                 |





## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_157 | 1174928  | 3176757 | A             | 789.3          | 39.5        | 9/7/2017 | -9.222    | 0.008     | 1.95      | 0.2361211  | 0.000000                 | 0.001889                 | 0.460436                 |
| SeepArea32L-1049090717_186 | 1174943  | 3177361 | A             | 787.9          | 40.4        | 9/7/2017 | -0.782    | 0         | 4.59      | 0.2350257  | 0.000000                 | 0.000000                 | 1.078768                 |
| SeepArea32L-1049090717_184 | 1174950  | 3177178 | A             | 789.4          | 40.9        | 9/7/2017 | -0.531    | 0         | 0.736     | 0.2350983  | 0.000000                 | 0.000000                 | 0.173032                 |
| SeepArea32L-1049090717_102 | 1174951  | 3176057 | A             | 790.1          | 23.0        | 9/7/2017 | 22.086    | 0         | 0.824     | 0.2495292  | 5.511103                 | 0.000000                 | 0.205612                 |
| SeepArea32L-1049090717_141 | 1174952  | 3176548 | A             | 789.5          | 34.2        | 9/7/2017 | -1.801    | 0.003     | 3.225     | 0.2402537  | 0.000000                 | 0.000721                 | 0.774818                 |
| SeepArea32L-1049090717_177 | 1174954  | 3176839 | A             | 788.7          | 41.4        | 9/7/2017 | -0.13     | 0.008     | 2.568     | 0.2345164  | 0.000000                 | 0.001876                 | 0.602238                 |
| SeepArea32L-1049090717_103 | 1174959  | 3176155 | A             | 790.1          | 23.1        | 9/7/2017 | -0.106    | 0         | 0.985     | 0.249445   | 0.000000                 | 0.000000                 | 0.245703                 |
| SeepArea32L-1049090717_100 | 1174960  | 3175830 | A             | 790.9          | 22.7        | 9/7/2017 | 0         | 0         | 0.849     | 0.2500352  | 0.000000                 | 0.000000                 | 0.212280                 |
| SeepArea32L-1049090717_185 | 1174960  | 3177251 | A             | 788.2          | 40.6        | 9/7/2017 | -0.512    | 0.001     | 0.429     | 0.2349653  | 0.000000                 | 0.000235                 | 0.100800                 |
| SeepArea32L-1049090717_176 | 1174962  | 3176952 | A             | 788.7          | 41.3        | 9/7/2017 | -0.001    | 0.012     | 0.797     | 0.234591   | 0.000000                 | 0.002815                 | 0.186969                 |
| SeepArea32L-1049090717_107 | 1174962  | 3176340 | A             | 791.5          | 23.4        | 9/7/2017 | 0         | 0         | 1.801     | 0.2496342  | 0.000000                 | 0.000000                 | 0.449591                 |
| SeepArea32L-1049090717_136 | 1174964  | 3176450 | A             | 790.1          | 31.9        | 9/7/2017 | 1.765     | 0.003     | 1.269     | 0.2422491  | 0.427570                 | 0.000727                 | 0.307414                 |
| SeepArea32L-1049090717_104 | 1174966  | 3176253 | A             | 790.1          | 23.1        | 9/7/2017 | 0         | 0         | 2.628     | 0.249445   | 0.000000                 | 0.000000                 | 0.655541                 |
| SeepArea32L-1049090717_101 | 1174967  | 3175950 | A             | 790.3          | 23.0        | 9/7/2017 | 0         | 0.001     | 1.502     | 0.2495924  | 0.000000                 | 0.000250                 | 0.374888                 |
| SeepArea32L-1049090717_175 | 1174972  | 3177044 | A             | 788.1          | 41.2        | 9/7/2017 | 2.049     | 0.004     | 2.181     | 0.2344871  | 0.480464                 | 0.000938                 | 0.511416                 |
| SeepArea32L-1049090717_152 | 1174983  | 3176664 | A             | 789.3          | 38.4        | 9/7/2017 | -0.517    | 0.001     | 1.069     | 0.2369548  | 0.000000                 | 0.000237                 | 0.253305                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_187 | 1174984  | 3177454 | A             | 787.4          | 40.2        | 9/7/2017 | -3.523    | 0.001     | -2.2      | 0.2350265  | 0.000000                 | 0.000235                 | 0.000000                 |
| SeepArea32L-1049090717_158 | 1175034  | 3176742 | A             | 789.0          | 39.8        | 9/7/2017 | -0.73     | 0.003     | 5.089     | 0.2358051  | 0.000000                 | 0.000707                 | 1.200012                 |
| SeepArea32L-1049090717_142 | 1175041  | 3176546 | A             | 789.5          | 34.6        | 9/7/2017 | 5.035     | 0.001     | 5.275     | 0.2399414  | 1.208105                 | 0.000240                 | 1.265691                 |
| SeepArea32L-1049090717_113 | 1175055  | 3175869 | A             | 788.7          | 24.4        | 9/7/2017 | -0.049    | 0.001     | 0.53      | 0.2479151  | 0.000000                 | 0.000248                 | 0.131395                 |
| SeepArea32L-1049090717_111 | 1175056  | 3176064 | A             | 788.7          | 24.0        | 9/7/2017 | -0.121    | 0.001     | 0.634     | 0.2482488  | 0.000000                 | 0.000248                 | 0.157390                 |
| SeepArea32L-1049090717_173 | 1175058  | 3176952 | A             | 788.7          | 40.9        | 9/7/2017 | 17.891    | 0         | 1.148     | 0.2348898  | 4.202414                 | 0.000000                 | 0.269653                 |
| SeepArea32L-1049090717_151 | 1175059  | 3176655 | A             | 789.4          | 38.2        | 9/7/2017 | -0.092    | 0.005     | 1.682     | 0.237137   | 0.000000                 | 0.001186                 | 0.398864                 |
| SeepArea32L-1049090717_174 | 1175060  | 3177039 | A             | 788.1          | 41.0        | 9/7/2017 | -0.224    | 0.003     | 1.578     | 0.2346364  | 0.000000                 | 0.000704                 | 0.370256                 |
| SeepArea32L-1049090717_112 | 1175062  | 3175954 | A             | 789.4          | 24.2        | 9/7/2017 | -0.581    | 0.001     | 0.678     | 0.248302   | 0.000000                 | 0.000248                 | 0.168349                 |
| SeepArea32L-1049090717_109 | 1175066  | 3176251 | A             | 789.8          | 23.7        | 9/7/2017 | 0         | 0         | 2.829     | 0.2488463  | 0.000000                 | 0.000000                 | 0.703986                 |
| SeepArea32L-1049090717_135 | 1175067  | 3176435 | A             | 792.1          | 31.5        | 9/7/2017 | -0.991    | -0.001    | 1.941     | 0.2431812  | 0.000000                 | 0.000000                 | 0.472015                 |
| SeepArea32L-1049090717_108 | 1175067  | 3176349 | A             | 790.1          | 23.5        | 9/7/2017 | 0         | -0.001    | 0.299     | 0.2491087  | 0.000000                 | 0.000000                 | 0.074483                 |
| SeepArea32L-1049090717_172 | 1175068  | 3176849 | A             | 787.6          | 40.9        | 9/7/2017 | 20.165    | 0.007     | 1.988     | 0.2345622  | 4.729947                 | 0.001642                 | 0.466310                 |
| SeepArea32L-1049090717_169 | 1175086  | 3177177 | A             | 786.3          | 40.7        | 9/7/2017 | -1.647    | 0.004     | 0.491     | 0.2343243  | 0.000000                 | 0.000937                 | 0.115053                 |
| SeepArea32L-1049090717_110 | 1175087  | 3176134 | A             | 789.3          | 23.9        | 9/7/2017 | 0         | 0         | 1.878     | 0.2485213  | 0.000000                 | 0.000000                 | 0.466723                 |
| SeepArea32L-1049090717_168 | 1175108  | 3177227 | A             | 785.6          | 40.8        | 9/7/2017 | -1.111    | 0.002     | 0.477     | 0.2340411  | 0.000000                 | 0.000468                 | 0.111638                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_159 | 1175139  | 3176762 | A             | 788.6          | 40.0        | 9/7/2017 | 3.332     | 0.004     | 2.966     | 0.235535   | 0.784803                 | 0.000942                 | 0.698597                 |
| SeepArea32L-1049090717_150 | 1175153  | 3176646 | A             | 789.0          | 38.1        | 9/7/2017 | -1.398    | 0.003     | 0.772     | 0.237093   | 0.000000                 | 0.000711                 | 0.183036                 |
| SeepArea32L-1049090717_143 | 1175154  | 3176564 | A             | 789.1          | 35.1        | 9/7/2017 | 2.321     | 0         | 0.539     | 0.2394308  | 0.555719                 | 0.000000                 | 0.129053                 |
| SeepArea32L-1049090717_167 | 1175164  | 3177155 | A             | 786.0          | 40.9        | 9/7/2017 | -0.637    | 0         | 0.746     | 0.2340857  | 0.000000                 | 0.000000                 | 0.174628                 |
| SeepArea32L-1049090717_114 | 1175171  | 3175948 | A             | 789.0          | 24.7        | 9/7/2017 | -2.498    | 0.003     | 0.159     | 0.2477596  | 0.000000                 | 0.000743                 | 0.039394                 |
| SeepArea32L-1049090717_128 | 1175175  | 3176064 | A             | 787.4          | 29.1        | 9/7/2017 | 16.724    | 0.005     | 0.958     | 0.2436577  | 4.074932                 | 0.001218                 | 0.233424                 |
| SeepArea32L-1049090717_134 | 1175176  | 3176464 | A             | 788.6          | 31.2        | 9/7/2017 | -0.001    | 0.003     | 1.699     | 0.2423453  | 0.000000                 | 0.000727                 | 0.411745                 |
| SeepArea32L-1049090717_132 | 1175176  | 3176350 | A             | 788.2          | 30.4        | 9/7/2017 | 0         | 0.002     | 1.801     | 0.2428607  | 0.000000                 | 0.000486                 | 0.437392                 |
| SeepArea32L-1049090717_131 | 1175182  | 3176285 | A             | 788.0          | 30.0        | 9/7/2017 | 1.526     | 0.003     | 1.997     | 0.2431195  | 0.371000                 | 0.000729                 | 0.485510                 |
| SeepArea32L-1049090717_129 | 1175184  | 3176154 | A             | 788.2          | 29.4        | 9/7/2017 | 0         | 0.003     | 1.258     | 0.2436634  | 0.000000                 | 0.000731                 | 0.306529                 |
| SeepArea32L-1049090717_171 | 1175185  | 3176847 | A             | 786.7          | 40.8        | 9/7/2017 | 0         | 0.001     | 0.712     | 0.2343688  | 0.000000                 | 0.000234                 | 0.166871                 |
| SeepArea32L-1049090717_130 | 1175188  | 3176232 | A             | 788.3          | 29.7        | 9/7/2017 | 0         | -0.001    | 1.625     | 0.243453   | 0.000000                 | 0.000000                 | 0.395611                 |
| SeepArea32L-1049090717_170 | 1175197  | 3176937 | A             | 786.1          | 40.7        | 9/7/2017 | -2.149    | 0.002     | 0.33      | 0.2342647  | 0.000000                 | 0.000469                 | 0.077307                 |
| SeepArea32L-1049090717_166 | 1175229  | 3177040 | A             | 785.3          | 41.0        | 9/7/2017 | -1.368    | 0.002     | 0.52      | 0.2338028  | 0.000000                 | 0.000468                 | 0.121577                 |
| SeepArea32L-1049090717_160 | 1175245  | 3176763 | A             | 788.0          | 40.4        | 9/7/2017 | 30.124    | 0.001     | 1.598     | 0.2350556  | 7.080813                 | 0.000235                 | 0.375619                 |
| SeepArea32L-1049090717_125 | 1175253  | 3176329 | A             | 787.1          | 28.0        | 9/7/2017 | -0.313    | 0.003     | 1.92      | 0.2444546  | 0.000000                 | 0.000733                 | 0.469353                 |

## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_115 | 1175257  | 3175939 | A             | 787.4          | 24.9        | 9/7/2017 | -1.227    | -0.001    | -0.132    | 0.2470913  | 0.000000                 | 0.000000                 | 0.000000                 |
| SeepArea32L-1049090717_144 | 1175257  | 3176564 | A             | 789.0          | 35.5        | 9/7/2017 | -1.118    | 0.005     | 1.479     | 0.2390902  | 0.000000                 | 0.001195                 | 0.353614                 |
| SeepArea32L-1049090717_126 | 1175257  | 3176259 | A             | 787.1          | 28.2        | 9/7/2017 | -1.352    | 0.003     | 4.135     | 0.2442923  | 0.000000                 | 0.000733                 | 1.010149                 |
| SeepArea32L-1049090717_133 | 1175268  | 3176454 | A             | 788.3          | 30.7        | 9/7/2017 | 0         | 0.009     | 2.014     | 0.2426517  | 0.000000                 | 0.002184                 | 0.488701                 |
| SeepArea32L-1049090717_116 | 1175270  | 3176047 | A             | 786.3          | 25.1        | 9/7/2017 | -0.358    | 0.001     | 0.154     | 0.2465806  | 0.000000                 | 0.000247                 | 0.037973                 |
| SeepArea32L-1049090717_149 | 1175272  | 3176636 | A             | 788.7          | 37.8        | 9/7/2017 | 14.264    | 0.002     | 2.51      | 0.2372315  | 3.383870                 | 0.000474                 | 0.595451                 |
| SeepArea32L-1049090717_165 | 1175281  | 3176948 | A             | 785.6          | 41.1        | 9/7/2017 | -0.755    | 0.001     | 0.913     | 0.2338177  | 0.000000                 | 0.000234                 | 0.213476                 |
| SeepArea32L-1049090717_127 | 1175287  | 3176176 | A             | 787.1          | 28.5        | 9/7/2017 | -0.001    | 0.003     | 1.651     | 0.2440494  | 0.000000                 | 0.000732                 | 0.402926                 |
| SeepArea32L-1049090717_117 | 1175324  | 3176052 | A             | 786.5          | 25.3        | 9/7/2017 | -2.197    | -0.001    | 0.436     | 0.2464781  | 0.000000                 | 0.000000                 | 0.107464                 |
| SeepArea32L-1049090717_164 | 1175329  | 3176861 | A             | 785.9          | 41.1        | 9/7/2017 | -1.003    | 0.002     | 0.407     | 0.2339069  | 0.000000                 | 0.000468                 | 0.095200                 |
| SeepArea32L-1049090717_145 | 1175341  | 3176531 | A             | 788.7          | 35.9        | 9/7/2017 | -2.467    | 0.001     | 2.49      | 0.23869    | 0.000000                 | 0.000239                 | 0.594338                 |
| SeepArea32L-1049090717_161 | 1175363  | 3176771 | A             | 787.5          | 40.7        | 9/7/2017 | -2.063    | 0         | 0.586     | 0.2346819  | 0.000000                 | 0.000000                 | 0.137524                 |
| SeepArea32L-1049090717_118 | 1175364  | 3176000 | A             | 786.7          | 25.7        | 9/7/2017 | 0         | 0.003     | 0.461     | 0.2462107  | 0.000000                 | 0.000739                 | 0.113503                 |
| SeepArea32L-1049090717_123 | 1175365  | 3176237 | A             | 785.8          | 27.5        | 9/7/2017 | -0.001    | 0.002     | 1.105     | 0.2444567  | 0.000000                 | 0.000489                 | 0.270125                 |
| SeepArea32L-1049090717_148 | 1175370  | 3176664 | A             | 788.3          | 37.6        | 9/7/2017 | 16.167    | 0.004     | 1.651     | 0.2372638  | 3.835844                 | 0.000949                 | 0.391723                 |
| SeepArea32L-1049090717_124 | 1175375  | 3176334 | A             | 786.3          | 27.8        | 9/7/2017 | -1.026    | 0.005     | 1.873     | 0.2443684  | 0.000000                 | 0.001222                 | 0.457702                 |



## APPENDIX B FLUX DATA (Continued)

| Site Point ID              | Northing | Easting | Accum Chamber | Pressure (HPa) | Temp (DegC) | Date     | CH4 slope | H2S slope | CO2 slope | AcK factor | CH4 flux (moles/day/m^2) | H2S flux (moles/day/m^2) | CO2 flux (moles/day/m^2) |
|----------------------------|----------|---------|---------------|----------------|-------------|----------|-----------|-----------|-----------|------------|--------------------------|--------------------------|--------------------------|
| SeepArea32L-1049090717_163 | 1175398  | 3176816 | A             | 786.5          | 41.0        | 9/7/2017 | -1.601    | -0.001    | 0.696     | 0.23416    | 0.000000                 | 0.000000                 | 0.162975                 |
| SeepArea32L-1049090717_122 | 1175416  | 3176158 | A             | 784.8          | 27.2        | 9/7/2017 | -1.063    | 0.001     | 0.863     | 0.2443895  | 0.000000                 | 0.000244                 | 0.210908                 |
| SeepArea32L-1049090717_162 | 1175450  | 3176764 | A             | 786.8          | 40.9        | 9/7/2017 | -1.073    | -0.001    | -0.078    | 0.2343239  | 0.000000                 | 0.000000                 | 0.000000                 |
| SeepArea32L-1049090717_146 | 1175451  | 3176545 | A             | 788.7          | 36.4        | 9/7/2017 | 0         | 0.002     | 0.665     | 0.2383045  | 0.000000                 | 0.000477                 | 0.158472                 |
| SeepArea32L-1049090717_119 | 1175452  | 3176068 | A             | 785.6          | 26.1        | 9/7/2017 | 0         | 0.002     | 1.374     | 0.2455378  | 0.000000                 | 0.000491                 | 0.337369                 |
| SeepArea32L-1049090717_120 | 1175461  | 3175906 | A             | 784.7          | 26.5        | 9/7/2017 | -0.238    | 0.002     | 0.379     | 0.2449291  | 0.000000                 | 0.000490                 | 0.092828                 |
| SeepArea32L-1049090717_147 | 1175474  | 3176650 | A             | 788.8          | 37.2        | 9/7/2017 | 0         | 0.003     | 0.302     | 0.2377203  | 0.000000                 | 0.000713                 | 0.071792                 |
| SeepArea32L-1049090717_121 | 1175475  | 3176153 | A             | 784.0          | 26.9        | 9/7/2017 | -1.13     | 0.002     | 3.906     | 0.2443844  | 0.000000                 | 0.000489                 | 0.954566                 |

**APPENDIX C**  
**VOLUMETRIC FLUX CALCULATIONS**



---

# Grid Volume Computations

---

Mon Oct 02 09:57:19 2017

## Upper Surface

|                 |  |
|-----------------|--|
| Grid File Name: | C:\Cindy\XTO_Rule608\Surfer\32L_1021_CH4notail.grd |
| Grid Size:      | 37 rows x 40 columns                               |
| X Minimum:      | 3178364.23   |
| X Maximum:      | 3178954.875  |
| X Spacing:      | 15.144743589744                                    |
| Y Minimum:      | 1173747.159  |
| Y Maximum:      | 1174285.756  |
| Y Spacing:      | 14.96102777778                                     |
| Z Minimum:      | -6.8517123569457                                   |
| Z Maximum:      | 24.327741978336                                    |

## Lower Surface

Level Surface defined by  $Z = 0$

## Volumes

|                 |        |
|-----------------|--------|
| Z Scale Factor: | 0.0929 |
|-----------------|--------|

### Total Volumes by:

|                     |                 |
|---------------------|-----------------|
| Trapezoidal Rule:   | 2563.9729273788 |
| Simpson's Rule:     | 2362.3108591918 |
| Simpson's 3/8 Rule: | 2381.9367032652 |

### Cut & Fill Volumes

|                         |                 |
|-------------------------|-----------------|
| Positive Volume [Cut]:  | 6696.1024215614 |
| Negative Volume [Fill]: | 4132.1294941827 |
| Net Volume [Cut-Fill]:  | 2563.9729273788 |

## Areas

### Planar Areas

|                              |                 |
|------------------------------|-----------------|
| Positive Planar Area [Cut]:  | 127165.25229062 |
| Negative Planar Area [Fill]: | 114483.30905687 |

|                      |                 |
|----------------------|-----------------|
| Blanked Planar Area: | 76471.06371756  |
| Total Planar Area:   | 318119.62506505 |

**Surface Areas**

|                               |                 |
|-------------------------------|-----------------|
| Positive Surface Area [Cut]:  | 127173.29459679 |
| Negative Surface Area [Fill]: | 114485.93690344 |



---

# Grid Volume Computations

---

Mon Oct 02 10:32:13 2017

## Upper Surface

|                 |  |
|-----------------|--|
| Grid File Name: | C:\Cindy\XTO_Rule608\Surfer\32L_1030_CH4notail.grd |
| Grid Size:      | 25 rows x 24 columns                               |
| X Minimum:      | 3164562.739  |
| X Maximum:      | 3164909.548  |
| X Spacing:      | 15.078652173908                                    |
| Y Minimum:      | 1146059.353  |
| Y Maximum:      | 1146416.077  |
| Y Spacing:      | 14.863500000007                                    |
| Z Minimum:      | -2.7045040729012                                   |
| Z Maximum:      | 59.057998826331                                    |

## Lower Surface

Level Surface defined by  $Z = 0$

## Volumes

|                 |        |
|-----------------|--------|
| Z Scale Factor: | 0.0929 |
|-----------------|--------|

### Total Volumes by:

|                     |                 |
|---------------------|-----------------|
| Trapezoidal Rule:   | 13852.486093281 |
| Simpson's Rule:     | 13963.969980993 |
| Simpson's 3/8 Rule: | 13441.932880772 |

### Cut & Fill Volumes

|                         |                 |
|-------------------------|-----------------|
| Positive Volume [Cut]:  | 17355.476667705 |
| Negative Volume [Fill]: | 3502.9905744244 |
| Net Volume [Cut-Fill]:  | 13852.486093281 |

## Areas

### Planar Areas

|                              |                 |
|------------------------------|-----------------|
| Positive Planar Area [Cut]:  | 23054.131093709 |
| Negative Planar Area [Fill]: | 27709.399208244 |

|                      |                 |
|----------------------|-----------------|
| Blanked Planar Area: | 72951.563414065 |
| Total Planar Area:   | 123715.09371602 |

**Surface Areas**

|                               |                 |
|-------------------------------|-----------------|
| Positive Surface Area [Cut]:  | 23096.591006825 |
| Negative Surface Area [Fill]: | 27709.721447286 |

---

# Grid Volume Computations

---

Mon Oct 02 09:58:29 2017

## Upper Surface

|                 |  |
|-----------------|--|
| Grid File Name: | C:\Cindy\XTO_Rule608\Surfer\32L_1049_CH4notail.grd |
| Grid Size:      | 68 rows x 100 columns                              |
| X Minimum:      | 3175725.854  |
| X Maximum:      | 3178466.386  |
| X Spacing:      | 27.682141414143                                    |
| Y Minimum:      | 1173655.284  |
| Y Maximum:      | 1175575.434  |
| Y Spacing:      | 28.658955223879                                    |
| Z Minimum:      | -1.0707273873441                                   |
| Z Maximum:      | 6.0880273780417                                    |

## Lower Surface

Level Surface defined by  $Z = 0$

## Volumes

|                 |        |
|-----------------|--------|
| Z Scale Factor: | 0.0929 |
|-----------------|--------|

### Total Volumes by:

|                     |                 |
|---------------------|-----------------|
| Trapezoidal Rule:   | 58693.179933657 |
| Simpson's Rule:     | 58733.269672081 |
| Simpson's 3/8 Rule: | 58653.351401944 |

### Cut & Fill Volumes

|                         |                 |
|-------------------------|-----------------|
| Positive Volume [Cut]:  | 66302.559819074 |
| Negative Volume [Fill]: | 7609.3798854174 |
| Net Volume [Cut-Fill]:  | 58693.179933657 |

## Areas

### Planar Areas

|                              |                |
|------------------------------|----------------|
| Positive Planar Area [Cut]:  | 1738489.41044  |
| Negative Planar Area [Fill]: | 2033054.898188 |

|                      |                |
|----------------------|----------------|
| Blanked Planar Area: | 1490688.211172 |
| Total Planar Area:   | 5262232.5198   |

**Surface Areas**

|                               |                 |
|-------------------------------|-----------------|
| Positive Surface Area [Cut]:  | 1738491.4358757 |
| Negative Surface Area [Fill]: | 2033055.0042226 |



**APPENDIX D**  
**NATURAL SPRING ANALYTICAL REPORTS**



**Technical Report for****LT Environmental****Colo Rule 608 Compliance Raton Basin CO****013917018****SGS Accutest Job Number: D97689****Sampling Date: 09/06/17****Report to:****LT Environmental  
4600 W 60th Ave  
Arvada, CO 80003  
dhencmann@ltenv.com****ATTN: Devin Hencmann****Total number of pages in report: 60**

Test results contained within this data package meet the requirements  
of the National Environmental Laboratory Accreditation Program  
and/or state specific certification programs as applicable.

**Scott Heideman**  
**Laboratory Director****Client Service contact: Jen Jorschumb 303-425-6021**

Certifications: CO (CO00049), ID (CO00049), NE (NE-OS-06-04), ND (R-027), NJ (CO007), OK (D9942)  
UT (NELAP CO00049), LA (LA150028), TX (T104704511), WY (8TMS-L)

This report shall not be reproduced, except in its entirety, without the written approval of SGS Accutest.  
Test results relate only to samples analyzed.

