

Rec 12/15/2016

Doc #2099987

Project 2042

# 2016 COLORADO RULE 608 COMPLIANCE REPORT

## RATON BASIN, COLORADO



OCTOBER 2016



Prepared for:

XTO ENERGY, INC.  
Trinidad, Colorado



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**OCTOBER 2016**

**Prepared for:**

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## 2016 Rule 608 Compliance Report

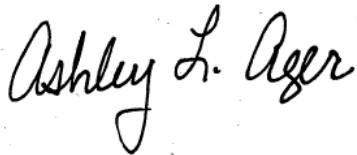
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## EXECUTIVE SUMMARY

LT Environmental, Inc. (LTE) completed the tasks for the 2016 Colorado Rule 608 Compliance Program on behalf of XTO Energy, Inc. (XTO) with respect to XTO operations in Las Animas County, Colorado (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 ( $\frac{1}{4}$ ) mile of proposed coalbed methane (CBM) wells;
- 608(b) – Water well sampling; and
- 608(c) – Coal outcrop and coal mine monitoring.

The 2016 Colorado Rule 608 Compliance Program meets the requirements of subsections a, b, and c of the COGCC Rule 608.

The 2016 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. XTO has not installed any new CBM production wells in the Raton Basin since 2011 and, as a result, the 2016 Project Area is identical to the 2011 Project Area. Due to the absence of any proposed 2016 CBM production wells by XTO, tasks 1, 2, and subtasks of task 3, and 4 were omitted from the 2016 Rule 608 Compliance Program.

LTE identified, through previous investigations, three mapping areas for surveying in 2016. Based on the findings from 2015 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 XTO continue conducting Rule 608 compliance activities in Las Animas County in accordance with the COGCC-approved *Work Plan* as XTO development activities continue and/or expand. Based on the findings from 2016 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 2017 flux survey.

## 1.0 INTRODUCTION

LT Environmental, Inc. (LTE) has prepared this 2016 Colorado Rule 608 Compliance Report for XTO Energy, Inc. (XTO) to summarize the tasks completed with respect to XTO operations in Las Animas County, Colorado (Project Area, Figure 1). 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 seventh 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 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 XTO proposed drilling area 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 has proposed to drill CBM production wells in the Project Area of the Raton Basin over the next several years (red outline on Figure 1), which began in 2010. XTO did not install any CBM production wells in the Project Area in 2012, 2013, 2014, 2015, or 2016. As a result, the 2016 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 2016 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**

XTO did not propose or install any new CBM production wells in 2016. As a result, some tasks and subtasks were omitted from the 2016 Colorado Rule 608 Compliance Program as described below. XTO confirmed the change with the COGCC as described in the 2016 Colorado Rule 608 Compliance Cost Estimate, dated June 8, 2016. Historical procedures and findings for these tasks are described in previous annual reports.

There were no new P&A production wells within the 2016 Project Area to assess in 2016, and as a result, Task 1 was not conducted for the 2016 Colorado Rule 608 Compliance Program.

A review of water wells within the 2016 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 2016. As a result, Task 2 was not conducted during the 2016 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 2016.

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 2016.

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 by not sampling Spring 05 (Vega Canyon), Spring 07 (Spring Canyon), or Spring 08 (Middle Lorencito). LTE was not granted property access for Spring 03, Spring 04, Spring 06, Spring 09, or Spring 10. As a result, natural spring water samples from these eight springs were not collected in 2016.

## **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 2016 results are summarized in Section 3.0. The conclusions of the 2016 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 2016 PROJECT AREA**

The 2016 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 2016 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 2016 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 2016 Project Area. LTE requested to gain access to all properties where field work was proposed, but was denied access to two properties and one property owner did not respond to our access request; as a result, no investigation activities were conducted on those properties. The 2016 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 mol/m<sup>2</sup>·day to 300 mol/m<sup>2</sup>·day. Methane fluxes below 0.2 mol/m<sup>2</sup>·day are detectable with decreased accuracy. As a result, reporting of methane fluxes will not include values less than 0.2 mol/m<sup>2</sup>·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<sup>®</sup> 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 2016 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® 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 6010/6020;
- Dissolved Metals [selenium (Se), manganese (Mn)] by EPA Method 6010/6020;
- Alkalinity (carbonate/bicarbonate) by EPA Method 300;
- Major Anions [chloride (Cl), sulfate (SO<sub>4</sub>), bromide (Br), and fluoride (F)] by EPA Method 300;
- SC by MCA Method WW 120.1;
- Nitrate/Nitrite as Nitrogen (N) by EPA Method 353.3;
- TDS by EPA Method 160.1;
- 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 2016. Water samples were not collected from Spring 01 and Spring 02 (also known as Quiet Spring) due to stagnation of the water from the natural springs, and Chavez 03 was found to be dry at the time of the sampling event.

## **3.0 RESULTS**

### **3.1 FLUX SURVEY**

As a result of the 2015 Colorado Rule 608 Compliance Program, LTE identified three mapping areas for surveying in 2016. 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 14.1 MCFD for area L-1021, 5.4 MCFD for area L-1030, and 204.3 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 2016 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. Five natural springs were located on private property with no access granted. Two natural springs (Chavez 01, and Chavez 02) were sampled on August 25, 2016. Chavez 03 was found to be dry and Spring 01 and Spring 02 (Quiet Spring) 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 the field logbook. The 2016 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 2016 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 three natural springs.

## 4.0 CONCLUSIONS

The 2016 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 2016. 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 still 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 XTO continue conducting Rule 608 compliance activities in Las Animas County in accordance with the COGCC-approved *Work Plan* as XTO development activities expand. Based on the findings from 2016 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 2017 flux survey.



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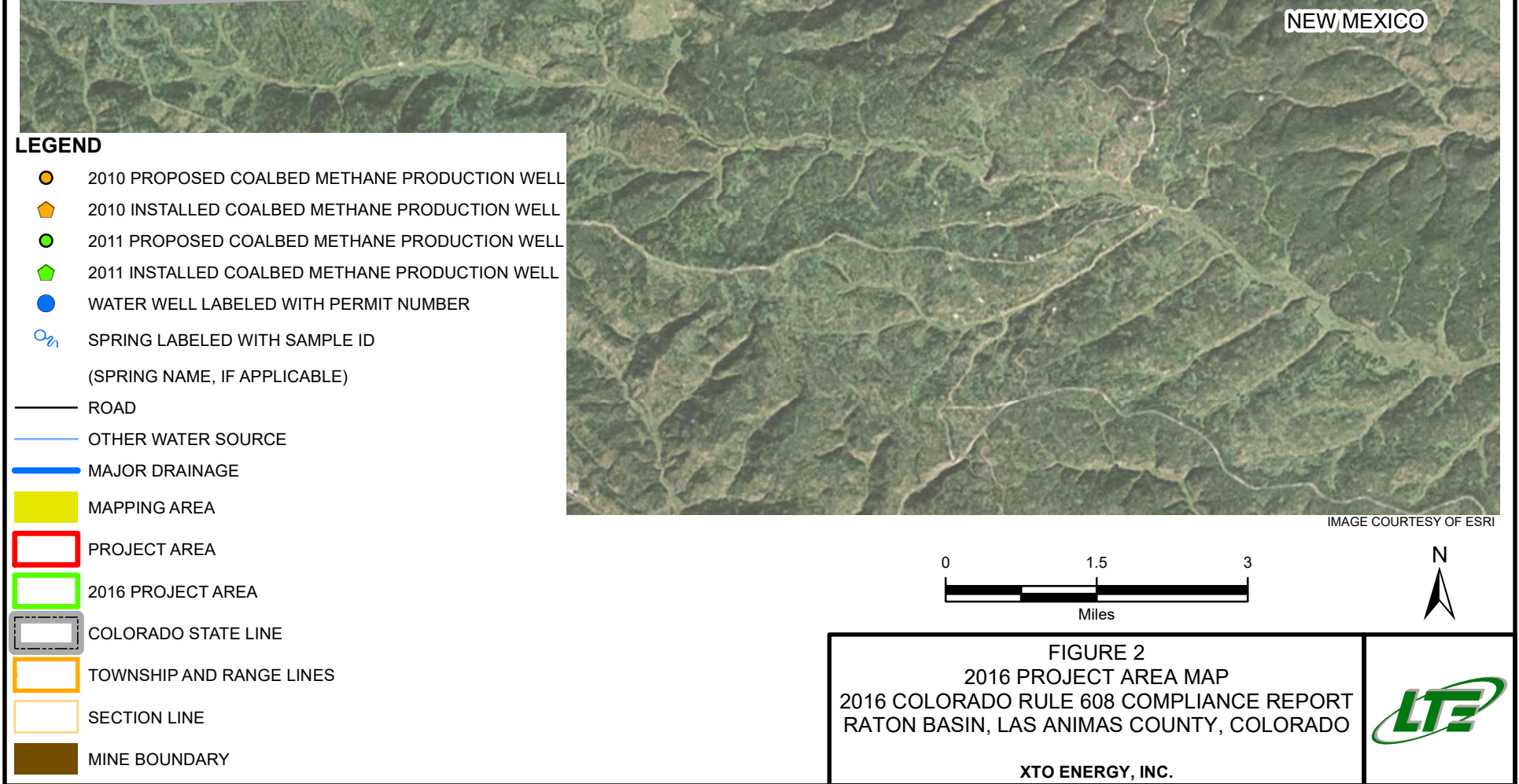
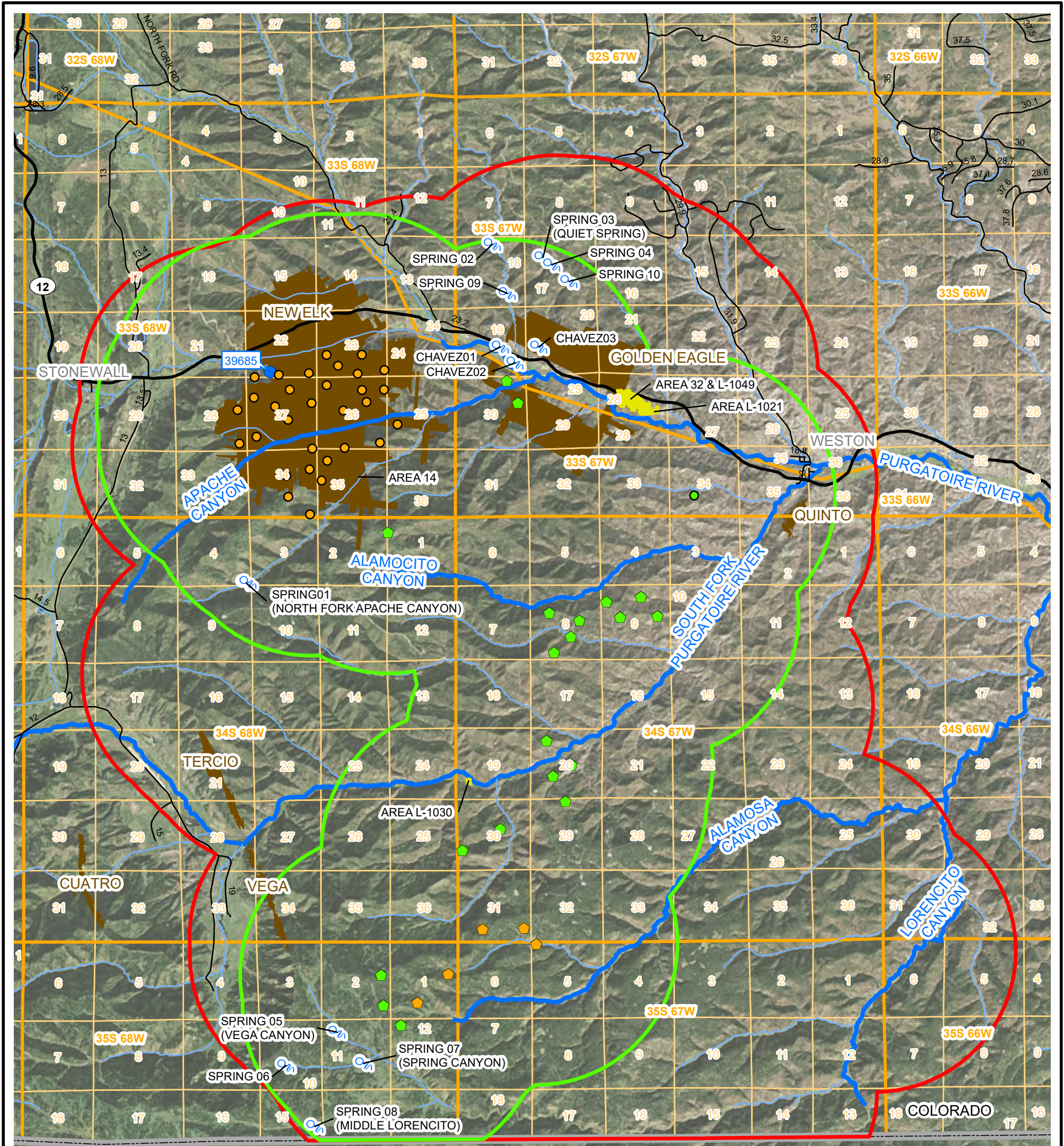
## FIGURES













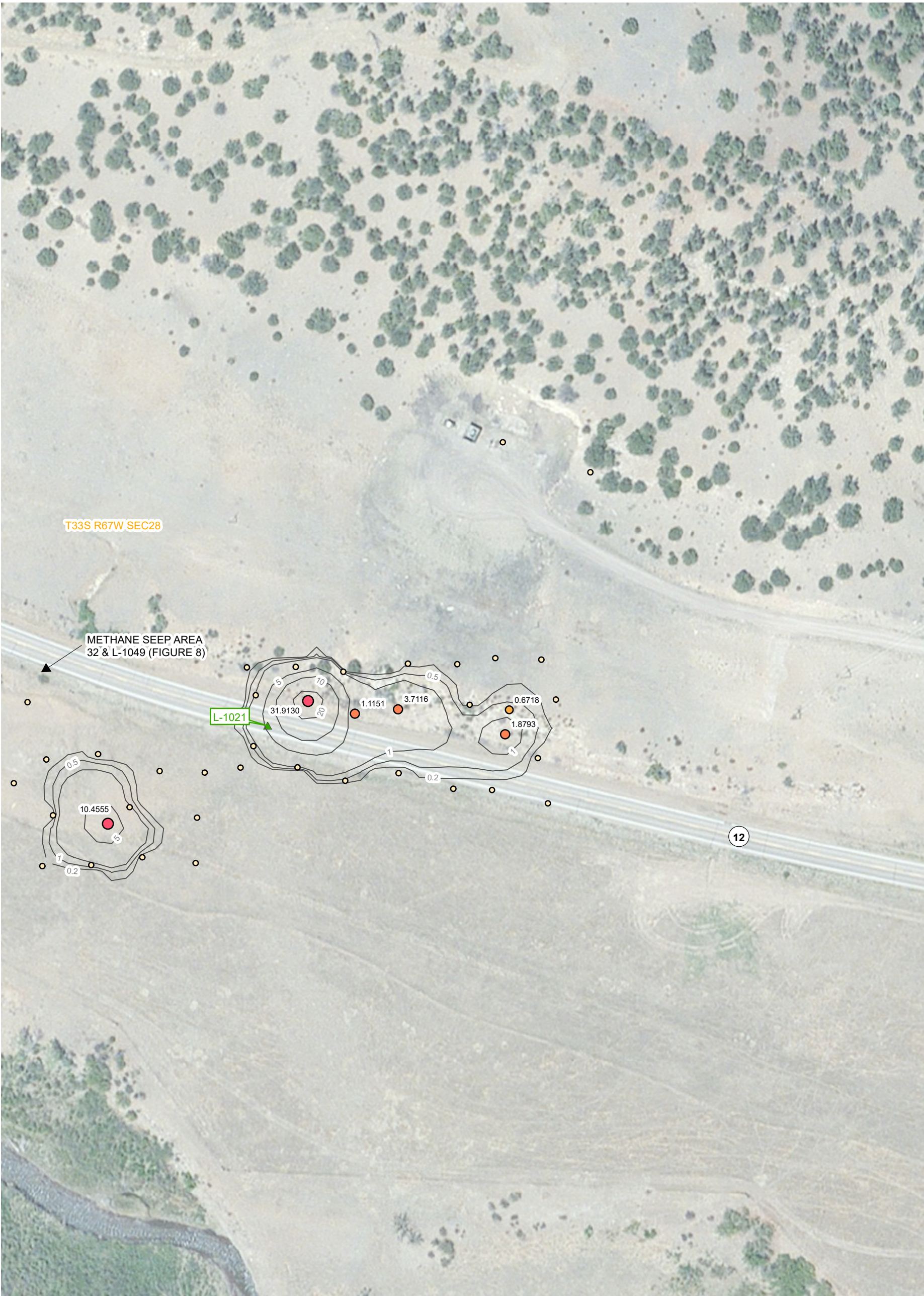


IMAGE COURTESY OF ESRI

**LEGEND**

2016 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 - 50.0000

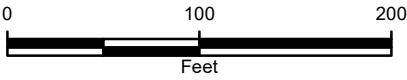
▲ 2011 SUSPECT METHANE SEEP (ID LABELED IN GREEN)

— 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

SECTION LINE



**FIGURE 3**  
**METHANE FLUX CONTOURS**  
**MAPPING AREA L-1021**  
**2016 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**XTO ENERGY, INC.**







IMAGE COURTESY OF ESRI

**LEGEND**

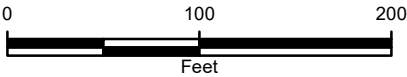
2016 METHANE FLUX MEASUREMENT  
(mol/m<sup>2</sup> • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 50.0000