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Sample Summary

LT Environmental

Job No: D97689

Colo Rule 608 Compliance Raton Basin CO  
Project No: 013917018

| Sample Number | Collected Date | Time By    | Received | Matrix Code | Type             | Client Sample ID |
|---------------|----------------|------------|----------|-------------|------------------|------------------|
| D97689-1      | 09/06/17       | 12:05 JACJ | 09/07/17 | AQ          | Water            | CHAVEZ-01        |
| D97689-1A     | 09/06/17       | 12:05 JACJ | 09/07/17 | AQ          | Water            | CHAVEZ-01        |
| D97689-1B     | 09/06/17       | 12:05 JACJ | 09/07/17 | AQ          | Water            | CHAVEZ-01        |
| D97689-1F     | 09/06/17       | 12:05 JACJ | 09/07/17 | AQ          | Water Filtered   | CHAVEZ-01        |
| D97689-2      | 09/06/17       | 11:18 JACJ | 09/07/17 | AQ          | Water            | CHAVEZ-02        |
| D97689-2A     | 09/06/17       | 11:18 JACJ | 09/07/17 | AQ          | Water            | CHAVEZ-02        |
| D97689-2B     | 09/06/17       | 11:18 JACJ | 09/07/17 | AQ          | Water            | CHAVEZ-02        |
| D97689-2F     | 09/06/17       | 11:18 JACJ | 09/07/17 | AQ          | Water Filtered   | CHAVEZ-02        |
| D97689-3      | 09/06/17       | 00:00 JACJ | 09/07/17 | AQ          | Trip Blank Water | TRIP BLANK       |



## CASE NARRATIVE / CONFORMANCE SUMMARY

2

**Client:** LT Environmental

**Job No** D97689

**Site:** Colo Rule 608 Compliance Raton Basin CO

**Report Date** 9/19/2017 12:22:40 P

On 09/07/2017, 2 sample(s), 1 Trip Blank(s), and 0 Field Blank(s) were received at SGS Accutest Mountain States (SAMS) at a temperature of 2.8 °C. The samples were intact and properly preserved, unless noted below. An SAMS Job Number of D97689 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GC By Method RSK175 MOD

**Matrix:** AQ

**Batch ID:** GFB914

- All samples were analyzed within the recommended method holding time.
- Sample(s) D97720-1AMS, D97720-1AMSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.
- The matrix spike (MS) recovery(s) of Methane are outside control limits. Probable cause due to the ratio of spike to sample concentration < 4.
- D97720-1AMS and D97720-1AMSD: The pH of the sample was >2 at time of analysis.

**Matrix:** AQ

**Batch ID:** GFB915

- All samples were analyzed within the recommended method holding time.
- Sample(s) D97765-1AMSD, D97765-1AMS were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.
- D97765-1AMS and D97765-1AMSD: The pH of the sample was >2 at time of analysis.
- D97765-1AMS for Methane: Outside control limits due to high level in sample relative to spike amount.

### Metals By Method EPA 200.7

**Matrix:** AQ

**Batch ID:** MP22914

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D97689-2FMS, D97689-2FMDS were used as the QC samples for the metals analysis.

### Metals By Method EPA 200.8

**Matrix:** AQ

**Batch ID:** MP22923

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D97689-1FMS, D97689-1FMDS were used as the QC samples for the metals analysis.

### Metals By Method SW846 6010C

**Matrix:** AQ

**Batch ID:** MP22928

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D97689-1AMS, D97689-1AMSD, D97689-1ASDL were used as the QC samples for the metals analysis.

Tuesday, September 19, 2017

Page 1 of 3

### Wet Chemistry By Method EPA 300.0/SW846 9056

|                   |                         |
|-------------------|-------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> R40207 |
|-------------------|-------------------------|

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D97689-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

|                   |                         |
|-------------------|-------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> R40208 |
|-------------------|-------------------------|

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D97689-2 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

### Wet Chemistry By Method EPA300.0/SW846 9056A

|                   |                          |
|-------------------|--------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> GP21132 |
|-------------------|--------------------------|

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D97639-1MS, D97639-1MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate, Bromide analysis.

### Wet Chemistry By Method HACH IRB-BART

|                   |                        |
|-------------------|------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> MB921 |
|-------------------|------------------------|

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method HACH SLYM-BART

|                   |                        |
|-------------------|------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> MB922 |
|-------------------|------------------------|

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method HACH SRB-BART

|                   |                        |
|-------------------|------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> MB923 |
|-------------------|------------------------|

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method SM 2320B-2011

|                   |                          |
|-------------------|--------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> GN40109 |
|-------------------|--------------------------|

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D97689-1DUP, D97689-2MS, D97689-2MSD were used as the QC samples for the Alkalinity, Total as CaCO<sub>3</sub> analysis.

|                   |                          |
|-------------------|--------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> GN40110 |
|-------------------|--------------------------|

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

|                   |                          |
|-------------------|--------------------------|
| <b>Matrix:</b> AQ | <b>Batch ID:</b> GN40111 |
|-------------------|--------------------------|

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method SM 2510B-2011

**Matrix:** AQ

**Batch ID:** GP21134

- Sample(s) D97689-1DUP were used as the QC samples for the Specific Conductivity analysis.

### Wet Chemistry By Method SM 2540C-2011

**Matrix:** AQ

**Batch ID:** GN40119

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D97658-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

### Wet Chemistry By Method SM4500HB+-2011/9040C

**Matrix:** AQ

**Batch ID:** GN40107

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D97689-1, D97689-2  
Analysis performed past recommended hold time.

### Wet Chemistry By Method USDA HANDBOOK 60

**Matrix:** AQ

**Batch ID:** MP22928

- D97689-1A, -2A for Sodium Adsorption Ratio: Calculated as:  $(\text{Na meq/L}) / \sqrt{[(\text{Ca meq/L}) + (\text{Mg meq/L})/2]}$

SAMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting SAMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

SAMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by SAMS indicated via signature on the report cover.

## Summary of Hits

**Job Number:** D97689  
**Account:** LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO  
**Collected:** 09/06/17



| Lab Sample ID | Client Sample ID | Result/<br>Qual | RL | MDL | Units | Method |
|---------------|------------------|-----------------|----|-----|-------|--------|
|---------------|------------------|-----------------|----|-----|-------|--------|

### D97689-1 CHAVEZ-01

|  |        |         |         |          |                       |
|--|--------|---------|---------|----------|-----------------------|
| Methane                                      | 0.0026 | 0.00080 | 0.00040 | mg/l     | RSK175 MOD            |
| Alkalinity, Bicarbonate as CaCO <sub>3</sub> | 137    | 5.0     |         | mg/l     | SM 2320B-2011         |
| Alkalinity, Total as CaCO <sub>3</sub>       | 137    | 5.0     |         | mg/l     | SM 2320B-2011         |
| Chloride                                     | 8.8    | 0.50    |         | mg/l     | EPA300.0/SW846 9056A  |
| Fluoride                                     | 0.22   | 0.10    |         | mg/l     | EPA300.0/SW846 9056A  |
| Solids, Total Dissolved                      | 202    | 10      |         | mg/l     | SM 2540C-2011         |
| Specific Conductivity                        | 325    | 1.0     |         | umhos/cm | SM 2510B-2011         |
| Sulfate                                      | 25.1   | 0.50    |         | mg/l     | EPA300.0/SW846 9056A  |
| pH <sup>a</sup>                              | 7.80   |         |         | su       | SM4500HB+ -2011/9040C |

### D97689-1A CHAVEZ-01

|                                      |       |     |  |       |                  |
|--------------------------------------|-------|-----|--|-------|------------------|
| Calcium                              | 50.0  | 2.0 |  | mg/l  | SW846 6010C      |
| Magnesium                            | 9.42  | 1.0 |  | mg/l  | SW846 6010C      |
| Sodium                               | 15.0  | 2.0 |  | mg/l  | SW846 6010C      |
| Sodium Adsorption Ratio <sup>b</sup> | 0.510 |     |  | ratio | USDA HANDBOOK 60 |

### D97689-1B CHAVEZ-01

|                           |        |     |  |        |                |
|---------------------------|--------|-----|--|--------|----------------|
| Iron-Related Bacteria     | 74500  | 25  |  | CFU/ml | HACH IRB-BART  |
| Slime Forming Bacteria    | 350000 | 500 |  | CFU/ml | HACH SLYM-BART |
| Sulfate Reducing Bacteria | 5000   | 200 |  | CFU/ml | HACH SRB-BART  |

### D97689-1F CHAVEZ-01

|           |       |     |  |      |           |
|-----------|-------|-----|--|------|-----------|
| Calcium   | 42100 | 400 |  | ug/l | EPA 200.7 |
| Magnesium | 8200  | 200 |  | ug/l | EPA 200.7 |
| Manganese | 2.3   | 2.0 |  | ug/l | EPA 200.8 |
| Sodium    | 12700 | 400 |  | ug/l | EPA 200.7 |

### D97689-2 CHAVEZ-02

|  |           |         |         |          |                       |
|--|-----------|---------|---------|----------|-----------------------|
| Methane                                      | 0.00052 J | 0.00080 | 0.00040 | mg/l     | RSK175 MOD            |
| Alkalinity, Bicarbonate as CaCO <sub>3</sub> | 223       | 5.0     |         | mg/l     | SM 2320B-2011         |
| Alkalinity, Total as CaCO <sub>3</sub>       | 223       | 5.0     |         | mg/l     | SM 2320B-2011         |
| Chloride                                     | 9.5       | 0.50    |         | mg/l     | EPA300.0/SW846 9056A  |
| Fluoride                                     | 0.27      | 0.10    |         | mg/l     | EPA300.0/SW846 9056A  |
| Nitrogen, Nitrate                            | 0.16      | 0.050   |         | mg/l     | EPA300.0/SW846 9056A  |
| Nitrogen, Nitrate + Nitrite <sup>c</sup>     | 0.16      | 0.054   |         | mg/l     | EPA 300.0/SW846 9056  |
| Solids, Total Dissolved                      | 290       | 10      |         | mg/l     | SM 2540C-2011         |
| Specific Conductivity                        | 471       | 1.0     |         | umhos/cm | SM 2510B-2011         |
| Sulfate                                      | 27.5      | 0.50    |         | mg/l     | EPA300.0/SW846 9056A  |
| pH <sup>a</sup>                              | 7.51      |         |         | su       | SM4500HB+ -2011/9040C |

## Summary of Hits

**Job Number:** D97689  
**Account:** LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO  
**Collected:** 09/06/17



| Lab Sample ID | Client Sample ID | Result/<br>Qual | RL | MDL | Units | Method |
|---------------|------------------|-----------------|----|-----|-------|--------|
|---------------|------------------|-----------------|----|-----|-------|--------|

### D97689-2A CHAVEZ-02

|                                      |       |     |  |       |                  |
|--------------------------------------|-------|-----|--|-------|------------------|
| Calcium                              | 73.0  | 2.0 |  | mg/l  | SW846 6010C      |
| Magnesium                            | 14.4  | 1.0 |  | mg/l  | SW846 6010C      |
| Sodium                               | 16.8  | 2.0 |  | mg/l  | SW846 6010C      |
| Sodium Adsorption Ratio <sup>b</sup> | 0.470 |     |  | ratio | USDA HANDBOOK 60 |

### D97689-2B CHAVEZ-02

|                           |        |     |  |        |                |
|---------------------------|--------|-----|--|--------|----------------|
| Iron-Related Bacteria     | 74500  | 25  |  | CFU/ml | HACH IRB-BART  |
| Slime Forming Bacteria    | 350000 | 500 |  | CFU/ml | HACH SLYM-BART |
| Sulfate Reducing Bacteria | 700    | 200 |  | CFU/ml | HACH SRB-BART  |

### D97689-2F CHAVEZ-02

|           |       |      |  |      |           |
|-----------|-------|------|--|------|-----------|
| Calcium   | 64500 | 400  |  | ug/l | EPA 200.7 |
| Iron      | 22.0  | 10   |  | ug/l | EPA 200.7 |
| Magnesium | 13400 | 200  |  | ug/l | EPA 200.7 |
| Manganese | 4.1   | 2.0  |  | ug/l | EPA 200.8 |
| Potassium | 1620  | 1000 |  | ug/l | EPA 200.7 |
| Sodium    | 15400 | 400  |  | ug/l | EPA 200.7 |

### D97689-3 TRIP BLANK

No hits reported in this sample.

(a) Analysis performed past recommended hold time.

(b) Calculated as:  $(\text{Na meq/L}) / \sqrt{[(\text{Ca meq/L}) + (\text{Mg meq/L})/2]}$

(c) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)



**Sample Results**

**Report of Analysis**

Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-01                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-1                                | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water                              | <b>Percent Solids:</b> | n/a      |
| <b>Method:</b>           | RSK175 MOD                              |                        |          |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

|        | File ID   | DF | Analyzed       | By | Prep Date | Prep Batch | Analytical Batch |
|--------|-----------|----|----------------|----|-----------|------------|------------------|
| Run #1 | FB19844.D | 1  | 09/08/17 16:02 | RB | n/a       | n/a        | GFB914           |
| Run #2 |           |    |                |    |           |            |                  |

|        | Initial Volume | Headspace Volume | Volume Injected | Temperature |
|--------|----------------|------------------|-----------------|-------------|
| Run #1 | 39.0 ml        | 4.0 ml           | 500 ul          | 22.0 Deg. C |
| Run #2 |                |                  |                 |             |

| CAS No. | Compound | Result | RL      | MDL     | Units | Q |
|---------|----------|--------|---------|---------|-------|---|
| 74-82-8 | Methane  | 0.0026 | 0.00080 | 0.00040 | mg/l  |   |

ND = Not detected

MDL = Method Detection Limit

J = Indicates an estimated value

RL = Reporting Limit

B = Indicates analyte found in associated method blank

E = Indicates value exceeds calibration range

N = Indicates presumptive evidence of a compound

## Report of Analysis

**Client Sample ID:** CHAVEZ-01**Lab Sample ID:** D97689-1**Matrix:** AQ - Water**Date Sampled:** 09/06/17**Date Received:** 09/07/17**Percent Solids:** n/a**Project:** Colo Rule 608 Compliance Raton Basin CO

## General Chemistry

| Analyte                                  | Result   | RL     | Units    | DF | Analyzed       | By | Method                |
|--|----------|--------|----------|----|----------------|----|-----------------------|
| Alkalinity, Bicarbonate as CaC           | 137      | 5.0    | mg/l     | 1  | 09/08/17 10:37 | MG | SM 2320B-2011         |
| Alkalinity, Carbonate                    | < 5.0    | 5.0    | mg/l     | 1  | 09/08/17 10:37 | MG | SM 2320B-2011         |
| Alkalinity, Total as CaCO <sub>3</sub>   | 137      | 5.0    | mg/l     | 1  | 09/08/17 10:37 | MG | SM 2320B-2011         |
| Bromide                                  | < 0.050  | 0.050  | mg/l     | 1  | 09/07/17 14:13 | JB | EPA300.0/SW846 9056A  |
| Chloride                                 | 8.8      | 0.50   | mg/l     | 1  | 09/07/17 14:13 | JB | EPA300.0/SW846 9056A  |
| Fluoride                                 | 0.22     | 0.10   | mg/l     | 1  | 09/07/17 14:13 | JB | EPA300.0/SW846 9056A  |
| Nitrogen, Nitrate                        | < 0.010  | 0.010  | mg/l     | 1  | 09/07/17 14:13 | JB | EPA300.0/SW846 9056A  |
| Nitrogen, Nitrate + Nitrite <sup>a</sup> | < 0.014  | 0.014  | mg/l     | 1  | 09/07/17 14:13 | JB | EPA 300.0/SW846 9056  |
| Nitrogen, Nitrite                        | < 0.0040 | 0.0040 | mg/l     | 1  | 09/07/17 14:13 | JB | EPA300.0/SW846 9056A  |
| Solids, Total Dissolved                  | 202      | 10     | mg/l     | 1  | 09/11/17       | SK | SM 2540C-2011         |
| Specific Conductivity                    | 325      | 1.0    | umhos/cm | 1  | 09/08/17 10:37 | MG | SM 2510B-2011         |
| Sulfate                                  | 25.1     | 0.50   | mg/l     | 1  | 09/07/17 14:13 | JB | EPA300.0/SW846 9056A  |
| pH <sup>b</sup>                          | 7.80     |        | su       | 1  | 09/08/17 10:37 | MG | SM4500HB+ -2011/9040C |

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

(b) Analysis performed past recommended hold time.