- 2011 SUSPECT 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

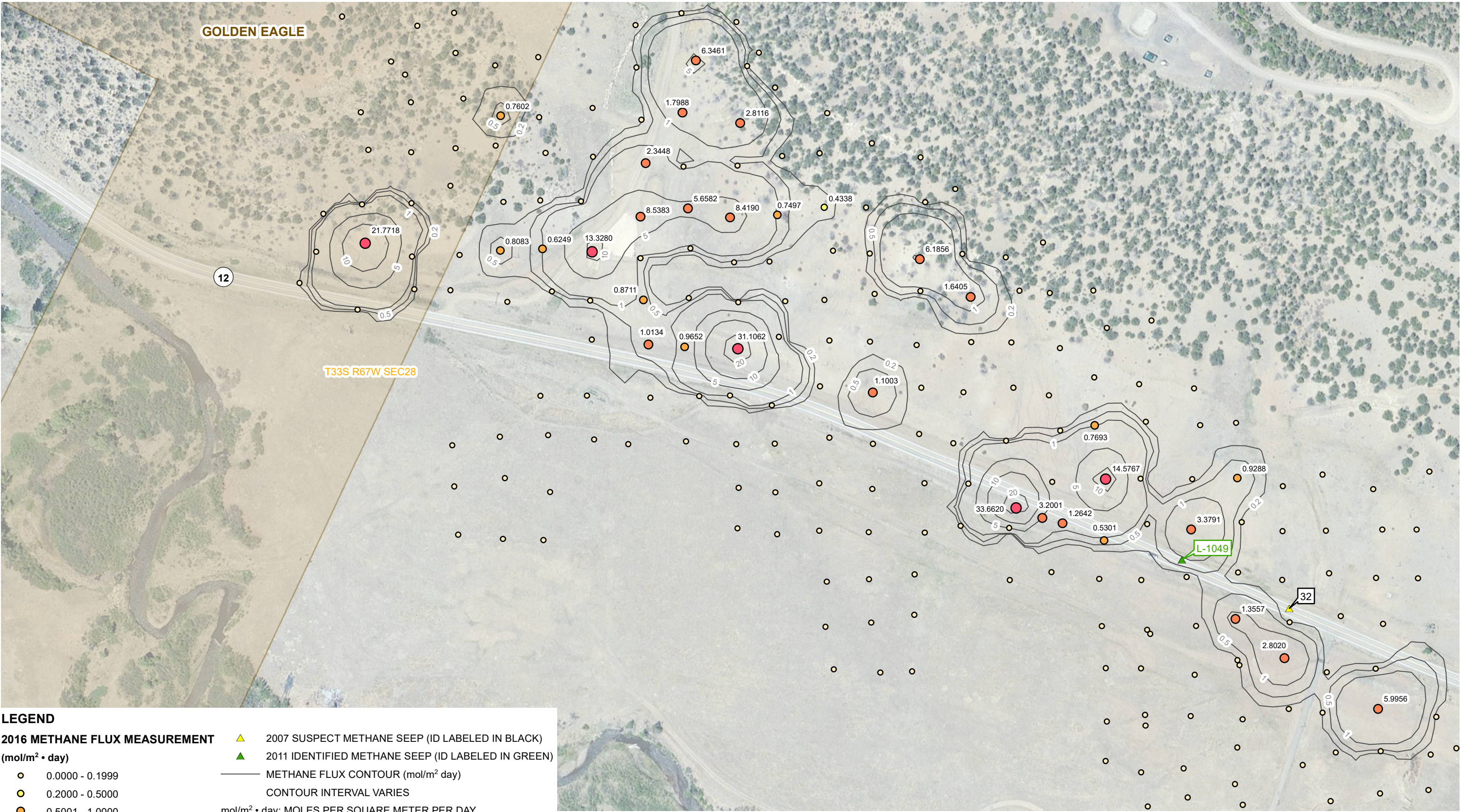
- LEWICKI MINE BOUNDARY
- SECTION LINE



**FIGURE 4**  
**METHANE FLUX CONTOURS**  
**MAPPING AREA L-1030**  
**2016 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**XTO ENERGY, INC.**







**LEGEND**

**2016 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 - 50.0000

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

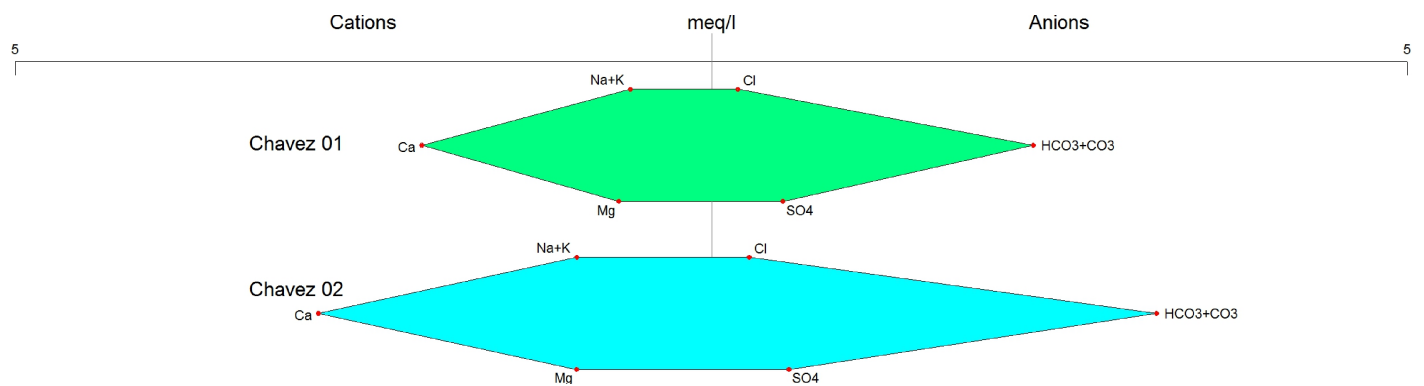
LEWICKI MINE BOUNDARY

SECTION LINE

FIGURE 5  
METHANE FLUX CONTOURS  
MAPPING AREAS 32 & L-1049  
2016 COLORADO RULE 608 COMPLIANCE REPORT  
RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
XTO ENERGY, INC.

P:\XTO Energy\GIS\IMXD\012916011\_RULE\_608\_2016\012916011\_FIG10\_CH4\_LANDSCAPE.mxd





## LEGEND

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

FIGURE 6  
 STIFF DIAGRAMS  
 AUGUST 25, 2016  
 2016 COLORADO RULE 608 COMPLIANCE REPORT  
 RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
 XTO ENERGY, INC



## TABLES



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

**2016 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**XTO ENERGY, INC.**

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	
Red River Ranch Holdings, LLC	14182121	4, 5, 6, 7, 8	35	67	No
	1418210	1, 2, 3, 10, 11, 12, 13, 14, 15	35	68	
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 (care of mibe.truillo@state.co.us)	10877304 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		17	33	67	Yes
Sabrina Blakeney	14239500	17	33	67	No Response
Richard W Stiles		18	33	67	No
Bill Toupal		28	33	67	Yes
		27, 28	33	67	
		27	33	67	
Veronica Law		19	33	67	Yes



**TABLE 2  
MAPPING AREA SUMMARIES**

**2015 COLORADO RULE 608 COMPLIANCE REPORT  
RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
XTO ENERGY, INC.**

Area IDs	Ground Survey Conducted							2007	2011			2012			2013			2014			2015			2016		
	2007	2010	2011	2012	2013	2014	2015	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)**
L-1021			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
L-1030			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
32 & L-1049	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

**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**

**2016 COLORADO RULE 608 COMPLIANCE REPORT  
RATON BASIN, LAS ANIMAS COUNTY, COLORADO  
XTO ENERGY, INC.**

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				
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
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
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				
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				

**Notes:**

Blank cells indicate no measurement.  
 µS/cm - microSiemens per centimeter  
 ORP - oxidation reduction potential  
 mV - millivolts  
 mg/L - milligrams per liter

°C - degrees Celsius  
 TDS - total dissolved solids  
 ppm - parts per million  
 NM - not measured  
 DO - dissolved oxygen



**TABLE 4**  
**NATURAL SPRING ANALYTICAL RESULTS**

**2016 COLORADO RULE 608 COMPLIANCE REPORT**  
**RATON BASIN, LAS ANIMAS COUNTY, COLORADO**  
**XTO ENERGY, INC.**

Natural Spring	Location	Sample Date	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Manganese (mg/L)	Selenium (mg/L)	Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Specific Conductivity (umhos/cm)	pH	Sulfate (mg/L)	Chloride (mg/L)	Bromide (mg/L)	Fluoride (mg/L)	Hydrogen Sulfide (mg/L)	Nitrogen as Nitrate (mg/L)	Nitrogen as Nitrite (mg/L)	Iron Reducing Bacteria (cfu/ml)	Slime Forming Bacteria (cfu/ml)	Sulfate Reducing Bacteria (cfu/ml)
Spring01	North Fork Apache Canyon	8/13/2010	3.4	0.65		97.7	1.41	0.0210	<0.00080	<5.0	205	280		10.13	2.9	3.3	<0.20	0.74	<0.50	<0.23	500	>350,000	700,000
		8/19/2011	2.2	0.52	136.0	1.64	0.1260	<0.00080	<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	<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	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	9/4/2012	44.5	8.12	20.4	<1.0	<0.0050	<0.0020	<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	<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	<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	<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	<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
Chavez02	Rancho Escondido	9/4/2012	49.3	9.56	18.2	1.43	<0.0050	<0.0020	<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	<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	<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	<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	<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
Chavez03	Rancho Escondido	9/4/2012	117.0	43.20	20.8	6.25	<0.0050	<0.0020	<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
		8/15/2013	113.0	48.20	22.3	5.50	<0.0050	<0.0020	<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	<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																				
Spring03 - Quiet Spring	Rancho Escondido	8/21/2014	STAGNANT WATER - NOT SAMPLED																				
		8/12/2015	STAGNANT WATER - NOT SAMPLED																				
		8/25/2016	STAGNANT WATER - NOT SAMPLED																				
			STAGNANT WATER - NOT SAMPLED																				

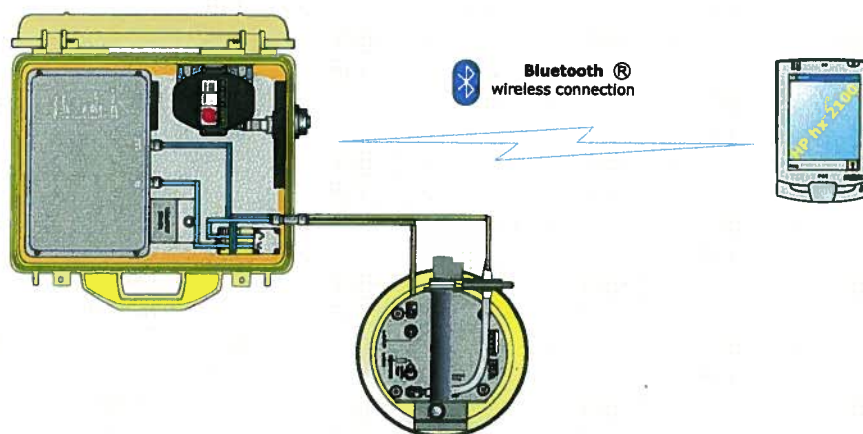
**Notes:**  
< - less than the laboratory reporting limit  
> - greater than  
cfu/ml - coliform units per milliliter  
mg/L - milligrams per liter  
NA - not analyzed  
umhos/cm - microhms per centimeter  
TDS - total dissolved solids

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



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

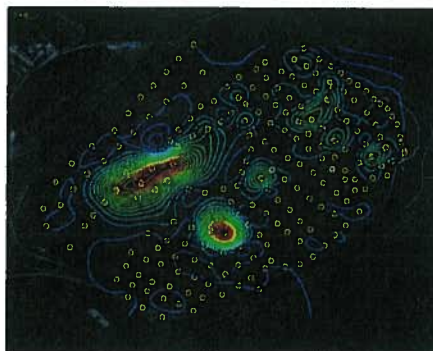
The WEST Systems Fluxmeter is a portable instrument for the measurement of soil gas diffuse degassing phenomena that uses the accumulation chamber method.



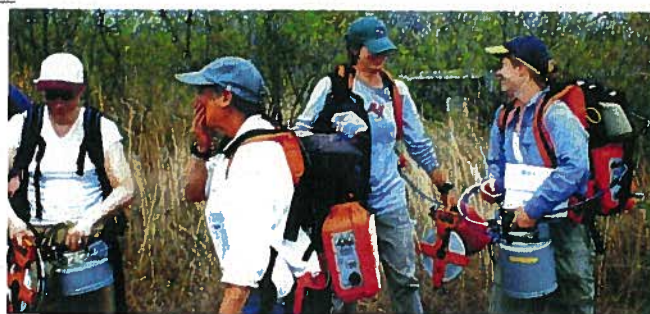
This method studied for soil respiration in agronomy (Parkinson) and for soil degassing in volcanic areas (R. Cioni et al.), has been designed by WEST Systems to obtain a portable instrument that allows the performance of measurements with very good accuracy in a short time. The instrument allows a wide 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

West Systems Srl  
Via Molise 3 - Zona Ind. Gello - 56025 Pontedera (PI) Italy  
Phone +39 0587 294216 [www.westsystems.com](http://www.westsystems.com)  
Fax +39 0587 296068 [g.virgili@westsystems.com](mailto:g.virgili@westsystems.com)

**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").

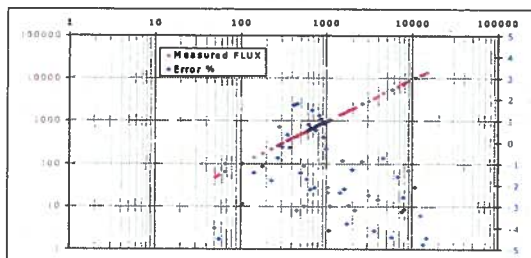
**Software** The instrument is supplied with a custom software, FluxManager, which allows recording and visualization of the increase in concentration of the target gas in the accumulation chamber, and then the flux calculations. The obtained measurements can be saved on the palmtop computer and then 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

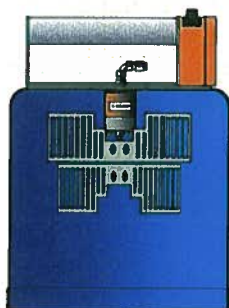
The standard flux meter configuration is supplied with a single gas detector, normally the carbon dioxide detector. The fluxmeter can host two sensors by the way special releases, based on specific customer request, it can be supplied with a maximum of 3 sensors.

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.



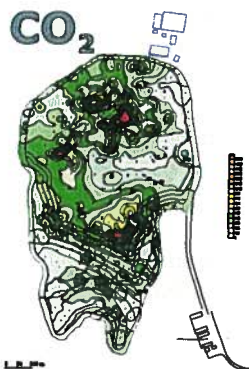
Accumulation Chamber Type B

## 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:

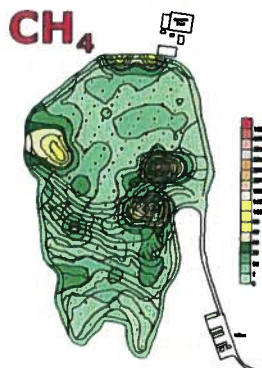
0 to 0.5 moles m <sup>-2</sup> day <sup>-1</sup>	25% (Acc.ch.A)
0.5 to 1 moles m <sup>-2</sup> day <sup>-1</sup>	15% (Acc.ch.A or B)
1 to 150 moles m <sup>-2</sup> day <sup>-1</sup>	10% (Acc.ch.B)
150 to 300 moles m <sup>-2</sup> day <sup>-1</sup>	10% (Acc.ch.B)
300 to 600 moles m <sup>-2</sup> day 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

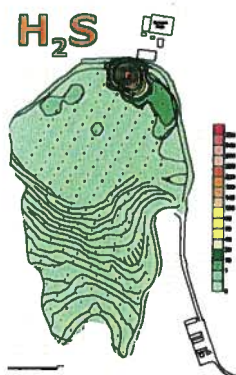
The methane sensor is an IR spectrometer. The full-scale range is 50000ppm, accuracy of 5% of reading, and repeatability is 2% of span. Detection limit 60 ppm, resolution 22 ppm. The detector was designed to measure the not controlled emissions of landfill, but it can be used to detect methane emission 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 an 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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Phone +39 0587 294216 www.westsystems.com  
Fax +39 0587 296068 g.virgili@westsystems.com

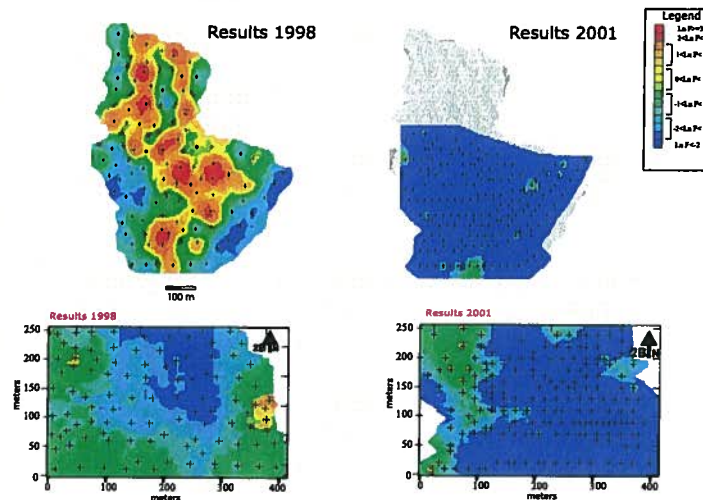
**WEST**  
Systems

## 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.

#### West Systems Srl

Via Molise 3 - Zona Ind. Gello - 56025 Pontedera (PI) Italy  
Phone +39 0587 294216 [www.westsystems.com](http://www.westsystems.com) (or .it)  
Fax +39 0587 296068 [g.virgili@westsystems.com](mailto:g.virgili@westsystems.com) (or .it)

Japan

#### SHOKO CO., LTD.

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

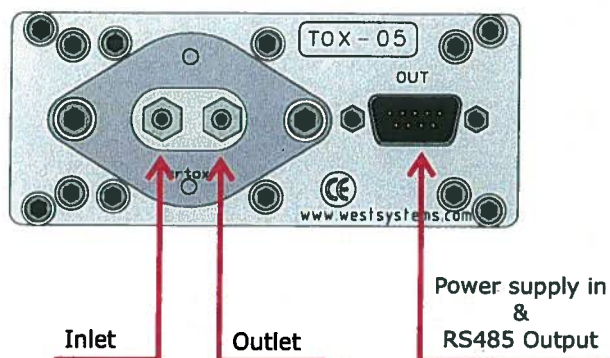
105-8432, Japan

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

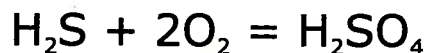
Factory calibration : 20 ppm

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

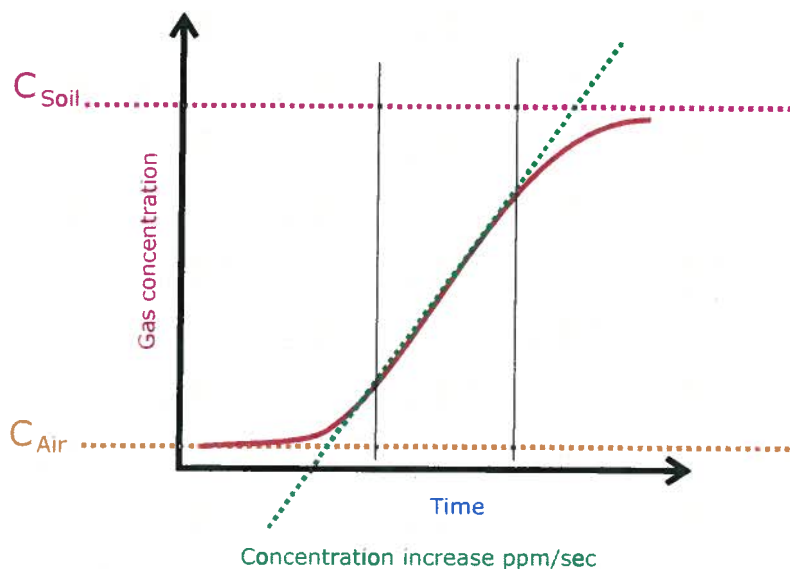
**Relative Humidity Range:** 0 to 95% RH, Non-Condensing

**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 0-5% CH <sub>4</sub>	1 % LEL or 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; extended -20 to 50°C
<b>Operating humidity:</b>	Continuous: 15-95% RH, non-condensing Intermittent duty: 5-95% RH, 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 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.

ID 08-04-27-MC / May 2000  
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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



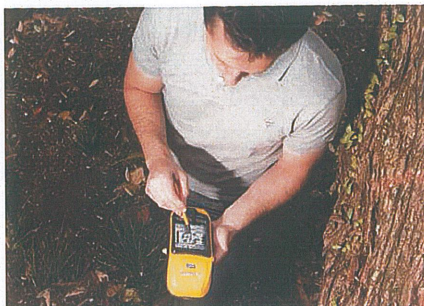
### THE ACCURACY YOU NEED ANYWHERE YOU NEED IT

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



SitePt	Site	AreaAbbrev	Northing	Easting	Date	CH4flux	H2Sflux	CO2flux	PRESSURE (HPa):	TEMP DegC	TIME:	CH4slope	H2Sslope	CO2slope
SeepArea32-L1049-082316_01	SeepArea32L 1049 082	L1049	1174049.17	3178041.24	23-Aug-16	0.00	0.01	0.31	788.3	35.4	23-08-2016 13:17:56	0	0.031	1.307
SeepArea32-L1049-082316_02	SeepArea32L 1049 082	L1049	1173969.52	3177958.36	23-Aug-16	0.00	0.00	0.31	788.5	36.3	23-08-2016 13:21:32	-4.149	0.012	1.309
SeepArea32-L1049-082316_03	SeepArea32L 1049 082	L1049	1173947.00	3177858.62	23-Aug-16	0.00	0.00	0.31	788.7	37.1	23-08-2016 13:24:12	-1.812	0.011	1.29
SeepArea32-L1049-082316_04	SeepArea32L 1049 082	L1049	1173885.99	3177847.24	23-Aug-16	0.00	0.00	0.19	788.9	37.8	23-08-2016 13:26:31	-1.571	0.021	0.797
SeepArea32-L1049-082316_05	SeepArea32L 1049 082	L1049	1173806.58	3177842.15	23-Aug-16	0.00	0.00	0.02	789.0	38.5	23-08-2016 13:29:17	0	0.011	0.072
SeepArea32-L1049-082316_06	SeepArea32L 1049 082	L1049	1173761.62	3177858.78	23-Aug-16	0.00	0.00	0.03	789.2	39.0	23-08-2016 13:31:25	0	0.008	0.117
SeepArea32-L1049-082316_07	SeepArea32L 1049 082	L1049	1173777.76	3177739.41	23-Aug-16	0.00	0.00	0.12	789.3	39.6	23-08-2016 13:34:17	-0.113	0.011	0.491
SeepArea32-L1049-082316_08	SeepArea32L 1049 082	L1049	1173757.92	3177653.22	23-Aug-16	0.00	0.00	0.09	789.1	40.0	23-08-2016 13:37:01	-0.441	0.011	0.399
SeepArea32-L1049-082316_09	SeepArea32L 1049 082	L1049	1173832.17	3177638.99	23-Aug-16	0.00	0.01	0.28	789.1	40.3	23-08-2016 13:39:25	-1.048	0.026	1.196
SeepArea32-L1049-082316_10	SeepArea32L 1049 082	L1049	1173840.64	3177730.96	23-Aug-16	0.00	0.01	0.22	789.0	40.7	23-08-2016 13:41:55	-1.244	0.025	0.935
SeepArea32-L1049-082316_11	SeepArea32L 1049 082	L1049	1173856.88	3177562.00	23-Aug-16	0.00	0.00	0.09	789.0	41.2	23-08-2016 13:44:49	-1.349	0.01	0.404
SeepArea32-L1049-082316_12	SeepArea32L 1049 082	L1049	1173942.31	3177564.62	23-Aug-16	0.00	0.00	0.23	788.9	41.7	23-08-2016 13:47:17	-0.618	0.012	0.997
SeepArea32-L1049-082316_13	SeepArea32L 1049 082	L1049	1173956.89	3177647.28	23-Aug-16	0.00	0.00	0.33	788.7	42.1	23-08-2016 13:50:22	-0.799	0.013	1.415
SeepArea32-L1049-082316_14	SeepArea32L 1049 082	L1049	1173933.23	3177648.15	23-Aug-16	0.00	0.01	1.46	788.7	42.5	23-08-2016 13:52:41	-0.658	0.027	6.24
SeepArea32-L1049-082316_15	SeepArea32L 1049 082	L1049	1173954.00	3177746.17	23-Aug-16	0.00	0.00	0.18	788.7	42.9	23-08-2016 13:55:18	-0.645	0.016	0.764
SeepArea32-L1049-082316_16	SeepArea32L 1049 082	L1049	1174043.70	3177754.89	23-Aug-16	0.00	0.00	0.16	788.9	43.2	23-08-2016 13:57:38	-1.105	0.018	0.689
SeepArea32-L1049-082316_17	SeepArea32L 1049 082	L1049	1174064.37	3177851.72	23-Aug-16	0.00	0.00	0.36	788.5	43.6	23-08-2016 14:00:35	-0.524	0.011	1.567
SeepArea32-L1049-082316_18	SeepArea32L 1049 082	L1049	1174075.50	3177847.42	23-Aug-16	0.00	0.00	0.31	788.3	44.0	23-08-2016 14:03:03	-0.792	0.012	1.351
SeepArea32-L1049-082316_19	SeepArea32L 1049 082	L1049	1174079.85	3177949.18	23-Aug-16	2.80	0.00	0.90	788.3	44.5	23-08-2016 14:06:45	12.072	0.016	3.856
SeepArea32-L1049-082316_20	SeepArea32L 1049 082	L1049	1174157.27	3177960.56	23-Aug-16	0.00	0.00	0.17	788.2	45.0	23-08-2016 14:09:37	-1.289	0.017	0.718
SeepArea32-L1049-082316_21	SeepArea32L 1049 082	L1049	1174164.75	3177843.09	23-Aug-16	1.36	0.00	0.42	788.1	45.3	23-08-2016 14:12:37	5.857	0.012	1.809
SeepArea32-L1049-082316_22	SeepArea32L 1049 082	L1049	1174149.27	3177757.72	23-Aug-16	0.00	0.00	2.75	788.1	45.5	23-08-2016 14:15:21	-0.532	0.014	11.895
SeepArea32-L1049-082316_23	SeepArea32L 1049 082	L1049	1174141.07	3177651.83	23-Aug-16	0.00	0.00	0.18	787.9	45.7	23-08-2016 14:18:14	-0.347	0.021	0.778
SeepArea32-L1049-082316_24	SeepArea32L 1049 082	L1049	1174132.40	3177658.56	23-Aug-16	0.00	0.00	0.22	787.9	45.9	23-08-2016 14:21:41	-0.981	-0.004	0.944
SeepArea32-L1049-082316_25	SeepArea32L 1049 082	L1049	1174057.40	3177638.60	23-Aug-16	0.00	0.01	0.60	788.1	46.1	23-08-2016 14:24:01	-1.45	0.025	2.591
SeepArea32-L1049-082316_26	SeepArea32L 1049 082	L1049	1174058.21	3177562.08	23-Aug-16	0.00	0.01	0.45	788.2	46.2	23-08-2016 14:27:03	-4.87	0.028	1.965
SeepArea32-L1049-082316_27	SeepArea32L 1049 082	L1049	1174149.15	3177553.51	23-Aug-16	0.00	0.00	0.05	788.3	46.4	23-08-2016 14:29:36	-1.86	0.021	0.199
SeepArea32-L1049-082316_28	SeepArea32L 1049 082	L1049	1174251.31	3177547.90	23-Aug-16	0.00	0.00	0.19	787.9	46.5	23-08-2016 14:32:08	-1.777	0.016	0.824
SeepArea32-L1049-082316_29	SeepArea32L 1049 082	L1049	1174265.90	3177444.58	23-Aug-16	0.00	0.00	0.08	787.8	46.6	23-08-2016 14:35:06	0	0.017	0.348
SeepArea32-L1049-082316_30	SeepArea32L 1049 082	L1049	1174248.98	3177354.07	23-Aug-16	0.00	0.01	0.28	787.9	46.6	23-08-2016 14:38:33	0	0.025	1.231
SeepArea32-L1049-082316_31	SeepArea32L 1049 082	L1049	1174362.16	3177352.71	23-Aug-16	0.00	0.00	0.07	787.9	46.6	23-08-2016 14:41:02	0	0.009	0.298
SeepArea32-L1049-082316_32	SeepArea32L 1049 082	L1049	1174405.36	3177367.80	23-Aug-16	33.66	0.00	1.33	787.7	46.6	23-08-2016 14:43:33	146.096	0.006	5.787
SeepArea32-L1049-082316_33	SeepArea32L 1049 082	L1049	1174366.53	3177247.48	23-Aug-16	0.00	0.00	0.05	787.7	46.5	23-08-2016 14:46:27	-2.969	0.015	0.232
SeepArea32-L1049-082316_34	SeepArea32L 1049 082	L1049	1174351.83	3177169.95	23-Aug-16	0.00	0.00	0.24	787.8	46.3	23-08-2016 14:49:36	-1.27	0.014	1.04
SeepArea32-L1049-082316_35	SeepArea32L 1049 082	L1049	1174261.23	3177147.98	23-Aug-16	0.00	0.00	0.20	788.2	46.1	23-08-2016 14:52:04	-1.671	0.01	0.883
SeepArea32-L1049-082316_36	SeepArea32L 1049 082	L1049	1174173.62	3177147.14	23-Aug-16	0.00	0.00	0.05	788.2	45.9	23-08-2016 14:54:56	0	0.009	0.198
SeepArea32-L1049-082316_37	SeepArea32L 1049 082	L1049	1174051.04	3177142.40	23-Aug-16	0.00	0.00	0.28	788.2	45.6	23-08-2016 14:57:30	-1.23	0.006	1.204
SeepArea32-L1049-082316_38	SeepArea32L 1049 082	L1049	1174048.31	3177073.52	23-Aug-16	0.00	0.00	0.16	788.2	45.4	23-08-2016 15:00:00	0	0.011	0.684
SeepArea32-L1049-082316_39	SeepArea32L 1049 082	L1049	1174055.53	3176972.97	23-Aug-16	0.00	0.01	0.12	788.3	45.2	23-08-2016 15:02:40	0	0.051	0.517
SeepArea32-L1049-082316_40	SeepArea32L 1049 082	L1049	1174147.82	3176954.82	23-Aug-16	0.00	0.01	0.11	788.2	45.0	23-08-2016 15:05:04	-1.52	0.061	0.489
SeepArea32-L1049-082316_41	SeepArea32L 1049 082	L1049	1174156.70	3177053.99	23-Aug-16	0.00	0.01	0.40	788.2	45.0	23-08-2016 15:07:28	0	0.03	1.724
SeepArea32-L1049-082316_42	SeepArea32L 1049 082	L1049	1174250.88	3177049.25	23-Aug-16	0.00	0.01	3.29	788.1	45.0	23-08-2016 15:10:08	-1.444	0.022	14.221
SeepArea32-L1049-082316_43	SeepArea32L 1049 082	L1049	1174245.48	3176957.43	23-Aug-16	0.00	0.00	0.65	787.9	45.0	23-08-2016 15:12:30	-0.768	0.019	2.795
SeepArea32-L1049-082316_44	SeepArea32L 1049 082	L1049	1174352.84	3177048.37	23-Aug-16	0.00	0.00	0.15	787.9	45.2	23-08-2016 15:16:01	-1.02	0.012	0.634
SeepArea32-L1049-082316_45	SeepArea32L 1049 082	L1049	1174356.07	3176941.25	23-Aug-16	0.00	0.00	0.35	787.9	45.3	23-08-2016 15:18:45	-1.016	0.009	1.501
SeepArea32-L1049-082316_46	SeepArea32L 1049 082	L1049	1174348.23	3176850.03	23-Aug-16	0.00	0.00	0.09	787.8	45.4	23-08-2016 15:21:04	-0.872	0.01	0.384
SeepArea32-L1049-082316_47	SeepArea32L 1049 082	L1049	1174360.97	3176764.13	23-Aug-16	0.00	0.00	0.10	787.9	45.4	23-08-2016 15:23:41	-1.052	0.012	0.431
SeepArea32-L1049-082316_48	SeepArea32L 1049 082	L1049	1174448.99	3176766.42	23-Aug-16	0.00	0.01	0.14	787.8	45.4	23-08-2016 15:26:24	-1.03	0.027	0.589
SeepArea32-L1049-082316_49	SeepArea32L 1049 082	L1049	1174543.76	3176761.44	23-Aug-16	0.00	0.00	0.03	787.7	45.4	23-08-2016 15:28:49	-0.272	0.018	0.151
SeepArea32-L1049-082316_50	SeepArea32L 1049 082	L1049	1174649.08	3176747.97	23-Aug-16	0.00	0.00	0.93	787.5	45.3	23-08-2016 15:31:38	-1.823	0.014	4.008
SeepArea32-L1049-082316_51	SeepArea32L 1049 082	L1049	1174647.63	3176681.33	23-Aug-16	0.00	0.01	0.73	787.4	45.0	23-08-2016 15:35:07	-1.676	0.031	3.155
SeepArea32-L1049-082316_52	SeepArea32L 1049 082	L1049	1174549.57	3176652.50	23-Aug-16	0.00	0.01	0.23	787.4	44.8	23-08-2016 15:38:07	0	0.026	0.991
SeepArea32-L1049-082316_53	SeepArea32L 1049 082	L1049	1174543.77	3176527.52	23-Aug-16	0.00	0.01	0.43	787.5	44.5	23-08-2016 15:41:32	0	0.032	1.845
SeepArea32-L1049-082316_54	SeepArea32L 1049 082	L1049	1174553.66	3176453.36	23-Aug-16	0.00	0.01	0.09	787.8	44.2	23-08-2016 15:44:04	0	0.023	0.399
SeepArea32-L1049-082316_55	SeepArea32L 1049 082	L1049	1174563.15	3176353.79	23-Aug-16	0.00	0.01	0.16	787.4	43.9	23-08-2016 15:46:55	0	0.026	0.706
SeepArea32-L1049-082316_56	SeepArea32L 1049 082	L1049	1174439.63	3176358.08	23-Aug-16	0.00	0.01	0.39	787.5	43.6	23-08-2016 15:49:49	0	0.04	1.691
SeepArea32-L1049-082316_57	SeepArea32L 1049 082	L1049	1174335.62	3176343.38	23-Aug-16	0.00	0.01	0.36	787.7	43.4	23-08-2016 15:52:31	-0.086	0.027	1.54
SeepArea32-L1049-082316_58	SeepArea32L 1049 082	L1049	1174338.14	3176256.01	23-Aug-16	0.00	0.00	0.15	787.8	43.1	23-08-2016 15:55:06	-0.041	0.017	0.643
SeepArea32-L1049-082316_59	SeepArea32L 1049 082	L1049	1174347.26	3176158.83	23-Aug-16	0.00	0.00	0.21	787.9	42.9	23-08-2016 15:58:03	-0.293	0.011	0.894
SeepArea32-L1049-082316_60	SeepArea32L 1049 082	L1049	1174452.04	3176150.38	23-Aug-16	0.00	0.00	0.12	787.8	42.7	23-08-2016 16:00:47	0	0.013	0.535
SeepArea32-L1049-082316_61	SeepArea32L 1049 082	L1049	1174470.10	3176260.09	23-Aug-16	0.00	0.00	0.34	787.7	42.5	23-08-2016 16:03:49	-0.391	0.012	1.461
SeepArea32-L1049-082316_62	SeepArea32L 1049 082	L1049	1174559.81	31										