RL = Reporting Limit

Report of Analysis

Client Sample ID: CHAVEZ-01

Lab Sample ID: D97689-1A

Matrix: AQ - Water

Date Sampled: 09/06/17

Date Received: 09/07/17

Percent Solids: n/a

Project: Colo Rule 608 Compliance Raton Basin CO

SAR Metals Analysis

| Analyte   | Result | RL  | Units | DF | Prep     | Analyzed By | Method                   | Prep Method                |
|-----------|--------|-----|-------|----|----------|-------------|--------------------------|----------------------------|
| Calcium   | 50.0   | 2.0 | mg/l  | 1  | 09/08/17 | 09/08/17 SB | SW846 6010C <sup>1</sup> | SW846 3010A/M <sup>2</sup> |
| Magnesium | 9.42   | 1.0 | mg/l  | 1  | 09/08/17 | 09/08/17 SB | SW846 6010C <sup>1</sup> | SW846 3010A/M <sup>2</sup> |
| Sodium    | 15.0   | 2.0 | mg/l  | 1  | 09/08/17 | 09/08/17 SB | SW846 6010C <sup>1</sup> | SW846 3010A/M <sup>2</sup> |

(1) Instrument QC Batch: MA8999

(2) Prep QC Batch: MP22928

RL = Reporting Limit

4.2  
4

Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-01                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-1A                               | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water                              | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

General Chemistry

| Analyte                              | Result | RL | Units | DF | Analyzed       | By | Method           |
|--------------------------------------|--------|----|-------|----|----------------|----|------------------|
| Sodium Adsorption Ratio <sup>a</sup> | 0.510  |    | ratio | 1  | 09/08/17 12:59 | SB | USDA HANDBOOK 60 |

(a) Calculated as: (Na meq/L) / sqrt [(Ca meq/L)+ (Mg meq/L)/2]

RL = Reporting Limit



Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-01                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-1B                               | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water                              | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

General Chemistry

| Analyte                   | Result | RL  | Units  | DF | Analyzed       | By | Method         |
|---------------------------|--------|-----|--------|----|----------------|----|----------------|
| Iron-Related Bacteria     | 74500  | 25  | CFU/ml | 1  | 09/11/17 10:45 | MM | HACH IRB-BART  |
| Slime Forming Bacteria    | 350000 | 500 | CFU/ml | 1  | 09/11/17 10:45 | MM | HACH SLYM-BART |
| Sulfate Reducing Bacteria | 5000   | 200 | CFU/ml | 1  | 09/11/17 10:45 | MM | HACH SRB-BART  |

RL = Reporting Limit

Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-01                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-1F                               | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water Filtered                     | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

Dissolved Metals Analysis

| Analyte   | Result | RL   | Units | DF | Prep     | Analyzed By | Method                 | Prep Method            |
|-----------|--------|------|-------|----|----------|-------------|------------------------|------------------------|
| Calcium   | 42100  | 400  | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Iron      | < 10   | 10   | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Magnesium | 8200   | 200  | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Manganese | 2.3    | 2.0  | ug/l  | 2  | 09/08/17 | 09/08/17 MR | EPA 200.8 <sup>1</sup> | EPA 200.8 <sup>4</sup> |
| Potassium | < 1000 | 1000 | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Selenium  | < 0.80 | 0.80 | ug/l  | 2  | 09/08/17 | 09/08/17 MR | EPA 200.8 <sup>1</sup> | EPA 200.8 <sup>4</sup> |
| Sodium    | 12700  | 400  | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |

- (1) Instrument QC Batch: MA9001
- (2) Instrument QC Batch: MA9011
- (3) Prep QC Batch: MP22914
- (4) Prep QC Batch: MP22923

RL = Reporting Limit

Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-02                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-2                                | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water                              | <b>Percent Solids:</b> | n/a      |
| <b>Method:</b>           | RSK175 MOD                              |                        |          |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

|        | File ID   | DF | Analyzed       | By | Prep Date | Prep Batch | Analytical Batch |
|--------|-----------|----|----------------|----|-----------|------------|------------------|
| Run #1 | FB19845.D | 1  | 09/08/17 16:07 | RB | n/a       | n/a        | GFB914           |
| Run #2 |           |    |                |    |           |            |                  |

|        | Initial Volume | Headspace Volume | Volume Injected | Temperature |
|--------|----------------|------------------|-----------------|-------------|
| Run #1 | 39.0 ml        | 4.0 ml           | 500 ul          | 22.0 Deg. C |
| Run #2 |                |                  |                 |             |

| CAS No. | Compound | Result  | RL      | MDL     | Units | Q |
|---------|----------|---------|---------|---------|-------|---|
| 74-82-8 | Methane  | 0.00052 | 0.00080 | 0.00040 | mg/l  | J |

ND = Not detected

MDL = Method Detection Limit

J = Indicates an estimated value

RL = Reporting Limit

B = Indicates analyte found in associated method blank

E = Indicates value exceeds calibration range

N = Indicates presumptive evidence of a compound

4.5  
4

## Report of Analysis

**Client Sample ID:** CHAVEZ-02**Lab Sample ID:** D97689-2**Matrix:** AQ - Water**Project:** Colo Rule 608 Compliance Raton Basin CO**Date Sampled:** 09/06/17**Date Received:** 09/07/17**Percent Solids:** n/a

## General Chemistry

| Analyte                                  | Result   | RL     | Units    | DF | Analyzed       | By | Method                |
|--|----------|--------|----------|----|----------------|----|-----------------------|
| Alkalinity, Bicarbonate as CaC           | 223      | 5.0    | mg/l     | 1  | 09/08/17 10:37 | MG | SM 2320B-2011         |
| Alkalinity, Carbonate                    | < 5.0    | 5.0    | mg/l     | 1  | 09/08/17 10:37 | MG | SM 2320B-2011         |
| Alkalinity, Total as CaCO <sub>3</sub>   | 223      | 5.0    | mg/l     | 1  | 09/08/17 10:37 | MG | SM 2320B-2011         |
| Bromide                                  | < 0.050  | 0.050  | mg/l     | 1  | 09/07/17 14:26 | JB | EPA300.0/SW846 9056A  |
| Chloride                                 | 9.5      | 0.50   | mg/l     | 1  | 09/07/17 14:26 | JB | EPA300.0/SW846 9056A  |
| Fluoride                                 | 0.27     | 0.10   | mg/l     | 1  | 09/07/17 14:26 | JB | EPA300.0/SW846 9056A  |
| Nitrogen, Nitrate                        | 0.16     | 0.050  | mg/l     | 5  | 09/07/17 17:01 | JB | EPA300.0/SW846 9056A  |
| Nitrogen, Nitrate + Nitrite <sup>a</sup> | 0.16     | 0.054  | mg/l     | 1  | 09/07/17 17:01 | JB | EPA 300.0/SW846 9056  |
| Nitrogen, Nitrite                        | < 0.0040 | 0.0040 | mg/l     | 1  | 09/07/17 14:26 | JB | EPA300.0/SW846 9056A  |
| Solids, Total Dissolved                  | 290      | 10     | mg/l     | 1  | 09/11/17       | SK | SM 2540C-2011         |
| Specific Conductivity                    | 471      | 1.0    | umhos/cm | 1  | 09/08/17 10:37 | MG | SM 2510B-2011         |
| Sulfate                                  | 27.5     | 0.50   | mg/l     | 1  | 09/07/17 14:26 | JB | EPA300.0/SW846 9056A  |
| pH <sup>b</sup>                          | 7.51     |        | su       | 1  | 09/08/17 10:37 | MG | SM4500HB+ -2011/9040C |

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

(b) Analysis performed past recommended hold time.

RL = Reporting Limit

Report of Analysis

Client Sample ID: CHAVEZ-02

Lab Sample ID: D97689-2A

Matrix: AQ - Water

Project: Colo Rule 608 Compliance Raton Basin CO

Date Sampled: 09/06/17

Date Received: 09/07/17

Percent Solids: n/a

SAR Metals Analysis

| Analyte   | Result | RL  | Units | DF | Prep     | Analyzed By | Method                   | Prep Method                |
|-----------|--------|-----|-------|----|----------|-------------|--------------------------|----------------------------|
| Calcium   | 73.0   | 2.0 | mg/l  | 1  | 09/08/17 | 09/08/17 SB | SW846 6010C <sup>1</sup> | SW846 3010A/M <sup>2</sup> |
| Magnesium | 14.4   | 1.0 | mg/l  | 1  | 09/08/17 | 09/08/17 SB | SW846 6010C <sup>1</sup> | SW846 3010A/M <sup>2</sup> |
| Sodium    | 16.8   | 2.0 | mg/l  | 1  | 09/08/17 | 09/08/17 SB | SW846 6010C <sup>1</sup> | SW846 3010A/M <sup>2</sup> |

(1) Instrument QC Batch: MA8999

(2) Prep QC Batch: MP22928

RL = Reporting Limit

4.6  
4



Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-02                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-2A                               | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water                              | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

General Chemistry

| Analyte                              | Result | RL | Units | DF | Analyzed       | By | Method           |
|--------------------------------------|--------|----|-------|----|----------------|----|------------------|
| Sodium Adsorption Ratio <sup>a</sup> | 0.470  |    | ratio | 1  | 09/08/17 13:42 | SB | USDA HANDBOOK 60 |

(a) Calculated as: (Na meq/L) / sqrt [(Ca meq/L)+ (Mg meq/L)/2]

RL = Reporting Limit

Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-02                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-2B                               | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water                              | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

General Chemistry

| Analyte                   | Result | RL  | Units  | DF | Analyzed       | By | Method         |
|---------------------------|--------|-----|--------|----|----------------|----|----------------|
| Iron-Related Bacteria     | 74500  | 25  | CFU/ml | 1  | 09/11/17 10:45 | MM | HACH IRB-BART  |
| Slime Forming Bacteria    | 350000 | 500 | CFU/ml | 1  | 09/11/17 10:45 | MM | HACH SLYM-BART |
| Sulfate Reducing Bacteria | 700    | 200 | CFU/ml | 1  | 09/11/17 10:45 | MM | HACH SRB-BART  |

RL = Reporting Limit

4.7  
4

Report of Analysis

|                          |   |                        |          |
|--------------------------|---|------------------------|----------|
| <b>Client Sample ID:</b> | CHAVEZ-02                               | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Lab Sample ID:</b>    | D97689-2F                               | <b>Date Received:</b>  | 09/07/17 |
| <b>Matrix:</b>           | AQ - Water Filtered                     | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |                        |          |

Dissolved Metals Analysis

| Analyte   | Result | RL   | Units | DF | Prep     | Analyzed By | Method                 | Prep Method            |
|-----------|--------|------|-------|----|----------|-------------|------------------------|------------------------|
| Calcium   | 64500  | 400  | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Iron      | 22.0   | 10   | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Magnesium | 13400  | 200  | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Manganese | 4.1    | 2.0  | ug/l  | 2  | 09/08/17 | 09/08/17 MR | EPA 200.8 <sup>1</sup> | EPA 200.8 <sup>4</sup> |
| Potassium | 1620   | 1000 | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |
| Selenium  | < 0.80 | 0.80 | ug/l  | 2  | 09/08/17 | 09/08/17 MR | EPA 200.8 <sup>1</sup> | EPA 200.8 <sup>4</sup> |
| Sodium    | 15400  | 400  | ug/l  | 1  | 09/08/17 | 09/12/17 SB | EPA 200.7 <sup>2</sup> | EPA 200.7 <sup>3</sup> |