SitePt	Site	AreaAbbrev	Northing	Easting	Date	CH4flux	H2Sflux	CO2flux	PRESSURE (HPa):	TEMP DegC	TIME:	CH4slope	H2Sslope	CO2slope
SeepArea32-L1049-082316_64	SeepArea32L 1049 082	L1049	1174648.41	3176337.24	23-Aug-16	0.00	0.00	0.08	787.5	41.9	23-08-2016 16:14:06	0	0.013	0.34
SeepArea32-L1049-082316_65	SeepArea32L 1049 082	L1049	1174648.71	3176437.80	23-Aug-16	0.00	0.00	0.00	787.4	41.7	23-08-2016 16:17:05	0	0.01	0.016
SeepArea32-L1049-082316_66	SeepArea32L 1049 082	L1049	1174644.53	3176575.39	23-Aug-16	0.00	0.00	0.02	787.4	41.6	23-08-2016 16:19:52	-0.093	0.003	0.076
SeepArea32-L1049-082316_67	SeepArea32L 1049 082	L1049	1174627.85	3176838.42	23-Aug-16	0.00	0.00	0.38	787.3	41.5	23-08-2016 16:23:32	-0.356	0.02	1.623
SeepArea32-L1049-082316_68	SeepArea32L 1049 082	L1049	1174544.74	3176844.73	23-Aug-16	0.00	0.00	0.21	787.5	41.4	23-08-2016 16:26:14	-0.026	0.018	0.881
SeepArea32-L1049-082316_69	SeepArea32L 1049 082	L1049	1174439.15	3176846.26	23-Aug-16	0.00	0.00	0.30	787.8	41.2	23-08-2016 16:29:12	-0.624	0.017	1.293
SeepArea32-L1049-082316_70	SeepArea32L 1049 082	L1049	1174458.60	3176941.23	23-Aug-16	0.00	0.01	0.36	787.7	41.1	23-08-2016 16:31:50	-0.454	0.023	1.517
SeepArea32-L1049-082316_71	SeepArea32L 1049 082	L1049	1174557.64	3176963.13	23-Aug-16	0.00	0.00	1.36	787.7	40.9	23-08-2016 16:34:36	0	0.015	5.81
SeepArea32-L1049-082316_72	SeepArea32L 1049 082	L1049	1174544.24	3177057.67	23-Aug-16	0.00	0.01	0.37	787.5	40.7	23-08-2016 16:37:09	0	0.028	1.563
SeepArea32-L1049-082316_73	SeepArea32L 1049 082	L1049	1174446.25	3177056.31	23-Aug-16	0.00	0.00	0.14	787.6	40.5	23-08-2016 16:39:35	-0.184	0.018	0.582
SeepArea32-L1049-082316_74	SeepArea32L 1049 082	L1049	1174458.92	3177169.02	23-Aug-16	0.00	0.00	0.07	787.9	40.3	23-08-2016 16:42:31	-0.018	0.012	0.314
SeepArea32-L1049-082316_75	SeepArea32L 1049 082	L1049	1174457.92	3177264.33	23-Aug-16	0.00	0.01	0.67	787.7	40.1	23-08-2016 16:45:12	-0.037	0.022	2.868
SeepArea32-L1049-082316_76	SeepArea32L 1049 082	L1049	1174383.63	3177424.65	23-Aug-16	3.20	0.01	1.79	787.7	40.0	23-08-2016 16:48:20	13.602	0.023	7.596
SeepArea32-L1049-082316_77	SeepArea32L 1049 082	L1049	1174372.11	3177468.35	23-Aug-16	1.26	0.01	1.04	787.7	39.8	23-08-2016 16:51:04	5.37	0.031	4.408
SeepArea32-L1049-082316_78	SeepArea32L 1049 082	L1049	1174334.81	3177558.49	23-Aug-16	0.53	0.00	1.92	787.5	39.5	23-08-2016 16:55:44	2.25	-0.003	8.147
SeepArea32-L1049-082316_79	SeepArea32L 1049 082	L1049	1174248.92	3177639.02	23-Aug-16	0.00	0.01	1.34	787.6	39.4	23-08-2016 16:58:35	0	0.027	5.683
SeepArea32-L1049-082316_80	SeepArea32L 1049 082	L1049	1174255.64	3177737.22	23-Aug-16	0.00	0.01	2.40	787.6	39.3	23-08-2016 17:01:30	0	0.031	10.191
SeepArea32-L1049-082316_81	SeepArea32L 1049 082	L1049	1174056.75	3178146.94	23-Aug-16	0.00	0.00	0.77	787.6	39.3	23-08-2016 17:06:27	-0.087	0.012	3.284
SeepArea32-L1049-082316_82	SeepArea32L 1049 082	L1049	1173969.84	3178152.08	23-Aug-16	6.00	0.00	4.86	788.6	39.1	23-08-2016 17:09:37	25.382	0.018	20.562
SeepArea32-L1049-082316_83	SeepArea32L 1049 082	L1049	1173878.20	3178157.88	23-Aug-16	0.00	0.01	3.03	788.4	39.0	23-08-2016 17:12:43	-0.659	0.028	12.846
SeepArea32-L1049-082316_84	SeepArea32L 1049 082	L1049	1173786.26	3178156.54	23-Aug-16	0.00	0.00	0.25	789.0	38.9	23-08-2016 17:15:21	0	0.016	1.038
SeepArea32-L1049-082316_85	SeepArea32L 1049 082	L1049	1173769.65	3178049.34	23-Aug-16	0.00	0.01	0.55	789.3	38.8	23-08-2016 17:18:05	0	0.027	2.343
SeepArea32-L1049-082316_86	SeepArea32L 1049 082	L1049	1173848.20	3177989.01	23-Aug-16	0.00	0.00	0.09	789.1	38.7	23-08-2016 17:21:10	-0.603	0.013	0.381
SeepArea32-L1049-082316_87	SeepArea32L 1049 082	L1049	1173874.94	3178060.59	23-Aug-16	0.00	0.00	0.36	789.0	38.7	23-08-2016 17:23:42	0	0.015	1.519
SeepArea32-L1049-082316_88	SeepArea32L 1049 082	L1049	1173961.50	3178031.86	23-Aug-16	0.00	0.00	0.32	789.0	38.6	23-08-2016 17:27:14	0	0.005	1.363
SeepArea32-L1049-082316_89	SeepArea32L 1049 082	L1049	1173870.78	3178266.29	23-Aug-16	0.00	0.00	0.19	788.7	38.6	23-08-2016 17:31:22	-0.039	0.015	0.794
SeepArea32-L1049-082316_90	SeepArea32L 1049 082	L1049	1173793.58	3178261.07	23-Aug-16	0.00	0.00	0.13	789.0	38.5	23-08-2016 17:34:07	-1.592	0.011	0.554
SeepArea32-L1049-082316_91	SeepArea32L 1049 082	L1049	1173798.81	3178351.35	23-Aug-16	0.00	0.00	0.12	789.0	38.4	23-08-2016 17:37:40	-0.517	0.006	0.503
SeepArea32-L1049-082316_92	SeepArea32L 1049 082	L1049	1173851.32	3178362.23	23-Aug-16	0.00	0.00	0.17	789.0	38.3	23-08-2016 17:40:56	0	0.009	0.71
SeepArea32-L1049-082316_93	SeepArea32L 1049 082	L1049	1173884.54	3178321.86	23-Aug-16	0.00	0.00	0.18	788.6	38.3	23-08-2016 17:43:20	0	0.012	0.759
SeepArea32-L1049-082316_94	SeepArea32L 1049 082	L1049	1173909.14	3178355.46	23-Aug-16	0.00	0.00	0.15	788.6	38.2	23-08-2016 17:45:59	-0.001	0.008	0.62
SeepArea32-L1049-082316_95	SeepArea32L 1049 082	L1049	1173968.51	3178335.89	23-Aug-16	0.00	0.00	0.13	788.5	38.1	23-08-2016 17:48:25	0	0.005	0.528
SeepArea32-L1049-082316_96	SeepArea32L 1049 082	L1049	1173952.26	3178278.31	23-Aug-16	0.00	0.01	0.90	788.3	37.9	23-08-2016 17:50:40	-0.001	0.022	3.796
SeepArea32-L1049-082416_100	SeepArea32L 1049 082	L1049	1174893.14	3175815.21	24-Aug-16	0.00	0.00	0.14	791.3	22.1	24-08-2016 08:00:10	0	0	0.544
SeepArea32-L1049-082416_101	SeepArea32L 1049 082	L1049	1174960.75	3175851.23	24-Aug-16	0.00	0.00	0.48	791.1	22.4	24-08-2016 08:03:24	0	0.002	1.898
SeepArea32-L1049-082416_102	SeepArea32L 1049 082	L1049	1175043.19	3175866.74	24-Aug-16	0.00	0.00	0.03	790.6	22.5	24-08-2016 08:05:53	0	0.001	0.128
SeepArea32-L1049-082416_103	SeepArea32L 1049 082	L1049	1175063.43	3175950.61	24-Aug-16	0.00	0.00	0.14	790.1	22.7	24-08-2016 08:08:48	0	0.001	0.57
SeepArea32-L1049-082416_104	SeepArea32L 1049 082	L1049	1175181.70	3175964.21	24-Aug-16	0.00	0.00	1.67	789.4	22.8	24-08-2016 08:12:22	0	0.001	6.712
SeepArea32-L1049-082416_105	SeepArea32L 1049 082	L1049	1175263.00	3175947.93	24-Aug-16	0.00	0.00	0.27	787.5	22.9	24-08-2016 08:14:57	0	0.002	1.077
SeepArea32-L1049-082416_106	SeepArea32L 1049 082	L1049	1175372.97	3176013.38	24-Aug-16	0.00	0.00	0.10	787.1	23.1	24-08-2016 08:18:36	-4.487	0.002	0.409
SeepArea32-L1049-082416_107	SeepArea32L 1049 082	L1049	1175344.81	3176043.85	24-Aug-16	0.00	0.00	0.18	786.8	23.2	24-08-2016 08:21:23	0	0.003	0.735
SeepArea32-L1049-082416_108	SeepArea32L 1049 082	L1049	1175450.81	3176070.50	24-Aug-16	0.00	0.00	0.06	786.3	23.4	24-08-2016 08:24:23	0	0.002	0.237
SeepArea32-L1049-082416_109	SeepArea32L 1049 082	L1049	1175470.71	3175907.53	24-Aug-16	0.00	0.00	0.19	785.8	23.6	24-08-2016 08:27:56	0	0.004	0.774
SeepArea32-L1049-082416_110	SeepArea32L 1049 082	L1049	1175478.61	3176150.05	24-Aug-16	0.00	0.00	0.78	784.8	23.8	24-08-2016 08:31:29	0	0.003	3.175
SeepArea32-L1049-082416_111	SeepArea32L 1049 082	L1049	1175391.85	3176153.03	24-Aug-16	0.00	0.00	0.31	785.6	24.0	24-08-2016 08:35:38	0	0.002	1.234
SeepArea32-L1049-082416_112	SeepArea32L 1049 082	L1049	1175364.59	3176239.18	24-Aug-16	0.00	0.00	0.17	786.4	24.0	24-08-2016 08:38:22	-1.562	0.003	0.692
SeepArea32-L1049-082416_113	SeepArea32L 1049 082	L1049	1175382.80	3176332.41	24-Aug-16	0.00	0.00	0.19	786.8	24.2	24-08-2016 08:41:27	0	0.004	0.758
SeepArea32-L1049-082416_114	SeepArea32L 1049 082	L1049	1175292.78	3176170.24	24-Aug-16	0.00	0.00	0.09	787.4	24.3	24-08-2016 08:44:35	-0.808	0.003	0.365
SeepArea32-L1049-082416_115	SeepArea32L 1049 082	L1049	1175284.87	3176056.67	24-Aug-16	0.00	0.00	0.05	788.0	24.4	24-08-2016 08:47:20	-0.016	0.002	0.189
SeepArea32-L1049-082416_116	SeepArea32L 1049 082	L1049	1175176.32	3176057.31	24-Aug-16	0.00	0.00	0.17	787.6	24.5	24-08-2016 08:50:15	-0.056	0.003	0.691
SeepArea32-L1049-082416_117	SeepArea32L 1049 082	L1049	1175185.05	3176153.32	24-Aug-16	0.00	0.00	0.29	788.7	24.6	24-08-2016 08:52:41	-1.704	0.002	1.173
SeepArea32-L1049-082416_118	SeepArea32L 1049 082	L1049	1175190.83	3176240.02	24-Aug-16	0.00	0.00	0.36	789.0	24.7	24-08-2016 08:55:05	-1.098	0.003	1.438
SeepArea32-L1049-082416_119	SeepArea32L 1049 082	L1049	1175255.87	3176250.78	24-Aug-16	0.76	0.00	0.73	788.6	24.9	24-08-2016 08:58:24	3.072	0	2.941
SeepArea32-L1049-082416_120	SeepArea32L 1049 082	L1049	1175252.32	3176334.66	24-Aug-16	0.00	0.00	0.23	788.2	25.1	24-08-2016 09:01:01	-3.347	0.005	0.938
SeepArea32-L1049-082416_121	SeepArea32L 1049 082	L1049	1175175.02	3176348.16	24-Aug-16	0.00	0.00	0.39	788.4	25.3	24-08-2016 09:04:01	0	0.004	1.583
SeepArea32-L1049-082416_122	SeepArea32L 1049 082	L1049	1175103.77	3176142.27	24-Aug-16	0.00	0.00	0.18	788.8	25.5	24-08-2016 09:07:22	0	0.004	0.724
SeepArea32-L1049-082416_123	SeepArea32L 1049 082	L1049	1175066.10	3176057.90	24-Aug-16	0.00	0.00	0.50	788.8	25.7	24-08-2016 09:10:56	0	0.003	2.038
SeepArea32-L1049-082416_124	SeepArea32L 1049 082	L1049	1174978.91	3175957.61	24-Aug-16	21.77	0.00	0.25	789.6	26.0	24-08-2016 09:14:21	88.191	0.005	1.032
SeepArea32-L1049-082416_125	SeepArea32L 1049 082	L1049	1174950.47	3176058.81	24-Aug-16	0.00	0.00	0.23	790.5	26.1	24-08-2016 09:17:38	-1.996	0.002	0.925
SeepArea32-L1049-082416_126	SeepArea32L 1049 082	L1049	1174953.57	3176161.69	24-Aug-16	0.00	0.00	0.12	790.9	26.3	24-08-2016 09:20:26	-0.01	0.003	0.489
SeepArea32-L1049-082416_127	SeepArea32L 1049 082	L1049	1174963.40	3176250.08	24-Aug-16	0.81	0.00	0.21	790.5	26.5	24-08-2016 09:23:00	3.276	0.004	0.862
SeepArea32-L1049-082416_128	SeepArea32L 1049 082	L1049	1175068.64	3176256.98	24-Aug-16									



SitePt	Site	AreaAbbrev	Northing	Easting	Date	CH4flux	H2Sflux	CO2flux	PRESSURE (HPa):	TEMP DegC	TIME:	CH4slope	H2Sslope	CO2slope
SeepArea32-L1049-082416_130	SeepArea32L 1049 082	L1049	1175069.92	3176425.27	24-Aug-16	0.00	0.00	0.15	789.6	27.1	24-08-2016 09:32:04	-0.349	0.003	0.617
SeepArea32-L1049-082416_131	SeepArea32L 1049 082	L1049	1175166.66	3176451.11	24-Aug-16	0.00	0.00	0.47	789.8	27.2	24-08-2016 09:34:50	-0.591	0.008	1.892
SeepArea32-L1049-082416_132	SeepArea32L 1049 082	L1049	1175272.31	3176450.15	24-Aug-16	0.00	0.00	0.18	789.4	27.4	24-08-2016 09:38:46	-0.517	0.006	0.736
SeepArea32-L1049-082416_133	SeepArea32L 1049 082	L1049	1175246.98	3176555.89	24-Aug-16	0.00	0.00	0.33	789.4	27.8	24-08-2016 09:41:44	0	0.007	1.365
SeepArea32-L1049-082416_134	SeepArea32L 1049 082	L1049	1175360.38	3176545.16	24-Aug-16	0.00	0.00	0.38	789.6	28.2	24-08-2016 09:44:43	-0.181	0.007	1.554
SeepArea32-L1049-082416_135	SeepArea32L 1049 082	L1049	1175451.98	3176543.23	24-Aug-16	0.00	0.00	0.23	789.6	28.7	24-08-2016 09:48:07	-1.439	0.005	0.937
SeepArea32-L1049-082416_136	SeepArea32L 1049 082	L1049	1175477.99	3176642.77	24-Aug-16	0.00	0.00	0.10	789.4	29.4	24-08-2016 09:51:12	-0.511	0.001	0.412
SeepArea32-L1049-082416_137	SeepArea32L 1049 082	L1049	1175458.79	3176761.85	24-Aug-16	0.00	0.00	0.09	789.1	30.2	24-08-2016 09:55:27	0	0.004	0.388
SeepArea32-L1049-082416_138	SeepArea32L 1049 082	L1049	1175392.52	3176810.46	24-Aug-16	0.00	0.00	0.16	787.5	30.7	24-08-2016 09:58:41	-0.617	0.005	0.641
SeepArea32-L1049-082416_139	SeepArea32L 1049 082	L1049	1175363.48	3176785.04	24-Aug-16	0.00	0.00	0.13	787.2	31.0	24-08-2016 10:01:20	-0.052	0.005	0.54
SeepArea32-L1049-082416_140	SeepArea32L 1049 082	L1049	1175316.72	3176845.66	24-Aug-16	0.00	0.00	0.03	787.2	31.2	24-08-2016 10:04:17	-0.803	0.003	0.143
SeepArea32-L1049-082416_141	SeepArea32L 1049 082	L1049	1175261.35	3176958.67	24-Aug-16	0.00	0.00	0.08	787.4	31.4	24-08-2016 10:07:35	-0.929	0.006	0.318
SeepArea32-L1049-082416_142	SeepArea32L 1049 082	L1049	1175196.15	3177055.27	24-Aug-16	0.00	0.00	0.23	786.3	31.5	24-08-2016 10:10:54	-0.737	0.007	0.956
SeepArea32-L1049-082416_143	SeepArea32L 1049 082	L1049	1175165.22	3177160.82	24-Aug-16	0.00	0.00	0.27	786.4	31.6	24-08-2016 10:14:20	-0.725	0.002	1.111
SeepArea32-L1049-082416_144	SeepArea32L 1049 082	L1049	1175096.78	3177236.16	24-Aug-16	0.00	0.00	0.09	786.7	31.6	24-08-2016 10:18:23	-0.29	0.004	0.354
SeepArea32-L1049-082416_145	SeepArea32L 1049 082	L1049	1175068.01	3177170.72	24-Aug-16	0.00	0.00	0.11	786.7	31.8	24-08-2016 10:22:31	0	0.006	0.463
SeepArea32-L1049-082416_146	SeepArea32L 1049 082	L1049	1175056.57	3177042.96	24-Aug-16	0.00	0.00	0.25	787.2	31.9	24-08-2016 10:25:47	-0.17	0.004	1.018
SeepArea32-L1049-082416_147	SeepArea32L 1049 082	L1049	1175057.03	3176952.34	24-Aug-16	0.43	0.00	0.25	788.4	32.0	24-08-2016 10:28:39	1.795	0.009	1.04
SeepArea32-L1049-082416_148	SeepArea32L 1049 082	L1049	1175174.43	3176941.88	24-Aug-16	0.00	0.00	0.14	788.7	32.4	24-08-2016 10:32:43	0	0.006	0.563
SeepArea32-L1049-082416_149	SeepArea32L 1049 082	L1049	1175168.22	3176860.77	24-Aug-16	0.00	0.00	0.22	787.5	32.7	24-08-2016 10:35:48	-0.557	0.003	0.898
SeepArea32-L1049-082416_150	SeepArea32L 1049 082	L1049	1175147.36	3176764.17	24-Aug-16	0.00	0.00	0.52	789.1	33.0	24-08-2016 10:39:32	-0.359	0.01	2.164
SeepArea32-L1049-082416_151	SeepArea32L 1049 082	L1049	1175239.84	3176769.70	24-Aug-16	2.81	0.00	0.19	789.1	33.5	24-08-2016 10:42:37	11.682	0.008	0.788
SeepArea32-L1049-082416_152	SeepArea32L 1049 082	L1049	1175375.36	3176673.72	24-Aug-16	6.35	0.00	0.68	788.4	33.9	24-08-2016 10:46:16	26.425	0.01	2.836
SeepArea32-L1049-082416_153	SeepArea32L 1049 082	L1049	1175262.32	3176644.96	24-Aug-16	1.80	0.00	3.49	788.8	34.3	24-08-2016 10:49:15	7.496	0.013	14.561
SeepArea32-L1049-082416_154	SeepArea32L 1049 082	L1049	1175145.42	3176647.17	24-Aug-16	0.00	0.00	0.33	789.4	38.0	24-08-2016 11:12:43	0	-0.008	1.392
SeepArea32-L1049-082416_155	SeepArea32L 1049 082	L1049	1175152.56	3176565.10	24-Aug-16	2.34	0.00	1.02	789.4	38.3	24-08-2016 11:16:26	9.891	0.009	4.307
SeepArea32-L1049-082416_156	SeepArea32L 1049 082	L1049	1175036.80	3176553.83	24-Aug-16	8.54	0.00	2.41	789.5	38.5	24-08-2016 11:19:09	36.036	0.021	10.171
SeepArea32-L1049-082416_157	SeepArea32L 1049 082	L1049	1175054.63	3176656.69	24-Aug-16	5.66	0.00	1.66	789.7	38.6	24-08-2016 11:21:47	23.882	0.016	7.024
SeepArea32-L1049-082416_158	SeepArea32L 1049 082	L1049	1175035.12	3176747.89	24-Aug-16	8.42	0.01	2.29	789.5	38.9	24-08-2016 11:24:42	35.578	0.026	9.69
SeepArea32-L1049-082416_159	SeepArea32L 1049 082	L1049	1175040.71	3176850.42	24-Aug-16	0.75	0.00	0.79	789.3	39.2	24-08-2016 11:27:58	3.172	0.015	3.353
SeepArea32-L1049-082416_160	SeepArea32L 1049 082	L1049	1174939.33	3176833.46	24-Aug-16	0.00	0.00	0.36	789.1	39.5	24-08-2016 11:30:42	-0.869	0.009	1.527
SeepArea32-L1049-082416_161	SeepArea32L 1049 082	L1049	1174937.63	3176756.80	24-Aug-16	0.00	0.00	0.16	789.5	39.7	24-08-2016 11:33:07	-1.094	0.007	0.684
SeepArea32-L1049-082416_162	SeepArea32L 1049 082	L1049	1174968.02	3176662.02	24-Aug-16	0.00	0.00	0.21	789.5	40.0	24-08-2016 11:35:43	-0.233	0.011	0.885
SeepArea32-L1049-082416_163	SeepArea32L 1049 082	L1049	1174946.73	3176553.70	24-Aug-16	0.00	0.00	0.75	789.7	40.3	24-08-2016 11:38:11	-2.307	0.007	3.195
SeepArea32-L1049-082416_164	SeepArea32L 1049 082	L1049	1174960.77	3176449.34	24-Aug-16	13.33	0.00	0.34	789.5	40.6	24-08-2016 11:40:51	56.63	0.017	1.427
SeepArea32-L1049-082416_165	SeepArea32L 1049 082	L1049	1174967.01	3176341.58	24-Aug-16	0.62	0.00	0.13	789.5	40.7	24-08-2016 11:43:27	2.656	0.005	0.539
SeepArea32-L1049-082416_166	SeepArea32L 1049 082	L1049	1174852.16	3176265.54	24-Aug-16	0.00	0.00	0.03	789.8	40.9	24-08-2016 11:46:10	-0.74	0.001	0.115
SeepArea32-L1049-082416_167	SeepArea32L 1049 082	L1049	1174874.80	3176362.17	24-Aug-16	0.00	0.00	0.28	789.8	41.0	24-08-2016 11:48:59	-1.364	0.004	1.171
SeepArea32-L1049-082416_168	SeepArea32L 1049 082	L1049	1174854.93	3176444.78	24-Aug-16	0.00	0.00	0.40	789.8	41.2	24-08-2016 11:51:40	-0.132	0.007	1.717
SeepArea32-L1049-082416_169	SeepArea32L 1049 082	L1049	1174856.34	3176560.16	24-Aug-16	0.87	0.00	0.53	789.8	41.3	24-08-2016 11:54:07	3.708	0.014	2.246
SeepArea32-L1049-082416_170	SeepArea32L 1049 082	L1049	1174860.44	3176658.54	24-Aug-16	0.00	0.00	0.08	789.8	41.4	24-08-2016 11:56:31	-0.585	0.005	0.332
SeepArea32-L1049-082416_171	SeepArea32L 1049 082	L1049	1174850.91	3176765.98	24-Aug-16	0.00	0.00	0.19	789.5	41.3	24-08-2016 11:58:55	-0.135	0.013	0.812
SeepArea32-L1049-082416_172	SeepArea32L 1049 082	L1049	1174750.30	3176764.87	24-Aug-16	31.11	0.00	0.41	789.8	41.2	24-08-2016 12:01:24	132.371	0.004	1.726
SeepArea32-L1049-082416_173	SeepArea32L 1049 082	L1049	1174754.39	3176649.61	24-Aug-16	0.97	0.00	2.32	790.0	41.1	24-08-2016 12:03:48	4.105	0.001	9.86
SeepArea32-L1049-082416_174	SeepArea32L 1049 082	L1049	1174759.75	3176571.26	24-Aug-16	1.01	0.00	0.57	789.8	40.8	24-08-2016 12:06:27	4.307	0.002	2.408
SeepArea32-L1049-082416_175	SeepArea32L 1049 082	L1049	1174770.23	3176448.63	24-Aug-16	0.00	0.00	0.10	790.0	40.6	24-08-2016 12:08:49	-0.252	0.007	0.41
SeepArea32-L1049-082416_176	SeepArea32L 1049 082	L1049	1174668.94	3176942.98	24-Aug-16	0.00	0.00	0.48	789.9	37.7	24-08-2016 13:15:38	-2.485	0.006	2.03
SeepArea32-L1049-082416_177	SeepArea32L 1049 082	L1049	1174768.31	3176963.03	24-Aug-16	0.00	0.00	0.19	789.8	37.5	24-08-2016 13:18:06	0	0.008	0.808
SeepArea32-L1049-082416_178	SeepArea32L 1049 082	L1049	1174776.44	3176853.74	24-Aug-16	0.00	0.00	0.05	789.8	37.4	24-08-2016 13:20:23	0	0.009	0.205
SeepArea32-L1049-082416_179	SeepArea32L 1049 082	L1049	1174853.55	3176867.59	24-Aug-16	0.00	0.00	0.09	789.5	37.3	24-08-2016 13:22:38	0	0.007	0.384
SeepArea32-L1049-082416_180	SeepArea32L 1049 082	L1049	1174856.50	3176952.51	24-Aug-16	0.00	0.00	0.52	789.7	37.3	24-08-2016 13:24:53	0	0.016	2.19
SeepArea32-L1049-082416_181	SeepArea32L 1049 082	L1049	1174963.21	3176971.15	24-Aug-16	0.00	0.00	0.67	789.1	37.3	24-08-2016 13:27:18	0	0.007	2.815
SeepArea32-L1049-082416_182	SeepArea32L 1049 082	L1049	1174957.04	3177050.63	24-Aug-16	0.00	0.00	1.22	788.7	37.4	24-08-2016 13:29:44	0	0.01	5.142
SeepArea32-L1049-082416_183	SeepArea32L 1049 082	L1049	1174944.59	3177159.04	24-Aug-16	6.19	0.00	0.37	788.6	37.4	24-08-2016 13:32:14	26.044	0.012	1.566
SeepArea32-L1049-082416_184	SeepArea32L 1049 082	L1049	1174956.07	3177251.45	24-Aug-16	0.00	0.00	0.04	788.3	37.5	24-08-2016 13:35:11	0	0.003	0.156
SeepArea32-L1049-082416_185	SeepArea32L 1049 082	L1049	1174948.74	3177345.47	24-Aug-16	0.00	0.00	0.15	787.9	37.7	24-08-2016 13:38:02	0	0.008	0.65
SeepArea32-L1049-082416_186	SeepArea32L 1049 082	L1049	1174980.55	3177426.17	24-Aug-16	0.00	0.00	0.11	787.7	37.7	24-08-2016 13:40:48	0	0.006	0.452
SeepArea32-L1049-082416_187	SeepArea32L 1049 082	L1049	1174876.79	3177535.03	24-Aug-16	0.00	0.00	0.32	787.5	37.8	24-08-2016 13:44:13	-3.135	0.008	1.347
SeepArea32-L1049-082416_188	SeepArea32L 1049 082	L1049	1174811.61	3177661.15	24-Aug-16	0.00	0.00	0.21	787.2	37.8	24-08-2016 13:47:30	-2.336	0.01	0.868
SeepArea32-L1049-082416_189	SeepArea32L 1049 082	L1049	1174795.79	3177564.53	24-Aug-16	0.00	0.00	1.20	788.2	37.7	24-08-2016 13:50:20	0	0.007	5.07
SeepArea32-L1049-082416_190	SeepArea32L 1049 082	L1049	1174871.35	3177440.68	24-Aug-16	0.00	0.00	0.05	787.8	37.7	24-08-2016 13:53:39	0	0.004	0.21
SeepArea3														

SitePt	Site	AreaAbbrev	Northing	Easting	Date	CH4flux	H2Sflux	CO2flux	PRESSURE (HPa):	TEMP DegC	TIME:	CH4slope	H2Sslope	CO2slope
SeepArea32-L1049-082416_193	SeepArea32L 1049 082	L1049	1174875.76	3177160.48	24-Aug-16	0.00	0.00	0.61	788.7	37.3	24-08-2016 14:02:49	0	0.006	2.583
SeepArea32-L1049-082416_194	SeepArea32L 1049 082	L1049	1174869.35	3177061.11	24-Aug-16	0.00	0.00	1.52	789.1	37.2	24-08-2016 14:05:41	0	0.006	6.392
SeepArea32-L1049-082416_195	SeepArea32L 1049 082	L1049	1174765.80	3177051.14	24-Aug-16	0.00	0.00	0.25	789.1	37.0	24-08-2016 14:09:03	0	0.009	1.033
SeepArea32-L1049-082416_196	SeepArea32L 1049 082	L1049	1174758.53	3177152.27	24-Aug-16	0.00	0.00	0.37	789.6	36.9	24-08-2016 14:11:37	0	0.005	1.562
SeepArea32-L1049-082416_197	SeepArea32L 1049 082	L1049	1174764.62	3177270.53	24-Aug-16	0.00	0.00	0.33	789.5	36.7	24-08-2016 14:14:27	0	0.006	1.39
SeepArea32-L1049-082416_198	SeepArea32L 1049 082	L1049	1174764.18	3177357.63	24-Aug-16	0.00	0.00	0.40	789.3	36.3	24-08-2016 14:18:51	-4.913	0.002	1.659
SeepArea32-L1049-082416_199	SeepArea32L 1049 082	L1049	1174751.85	3177462.86	24-Aug-16	0.00	0.00	0.36	789.3	36.0	24-08-2016 14:21:43	0	0.003	1.513
SeepArea32-L1049-082416_200	SeepArea32L 1049 082	L1049	1174688.33	3177537.03	24-Aug-16	0.00	0.00	0.39	789.4	35.8	24-08-2016 14:24:19	0	0.002	1.623
SeepArea32-L1049-082416_201	SeepArea32L 1049 082	L1049	1174673.64	3177634.53	24-Aug-16	0.00	0.00	0.61	789.5	35.6	24-08-2016 14:26:55	-0.143	0.004	2.532
SeepArea32-L1049-082416_202	SeepArea32L 1049 082	L1049	1174664.24	3177753.53	24-Aug-16	0.00	0.00	1.31	789.6	35.4	24-08-2016 14:29:24	-0.156	0.005	5.468
SeepArea32-L1049-082416_203	SeepArea32L 1049 082	L1049	1174589.60	3177844.42	24-Aug-16	0.00	0.00	0.08	789.4	35.3	24-08-2016 14:32:11	0	0.004	0.329
SeepArea32-L1049-082416_204	SeepArea32L 1049 082	L1049	1174584.62	3177766.56	24-Aug-16	0.00	0.00	0.15	789.8	35.2	24-08-2016 14:34:33	-0.894	0.006	0.626
SeepArea32-L1049-082416_205	SeepArea32L 1049 082	L1049	1174592.05	3177648.79	24-Aug-16	0.00	0.00	0.35	789.8	35.0	24-08-2016 14:38:13	-9.205	-0.003	1.447
SeepArea32-L1049-082416_206	SeepArea32L 1049 082	L1049	1174584.52	3177538.13	24-Aug-16	0.77	0.00	0.67	789.8	34.9	24-08-2016 14:41:37	3.208	0.005	2.774
SeepArea32-L1049-082416_207	SeepArea32L 1049 082	L1049	1174573.04	3177463.68	24-Aug-16	0.00	0.00	0.24	790.1	34.8	24-08-2016 14:44:29	-3.243	0.002	1.008
SeepArea32-L1049-082416_208	SeepArea32L 1049 082	L1049	1174649.46	3177438.99	24-Aug-16	0.00	0.00	0.10	790.1	34.7	24-08-2016 14:47:00	0	0.002	0.432
SeepArea32-L1049-082416_209	SeepArea32L 1049 082	L1049	1174666.03	3177361.94	24-Aug-16	0.00	0.00	0.18	789.8	34.6	24-08-2016 14:49:14	0	0.003	0.753
SeepArea32-L1049-082416_210	SeepArea32L 1049 082	L1049	1174656.21	3177253.97	24-Aug-16	0.00	0.00	0.38	789.6	34.5	24-08-2016 14:51:53	-0.229	0.004	1.564
SeepArea32-L1049-082416_211	SeepArea32L 1049 082	L1049	1174665.97	3177162.52	24-Aug-16	0.00	0.00	0.55	790.2	34.3	24-08-2016 14:54:22	-1.51	0.003	2.282
SeepArea32-L1049-082416_212	SeepArea32L 1049 082	L1049	1174655.69	3177057.12	24-Aug-16	1.10	0.00	0.82	790.3	34.2	24-08-2016 14:56:48	4.575	0.003	3.4
SeepArea32-L1049-082416_213	SeepArea32L 1049 082	L1049	1174565.82	3177157.93	24-Aug-16	0.00	0.00	0.40	790.6	34.0	24-08-2016 15:00:13	0	0.002	1.673
SeepArea32-L1049-082416_214	SeepArea32L 1049 082	L1049	1174545.82	3177231.91	24-Aug-16	0.00	0.00	0.13	791.0	33.9	24-08-2016 15:02:46	-0.64	0.002	0.525
SeepArea32-L1049-082416_215	SeepArea32L 1049 082	L1049	1174551.13	3177346.33	24-Aug-16	0.00	0.00	0.22	791.0	33.7	24-08-2016 15:05:52	-1.099	0.003	0.902
SeepArea32-L1049-082416_216	SeepArea32L 1049 082	L1049	1174461.64	3177446.04	24-Aug-16	0.00	0.00	0.38	790.7	33.5	24-08-2016 15:08:55	0	0.003	1.569
SeepArea32-L1049-082416_217	SeepArea32L 1049 082	L1049	1174467.60	3177561.98	24-Aug-16	14.58	0.00	0.30	790.9	33.4	24-08-2016 15:13:27	60.407	0.012	1.228
SeepArea32-L1049-082416_218	SeepArea32L 1049 082	L1049	1174468.84	3177637.60	24-Aug-16	0.00	0.00	0.16	790.7	33.2	24-08-2016 15:16:00	0	0	0.682
SeepArea32-L1049-082416_219	SeepArea32L 1049 082	L1049	1174467.61	3177749.40	24-Aug-16	0.00	0.00	0.86	790.6	33.1	24-08-2016 15:18:38	-1.067	0.01	3.55
SeepArea32-L1049-082416_220	SeepArea32L 1049 082	L1049	1174470.09	3177847.16	24-Aug-16	0.93	0.00	0.44	790.3	33.0	24-08-2016 15:21:08	3.847	0.003	1.832
SeepArea32-L1049-082416_221	SeepArea32L 1049 082	L1049	1174452.39	3177945.87	24-Aug-16	0.00	0.00	1.87	790.3	32.8	24-08-2016 15:23:43	-0.585	0.002	7.735
SeepArea32-L1049-082416_222	SeepArea32L 1049 082	L1049	1174477.82	3178031.88	24-Aug-16	0.00	0.00	0.06	790.5	32.7	24-08-2016 15:26:19	-0.601	0.001	0.24
SeepArea32-L1049-082416_223	SeepArea32L 1049 082	L1049	1174445.90	3178141.58	24-Aug-16	0.00	0.00	0.16	790.5	32.6	24-08-2016 15:28:52	-1.931	0.001	0.655
SeepArea32-L1049-082416_224	SeepArea32L 1049 082	L1049	1174483.94	3178263.09	24-Aug-16	0.00	0.00	0.12	790.3	32.5	24-08-2016 15:31:55	0	0.002	0.493
SeepArea32-L1049-082416_225	SeepArea32L 1049 082	L1049	1174358.50	3178235.65	24-Aug-16	0.00	0.00	0.10	790.2	32.4	24-08-2016 15:35:48	0	0.004	0.417
SeepArea32-L1049-082416_226	SeepArea32L 1049 082	L1049	1174358.28	3178161.28	24-Aug-16	0.00	0.00	1.33	790.7	32.2	24-08-2016 15:38:08	-0.474	0.001	5.498
SeepArea32-L1049-082416_227	SeepArea32L 1049 082	L1049	1174356.17	3178039.35	24-Aug-16	0.00	0.00	1.27	790.9	32.1	24-08-2016 15:40:39	0	0.002	5.228
SeepArea32-L1049-082416_228	SeepArea32L 1049 082	L1049	1174355.00	3177945.19	24-Aug-16	0.00	0.00	1.83	790.9	32.0	24-08-2016 15:42:58	-0.022	0.003	7.54
SeepArea32-L1049-082416_229	SeepArea32L 1049 082	L1049	1174374.45	3177856.56	24-Aug-16	0.00	0.00	0.92	790.7	31.9	24-08-2016 15:45:22	-0.236	0.001	3.795
SeepArea32-L1049-082416_230	SeepArea32L 1049 082	L1049	1174358.72	3177747.32	24-Aug-16	3.38	0.00	1.58	790.9	31.8	24-08-2016 15:48:09	13.93	0.002	6.502
SeepArea32-L1049-082416_231	SeepArea32L 1049 082	L1049	1174370.45	3177651.98	24-Aug-16	0.00	0.00	2.06	791.0	31.7	24-08-2016 15:51:15	0	0.003	8.498
SeepArea32-L1049-082416_232	SeepArea32L 1049 082	L1049	1174249.32	3177944.55	24-Aug-16	0.00	0.00	0.00	791.0	31.7	24-08-2016 15:56:12	-2.843	0.001	-4.147
SeepArea32-L1049-082416_233	SeepArea32L 1049 082	L1049	1174263.64	3178045.88	24-Aug-16	0.00	0.00	0.19	791.3	31.6	24-08-2016 15:58:52	0	0.002	0.77
SeepArea32-L1049-082416_234	SeepArea32L 1049 082	L1049	1174253.84	3178147.76	24-Aug-16	0.00	0.00	1.31	791.5	31.5	24-08-2016 16:01:30	-1.152	0.002	5.387
SeepArea32-L1049-082416_235	SeepArea32L 1049 082	L1049	1174252.64	3178238.47	24-Aug-16	0.00	0.00	0.03	791.3	31.4	24-08-2016 16:03:56	-0.342	0.001	0.113
SeepArea32-L1049-082416_236	SeepArea32L 1049 082	L1049	1174154.11	3178162.90	24-Aug-16	0.00	0.00	0.45	791.5	31.3	24-08-2016 16:06:33	-0.019	0.002	1.864
SeepArea32-L1049-082416_237	SeepArea32L 1049 082	L1049	1174170.78	3178071.05	24-Aug-16	0.00	0.00	0.07	791.7	31.2	24-08-2016 16:09:27	0	0.002	0.281
SeepArea32-L1049-082416_238	SeepArea32L 1049 082	L1049	1174265.31	3177849.01	24-Aug-16	0.00	0.00	0.27	791.7	31.2	24-08-2016 16:12:28	0	0.002	1.127
SeepArea32-L1049-082416_97	SeepArea32L 1049 082	L1049	1174877.30	3176142.12	24-Aug-16	0.00	0.00	0.19	790.9	21.3	24-08-2016 07:52:00	0	-0.008	0.748
SeepArea32-L1049-082416_98	SeepArea32L 1049 082	L1049	1174879.36	3176063.98	24-Aug-16	0.00	0.00	0.17	791.0	21.7	24-08-2016 07:54:38	0	-0.001	0.663
SeepArea32-L1049-082416_99	SeepArea32L 1049 082	L1049	1174835.49	3175940.78	24-Aug-16	0.00	0.00	0.16	791.1	22.0	24-08-2016 07:57:40	0	0.001	0.633
SeepArea-L1021-082516_01	SeepAreaL 1021 08251	L1021	1173914.70	3178408.89	25-Aug-16	0.00	0.00	0.30	791.8	27.8	25-08-2016 13:04:58	-2.554	0.006	1.228
SeepArea-L1021-082516_02	SeepAreaL 1021 08251	L1021	1173859.75	3178441.56	25-Aug-16	0.00	0.00	2.78	792.4	28.2	25-08-2016 13:07:38	0	0.002	11.302
SeepArea-L1021-082516_03	SeepAreaL 1021 08251	L1021	1173842.67	3178419.07	25-Aug-16	10.46	0.00	12.32	792.4	28.5	25-08-2016 13:09:42	42.555	0.007	50.14
SeepArea-L1021-082516_04	SeepAreaL 1021 08251	L1021	1173799.94	3178401.91	25-Aug-16	0.00	0.00	0.31	792.4	28.8	25-08-2016 13:11:47	-1.671	0.005	1.266
SeepArea-L1021-082516_05	SeepAreaL 1021 08251	L1021	1173807.86	3178454.69	25-Aug-16	0.00	0.00	0.12	795.3	29.1	25-08-2016 13:13:53	-0.66	0.004	0.507
SeepArea-L1021-082516_06	SeepAreaL 1021 08251	L1021	1173801.89	3178509.91	25-Aug-16	0.00	0.00	0.15	792.5	29.4	25-08-2016 13:16:47	-0.084	0.014	0.597
SeepArea-L1021-082516_07	SeepAreaL 1021 08251	L1021	1173848.83	3178511.38	25-Aug-16	0.00	0.00	0.15	792.4	29.7	25-08-2016 13:19:01	-1.186	-0.003	0.602
SeepArea-L1021-082516_08	SeepAreaL 1021 08251	L1021	1173897.26	3178472.81	25-Aug-16	0.00	0.00	0.26	792.2	29.9	25-08-2016 13:21:16	-2.44	0.001	1.077
SeepArea-L1021-082516_09	SeepAreaL 1021 08251	L1021	1173895.60	3178519.43	25-Aug-16	0.00	0.00	0.22	792.2	30.0	25-08-2016 13:23:19	-3.382	0.003	0.892
SeepArea-L1021-082516_10	SeepAreaL 1021 08251	L1021	1173900.75	3178556.40	25-Aug-16	0.00	0.00	0.50	792.2	30.2	25-08-2016 13:25:32	-1.742	0.004	2.065
SeepArea-L1021-082516_11	SeepAreaL 1021 08251	L1021	1173922.97	3178569.77	25-Aug-16	0.00	0.00	0.39	792.1	30.3	25-08-2016 13:27:42	-0.703	0.004	1.615
SeepArea-L1021-082516_12	SeepAreaL 1021 08251	L1021	1173901.10	3178615.38	25-Aug-16	0.00	0.00	0.48	792.1	30.5	25-08-2016 13:29:57	-0.728	0.002	1.974
SeepArea-L1021-082516_13	SeepAreaL 1021 08251	L1021	1173887.19	3178664.97										