- (1) Instrument QC Batch: MA9001
- (2) Instrument QC Batch: MA9011
- (3) Prep QC Batch: MP22914
- (4) Prep QC Batch: MP22923

RL = Reporting Limit

Report of Analysis

|                          |   |  |  |  |  |                        |          |
|--------------------------|---|--|--|--|--|------------------------|----------|
| <b>Client Sample ID:</b> | TRIP BLANK                              |  |  |  |  |                        |          |
| <b>Lab Sample ID:</b>    | D97689-3                                |  |  |  |  | <b>Date Sampled:</b>   | 09/06/17 |
| <b>Matrix:</b>           | AQ - Trip Blank Water                   |  |  |  |  | <b>Date Received:</b>  | 09/07/17 |
| <b>Method:</b>           | RSK175 MOD                              |  |  |  |  | <b>Percent Solids:</b> | n/a      |
| <b>Project:</b>          | Colo Rule 608 Compliance Raton Basin CO |  |  |  |  |                        |          |

|        | File ID   | DF | Analyzed       | By | Prep Date | Prep Batch | Analytical Batch |
|--------|-----------|----|----------------|----|-----------|------------|------------------|
| Run #1 | FB19881.D | 1  | 09/13/17 15:06 | RB | n/a       | n/a        | GFB915           |
| Run #2 |           |    |                |    |           |            |                  |

|        | Initial Volume | Headspace Volume | Volume Injected | Temperature |
|--------|----------------|------------------|-----------------|-------------|
| Run #1 | 39.0 ml        | 4.0 ml           | 500 ul          | 21.0 Deg. C |
| Run #2 |                |                  |                 |             |

| CAS No. | Compound | Result | RL      | MDL     | Units | Q |
|---------|----------|--------|---------|---------|-------|---|
| 74-82-8 | Methane  | ND     | 0.00080 | 0.00040 | mg/l  |   |

ND = Not detected      MDL = Method Detection Limit      J = Indicates an estimated value  
RL = Reporting Limit      B = Indicates analyte found in associated method blank  
E = Indicates value exceeds calibration range      N = Indicates presumptive evidence of a compound

4.9  
4

## Misc. Forms

5

## Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody





## CHAIN OF CUSTODY

Page 1 of 1

4036 Youngfield Street, Wheat Ridge, CO 80033  
TEL: 303-425-6021 FAX: 303-425-6854  
www.accutest.com

|  |                         |
|--|-------------------------|
| Bottle Order Control #   | FED-EX Tracking #       |
| SGS Quote #  | SGS Job # <b>D97689</b> |
| Requested Analysis (see TEST CODE sheet)   |                         |
| Matrix Codes   |                         |
| DW - Drinking Water<br>GW - Ground Water<br>WW - Water<br>SW - Surface Water<br>SO - Soil<br>SL - Sludge<br>SED - Sediment<br>OI - Oil<br>LIQ - Other Liquid<br>AIR - Air<br>SOL - Other Solid<br>WP - Wipe<br>FB - Field Blank<br>EB - Equipment Blank<br>RB - Rinse Blank<br>TB - Trip Blank |                         |
| LAB USE ONLY   |                         |

XX See attached/bottles

Br, Cl, F, SO<sub>4</sub>, NO<sub>3</sub>, NO<sub>2</sub>  
Phoscon, TDS  
KCA-BICAIK  
VLSH 175CH4  
ICBA, SEBA, S4RBA  
DISS MET LC  
XSAK

01  
02  
Th 03  
my  
R

|  |  |   |              |
|--|--|---|--------------|
| Client / Reporting Information                     |  | Project Information                               |              |
| Company: <b>LT Environmental</b>                   | Project Name: <b>608 Compliance</b>    | Billing Information (if different from Report to) |              |
| Street: <b>848 E. 2nd Ave</b>                      | Street:                                | Company: <b>LT Environmental</b>                  |              |
| City, State: <b>Durango, CO</b>                    | City, State: <b>Weston, CO</b>         | Street Address: <b>4600 W 60th</b>                |              |
| Project Contact: <b>Devin Hencmann</b>             | Project #: <b>013917018</b>            | City, State ZIP: <b>Denver, CO 80003</b>          |              |
| Phone: <b>970-385-1096</b>                         | Client Purchase Order #:               | Attention: <b>Maureen Anderson</b>                |              |
| Email: <b>dhenemann@ltenv.com</b>                  | Project Manager: <b>Devin Hencmann</b> | Collection  |              |
| Sampler(s) Name(s): <b>Josh Adams, Chris Jones</b> |  | Number of preserved Bottles                       |              |
| Field ID / Point of Collection                     | Date                                   | Time  | Sampled by   |
| <b>Chavez-01</b>                                   | <b>7-6-17</b>                          | <b>1205</b>                                       | <b>JW/GW</b> |
| <b>Chavez-02</b>                                   | <b>↓</b>                               | <b>1118</b>                                       | <b>JW/GW</b> |

|  |   |                                 |
|--|---|---------------------------------|
| Turnaround Time (Business days)  | Data Deliverable Information  | Comments / Special Instructions |
| <input checked="" type="checkbox"/> Std. 10 Business Days<br><input type="checkbox"/> 5 Day RUSH<br><input type="checkbox"/> 3 Day Emergency<br><input type="checkbox"/> 2 Day Emergency<br><input type="checkbox"/> 1 Day Emergency | <input type="checkbox"/> Commercial "A" (Level 1, Results Only)<br><input checked="" type="checkbox"/> Commercial "B" (Level 2, Results + QC Summary)<br><input type="checkbox"/> COMMBN (Results/QC/Narrative)<br><input type="checkbox"/> COMMBN+ (Results/QC/Narrative (+ chromatograms))<br><input type="checkbox"/> REDT2<br><input type="checkbox"/> FULT1<br><input type="checkbox"/> EDD Format |                                 |

Emergency & Rush T/A data available VIA LabLink. RUSH TAT approval needed.

Sample Custody must be documented below each time samples change possession, including courier delivery.

|                          |                      |              |                  |                      |              |
|--------------------------|----------------------|--------------|------------------|----------------------|--------------|
| Relinquished by Sampler: | Date/Time:           | Received By: | Relinquished By: | Date/Time:           | Received By: |
| 1 <b>JW</b>              | <b>9-6-17 / 1400</b> | 1 <b>JW</b>  | 2 <b>JW</b>      | <b>9-7-17 / 1015</b> | 2 <b>JW</b>  |
| Relinquished by Sampler: | Date/Time:           | Received By: | Relinquished By: | Date/Time:           | Received By: |
| 3 <b>JW</b>              |                      | 3 <b>JW</b>  | 4 <b>JW</b>      |                      | 4 <b>JW</b>  |

Judiciary Seal # Intact ☒ Not intact ☐ Absent ☐

Preserved where applicable ☒ Cooler Temp. °C: **2.8** Therm. ID: **7136** On Ice ☒

Form MSQA 064-01, RV 6/19/17  
http://www.sgs.com/terms-and-conditions

D97689: Chain of Custody

Page 1 of 2



# SGS Accutest Sample Receipt Summary

Job Number: D97689

Client: LT ENVIRONMENTAL

Project: 608 COMPLIANCE

Date / Time Received: 9/7/2017 10:15:00 AM

Delivery Method:

Airbill #'s: fx

Cooler Temps (Initial/Adjusted): #1: (2.8/2.8):

## Cooler Security

Y or N

Y or N

- |                           |                                     |                          |                       |                                     |                          |
|---------------------------|-------------------------------------|--------------------------|-----------------------|-------------------------------------|--------------------------|
| 1. Custody Seals Present: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. COC Present:       | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Custody Seals Intact:  | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. Smpl Dates/Time OK | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

## Cooler Temperature

Y or N

- |                              |                                     |                          |
|------------------------------|-------------------------------------|--------------------------|
| 1. Temp criteria achieved:   | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Cooler temp verification: | Bar Therm;                          |                          |
| 3. Cooler media:             | Ice (Bag)                           |                          |
| 4. No. Coolers:              | 1                                   |                          |

## Quality Control Preservation

Y or N

N/A

- |                                 |                                     |                          |                          |
|---------------------------------|-------------------------------------|--------------------------|--------------------------|
| 1. Trip Blank present / cooler: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Trip Blank listed on COC:    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Samples preserved properly:  | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                          |
| 4. VOCs headspace free:         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Comments

## Sample Integrity - Documentation

Y or N

- |  |                                     |                          |
|--|-------------------------------------|--------------------------|
| 1. Sample labels present on bottles:   | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Container labeling complete:        | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. Sample container label / COC agree: | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

## Sample Integrity - Condition

Y or N

- |                                  |                                     |                          |
|----------------------------------|-------------------------------------|--------------------------|
| 1. Sample recvd within HT:       | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. All containers accounted for: | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. Condition of sample:          | Intact                              |                          |

## Sample Integrity - Instructions

Y or N

N/A

- |   |                                     |                                     |                                     |
|---|-------------------------------------|-------------------------------------|-------------------------------------|
| 1. Analysis requested is clear:           | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |                                     |
| 2. Bottles received for unspecified tests | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |                                     |
| 3. Sufficient volume recvd for analysis:  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |                                     |
| 4. Compositing instructions clear:        | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| 5. Filtering instructions clear:          | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |

D97689: Chain of Custody

Page 2 of 2

## GC Volatiles

## QC Data Summaries

---

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries

Method Blank Summary

Job Number: D97689  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

| Sample    | File ID   | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|-----------|-----------|----|----------|----|-----------|------------|------------------|
| GFB914-MB | FB19833.D | 1  | 09/08/17 | RB | n/a       | n/a        | GFB914           |

The QC reported here applies to the following samples: Method: RSK175 MOD

D97689-1, D97689-2

| CAS No. | Compound | Result | RL      | MDL     | Units | Q |
|---------|----------|--------|---------|---------|-------|---|
| 74-82-8 | Methane  | ND     | 0.00080 | 0.00040 | mg/l  |   |

Method Blank Summary

Job Number: D97689  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

| Sample    | File ID   | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|-----------|-----------|----|----------|----|-----------|------------|------------------|
| GFB915-MB | FB19876.D | 1  | 09/13/17 | RB | n/a       | n/a        | GFB915           |

The QC reported here applies to the following samples: Method: RSK175 MOD

D97689-3

| CAS No. | Compound | Result | RL      | MDL     | Units | Q |
|---------|----------|--------|---------|---------|-------|---|
| 74-82-8 | Methane  | ND     | 0.00080 | 0.00040 | mg/l  |   |

Blank Spike Summary

Job Number: D97689  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

|           |           |    |          |    |           |            |                  |
|-----------|-----------|----|----------|----|-----------|------------|------------------|
| Sample    | File ID   | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
| GFB914-BS | FB19834.D | 10 | 09/08/17 | RB | n/a       | n/a        | GFB914           |

The QC reported here applies to the following samples: Method: RSK175 MOD

D97689-1, D97689-2

| CAS No. | Compound | Spike<br>mg/l | BSP<br>mg/l | BSP<br>% | Limits |
|---------|----------|---------------|-------------|----------|--------|
| 74-82-8 | Methane  | 0.512         | 0.536       | 105      | 70-133 |

\* = Outside of Control Limits.



Blank Spike Summary

Job Number: D97689  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

|           |           |    |          |    |           |            |                  |
|-----------|-----------|----|----------|----|-----------|------------|------------------|
| Sample    | File ID   | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
| GFB915-BS | FB19877.D | 10 | 09/13/17 | RB | n/a       | n/a        | GFB915           |

The QC reported here applies to the following samples: Method: RSK175 MOD

D97689-3

| CAS No. | Compound | Spike<br>mg/l | BSP<br>mg/l | BSP<br>% | Limits |
|---------|----------|---------------|-------------|----------|--------|
| 74-82-8 | Methane  | 0.512         | 0.479       | 94       | 70-133 |

\* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

Page 1 of 1

**Job Number:** D97689

**Account:** LTENCODE LT Environmental

**Project:** Colo Rule 608 Compliance Raton Basin CO

| Sample                    | File ID   | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---------------------------|-----------|----|----------|----|-----------|------------|------------------|
| D97720-1AMS <sup>a</sup>  | FB19839.D | 25 | 09/08/17 | RB | n/a       | n/a        | GFB914           |
| D97720-1AMSD <sup>a</sup> | FB19841.D | 25 | 09/08/17 | RB | n/a       | n/a        | GFB914           |
| D97720-1A <sup>a</sup>    | FB19836.D | 1  | 09/08/17 | RB | n/a       | n/a        | GFB914           |
| D97720-1A <sup>a</sup>    | FB19838.D | 25 | 09/08/17 | RB | n/a       | n/a        | GFB914           |

**The QC reported here applies to the following samples:**

**Method:** RSK175 MOD

D97689-1, D97689-2

| CAS No. | Compound | D97720-1A<br>mg/l | Spike<br>Q<br>mg/l | MS<br>mg/l | MS<br>% | Spike<br>mg/l | MSD<br>mg/l | MSD<br>% | RPD | Limits<br>Rec/RPD |
|---------|----------|-------------------|--------------------|------------|---------|---------------|-------------|----------|-----|-------------------|
| 74-82-8 | Methane  | 4.21 <sup>b</sup> | 0.512              | 6.37       | 422     | 0.512         | 5.30        | 213      | 18  | 15-196/30         |

(a) The pH of the sample was > 2 at time of analysis.

(b) Result is from Run #2.

\* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

Page 1 of 1

**Job Number:** D97689  
**Account:** LTENCODE LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO

| Sample                    | File ID   | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---------------------------|-----------|----|----------|----|-----------|------------|------------------|
| D97765-1AMS <sup>a</sup>  | FB19888.D | 25 | 09/13/17 | RB | n/a       | n/a        | GFB915           |
| D97765-1AMSD <sup>a</sup> | FB19890.D | 25 | 09/13/17 | RB | n/a       | n/a        | GFB915           |
| D97765-1A <sup>a</sup>    | FB19884.D | 1  | 09/13/17 | RB | n/a       | n/a        | GFB915           |
| D97765-1A <sup>a</sup>    | FB19886.D | 25 | 09/13/17 | RB | n/a       | n/a        | GFB915           |

The QC reported here applies to the following samples:

Method: RSK175 MOD

D97689-3

| CAS No. | Compound | D97765-1A<br>mg/l | Spike<br>Q<br>mg/l | MS<br>mg/l | MS<br>%           | Spike<br>mg/l | MSD<br>mg/l | MSD<br>%          | RPD | Limits<br>Rec/RPD |
|---------|----------|-------------------|--------------------|------------|-------------------|---------------|-------------|-------------------|-----|-------------------|
| 74-82-8 | Methane  | 2.48 <sup>c</sup> | 0.512              | 3.15       | 131* <sup>b</sup> | 0.512         | 3.64        | 227* <sup>b</sup> | 14  | 15-196/30         |

(a) The pH of the sample was > 2 at time of analysis.

(b) Outside control limits due to high level in sample relative to spike amount.

(c) Result is from Run #2.

\* = Outside of Control Limits.

## Metals Analysis

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Matrix Spike and Duplicate Summaries
- Blank Spike and Lab Control Sample Summaries
- Serial Dilution Summaries

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22914  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 09/08/17

| Metal      | RL   | IDL | MDL | MB<br>raw | final |
|------------|------|-----|-----|-----------|-------|
| Aluminum   | 100  | 11  | 46  |           |       |
| Antimony   | 30   | 2.1 | 8.7 |           |       |
| Arsenic    | 25   | 3.8 | 12  |           |       |
| Barium     | 10   | .2  | .2  |           |       |
| Beryllium  | 10   | .9  | 1.6 |           |       |
| Boron      | 50   | .8  | 3.7 |           |       |
| Cadmium    | 10   | .2  | .6  |           |       |
| Calcium    | 400  | 2.4 | 22  | 2.2       | <400  |
| Chromium   | 10   | .3  | 1   |           |       |
| Cobalt     | 5.0  | .5  | 1.2 |           |       |
| Copper     | 10   | .8  | 2.9 |           |       |
| Iron       | 10   | 1.5 | 6.9 | 2.0       | <10   |
| Lead       | 50   | 2.1 | 9.1 |           |       |
| Lithium    | 5.0  | .4  | 1   |           |       |
| Magnesium  | 200  | 6.8 | 39  | 10.8      | <200  |
| Manganese  | 5.0  | .5  | .4  |           |       |
| Molybdenum | 10   | .4  | 3.6 |           |       |
| Nickel     | 30   | .5  | 2.1 |           |       |
| Phosphorus | 100  | 15  | 47  |           |       |
| Potassium  | 1000 | 99  | 61  | 2.5       | <1000 |
| Selenium   | 50   | 7.1 | 15  |           |       |
| Silicon    | 50   | 4.7 | 6.2 |           |       |
| Silver     | 30   | .3  | .9  |           |       |
| Sodium     | 400  | 7.3 | 14  | -0.70     | <400  |
| Strontium  | 5.0  | .01 | .3  |           |       |
| Thallium   | 10   | 1.8 | 9.1 |           |       |
| Tin        | 50   | 12  | 25  |           |       |
| Titanium   | 10   | .1  | 2.5 |           |       |
| Uranium    | 50   | 2.9 | 4.4 |           |       |
| Vanadium   | 10   | .4  | .6  |           |       |
| Zinc       | 30   | .4  | 3.5 |           |       |

Associated samples MP22914: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
(\*) Outside of QC limits

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22914  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 09/08/17

| Metal | RL | IDL | MDL | MB<br>raw | final |
|-------|----|-----|-----|-----------|-------|
|-------|----|-----|-----|-----------|-------|

(anr) Analyte not requested



MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22914  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | D97689-2F<br>Original MS |       | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|------------|--------------------------|-------|---------------------|-------|--------------|
| Aluminum   |                          |       |                     |       |              |
| Antimony   |                          |       |                     |       |              |
| Arsenic    |                          |       |                     |       |              |
| Barium     |                          |       |                     |       |              |
| Beryllium  |                          |       |                     |       |              |
| Boron      | anr                      |       |                     |       |              |
| Cadmium    |                          |       |                     |       |              |
| Calcium    | 64500                    | 85900 | 25000               | 85.6  | 70-130       |
| Chromium   | anr                      |       |                     |       |              |
| Cobalt     |                          |       |                     |       |              |
| Copper     | anr                      |       |                     |       |              |
| Iron       | 22.0                     | 5090  | 5000                | 101.4 | 70-130       |
| Lead       | anr                      |       |                     |       |              |
| Lithium    |                          |       |                     |       |              |
| Magnesium  | 13400                    | 38200 | 25000               | 99.2  | 70-130       |
| Manganese  | anr                      |       |                     |       |              |
| Molybdenum | anr                      |       |                     |       |              |
| Nickel     | anr                      |       |                     |       |              |
| Phosphorus |                          |       |                     |       |              |
| Potassium  | 1620                     | 27100 | 25000               | 101.9 | 70-130       |
| Selenium   |                          |       |                     |       |              |
| Silicon    |                          |       |                     |       |              |
| Silver     |                          |       |                     |       |              |
| Sodium     | 15400                    | 39500 | 25000               | 96.4  | 70-130       |
| Strontium  | anr                      |       |                     |       |              |
| Thallium   |                          |       |                     |       |              |
| Tin        |                          |       |                     |       |              |
| Titanium   |                          |       |                     |       |              |
| Uranium    |                          |       |                     |       |              |
| Vanadium   |                          |       |                     |       |              |
| Zinc       | anr                      |       |                     |       |              |

Associated samples MP22914: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22914  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 09/08/17

| Metal | D97689-2F<br>Original MS | Spikelot<br>ICPALL2 % Rec | QC<br>Limits |
|-------|--------------------------|---------------------------|--------------|
|-------|--------------------------|---------------------------|--------------|

(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22914  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | D97689-2F<br>Original MSD |       | Spikelet<br>ICPAL2 | % Rec | MSD<br>RPD | QC<br>Limit |
|------------|---------------------------|-------|--------------------|-------|------------|-------------|
| Aluminum   |                           |       |                    |       |            |             |
| Antimony   |                           |       |                    |       |            |             |
| Arsenic    |                           |       |                    |       |            |             |
| Barium     |                           |       |                    |       |            |             |
| Beryllium  |                           |       |                    |       |            |             |
| Boron      | anr                       |       |                    |       |            |             |
| Cadmium    |                           |       |                    |       |            |             |
| Calcium    | 64500                     | 88900 | 25000              | 97.6  | 3.4        | 20          |
| Chromium   | anr                       |       |                    |       |            |             |
| Cobalt     |                           |       |                    |       |            |             |
| Copper     | anr                       |       |                    |       |            |             |
| Iron       | 22.0                      | 5140  | 5000               | 102.4 | 1.0        | 20          |
| Lead       | anr                       |       |                    |       |            |             |
| Lithium    |                           |       |                    |       |            |             |
| Magnesium  | 13400                     | 38500 | 25000              | 100.4 | 0.8        | 20          |
| Manganese  | anr                       |       |                    |       |            |             |
| Molybdenum | anr                       |       |                    |       |            |             |
| Nickel     | anr                       |       |                    |       |            |             |
| Phosphorus |                           |       |                    |       |            |             |
| Potassium  | 1620                      | 26800 | 25000              | 100.7 | 1.1        | 20          |
| Selenium   |                           |       |                    |       |            |             |
| Silicon    |                           |       |                    |       |            |             |
| Silver     |                           |       |                    |       |            |             |
| Sodium     | 15400                     | 39900 | 25000              | 98.0  | 1.0        | 20          |
| Strontium  | anr                       |       |                    |       |            |             |
| Thallium   |                           |       |                    |       |            |             |
| Tin        |                           |       |                    |       |            |             |
| Titanium   |                           |       |                    |       |            |             |
| Uranium    |                           |       |                    |       |            |             |
| Vanadium   |                           |       |                    |       |            |             |
| Zinc       | anr                       |       |                    |       |            |             |

Associated samples MP22914: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

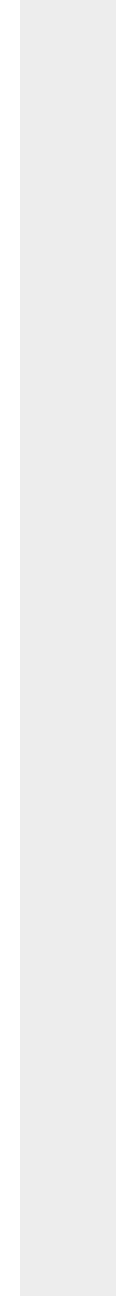
QC Batch ID: MP22914  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 09/08/17

| Metal | D97689-2F<br>Original MSD | Spikelot<br>ICPALL2 % Rec | MSD<br>RPD | QC<br>Limit |
|-------|---------------------------|---------------------------|------------|-------------|
|-------|---------------------------|---------------------------|------------|-------------|

(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



## SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D97689

Account: LTENCODE - LT Environmental

Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22914

Methods: EPA 200.7

Matrix Type: AQUEOUS

Units: ug/l

Prep Date:

09/08/17

| Metal      | BSP<br>Result | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|------------|---------------|---------------------|-------|--------------|
| Aluminum   |               |                     |       |              |
| Antimony   |               |                     |       |              |
| Arsenic    |               |                     |       |              |
| Barium     |               |                     |       |              |
| Beryllium  |               |                     |       |              |
| Boron      | anr           |                     |       |              |
| Cadmium    |               |                     |       |              |
| Calcium    | 24400         | 25000               | 97.6  | 85-115       |
| Chromium   | anr           |                     |       |              |
| Cobalt     |               |                     |       |              |
| Copper     | anr           |                     |       |              |
| Iron       | 5030          | 5000                | 100.6 | 85-115       |
| Lead       | anr           |                     |       |              |
| Lithium    |               |                     |       |              |
| Magnesium  | 24800         | 25000               | 99.2  | 85-115       |
| Manganese  | anr           |                     |       |              |
| Molybdenum | anr           |                     |       |              |
| Nickel     | anr           |                     |       |              |
| Phosphorus |               |                     |       |              |
| Potassium  | 24800         | 25000               | 99.2  | 85-115       |
| Selenium   |               |                     |       |              |
| Silicon    |               |                     |       |              |
| Silver     |               |                     |       |              |
| Sodium     | 24300         | 25000               | 97.2  | 85-115       |
| Strontium  | anr           |                     |       |              |
| Thallium   |               |                     |       |              |
| Tin        |               |                     |       |              |
| Titanium   |               |                     |       |              |
| Uranium    |               |                     |       |              |
| Vanadium   |               |                     |       |              |
| Zinc       | anr           |                     |       |              |

Associated samples MP22914: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
(\*) Outside of QC limits

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

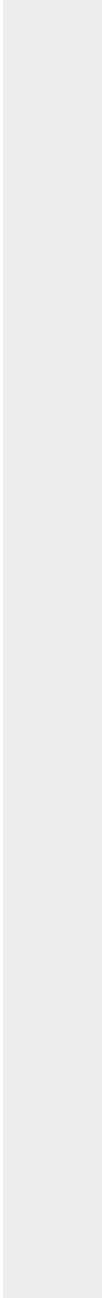
QC Batch ID: MP22914  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 09/08/17

| Metal | BSP<br>Result | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|-------|---------------|---------------------|-------|--------------|
|-------|---------------|---------------------|-------|--------------|

(anr) Analyte not requested





BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22923  
Matrix Type: AQUEOUS

Methods: EPA 200.8  
Units: ug/l

Prep Date: 09/08/17

| Metal      | RL   | IDL   | MDL  | MB<br>raw | final |
|------------|------|-------|------|-----------|-------|
| Aluminum   | 50   | 1.1   | 2    |           |       |
| Antimony   | 0.40 | .0022 | .011 |           |       |
| Arsenic    | 0.20 | .017  | .044 |           |       |
| Barium     | 2.0  | .016  | .079 |           |       |
| Beryllium  | 0.20 | .016  | .069 |           |       |
| Boron      | 40   | .49   | 2.1  |           |       |
| Cadmium    | 0.10 | .036  | .042 |           |       |
| Calcium    | 400  | 5.6   | 12   |           |       |
| Chromium   | 2.0  | .053  | .053 |           |       |
| Cobalt     | 0.20 | .0049 | .015 |           |       |
| Copper     | 2.0  | .06   | .13  |           |       |
| Iron       | 10   | 3.5   | 4.6  |           |       |
| Lead       | 0.50 | .0079 | .008 |           |       |
| Magnesium  | 100  | 1.3   | 1.3  |           |       |
| Manganese  | 1.0  | .12   | .13  | 0.11      | <1.0  |
| Molybdenum | 1.0  | .049  | .029 |           |       |
| Nickel     | 2.0  | .0088 | .027 |           |       |
| Phosphorus | 60   | 2.6   | 4.3  |           |       |
| Potassium  | 200  | 2.9   | 2.9  |           |       |
| Selenium   | 0.40 | .071  | .21  | -0.028    | <0.40 |
| Silver     | 0.10 | .0019 | .008 |           |       |
| Sodium     | 500  | 4.9   | 4.9  |           |       |
| Strontium  | 20   | .01   | .015 |           |       |
| Thallium   | 0.20 | .0024 | .005 |           |       |
| Tin        | 10   | .063  | 1.3  |           |       |
| Titanium   | 2.0  | .059  | .092 |           |       |
| Uranium    | 0.20 | .0017 | .002 |           |       |
| Vanadium   | 1.0  | .037  | .2   |           |       |
| Zinc       | 10   | .21   | .96  |           |       |