APPENDIX B - FLUX DATA

SitePt	Site	AreaAbbrev	Northing	Easting	Date	CH4flux	H2Sflux	CO2flux	PRESSURE (HPa):	TEMP DegC	TIME:	CH4slope	H2Sslope	CO2slope
SeepArea-L1021-082516_15	SeepAreaL 1021 08251	L1021	1173878.83	3178776.76	25-Aug-16	0.00	0.00	0.47	792.5	31.0	25-08-2016 13:36:48	-1.044	0.003	1.922
SeepArea-L1021-082516_16	SeepAreaL 1021 08251	L1021	1173863.67	3178874.74	25-Aug-16	0.00	0.00	0.58	792.5	31.4	25-08-2016 13:41:39	-0.547	0.003	2.376
SeepArea-L1021-082516_17	SeepAreaL 1021 08251	L1021	1173877.56	3178816.93	25-Aug-16	0.00	0.00	0.62	792.4	31.4	25-08-2016 13:44:08	0	0.004	2.534
SeepArea-L1021-082516_18	SeepAreaL 1021 08251	L1021	1173910.51	3178864.29	25-Aug-16	0.00	0.00	0.23	792.2	31.6	25-08-2016 13:48:48	-2.382	-0.001	0.948
SeepArea-L1021-082516_19	SeepAreaL 1021 08251	L1021	1173935.14	3178830.37	25-Aug-16	1.88	0.00	1.38	792.4	31.7	25-08-2016 13:51:31	7.73	0.004	5.676
SeepArea-L1021-082516_20	SeepAreaL 1021 08251	L1021	1173960.59	3178834.79	25-Aug-16	0.67	0.00	0.99	792.2	31.9	25-08-2016 13:54:54	2.766	0.005	4.07
SeepArea-L1021-082516_21	SeepAreaL 1021 08251	L1021	1173965.77	3178793.78	25-Aug-16	0.00	0.00	0.38	791.5	32.1	25-08-2016 13:59:30	-0.186	0	1.576
SeepArea-L1021-082516_22	SeepAreaL 1021 08251	L1021	1174007.83	3178780.94	25-Aug-16	0.00	0.00	0.51	791.4	32.1	25-08-2016 14:01:54	-0.073	0.004	2.123
SeepArea-L1021-082516_23	SeepAreaL 1021 08251	L1021	1174014.04	3178820.28	25-Aug-16	0.00	0.00	0.73	791.4	32.2	25-08-2016 14:04:06	-0.241	0.004	3.026
SeepArea-L1021-082516_24	SeepAreaL 1021 08251	L1021	1174012.51	3178867.96	25-Aug-16	0.00	0.00	0.09	791.4	32.3	25-08-2016 14:06:19	-0.109	0.005	0.381
SeepArea-L1021-082516_25	SeepAreaL 1021 08251	L1021	1173971.24	3178883.16	25-Aug-16	0.00	0.00	0.46	791.5	32.4	25-08-2016 14:09:00	0	0.005	1.914
SeepArea-L1021-082516_26	SeepAreaL 1021 08251	L1021	1174008.39	3178729.82	25-Aug-16	0.00	0.00	0.79	791.5	32.7	25-08-2016 14:12:50	-0.678	0.005	3.281
SeepArea-L1021-082516_27	SeepAreaL 1021 08251	L1021	1174000.11	3178663.00	25-Aug-16	0.00	0.00	0.36	791.9	32.8	25-08-2016 14:15:24	-0.273	0.004	1.491
SeepArea-L1021-082516_28	SeepAreaL 1021 08251	L1021	1174005.05	3178613.68	25-Aug-16	0.00	0.00	0.69	791.9	32.8	25-08-2016 14:17:42	-0.326	0.006	2.831
SeepArea-L1021-082516_29	SeepAreaL 1021 08251	L1021	1174004.60	3178563.12	25-Aug-16	0.00	0.00	0.82	791.8	32.9	25-08-2016 14:20:08	-0.694	0.006	3.403
SeepArea-L1021-082516_30	SeepAreaL 1021 08251	L1021	1173975.74	3178572.33	25-Aug-16	0.00	0.00	0.08	792.1	33.2	25-08-2016 14:23:27	-0.081	0.008	0.341
SeepArea-L1021-082516_31	SeepAreaL 1021 08251	L1021	1173969.68	3178626.50	25-Aug-16	31.91	0.00	3.83	792.2	33.3	25-08-2016 14:25:41	131.99	0.009	15.826
SeepArea-L1021-082516_32	SeepAreaL 1021 08251	L1021	1173956.52	3178674.88	25-Aug-16	1.12	0.00	0.83	792.4	33.5	25-08-2016 14:28:46	4.614	0.009	3.426
SeepArea-L1021-082516_33	SeepAreaL 1021 08251	L1021	1173961.06	3178719.66	25-Aug-16	3.71	0.00	1.63	792.4	33.8	25-08-2016 14:31:12	15.372	0.008	6.745
SeepArea-L1021-082516_34	SeepAreaL 1021 08251	L1021	1174206.48	3178918.80	25-Aug-16	0.00	0.00	0.59	792.1	35.2	25-08-2016 14:42:37	-0.245	0.008	2.447
SeepArea-L1021-082516_35	SeepAreaL 1021 08251	L1021	1174237.60	3178828.02	25-Aug-16	0.00	0.00	0.03	790.5	35.4	25-08-2016 14:45:15	-0.009	0.012	0.144
SeepAreaL-1030_082316_03	SeepAreaL-1030 08231	L1030	1146358.68	3164721.25	23-Aug-16	0.00	0.00	0.30	779.4	30.1	23-08-2016 10:54:26	-0.201	0.015	1.231
SeepAreaL-1030-082316_01	SeepAreaL-1030 82316	L1030	1146313.83	3164651.28	23-Aug-16	0.00	0.00	0.28	779.1	28.1	23-08-2016 10:47:30	0	0.006	1.166
SeepAreaL-1030-082316_02	SeepAreaL-1030 08231	L1030	1146359.97	3164666.30	23-Aug-16	0.00	0.01	0.46	779.1	29.0	23-08-2016 10:50:57	0	0.026	1.903
SeepAreaL-1030-082316_04	SeepAreaL-1030 08231	L1030	1146359.21	3164761.06	23-Aug-16	0.30	0.00	0.38	779.4	31.1	23-08-2016 10:57:43	1.235	0.018	1.576
SeepAreaL-1030-082316_05	SeepAreaL-1030 08231	L1030	1146364.46	3164824.70	23-Aug-16	0.00	0.00	0.38	779.4	31.1	23-08-2016 10:57:55	-0.287	0.018	1.576
SeepAreaL-1030-082316_06	SeepAreaL-1030 08231	L1030	1146315.87	3164798.76	23-Aug-16	0.00	0.01	0.32	779.7	32.2	23-08-2016 11:00:49	-0.441	0.024	1.342
SeepAreaL-1030-082316_07	SeepAreaL-1030 08231	L1030	1146309.45	3164773.26	23-Aug-16	0.00	0.01	0.56	779.5	33.1	23-08-2016 11:03:56	-0.672	0.031	2.365
SeepAreaL-1030-082316_08	SeepAreaL-1030 08231	L1030	1146320.46	3164730.67	23-Aug-16	11.04	0.01	2.99	779.3	33.8	23-08-2016 11:06:31	46.513	0.026	12.602
SeepAreaL-1030-082316_09	SeepAreaL-1030 08231	L1030	1146286.10	3164753.32	23-Aug-16	0.00	0.00	0.41	779.1	35.7	23-08-2016 11:13:29	0	0.019	1.745
SeepAreaL-1030-082316_10	SeepAreaL-1030 08231	L1030	1146255.42	3164759.45	23-Aug-16	10.44	0.01	1.07	779.1	36.5	23-08-2016 11:17:24	44.361	0.029	4.557
SeepAreaL-1030-082316_11	SeepAreaL-1030 08231	L1030	1146256.84	3164720.65	23-Aug-16	0.00	0.00	0.00	779.1	37.3	23-08-2016 11:21:03	-5.925	-0.036	-3.302
SeepAreaL-1030-082316_12	SeepAreaL-1030 08231	L1030	1146263.27	3164666.02	23-Aug-16	0.00	0.00	0.31	779.0	37.7	23-08-2016 11:24:57	-0.301	-0.002	1.323
SeepAreaL-1030-082316_13	SeepAreaL-1030 08231	L1030	1146202.25	3164667.09	23-Aug-16	0.00	0.00	0.14	778.7	38.1	23-08-2016 11:29:16	-0.382	0.021	0.603
SeepAreaL-1030-082316_14	SeepAreaL-1030 08231	L1030	1146216.28	3164707.53	23-Aug-16	0.00	0.01	0.53	778.7	38.6	23-08-2016 11:32:51	0	0.03	2.276
SeepAreaL-1030-082316_15	SeepAreaL-1030 08231	L1030	1146210.09	3164776.21	23-Aug-16	0.10	0.00	0.27	778.7	39.2	23-08-2016 11:36:58	0.44	0.014	1.151
SeepAreaL-1030-082316_16	SeepAreaL-1030 08231	L1030	1146203.42	3164824.34	23-Aug-16	0.00	0.01	0.17	778.9	39.5	23-08-2016 11:40:16	-0.318	0.023	0.729
SeepAreaL-1030-082316_17	SeepAreaL-1030 08231	L1030	1146097.88	3164855.76	23-Aug-16	0.00	0.00	0.08	778.7	39.6	23-08-2016 11:44:22	0	0.019	0.35
SeepAreaL-1030-082316_18	SeepAreaL-1030 08231	L1030	1146259.43	3164823.04	23-Aug-16	0.00	0.00	0.01	778.8	39.6	23-08-2016 11:47:49	0	0.007	0.046



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



---

# Grid Volume Computations

---

Fri Sep 16 11:51:58 2016

## Upper Surface

Grid File Name:	P:\XTO Energy\608\2016 Survey\Surfer\L1021_CH4_notail.grd
Grid Size:	38 rows x 45 columns
X Minimum:	3178301.347
X Maximum:	3178968.803
X Spacing:	15.169454545449
Y Minimum:	1173748.814
Y Maximum:	1174297.602
Y Spacing:	14.832108108107
Z Minimum:	0
Z Maximum:	26.183054506229

## Lower Surface

Level Surface defined by  $Z = 0$

## Volumes

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

### Total Volumes by:

Trapezoidal Rule:	12587.562316358
Simpson's Rule:	12595.790859686
Simpson's 3/8 Rule:	12553.947185822

### Cut & Fill Volumes

Positive Volume [Cut]:	12587.562316358
Negative Volume [Fill]:	0
Net Volume [Cut-Fill]:	12587.562316358

## Areas

### Planar Areas

Positive Planar Area [Cut]:	189445.78137717
Negative Planar Area [Fill]:	0

Blanked Planar Area:	176846.06195066
Total Planar Area:	366291.84332784

**Surface Areas**

Positive Surface Area [Cut]:	189455.99450388
Negative Surface Area [Fill]:	0



---

# Grid Volume Computations

---

Fri Sep 16 11:52:30 2016

## Upper Surface

Grid File Name:	P:\XTO Energy\608\2016 Survey\Surfer\L1030_CH4_notail.grd
Grid Size:	25 rows x 21 columns
X Minimum:	3164601.28
X Maximum:	3164905.765
X Spacing:	15.224250000017
Y Minimum:	1146047.882
Y Maximum:	1146414.464
Y Spacing:	15.274249999997
Z Minimum:	0
Z Maximum:	8.9502275846768

## Lower Surface

Level Surface defined by  $Z = 0$

## Volumes

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

### Total Volumes by:

Trapezoidal Rule:	4795.9881603108
Simpson's Rule:	4782.2380459969
Simpson's 3/8 Rule:	4794.2447555136

### Cut & Fill Volumes

Positive Volume [Cut]:	4795.9881603108
Negative Volume [Fill]:	0
Net Volume [Cut-Fill]:	4795.9881603108

## Areas

### Planar Areas

Positive Planar Area [Cut]:	77319.217687103
Negative Planar Area [Fill]:	0

Blanked Planar Area:	34299.502583001
Total Planar Area:	111618.7202701

**Surface Areas**

Positive Surface Area [Cut]:	77321.073349513
Negative Surface Area [Fill]:	0

---

# Grid Volume Computations

---

Fri Sep 16 11:52:50 2016

## Upper Surface

Grid File Name:	P:\XTO Energy\608\2016 Survey\Surfer\L1049_CH4_notail.grd
Grid Size:	65 rows x 113 columns
X Minimum:	3175115.209
X Maximum:	3178462.234
X Spacing:	29.884151785718
Y Minimum:	1173657.917
Y Maximum:	1175578.613
Y Spacing:	30.010875
Z Minimum:	0
Z Maximum:	27.600125125098

## Lower Surface

Level Surface defined by  $Z = 0$

## Volumes

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

### Total Volumes by:

Trapezoidal Rule:	182406.90221517
Simpson's Rule:	182442.69974753
Simpson's 3/8 Rule:	182674.12530114

### Cut & Fill Volumes

Positive Volume [Cut]:	182406.90221517
Negative Volume [Fill]:	0
Net Volume [Cut-Fill]:	182406.90221517

## Areas

### Planar Areas

Positive Planar Area [Cut]:	3222828.8353657
Negative Planar Area [Fill]:	0



Blanked Planar Area:	3205788.694035
Total Planar Area:	6428617.5294007

### **Surface Areas**

Positive Surface Area [Cut]:	3222857.1860017
Negative Surface Area [Fill]:	0

**APPENDIX D**  
**NATURAL SPRING ANALYTICAL RESULTS**



### Technical Report for

### LT Environmental

### Colo Rule 608 Compliance Raton Basin CO

SGS Accutest Job Number: D86155

Sampling Date: 08/25/16

### Report to:

LT Environmental  
4600 W 60th Ave  
Arvada, CO 80003  
dhencmann@ltenv.com

ATTN: Devin Hencmann

Total number of pages in report: 52



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: Renea Lewis 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)

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Test results relate only to samples analyzed.

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Sample Summary

LT Environmental

Job No: D86155

Colo Rule 608 Compliance Raton Basin CO

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
D86155-1	08/25/16	11:20 JA	08/26/16	AQ	Ground Water	CHAVEZ-01
D86155-1A	08/25/16	11:20 JA	08/26/16	AQ	Ground Water	CHAVEZ-01
D86155-1B	08/25/16	11:20 JA	08/26/16	AQ	Ground Water	CHAVEZ-01
D86155-1F	08/25/16	11:20 JA	08/26/16	AQ	Groundwater Filtered	CHAVEZ-01

## CASE NARRATIVE / CONFORMANCE SUMMARY

2

**Client:** LT Environmental

**Job No** D86155

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

**Report Date** 9/7/2016 5:24:28 PM

On 08/26/2016, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 4 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D86155 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:** GFB824

- All samples were analyzed within the recommended method holding time.
- Sample(s) D86072-1AMS, D86072-1AMSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.
- D86072-1AMS and -1AMSD: The pH of the sample was >2 at time of analysis.

### Metals By Method EPA 200.7

**Matrix:** AQ

**Batch ID:** MP19616

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86050-1AMS, D86050-1AMSD were used as the QC samples for the metals analysis.

### Metals By Method EPA 200.8

**Matrix:** AQ

**Batch ID:** MP19629

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86155-1FMS, D86155-1FMDS were used as the QC samples for the metals analysis.

### Metals By Method SW846 6010C

**Matrix:** AQ

**Batch ID:** MP19617

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86047-1AMS, D86047-1AMSD, D86047-1ASDL were used as the QC samples for the metals analysis.
- The matrix spike (MS) recovery(s) of Sodium are outside control limits. Spike amount low relative to the sample amount. Refer to lab control or spike blank for recovery information.

Wednesday, September 07, 2016

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

**Matrix:** AQ **Batch ID:** GP18710

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86162-3MS, D86162-3MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate, Bromide analysis.
- D86155-1 for Nitrogen, Nitrate: Elevated detection limit due to matrix interference.

**Matrix:** AQ **Batch ID:** R34996

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D86155-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

### Wet Chemistry By Method HACH IRB-BART

**Matrix:** AQ **Batch ID:** MB762

- 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

**Matrix:** AQ **Batch ID:** MB763

- 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

**Matrix:** AQ **Batch ID:** MB764

- 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:** GP18730

- Sample(s) D86174-1DUP were used as the QC samples for the Specific Conductivity analysis.

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

**Matrix:** AQ **Batch ID:** GN35844

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D85962-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

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

**Matrix:** AQ **Batch ID:** GN35848

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D86155-1

### Wet Chemistry By Method USDA HANDBOOK 60

**Matrix:** AQ **Batch ID:** MP19617

- D86155-1A for Sodium Adsorption Ratio: Calculated as:  $(\text{Na meq/L}) / \sqrt{[(\text{Ca meq/L}) + (\text{Mg meq/L})/2]}$

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS'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.

AMS 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 AMS indicated via signature on the report cover.



## Summary of Hits

Page 1 of 1

**Job Number:** D86155  
**Account:** LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO  
**Collected:** 08/25/16

Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
---------------	------------------	-----------------	----	-----	-------	--------

### D86155-1 CHAVEZ-01

Methane	0.0022	0.00080	0.00040	mg/l	RSK175 MOD
Alkalinity, Bicarbonate as CaCO <sub>3</sub>	141	5.0		mg/l	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	141	5.0		mg/l	SM 2320B-2011
Chloride	6.7	0.50		mg/l	EPA 300.0/SW846 9056
Fluoride	0.21	0.10		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	200	10		mg/l	SM 2540C-2011
Specific Conductivity	291	1.0		umhos/cm	SM 2510B-2011
Sulfate	24.6	0.50		mg/l	EPA 300.0/SW846 9056
pH	7.13			su	SM4500HB+ -2011/9040C

### D86155-1A CHAVEZ-01

Calcium	45.2	2.0		mg/l	SW846 6010C
Magnesium	8.50	1.0		mg/l	SW846 6010C
Sodium	14.5	2.0		mg/l	SW846 6010C
Sodium Adsorption Ratio <sup>a</sup>	0.519			ratio	USDA HANDBOOK 60

### D86155-1B CHAVEZ-01

Iron-Related Bacteria	74500	25		CFU/ml	HACH IRB-BART
Slime Forming Bacteria	66500	500		CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	1200	200		CFU/ml	HACH SRB-BART

### D86155-1F CHAVEZ-01

Calcium	41700	400		ug/l	EPA 200.7
Magnesium	8090	200		ug/l	EPA 200.7
Selenium	1.1	0.80		ug/l	EPA 200.8
Sodium	13400	400		ug/l	EPA 200.7

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



Sample Results

Report of Analysis

Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-01		
<b>Lab Sample ID:</b>	D86155-1	<b>Date Sampled:</b>	08/25/16
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b>	08/26/16
<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	FB17367.D	1	08/30/16	JJ	n/a	n/a	GFB824
Run #2							

	Initial Volume	Headspace Volume	Volume Injected	Temperature
Run #1	39.0 ml	4.0 ml	500 ul	23.0 Deg. C
Run #2				

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	0.0022	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

<b>Client Sample ID:</b> CHAVEZ-01	<b>Date Sampled:</b> 08/25/16
<b>Lab Sample ID:</b> D86155-1	<b>Date Received:</b> 08/26/16
<b>Matrix:</b> AQ - Ground 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
Alkalinity, Bicarbonate as CaC	141	5.0	mg/l	1	09/12/16	JD	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	09/12/16	JD	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	141	5.0	mg/l	1	09/12/16 08:00	JD	SM 2320B-2011
Bromide	< 0.050	0.050	mg/l	1	08/26/16 11:35	JB	EPA 300.0/SW846 9056
Chloride	6.7	0.50	mg/l	1	08/26/16 11:35	JB	EPA 300.0/SW846 9056
Fluoride	0.21	0.10	mg/l	1	08/26/16 11:35	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrate <sup>a</sup>	< 0.050	0.050	mg/l	5	08/26/16 17:22	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>b</sup>	< 0.054	0.054	mg/l	1	08/26/16 17:22	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrite	< 0.0040	0.0040	mg/l	1	08/26/16 11:35	JB	EPA 300.0/SW846 9056
Solids, Total Dissolved	200	10	mg/l	1	08/29/16	JD	SM 2540C-2011
Specific Conductivity	291	1.0	umhos/cm	1	08/31/16	JD	SM 2510B-2011
Sulfate	24.6	0.50	mg/l	1	08/26/16 11:35	JB	EPA 300.0/SW846 9056
pH	7.13		su	1	08/29/16 13:15	TB	SM4500HB+ -2011/9040C

(a) Elevated detection limit due to matrix interference.

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

RL = Reporting Limit



Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-01	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86155-1A	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	Colo Rule 608 Compliance Raton Basin CO		

SAR Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Calcium	45.2	2.0	mg/l	1	08/29/16	08/30/16 JM	SW846 6010C <sup>1</sup>	SW846 3010A/M <sup>2</sup>
Magnesium	8.50	1.0	mg/l	1	08/29/16	08/30/16 JM	SW846 6010C <sup>1</sup>	SW846 3010A/M <sup>2</sup>
Sodium	14.5	2.0	mg/l	1	08/29/16	08/30/16 JM	SW846 6010C <sup>1</sup>	SW846 3010A/M <sup>2</sup>

(1) Instrument QC Batch: MA7663  
(2) Prep QC Batch: MP19617

RL = Reporting Limit

Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-01	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86155-1A	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground 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>	0.519		ratio	1	08/30/16 16:11	JM	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>	08/25/16
<b>Lab Sample ID:</b>	D86155-1B	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground 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	08/30/16 15:30	MM	HACH IRB-BART
Slime Forming Bacteria	66500	500	CFU/ml	1	08/30/16 15:30	MM	HACH SLYM-BART
Sulfate Reducing Bacteria	1200	200	CFU/ml	1	08/30/16 15:30	MM	HACH SRB-BART

RL = Reporting Limit

Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-01	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86155-1F	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Groundwater 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	41700	400	ug/l	1	08/29/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Iron	< 10	10	ug/l	1	08/29/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Magnesium	8090	200	ug/l	1	08/29/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Manganese	< 5.0	5.0	ug/l	1	08/29/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Potassium	< 1000	1000	ug/l	1	08/29/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Selenium	1.1	0.80	ug/l	2	08/31/16	09/06/16 JM	EPA 200.8 <sup>2</sup>	EPA 200.8 <sup>4</sup>
Sodium	13400	400	ug/l	1	08/29/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>

- (1) Instrument QC Batch: MA7669
- (2) Instrument QC Batch: MA7678
- (3) Prep QC Batch: MP19616
- (4) Prep QC Batch: MP19629

RL = Reporting Limit



**Subcontract Lab Data**

5

**Report of Analysis**



## industrial LABORATORIES

Industrial Laboratories is your independent,  
third-party analytical testing laboratory

To : SGS Accutest Laboratories  
4036 Youngfield St.  
Wheat Ridge, CO 80033

Attn : Renea Lewis

## Test Report

Report # Rpt-16090506

Date Reported : 9/5/2016

Date Received : 8/26/2016

Client ID : ACCUTEST

Client PO : D86155X

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SampleCode	Client Sample ID	Test Method	Result	Units	Date Analyzed
16082613-01A	<u>D86155X-1, 8/25/16, 11:20 AM</u>				
		Total Coliforms by MPN			AT
		IL-MIC-M043 / SMEWW 9221 B			8/29/2016 13:00
		Total Coliforms	900	MPN/100mL	
		Fecal Coliforms	26	MPN/100mL	

Submitted By :

\* = Scope Analysis  
# = Subcontracted Analysis  
‡ = Case Narrative on Sample

Measurement of Uncertainty for Scope methods are available upon request.

Samples received in good condition unless otherwise noted in case narrative

Page 1 of 1

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SGS

16 of 52  
ACCUTEST  
D86155

SGS

### Misc. Forms

### Custody Documents and Other Forms

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Includes the following where applicable:

- Chain of Custody





4036 Youngfield Street, Wheat Ridge, CO 80033  
TEL: 303-425-6021 FAX: 303-425-6854  
[www.acculist.com](http://www.acculist.com)

[illegible]

6.1

## D86155: Chain of Custody

Page 1 of 2

## SGS Accutest Sample Receipt Summary

Job Number: D86155

Client: LT

Project: 608

Date / Time Received: 8/26/2016 9:53:00 AM

Delivery Method:

Airbill #'s: HD

Cooler Temps (Initial/Adjusted): #1: (4/4):

### Cooler Security

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

D86155: Chain of Custody

Page 2 of 2

## GC Volatiles

## QC Data Summaries

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Includes the following where applicable:

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

Method Blank Summary

Job Number: D86155  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
GFB824-MB	FB17349.D	1	08/30/16	JJ	n/a	n/a	GFB824

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

D86155-1

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

7.1.1  
7



Blank Spike Summary

Job Number: D86155  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
GFB824-BS	FB17350.D	10	08/30/16	JJ	n/a	n/a	GFB824

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

D86155-1

CAS No.	Compound	Spike mg/l	BSP mg/l	BSP %	Limits
74-82-8	Methane	0.512	0.540	105	70-134

\* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

Page 1 of 1

**Job Number:** D86155  
**Account:** LTENCODE LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
D86072-1AMS <sup>a</sup>	FB17354.D	25	08/30/16	JJ	n/a	n/a	GFB824
D86072-1AMSD <sup>a</sup>	FB17355.D	25	08/30/16	JJ	n/a	n/a	GFB824
D86072-1A <sup>a</sup>	FB17351.D	1	08/30/16	JJ	n/a	n/a	GFB824
D86072-1A <sup>a</sup>	FB17353.D	25	08/30/16	JJ	n/a	n/a	GFB824

The QC reported here applies to the following samples:

Method: RSK175 MOD

D86155-1

CAS No.	Compound	D86072-1A mg/l	Spike Q mg/l	MS mg/l	MS %	Spike mg/l	MSD mg/l	MSD %	RPD	Limits Rec/RPD
74-82-8	Methane	8.37 <sup>c</sup>	0.512	8.62	49	0.512	8.25	-23* <sup>b</sup>	4	42-155/30

(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: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19616  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/29/16

Metal	RL	IDL	MDL	MB 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	11.6	<400
Chromium	10	.3	1		
Cobalt	5.0	.5	1.2		
Copper	10	.8	2.9		
Iron	10	1.5	6.9	3.0	<10
Lead	50	2.1	9.1		
Lithium	5.0	.4	1		
Magnesium	200	6.8	39	6.0	<200
Manganese	5.0	.5	.4	-0.60	<5.0
Molybdenum	10	.4	3.6		
Nickel	30	.5	2.1		
Phosphorus	100	15	47		
Potassium	1000	99	61	7.2	<1000
Selenium	50	7.1	15		
Silicon	50	4.7	6.2		
Silver	30	.3	.9		
Sodium	400	7.3	14	27.3	<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 MP19616: D86155-1F

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

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19616  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/29/16

Metal	RL	IDL	MDL	MB raw	final
-------	----	-----	-----	-----------	-------

(anr) Analyte not requested



MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19616  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 08/29/16

Metal	D86050-1A Original MS		Spikelot ICPAL2	% Rec	QC Limits
Aluminum					
Antimony					
Arsenic	anr				
Barium					
Beryllium					
Boron	anr				
Cadmium					
Calcium	193000	211000	25000	72.0	70-130
Chromium					
Cobalt					
Copper					
Iron	55.2	4720	5000	93.3	70-130
Lead					
Lithium					
Magnesium	31700	56100	25000	97.6	70-130
Manganese	1.4	440	500	87.7	70-130
Molybdenum					
Nickel					
Phosphorus					
Potassium	5700	31000	25000	101.2	70-130
Selenium	anr				
Silicon					
Silver					
Sodium	163000	187000	25000	96.0	70-130
Strontium	anr				
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP19616: D86155-1F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

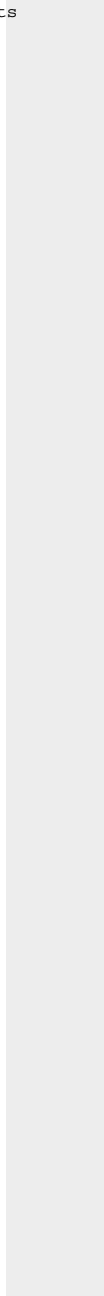
QC Batch ID: MP19616  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/29/16

Metal	D86050-1A Original MS	SpikeLot ICPALL2	% Rec	QC Limits
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(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19616  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 08/29/16

	D86050-1A		Spikelot		MSD	QC
Metal	Original	MSD	ICPALL2	% Rec	RPD	Limit
Aluminum						
Antimony						
Arsenic	anr					
Barium						
Beryllium						
Boron	anr					
Cadmium						
Calcium	193000	216000	25000	92.0	2.3	20
Chromium						
Cobalt						
Copper						
Iron	55.2	4780	5000	94.5	1.3	20
Lead						
Lithium						
Magnesium	31700	56400	25000	98.8	0.5	20
Manganese	1.4	447	500	89.1	1.6	20
Molybdenum						
Nickel						
Phosphorus						
Potassium	5700	31200	25000	102.0	0.6	20
Selenium	anr					
Silicon						
Silver						
Sodium	163000	187000	25000	96.0	0.0	20
Strontium	anr					
Thallium						
Tin						
Titanium						
Uranium						
Vanadium						
Zinc						

Associated samples MP19616: D86155-1F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

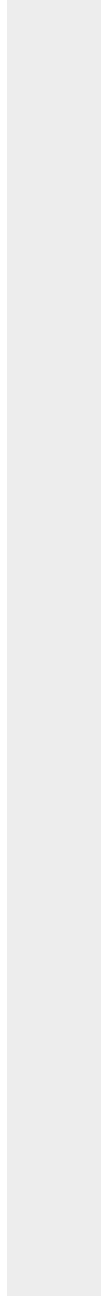
QC Batch ID: MP19616  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/29/16

Metal	D86050-1A Original MSD	Spielot ICPALL2 % Rec	MSD RPD	QC Limit
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(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



8.1.2  
8

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19616  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 08/29/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony				
Arsenic	anr			
Barium				
Beryllium				
Boron	anr			
Cadmium				
Calcium	23600	25000	94.4	85-115
Chromium				
Cobalt				
Copper				
Iron	4760	5000	95.2	85-115
Lead				
Lithium				
Magnesium	24900	25000	99.6	85-115
Manganese	459	500	91.8	85-115
Molybdenum				
Nickel				
Phosphorus				
Potassium	25100	25000	100.4	85-115
Selenium	anr			
Silicon				
Silver				
Sodium	24400	25000	97.6	85-115
Strontium	anr			
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP19616: D86155-1F

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

8.1.3  
8



SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

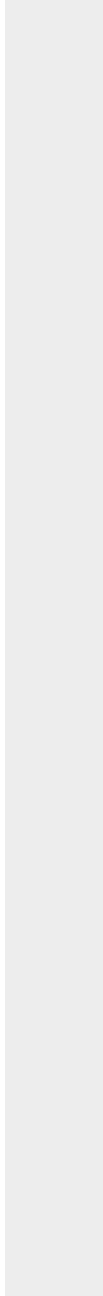
QC Batch ID: MP19616  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/29/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
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(anr) Analyte not requested



8.1.3

8

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	RL	IDL	MDL	MB raw	final
Aluminum	500	55	65		
Antimony	150	11	44		
Arsenic	130	19	60		
Barium	50	1	2		
Beryllium	50	4.5	8		
Boron	250	4	18		
Cadmium	50	1	4		
Calcium	2000	12	50	-35	<2000
Chromium	50	1.5	3.5		
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	32.5	<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	50		
Silicon	250	24	42		
Silver	150	1.5	3		
Sodium	2000	37	70	-60	<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 MP19617: D86155-1A

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

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

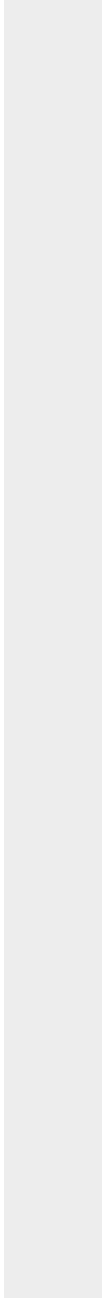
QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	RL	IDL	MDL	MB raw	final
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(anr) Analyte not requested



8.2.1

8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MS		Spikelot ICPALL2	% Rec	QC Limits
Aluminum					
Antimony					
Arsenic					
Barium					
Beryllium					
Boron					
Cadmium					
Calcium	12800	137000	125000	99.4	75-125
Chromium					
Cobalt					
Copper					
Iron					
Lead					
Lithium					
Magnesium	6440	128000	125000	97.2	75-125
Manganese					
Molybdenum					
Nickel					
Phosphorus					
Potassium					
Selenium					
Silicon					
Silver					
Sodium	545000	625000	125000	64.0 (a)	75-125
Strontium					
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP19617: D86155-1A

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

8.2.2  
8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MS	Spikelot ICPALL2 % Rec	QC Limits
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(N) Matrix Spike Rec. outside of QC limits

(anr) Analyte not requested

(a) Spike amount low relative to the sample amount. Refer to lab control or spike blank for recovery information.

8.2.2

8



MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MSD		Spikelot ICPALL2 % Rec		MSD RPD	QC Limit
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Calcium	12800	142000	125000	103.4	3.6	20
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Lithium						
Magnesium	6440	132000	125000	100.4	3.1	20
Manganese						
Molybdenum						
Nickel						
Phosphorus						
Potassium						
Selenium						
Silicon						
Silver						
Sodium	545000	654000	125000	87.2	4.5	20
Strontium						
Thallium						
Tin						
Titanium						
Uranium						
Vanadium						
Zinc						

Associated samples MP19617: D86155-1A

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

8.2.2  
8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

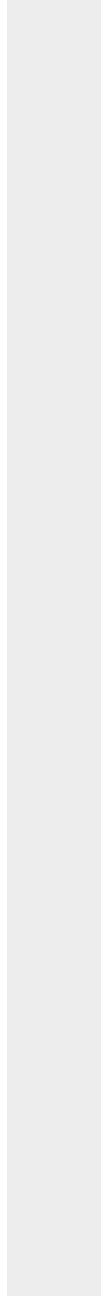
QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MSD	Spielot ICPALL2 % Rec	MSD RPD	QC Limit
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(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



8.2.2

8

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Boron				
Cadmium				
Calcium	131000	125000	104.8	80-120
Chromium				
Cobalt				
Copper				
Iron				
Lead				
Lithium				
Magnesium	131000	125000	104.8	80-120
Manganese				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silicon				
Silver				
Sodium	135000	125000	108.0	80-120
Strontium				
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP19617: D86155-1A

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

8.2.3  
8

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

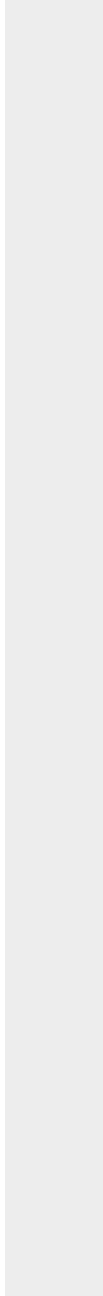
QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
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(anr) Analyte not requested



SERIAL DILUTION RESULTS SUMMARY

Login Number: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original SDL 1:5		%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Boron				
Cadmium				
Calcium	2550	2460	3.6	0-10
Chromium				
Cobalt				
Copper				
Iron				
Lead				
Lithium				
Magnesium	1290	1310	1.7	0-10
Manganese				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silicon				
Silver				
Sodium	109000	114000	4.6	0-10
Strontium				
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP19617: D86155-1A

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

8.2.4  
8



Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

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

	D86047-1A	QC
Metal	Original SDL 1:5 %DIF	Limits

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
Matrix Type: AQUEOUS

Methods: EPA 200.8  
Units: ug/l

Prep Date: 08/31/16

Metal	RL	IDL	MDL	MB 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		
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	.06	.21	0.030	<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 MP19629: D86155-1F

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: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 08/31/16

Metal	D86155-1F Original MS	Spikelot ICPALL2	% Rec	QC Limits
Aluminum	anr			
Antimony				
Arsenic	anr			
Barium	anr			
Beryllium				
Boron				
Cadmium	anr			
Calcium				
Chromium				
Cobalt				
Copper	anr			
Iron	anr			
Lead	anr			
Magnesium				
Manganese	anr			
Molybdenum				
Nickel	anr			
Phosphorus				
Potassium				
Selenium	1.1	218	200	108.5 70-130
Silver	anr			
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Uranium	anr			
Vanadium				
Zinc				

Associated samples MP19629: D86155-1F

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: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 08/31/16

Metal	D86155-1F Original MSD	Spikelot ICPALL2	% Rec	MSD RPD	QC Limit	
Aluminum	anr					
Antimony						
Arsenic	anr					
Barium	anr					
Beryllium						
Boron						
Cadmium	anr					
Calcium						
Chromium						
Cobalt						
Copper	anr					
Iron	anr					
Lead	anr					
Magnesium						
Manganese	anr					
Molybdenum						
Nickel	anr					
Phosphorus						
Potassium						
Selenium	1.1	218	200	108.5	0.0	20
Silver	anr					
Sodium						
Strontium						
Thallium						
Tin						
Titanium						
Uranium	anr					
Vanadium						
Zinc						

Associated samples MP19629: D86155-1F

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: D86155  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 08/31/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum	anr			
Antimony				
Arsenic	anr			
Barium	anr			
Beryllium				
Boron				
Cadmium	anr			
Calcium				
Chromium				
Cobalt				
Copper	anr			
Iron	anr			
Lead	anr			
Magnesium				
Manganese	anr			
Molybdenum				
Nickel	anr			
Phosphorus				
Potassium				
Selenium	224	200	112.0	85-115
Silver	anr			
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Uranium	anr			
Vanadium				
Zinc				

Associated samples MP19629: D86155-1F

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

8.3.3  
8



## 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: D86155  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Analyte	Batch ID	RL	MB Result	Units	Spike Amount	BSP Result	BSP %Recov	QC Limits
Alkalinity, Bicarbonate as CaC	GN35983	5.0	0.0	mg/l	100	101	101.0	90-110%
Alkalinity, Carbonate	GN35984	5.0	0.0	mg/l	100	101	101.0	80-120%
Alkalinity, Total as CaCO3	GN35982	5.0	0.0	mg/l	100	101	101.0	90-110%
Alkalinity, Total as CaCO3	GN35982			mg/l	10	10.0	100.0	90-110%
Bromide	GP18710/GN35839	0.050	0.0	mg/l	0.5	0.492	98.4	90-110%
Chloride	GP18710/GN35839	0.50	0.0	mg/l	5	5.01	100.2	90-110%
Fluoride	GP18710/GN35839	0.10	0.0	mg/l	1	0.999	99.9	90-110%
Iron-Related Bacteria	MB762	25	<25	CFU/ml				
Nitrogen, Nitrate	GP18710/GN35839	0.010	0.0	mg/l	0.1	0.0976	97.6	90-110%
Nitrogen, Nitrite	GP18710/GN35839	0.0040	0.0	mg/l	0.05	0.0495	99.0	90-110%
Slime Forming Bacteria	MB763	500	<500	CFU/ml				
Solids, Total Dissolved	GN35844	10	0.0	mg/l				
Solids, Total Dissolved	GN35844	10	0.0	mg/l	400	400	100.0	90-110%
Specific Conductivity	GP18730/GN35885			umhos/cm	100.8	93.8	93.2	90-110%
Sulfate	GP18710/GN35839	0.50	0.0	mg/l	5	4.91	98.2	90-110%
Sulfate Reducing Bacteria	MB764	200	<200	CFU/ml				
pH	GN35848			su	8.00	7.97	99.6	99.1-100.9%