Associated samples MP22923: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
(\*) Outside of QC limits  
(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22923  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | D97689-1F<br>Original MS | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|------------|--------------------------|---------------------|-------|--------------|
| Aluminum   | anr                      |                     |       |              |
| Antimony   |                          |                     |       |              |
| Arsenic    |                          |                     |       |              |
| Barium     |                          |                     |       |              |
| Beryllium  |                          |                     |       |              |
| Boron      |                          |                     |       |              |
| Cadmium    |                          |                     |       |              |
| Calcium    |                          |                     |       |              |
| Chromium   | anr                      |                     |       |              |
| Cobalt     |                          |                     |       |              |
| Copper     | anr                      |                     |       |              |
| Iron       | anr                      |                     |       |              |
| Lead       | anr                      |                     |       |              |
| Magnesium  |                          |                     |       |              |
| Manganese  | 2.3                      | 109                 | 100   | 106.7 70-130 |
| Molybdenum | anr                      |                     |       |              |
| Nickel     | anr                      |                     |       |              |
| Phosphorus |                          |                     |       |              |
| Potassium  |                          |                     |       |              |
| Selenium   | 0.32                     | 210                 | 200   | 104.8 70-130 |
| Silver     |                          |                     |       |              |
| Sodium     |                          |                     |       |              |
| Strontium  |                          |                     |       |              |
| Thallium   |                          |                     |       |              |
| Tin        |                          |                     |       |              |
| Titanium   |                          |                     |       |              |
| Uranium    | anr                      |                     |       |              |
| Vanadium   |                          |                     |       |              |
| Zinc       | anr                      |                     |       |              |

Associated samples MP22923: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits  
 (N) Matrix Spike Rec. outside of QC limits  
 (anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22923  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | D97689-1F<br>Original MSD |     | Spikelot<br>ICPALL2 % Rec |       | MSD<br>RPD | QC<br>Limit |
|------------|---------------------------|-----|---------------------------|-------|------------|-------------|
| Aluminum   | anr                       |     |                           |       |            |             |
| Antimony   |                           |     |                           |       |            |             |
| Arsenic    |                           |     |                           |       |            |             |
| Barium     |                           |     |                           |       |            |             |
| Beryllium  |                           |     |                           |       |            |             |
| Boron      |                           |     |                           |       |            |             |
| Cadmium    |                           |     |                           |       |            |             |
| Calcium    |                           |     |                           |       |            |             |
| Chromium   | anr                       |     |                           |       |            |             |
| Cobalt     |                           |     |                           |       |            |             |
| Copper     | anr                       |     |                           |       |            |             |
| Iron       | anr                       |     |                           |       |            |             |
| Lead       | anr                       |     |                           |       |            |             |
| Magnesium  |                           |     |                           |       |            |             |
| Manganese  | 2.3                       | 108 | 100                       | 105.7 | 0.9        | 20          |
| Molybdenum | anr                       |     |                           |       |            |             |
| Nickel     | anr                       |     |                           |       |            |             |
| Phosphorus |                           |     |                           |       |            |             |
| Potassium  |                           |     |                           |       |            |             |
| Selenium   | 0.32                      | 207 | 200                       | 103.3 | 1.4        | 20          |
| Silver     |                           |     |                           |       |            |             |
| Sodium     |                           |     |                           |       |            |             |
| Strontium  |                           |     |                           |       |            |             |
| Thallium   |                           |     |                           |       |            |             |
| Tin        |                           |     |                           |       |            |             |
| Titanium   |                           |     |                           |       |            |             |
| Uranium    | anr                       |     |                           |       |            |             |
| Vanadium   |                           |     |                           |       |            |             |
| Zinc       | anr                       |     |                           |       |            |             |

Associated samples MP22923: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits  
 (N) Matrix Spike Rec. outside of QC limits  
 (anr) Analyte not requested

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22923  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | BSP<br>Result | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|------------|---------------|---------------------|-------|--------------|
| Aluminum   | anr           |                     |       |              |
| Antimony   |               |                     |       |              |
| Arsenic    |               |                     |       |              |
| Barium     |               |                     |       |              |
| Beryllium  |               |                     |       |              |
| Boron      |               |                     |       |              |
| Cadmium    |               |                     |       |              |
| Calcium    |               |                     |       |              |
| Chromium   | anr           |                     |       |              |
| Cobalt     |               |                     |       |              |
| Copper     | anr           |                     |       |              |
| Iron       | anr           |                     |       |              |
| Lead       | anr           |                     |       |              |
| Magnesium  |               |                     |       |              |
| Manganese  | 108           | 100                 | 108.0 | 85-115       |
| Molybdenum | anr           |                     |       |              |
| Nickel     | anr           |                     |       |              |
| Phosphorus |               |                     |       |              |
| Potassium  |               |                     |       |              |
| Selenium   | 210           | 200                 | 105.0 | 85-115       |
| Silver     |               |                     |       |              |
| Sodium     |               |                     |       |              |
| Strontium  |               |                     |       |              |
| Thallium   |               |                     |       |              |
| Tin        |               |                     |       |              |
| Titanium   |               |                     |       |              |
| Uranium    | anr           |                     |       |              |
| Vanadium   |               |                     |       |              |
| Zinc       | anr           |                     |       |              |

Associated samples MP22923: D97689-1F, D97689-2F

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits  
 (anr) Analyte not requested

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22928  
Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
Units: ug/l

Prep Date: 09/08/17

| Metal      | RL   | IDL | MDL | MB<br>raw | final |
|------------|------|-----|-----|-----------|-------|
| Aluminum   | 500  | 55  | 65  |           |       |
| Antimony   | 150  | 11  | 44  |           |       |
| Arsenic    | 130  | 19  | 60  |           |       |
| Barium     | 50   | 1   | 6.5 |           |       |
| Beryllium  | 50   | 4.5 | 8   |           |       |
| Boron      | 250  | 4   | 18  |           |       |
| Cadmium    | 50   | 1   | 9.5 |           |       |
| Calcium    | 2000 | 12  | 50  | -17       | <2000 |
| Chromium   | 50   | 1.5 | 5.5 |           |       |
| Cobalt     | 25   | 2.5 | 6   |           |       |
| Copper     | 50   | 4   | 19  |           |       |
| Iron       | 350  | 7.5 | 35  |           |       |
| Lead       | 250  | 11  | 25  |           |       |
| Lithium    | 25   | 2   | 3.5 |           |       |
| Magnesium  | 1000 | 34  | 200 | 27.5      | <1000 |
| Manganese  | 25   | 2.5 | 4.5 |           |       |
| Molybdenum | 50   | 2   | 18  |           |       |
| Nickel     | 150  | 2.5 | 14  |           |       |
| Phosphorus | 500  | 75  | 170 |           |       |
| Potassium  | 5000 | 500 | 360 |           |       |
| Selenium   | 250  | 36  | 55  |           |       |
| Silicon    | 250  | 24  | 42  |           |       |
| Silver     | 150  | 1.5 | 3.1 |           |       |
| Sodium     | 2000 | 37  | 70  | -44       | <2000 |
| Strontium  | 25   | .05 | 1.5 |           |       |
| Thallium   | 50   | 9   | 40  |           |       |
| Tin        | 250  | 60  | 60  |           |       |
| Titanium   | 50   | .5  | 14  |           |       |
| Uranium    | 250  | 15  | 22  |           |       |
| Vanadium   | 50   | 2   | 3   |           |       |
| Zinc       | 150  | 2   | 18  |           |       |

Associated samples MP22928: D97689-1A, D97689-2A

Results < IDL are shown as zero for calculation purposes  
(\*) Outside of QC limits

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

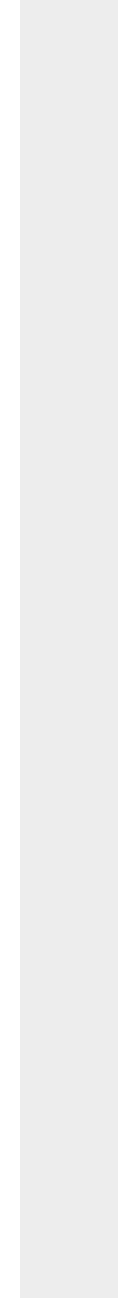
QC Batch ID: MP22928  
Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
Units: ug/l

Prep Date: 09/08/17

| Metal | RL | IDL | MDL | MB<br>raw | final |
|-------|----|-----|-----|-----------|-------|
|-------|----|-----|-----|-----------|-------|

(anr) Analyte not requested





MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22928  
 Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | D97689-1A<br>Original MS |        | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|------------|--------------------------|--------|---------------------|-------|--------------|
| Aluminum   |                          |        |                     |       |              |
| Antimony   |                          |        |                     |       |              |
| Arsenic    |                          |        |                     |       |              |
| Barium     |                          |        |                     |       |              |
| Beryllium  |                          |        |                     |       |              |
| Boron      |                          |        |                     |       |              |
| Cadmium    |                          |        |                     |       |              |
| Calcium    | 50000                    | 180000 | 125000              | 104.0 | 75-125       |
| Chromium   |                          |        |                     |       |              |
| Cobalt     |                          |        |                     |       |              |
| Copper     |                          |        |                     |       |              |
| Iron       |                          |        |                     |       |              |
| Lead       |                          |        |                     |       |              |
| Lithium    |                          |        |                     |       |              |
| Magnesium  | 9420                     | 136000 | 125000              | 101.3 | 75-125       |
| Manganese  |                          |        |                     |       |              |
| Molybdenum |                          |        |                     |       |              |
| Nickel     |                          |        |                     |       |              |
| Phosphorus |                          |        |                     |       |              |
| Potassium  |                          |        |                     |       |              |
| Selenium   |                          |        |                     |       |              |
| Silicon    |                          |        |                     |       |              |
| Silver     |                          |        |                     |       |              |
| Sodium     | 15000                    | 142000 | 125000              | 101.6 | 75-125       |
| Strontium  |                          |        |                     |       |              |
| Thallium   |                          |        |                     |       |              |
| Tin        |                          |        |                     |       |              |
| Titanium   |                          |        |                     |       |              |
| Uranium    |                          |        |                     |       |              |
| Vanadium   |                          |        |                     |       |              |
| Zinc       |                          |        |                     |       |              |

Associated samples MP22928: D97689-1A, D97689-2A

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

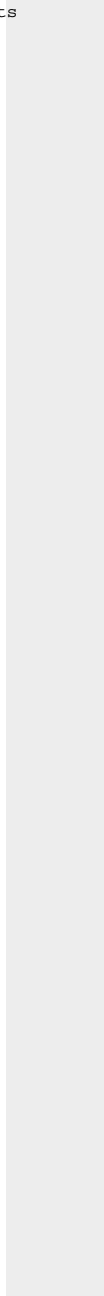
QC Batch ID: MP22928  
Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
Units: ug/l

Prep Date: 09/08/17

| Metal | D97689-1A<br>Original MS | Spikelot<br>ICPALL2 % Rec | QC<br>Limits |
|-------|--------------------------|---------------------------|--------------|
|-------|--------------------------|---------------------------|--------------|

(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22928  
 Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | D97689-1A<br>Original MSD |        | Spikelot<br>ICPALL2 % Rec |       | MSD<br>RPD | QC<br>Limit |
|------------|---------------------------|--------|---------------------------|-------|------------|-------------|
| Aluminum   |                           |        |                           |       |            |             |
| Antimony   |                           |        |                           |       |            |             |
| Arsenic    |                           |        |                           |       |            |             |
| Barium     |                           |        |                           |       |            |             |
| Beryllium  |                           |        |                           |       |            |             |
| Boron      |                           |        |                           |       |            |             |
| Cadmium    |                           |        |                           |       |            |             |
| Calcium    | 50000                     | 179000 | 125000                    | 103.2 | 0.6        | 20          |
| Chromium   |                           |        |                           |       |            |             |
| Cobalt     |                           |        |                           |       |            |             |
| Copper     |                           |        |                           |       |            |             |
| Iron       |                           |        |                           |       |            |             |
| Lead       |                           |        |                           |       |            |             |
| Lithium    |                           |        |                           |       |            |             |
| Magnesium  | 9420                      | 135000 | 125000                    | 100.5 | 0.7        | 20          |
| Manganese  |                           |        |                           |       |            |             |
| Molybdenum |                           |        |                           |       |            |             |
| Nickel     |                           |        |                           |       |            |             |
| Phosphorus |                           |        |                           |       |            |             |
| Potassium  |                           |        |                           |       |            |             |
| Selenium   |                           |        |                           |       |            |             |
| Silicon    |                           |        |                           |       |            |             |
| Silver     |                           |        |                           |       |            |             |
| Sodium     | 15000                     | 141000 | 125000                    | 100.8 | 0.7        | 20          |
| Strontium  |                           |        |                           |       |            |             |
| Thallium   |                           |        |                           |       |            |             |
| Tin        |                           |        |                           |       |            |             |
| Titanium   |                           |        |                           |       |            |             |
| Uranium    |                           |        |                           |       |            |             |
| Vanadium   |                           |        |                           |       |            |             |
| Zinc       |                           |        |                           |       |            |             |

Associated samples MP22928: D97689-1A, D97689-2A

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

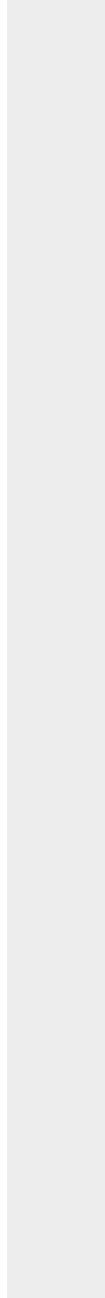
QC Batch ID: MP22928  
Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
Units: ug/l

Prep Date: 09/08/17

| Metal | D97689-1A<br>Original MSD | SpikeLot<br>ICPALL2 % Rec | MSD<br>RPD | QC<br>Limit |
|-------|---------------------------|---------------------------|------------|-------------|
|-------|---------------------------|---------------------------|------------|-------------|

(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22928  
 Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
 Units: ug/l

Prep Date: 09/08/17

| Metal      | BSP<br>Result | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|------------|---------------|---------------------|-------|--------------|
| Aluminum   |               |                     |       |              |
| Antimony   |               |                     |       |              |
| Arsenic    |               |                     |       |              |
| Barium     |               |                     |       |              |
| Beryllium  |               |                     |       |              |
| Boron      |               |                     |       |              |
| Cadmium    |               |                     |       |              |
| Calcium    | 131000        | 125000              | 104.8 | 80-120       |
| Chromium   |               |                     |       |              |
| Cobalt     |               |                     |       |              |
| Copper     |               |                     |       |              |
| Iron       |               |                     |       |              |
| Lead       |               |                     |       |              |
| Lithium    |               |                     |       |              |
| Magnesium  | 126000        | 125000              | 100.8 | 80-120       |
| Manganese  |               |                     |       |              |
| Molybdenum |               |                     |       |              |
| Nickel     |               |                     |       |              |
| Phosphorus |               |                     |       |              |
| Potassium  |               |                     |       |              |
| Selenium   |               |                     |       |              |
| Silicon    |               |                     |       |              |
| Silver     |               |                     |       |              |
| Sodium     | 127000        | 125000              | 101.6 | 80-120       |
| Strontium  |               |                     |       |              |
| Thallium   |               |                     |       |              |
| Tin        |               |                     |       |              |
| Titanium   |               |                     |       |              |
| Uranium    |               |                     |       |              |
| Vanadium   |               |                     |       |              |
| Zinc       |               |                     |       |              |

Associated samples MP22928: D97689-1A, D97689-2A

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D97689

Account: LTENCODE - LT Environmental

Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22928

Methods: SW846 6010C, USDA HANDBOOK 60

Matrix Type: AQUEOUS

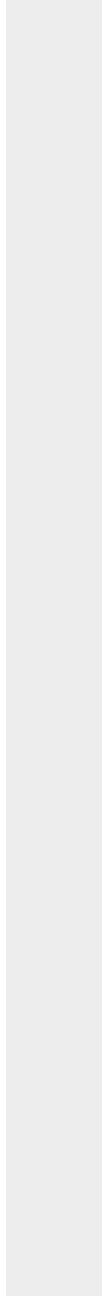
Units: ug/l

Prep Date:

09/08/17

| Metal | BSP<br>Result | Spikelot<br>ICPALL2 | % Rec | QC<br>Limits |
|-------|---------------|---------------------|-------|--------------|
|-------|---------------|---------------------|-------|--------------|

(anr) Analyte not requested





SERIAL DILUTION RESULTS SUMMARY

Login Number: D97689  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP22928  
 Matrix Type: AQUEOUS

Methods: SW846 6010C, USDA HANDBOOK 60  
 Units: ug/l

Prep Date: 09/08/17

| D97689-1A  |          | QC      |      |        |
|------------|----------|---------|------|--------|
| Metal      | Original | SDL 1:5 | %DIF | Limits |
| Aluminum   |          |         |      |        |
| Antimony   |          |         |      |        |
| Arsenic    |          |         |      |        |
| Barium     |          |         |      |        |
| Beryllium  |          |         |      |        |
| Boron      |          |         |      |        |
| Cadmium    |          |         |      |        |
| Calcium    | 10000    | 10300   | 2.6  | 0-10   |
| Chromium   |          |         |      |        |
| Cobalt     |          |         |      |        |
| Copper     |          |         |      |        |
| Iron       |          |         |      |        |
| Lead       |          |         |      |        |
| Lithium    |          |         |      |        |
| Magnesium  | 1880     | 1930    | 2.6  | 0-10   |
| Manganese  |          |         |      |        |
| Molybdenum |          |         |      |        |
| Nickel     |          |         |      |        |
| Phosphorus |          |         |      |        |
| Potassium  |          |         |      |        |
| Selenium   |          |         |      |        |
| Silicon    |          |         |      |        |
| Silver     |          |         |      |        |
| Sodium     | 3010     | 3040    | 1.1  | 0-10   |
| Strontium  |          |         |      |        |
| Thallium   |          |         |      |        |
| Tin        |          |         |      |        |
| Titanium   |          |         |      |        |
| Uranium    |          |         |      |        |
| Vanadium   |          |         |      |        |
| Zinc       |          |         |      |        |

Associated samples MP22928: D97689-1A, D97689-2A

Results < IDL are shown as zero for calculation purposes  
 (\*) Outside of QC limits

7.3.4  
7

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Methods: SW846 6010C, USDA HANDBOOK 60  
Units: ug/l

|       |                       |        |
|-------|-----------------------|--------|
|       | D97689-1A             | QC     |
| Metal | Original SDL 1:5 %DIF | Limits |

## General Chemistry

### QC Data Summaries

Includes the following where applicable:

- Method Blank and Blank Spike Summaries
- Duplicate Summaries
- Matrix Spike Summaries

METHOD BLANK AND SPIKE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

| Analyte                        | Batch ID        | RL     | MB<br>Result | Units    | Spike<br>Amount | BSP<br>Result | BSP<br>%Recov | QC<br>Limits |
|--------------------------------|-----------------|--------|--------------|----------|-----------------|---------------|---------------|--------------|
| Alkalinity, Bicarbonate as CaC | GN40110         | 5.0    | 2.3          | mg/l     | 100             | 102           | 102.0         | 90-110%      |
| Alkalinity, Carbonate          | GN40111         | 5.0    | 2.3          | mg/l     | 100             | 102           | 102.0         | 80-120%      |
| Alkalinity, Total as CaCO3     | GN40109         | 5.0    | 2.3          | mg/l     | 100             | 102           | 102.0         | 90-110%      |
| Bromide                        | GP21132/GN40106 | 0.050  | 0.0          | mg/l     | 0.5             | 0.508         | 101.6         | 90-110%      |
| Chloride                       | GP21132/GN40106 | 0.50   | 0.0          | mg/l     | 5               | 5.06          | 101.2         | 90-110%      |
| Fluoride                       | GP21132/GN40106 | 0.10   | 0.0          | mg/l     | 1               | 1.02          | 102.0         | 90-110%      |
| Iron-Related Bacteria          | MB921           | 25     | <25          | CFU/ml   |                 |               |               |              |
| Nitrogen, Nitrate              | GP21132/GN40106 | 0.010  | 0.0          | mg/l     | 0.1             | 0.108         | 108.0         | 90-110%      |
| Nitrogen, Nitrite              | GP21132/GN40106 | 0.0040 | 0.0          | mg/l     | 0.05            | 0.0540        | 108.0         | 90-110%      |
| Slime Forming Bacteria         | MB922           | 500    | <500         | CFU/ml   |                 |               |               |              |
| Solids, Total Dissolved        | GN40119         | 10     | 0.0          | mg/l     | 400             | 397           | 99.3          | 90-110%      |
| Specific Conductivity          | GP21134/GN40108 |        |              | umhos/cm | 998             | 996           | 99.8          | 90-110%      |
| Specific Conductivity          | GP21134/GN40108 |        |              | umhos/cm | 98.4            | 97.3          | 98.9          | 90-110%      |
| Sulfate                        | GP21132/GN40106 | 0.50   | 0.0          | mg/l     | 5               | 4.93          | 98.6          | 90-110%      |
| Sulfate Reducing Bacteria      | MB923           | 200    | <200         | CFU/ml   |                 |               |               |              |
| pH                             | GN40107         |        |              | su       | 6.00            | 6.01          | 100.2         | 99.1-100     |
| pH                             | GN40107         |        |              | su       | 8.00            | 7.99          | 99.9          | 99.1-100     |

Associated Samples:

Batch MB921: D97689-1B, D97689-2B  
Batch MB922: D97689-1B, D97689-2B  
Batch MB923: D97689-1B, D97689-2B  
Batch GN40107: D97689-1, D97689-2  
Batch GN40109: D97689-1, D97689-2  
Batch GN40110: D97689-1, D97689-2  
Batch GN40111: D97689-1, D97689-2  
Batch GN40119: D97689-1, D97689-2  
Batch GP21132: D97689-1, D97689-2  
Batch GP21134: D97689-1, D97689-2

(\*) Outside of QC limits

DUPLICATE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

| Analyte                                | Batch ID        | QC Sample | Units    | Original Result | DUP Result | RPD | QC Limits |
|--|-----------------|-----------|----------|-----------------|------------|-----|-----------|
| Alkalinity, Total as CaCO <sub>3</sub> | GN40109         | D97689-1  | mg/l     | 137             | 139        | 1.3 | 0-20%     |
| Solids, Total Dissolved                | GN40119         | D97658-1  | mg/l     | 544             | 536        | 1.5 | 0-5%      |
| Specific Conductivity                  | GP21134/GN40108 | D97689-1  | umhos/cm | 325             | 329        | 1.2 | 0-20%     |

Associated Samples:

Batch GN40109: D97689-1, D97689-2

Batch GN40119: D97689-1, D97689-2

Batch GP21134: D97689-1, D97689-2

(\*) Outside of QC limits

MATRIX SPIKE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

| Analyte                                | Batch ID        | QC Sample | Units | Original Result | Spike Amount | MS Result | %Rec  | QC Limits |
|--|-----------------|-----------|-------|-----------------|--------------|-----------|-------|-----------|
| Alkalinity, Total as CaCO <sub>3</sub> | GN40109         | D97689-2  | mg/l  | 223             | 100          | 319       | 95.9  | 80-120%   |
| Bromide                                | GP21132/GN40106 | D97639-1  | mg/l  | 0.25 U          | 5            | 5.2       | 104.0 | 80-120%   |
| Chloride                               | GP21132/GN40106 | D97639-1  | mg/l  | 53.9            | 50           | 107       | 106.2 | 80-120%   |
| Fluoride                               | GP21132/GN40106 | D97639-1  | mg/l  | 0.57 B          | 10           | 10.8      | 102.3 | 80-120%   |
| Nitrogen, Nitrate                      | GP21132/GN40106 | D97639-1  | mg/l  | 0.56            | 1            | 1.6       | 104.0 | 80-120%   |
| Nitrogen, Nitrite                      | GP21132/GN40106 | D97639-1  | mg/l  | 0.19            | 0.5          | 0.69      | 100.0 | 80-120%   |
| Sulfate                                | GP21132/GN40106 | D97639-1  | mg/l  | 60.8            | 50           | 110       | 98.4  | 80-120%   |

Associated Samples:

Batch GN40109: D97689-1, D97689-2

Batch GP21132: D97689-1, D97689-2

(\*) Outside of QC limits

(N) Matrix Spike Rec. outside of QC limits



MATRIX SPIKE DUPLICATE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D97689  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

| Analyte                                | Batch ID        | QC Sample | Units | Original Result | Spike Amount | MSD Result | RPD | QC Limit |
|--|-----------------|-----------|-------|-----------------|--------------|------------|-----|----------|
| Alkalinity, Total as CaCO <sub>3</sub> | GN40109         | D97689-2  | mg/l  | 223             | 100          | 319        | 0.1 | 20%      |
| Bromide                                | GP21132/GN40106 | D97639-1  | mg/l  | 0.25 U          | 5            | 5.1        | 1.9 | 20%      |
| Chloride                               | GP21132/GN40106 | D97639-1  | mg/l  | 53.9            | 50           | 107        | 0.0 | 20%      |
| Fluoride                               | GP21132/GN40106 | D97639-1  | mg/l  | 0.57 B          | 10           | 11.0       | 1.8 | 20%      |
| Nitrogen, Nitrate                      | GP21132/GN40106 | D97639-1  | mg/l  | 0.56            | 1            | 1.6        | 0.0 | 20%      |
| Nitrogen, Nitrite                      | GP21132/GN40106 | D97639-1  | mg/l  | 0.19            | 0.5          | 0.69       | 0.0 | 20%      |
| Sulfate                                | GP21132/GN40106 | D97639-1  | mg/l  | 60.8            | 50           | 112        | 1.8 | 20%      |

Associated Samples:

Batch GN40109: D97689-1, D97689-2

Batch GP21132: D97689-1, D97689-2

(\*) Outside of QC limits

(N) Matrix Spike Rec. outside of QC limits

8.4

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