Associated Samples:

Batch MB762: D86155-1B  
Batch MB763: D86155-1B  
Batch MB764: D86155-1B  
Batch GN35844: D86155-1  
Batch GN35848: D86155-1  
Batch GN35982: D86155-1  
Batch GN35983: D86155-1  
Batch GN35984: D86155-1  
Batch GP18710: D86155-1  
Batch GP18730: D86155-1

(\*) Outside of QC limits

DUPLICATE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D86155  
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 CaCO3	GN35982	D86303-1	mg/l	12.0	12.5	4.1	0-20%
Solids, Total Dissolved	GN35844	D85962-1	mg/l	1120	1200	6.9	0-20%
Specific Conductivity	GP18730/GN35885	D86174-1	umhos/cm	2150	2180	1.4	0-20%

Associated Samples:

Batch GN35844: D86155-1

Batch GN35982: D86155-1

Batch GP18730: D86155-1

(\*) Outside of QC limits

MATRIX SPIKE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D86155  
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
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.5	99.2	80-120%
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.5	99.2	80-120%
Chloride	GP18710/GN35839	D86162-3	mg/l	449	250	702	101.2	80-120%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.44	50	51.4	102.8	80-120%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.0	50	51.4	102.8	80-120%
Nitrogen, Nitrate	GP18710/GN35839	D86162-3	mg/l	16.5	5	21.4	98.0	80-120%
Nitrogen, Nitrite	GP18710/GN35839	D86162-3	mg/l	0.0	2.5	2.4	96.0	80-120%
Sulfate	GP18710/GN35839	D86162-3	mg/l	229	25	478	99.6	80-120%

Associated Samples:  
Batch GP18710: D86155-1  
(\*) Outside of QC limits  
(N) Matrix Spike Rec. outside of QC limits

MATRIX SPIKE DUPLICATE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D86155  
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
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.4	0.4	20%
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.4	0.4	20%
Chloride	GP18710/GN35839	D86162-3	mg/l	449	250	701	0.1	20%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.44	50	51.5	0.2	20%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.0	50	51.5	0.2	20%
Nitrogen, Nitrate	GP18710/GN35839	D86162-3	mg/l	16.5	5	21.4	0.0	20%
Nitrogen, Nitrite	GP18710/GN35839	D86162-3	mg/l	0.0	2.5	2.4	0.0	20%
Sulfate	GP18710/GN35839	D86162-3	mg/l	229	250	477	0.2	20%

Associated Samples:  
Batch GP18710: D86155-1  
(\*) Outside of QC limits  
(N) Matrix Spike Rec. outside of QC limits

### Technical Report for

LT Environmental

Colo Rule 608 Compliance Raton Basin CO

SGS Accutest Job Number: D86156

Sampling Date: 08/25/16

Report to:

LT Environmental  
4600 W 60th Ave  
Arvada, CO 80003  
dhencmann@ltenv.com

ATTN: Devin Hencmann

Total number of pages in report: 52



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: Renea Lewis 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: D86156

Colo Rule 608 Compliance Raton Basin CO

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
D86156-1	08/25/16	12:00 JA	08/26/16	AQ	Ground Water	CHAVEZ-02
D86156-1A	08/25/16	12:00 JA	08/26/16	AQ	Ground Water	CHAVEZ-02
D86156-1B	08/25/16	12:00 JA	08/26/16	AQ	Ground Water	CHAVEZ-02
D86156-1F	08/25/16	12:00 JA	08/26/16	AQ	Groundwater Filtered	CHAVEZ-02

## CASE NARRATIVE / CONFORMANCE SUMMARY

2

**Client:** LT Environmental

**Job No** D86156

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

**Report Date** 9/7/2016 5:26:32 PM

On 08/26/2016, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 4 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D86156 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:** GFB824

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86072-1AMS, D86072-1AMSD were used as the QC samples indicated.
- D86072-1AMS and -1AMSD: The pH of the sample was >2 at time of analysis.
- D86072-1AMS: The pH of the sample was >2 at time of analysis.

### Metals By Method EPA 200.7

**Matrix:** AQ

**Batch ID:** MP19628

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86156-1FMS, D86156-1FMDS were used as the QC samples for the metals analysis.

### Metals By Method EPA 200.8

**Matrix:** AQ

**Batch ID:** MP19629

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86155-1FMS, D86155-1FMDS were used as the QC samples for the metals analysis.

### Metals By Method SW846 6010C

**Matrix:** AQ

**Batch ID:** MP19617

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86047-1AMS, D86047-1AMSD, D86047-1ASDL were used as the QC samples for the metals analysis.
- The matrix spike (MS) recovery(s) of Sodium are outside control limits. Spike amount low relative to the sample amount. Refer to lab control or spike blank for recovery information.

Wednesday, September 07, 2016

Page 1 of 3

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

**Matrix:** AQ **Batch ID:** GP18710

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D86162-3MS, D86162-3MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate, Bromide analysis.

**Matrix:** AQ **Batch ID:** R34994

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D86156-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

### Wet Chemistry By Method HACH IRB-BART

**Matrix:** AQ **Batch ID:** MB762

- 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

**Matrix:** AQ **Batch ID:** MB762

- 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

**Matrix:** AQ **Batch ID:** MB764

- 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:** GP18730

- Sample(s) D86174-1DUP were used as the QC samples for the Specific Conductivity analysis.

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

**Matrix:** AQ **Batch ID:** GN35844

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D85962-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

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

**Matrix:** AQ **Batch ID:** GN35848

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D86156-1

### Wet Chemistry By Method USDA HANDBOOK 60

**Matrix:** AQ **Batch ID:** MP19617

- D86156-1A for Sodium Adsorption Ratio: Calculated as:  $(\text{Na meq/L}) / \sqrt{[(\text{Ca meq/L}) + (\text{Mg meq/L})/2]}$

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS'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.

AMS 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 AMS indicated via signature on the report cover.

## Summary of Hits

Page 1 of 1

**Job Number:** D86156  
**Account:** LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO  
**Collected:** 08/25/16

Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
---------------	------------------	-----------------	----	-----	-------	--------

### D86156-1 CHAVEZ-02

Alkalinity, Bicarbonate as CaCO <sub>3</sub>	195	5.0			mg/l	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	195	5.0			mg/l	SM 2320B-2011
Chloride	9.6	0.50			mg/l	EPA 300.0/SW846 9056
Fluoride	0.25	0.10			mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.42	0.050			mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.42	0.054			mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	262	10			mg/l	SM 2540C-2011
Specific Conductivity	382	1.0			umhos/cm	SM 2510B-2011
Sulfate	26.7	0.50			mg/l	EPA 300.0/SW846 9056
pH	7.26				su	SM4500HB+ -2011/9040C

### D86156-1A CHAVEZ-02

Calcium	66.2	2.0			mg/l	SW846 6010C
Magnesium	12.9	1.0			mg/l	SW846 6010C
Sodium	15.2	2.0			mg/l	SW846 6010C
Sodium Adsorption Ratio <sup>b</sup>	0.447				ratio	USDA HANDBOOK 60

### D86156-1B CHAVEZ-02

Iron-Related Bacteria	74500	25			CFU/ml	HACH IRB-BART
Slime Forming Bacteria	66500	500			CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	18000	200			CFU/ml	HACH SRB-BART

### D86156-1F CHAVEZ-02

Calcium	56600	400			ug/l	EPA 200.7
Iron	32.9	10			ug/l	EPA 200.7
Magnesium	11800	200			ug/l	EPA 200.7
Potassium	1540	1000			ug/l	EPA 200.7
Sodium	13200	400			ug/l	EPA 200.7

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

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



**Sample Results**

**Report of Analysis**

Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-02	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86156-1	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground 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	FB17368.D	1	08/30/16	JJ	n/a	n/a	GFB824
Run #2							

	Initial Volume	Headspace Volume	Volume Injected	Temperature
Run #1	39.0 ml	4.0 ml	500 ul	23.0 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

## Report of Analysis

<b>Client Sample ID:</b> CHAVEZ-02	<b>Date Sampled:</b> 08/25/16
<b>Lab Sample ID:</b> D86156-1	<b>Date Received:</b> 08/26/16
<b>Matrix:</b> AQ - Ground 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
Alkalinity, Bicarbonate as CaC	195	5.0	mg/l	1	09/12/16	JD	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	09/12/16	JD	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	195	5.0	mg/l	1	09/12/16 08:00	JD	SM 2320B-2011
Bromide	< 0.050	0.050	mg/l	1	08/26/16 11:48	JB	EPA 300.0/SW846 9056
Chloride	9.6	0.50	mg/l	1	08/26/16 11:48	JB	EPA 300.0/SW846 9056
Fluoride	0.25	0.10	mg/l	1	08/26/16 11:48	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.42	0.050	mg/l	5	08/26/16 17:35	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.42	0.054	mg/l	1	08/26/16 17:35	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrite	< 0.0040	0.0040	mg/l	1	08/26/16 11:48	JB	EPA 300.0/SW846 9056
Solids, Total Dissolved	262	10	mg/l	1	08/29/16	JD	SM 2540C-2011
Specific Conductivity	382	1.0	umhos/cm	1	08/31/16	JD	SM 2510B-2011
Sulfate	26.7	0.50	mg/l	1	08/26/16 11:48	JB	EPA 300.0/SW846 9056
pH	7.26		su	1	08/29/16 13:15	TB	SM4500HB+ -2011/9040C

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

RL = Reporting Limit

Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-02	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86156-1A	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	Colo Rule 608 Compliance Raton Basin CO		

SAR Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Calcium	66.2	2.0	mg/l	1	08/29/16	08/30/16 JM	SW846 6010C <sup>1</sup>	SW846 3010A/M <sup>2</sup>
Magnesium	12.9	1.0	mg/l	1	08/29/16	08/30/16 JM	SW846 6010C <sup>1</sup>	SW846 3010A/M <sup>2</sup>
Sodium	15.2	2.0	mg/l	1	08/29/16	08/30/16 JM	SW846 6010C <sup>1</sup>	SW846 3010A/M <sup>2</sup>

(1) Instrument QC Batch: MA7663  
(2) Prep QC Batch: MP19617

RL = Reporting Limit

Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-02	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86156-1A	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground 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>	0.447		ratio	1	08/30/16 16:17	JM	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>	08/25/16
<b>Lab Sample ID:</b>	D86156-1B	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Ground 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	08/30/16 15:30	MM	HACH IRB-BART
Slime Forming Bacteria	66500	500	CFU/ml	1	08/30/16 15:30	MM	HACH SLYM-BART
Sulfate Reducing Bacteria	18000	200	CFU/ml	1	08/30/16 15:30	MM	HACH SRB-BART

RL = Reporting Limit



Report of Analysis

<b>Client Sample ID:</b>	CHAVEZ-02	<b>Date Sampled:</b>	08/25/16
<b>Lab Sample ID:</b>	D86156-1F	<b>Date Received:</b>	08/26/16
<b>Matrix:</b>	AQ - Groundwater 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	56600	400	ug/l	1	08/31/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Iron	32.9	10	ug/l	1	08/31/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Magnesium	11800	200	ug/l	1	08/31/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Manganese	< 5.0	5.0	ug/l	1	08/31/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Potassium	1540	1000	ug/l	1	08/31/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>
Selenium	< 0.80	0.80	ug/l	2	08/31/16	09/06/16 JM	EPA 200.8 <sup>2</sup>	EPA 200.8 <sup>4</sup>
Sodium	13200	400	ug/l	1	08/31/16	08/31/16 JM	EPA 200.7 <sup>1</sup>	EPA 200.7 <sup>3</sup>

- (1) Instrument QC Batch: MA7669
- (2) Instrument QC Batch: MA7678
- (3) Prep QC Batch: MP19628
- (4) Prep QC Batch: MP19629

RL = Reporting Limit

Subcontract Lab Data

5

Report of Analysis



## industrial LABORATORIES

Industrial Laboratories is your independent,  
third-party analytical testing laboratory

To : SGS Accutest Laboratories  
4036 Youngfield St.  
Wheat Ridge, CO 80033

Attn : Renea Lewis

## Test Report

Report # Rpt-16090507

Date Reported : 9/5/2016

Date Received : 8/26/2016

Client ID : ACCUTEST

Client PO : D86156X

5

SampleCode	Client Sample ID	Test Method	Result	Units	Date Analyzed
16082614-01A	D86156X-I, 8/25/16, 12:00 PM				
		Total Coliforms by MPN			AT
		IL-MIC-M043 / SMEWW 9221 B			8/29/2016 13:00
		Total Coliforms	280	MPN/100mL	
		Fecal Coliforms	<2	MPN/100mL	

Submitted By :

\* = Scope Analysis  
# = Subcontracted Analysis  
‡ = Case Narrative on Sample

Measurement of Uncertainty for Scope methods are available upon request.  
Samples received in good condition unless otherwise noted in case narrative

Page 1 of 1

4046 Youngfield Street • Wheat Ridge, Colorado 80033 • (303) 287-9691 • (303) 287-0964 FAX • [www.industriallabs.net](http://www.industriallabs.net)

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SGS

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ACCUTEST  
D86156

[illegible]

## Misc. Forms

### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody



4036 Youngfield Street, Wheat Ridge, CO 80033  
TEL: 303-425-6021 FAX: 303-425-6854  
[www.acufest.com](http://www.acufest.com)

		<b>ACCUTEST</b> 4036 Youngfield Street, Wheat Ridge, CO 80033 TEL: 303-425-6021 FAX: 303-425-6854 www.acctest.com		FED-EX Tracking # _____ Bottle Order Control # _____	
BGS Accutest Quote # _____ BGS Accutest Job # <b>D36156</b>					
<b>Client / Reporting Information</b>		<b>Project Information</b>		<b>Requested Analysis (see TEST CODE sheet)</b>	
Company Name <b>LT Environmental</b>		Project Name <b>2016 XTO 608 compliance</b>		<div style="writing-mode: vertical-rl; transform: rotate(180deg); font-weight: bold; font-size: 2em;">           See Attached         </div>	
Street Address <b>848 E 2nd Ave</b>		Street 			
City <b>Durango</b>		State 			
Project Contact <b>Devin Hennemann</b>		Project # <b>012916011</b>			
Phone # <b>970 385 1096</b>		Client Purchase Order # 			
Sample(s) Name(s) <b>Seth Adams / Dustin Held</b>		Project Manager <b>Darin Hennemann</b>		Billing Information (if different from Report to) 	
Field ID / Point of Collection <b>CHAVEZ-62</b>		MEQHOI Val # 		Matrix <b>JA GW</b>	
Date <b>8-25-16</b>		Time <b>12:00</b>		Number of preserved Bottles 	
Sampled by <b>JA</b>		Matrix <b>JA</b>		# of bottles <b>GW</b>	
HCl 		NaOH 		HNO3 	
H2SO4 		NONE 		DI Water 	
MEQHOI 		UNQHOI 			
LAB USE ONLY <b>01</b>					
Turnaround Time (Business days) <input type="checkbox"/> Std. 15 Business Days <input type="checkbox"/> Std. 10 Business Days <input type="checkbox"/> 5 Day RUSH <input type="checkbox"/> 3 Day Emergency <input type="checkbox"/> 2 Day Emergency <input type="checkbox"/> 1 Day Emergency <input type="checkbox"/> Emergency & Rush T/A only available via LabLink		Approved By (SGS Accutest PM): I Date: 		Commercial "A" (Level 1) <input type="checkbox"/> Commercial "B" (Level 2) <input type="checkbox"/> COMMBN <input type="checkbox"/> COMMBN+ <input type="checkbox"/> Commercial "A" = Results Only <input type="checkbox"/> Commercial "B" = Results + QC Summary <input type="checkbox"/> Commercial BR = Results/QC Narrative (+ chromatograms)	
State Forms Required <input type="checkbox"/> Send Forms to State <input type="checkbox"/> Report by Fax <input type="checkbox"/> Report by PDF <input type="checkbox"/> EDD Format		Comments / Special Instructions <b>short hold Nitrate/Nitrite</b>		Date Time: <b>8-25-16 0953</b>	
Received By: <b>[Signature]</b>		Date Time: <b>8-25-16 0953</b>		Received By: <b>[Signature]</b>	
Relinquished by Sampler: <b>[Signature]</b>		Date Time: 		Received By: 	
Relinquished by: 		Date Time: 		Received By: 	
Date Time: 		Received By: 		Date Time: 	
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Date Time: 		Received By: 		Date Time: 	
Received By: 		Date Time: 		Received By: 	
Date Time: 		Received By: 		Date Time: 	
Received By: 		Date Time: 		Received By: 	
Date Time: 		Received By: 		Date Time: 	
Received By: 		Date Time: 		Received By: 	
Date Time: 		Received By: 		Date Time: 	
Received By: 		Date Time: 		Received By: 	
Date Time: 		Received By: 		Date Time: 	
Received By: 		Date Time: 		Received By: 	
Date Time: 					

6.1 6

## D86156: Chain of Custody

Page 1 of 2



# SGS Accutest Sample Receipt Summary

Job Number: D86156

Client: LT

Project: 608

Date / Time Received: 8/26/2016 9:53:00 AM

Delivery Method:

Airbill #'s: HD

Cooler Temps (Initial/Adjusted): #1: (4/4):

## Cooler Security

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

D86156: 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: D86156  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
GFB824-MB	FB17349.D	1	08/30/16	JJ	n/a	n/a	GFB824

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

D86156-1

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

7.1.1  
7

Blank Spike Summary

Job Number: D86156  
Account: LTENCODE LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
GFB824-BS	FB17350.D	10	08/30/16	JJ	n/a	n/a	GFB824

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

D86156-1

CAS No.	Compound	Spike mg/l	BSP mg/l	BSP %	Limits
74-82-8	Methane	0.512	0.540	105	70-134

\* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

Page 1 of 1

**Job Number:** D86156  
**Account:** LTENCODE LT Environmental  
**Project:** Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
D86072-1AMS <sup>a</sup>	FB17354.D	25	08/30/16	JJ	n/a	n/a	GFB824
D86072-1AMSD <sup>a</sup>	FB17355.D	25	08/30/16	JJ	n/a	n/a	GFB824
D86072-1A <sup>a</sup>	FB17351.D	1	08/30/16	JJ	n/a	n/a	GFB824
D86072-1A <sup>a</sup>	FB17353.D	25	08/30/16	JJ	n/a	n/a	GFB824

The QC reported here applies to the following samples:

Method: RSK175 MOD

D86156-1

CAS No.	Compound	D86072-1A mg/l	Spike Q mg/l	MS mg/l	MS %	Spike mg/l	MSD mg/l	MSD %	RPD	Limits Rec/RPD
74-82-8	Methane	8.37 <sup>c</sup>	0.512	8.62	49	0.512	8.25	-23* <sup>b</sup>	4	42-155/30

(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: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	RL	IDL	MDL	MB raw	final
Aluminum	500	55	65		
Antimony	150	11	44		
Arsenic	130	19	60		
Barium	50	1	2		
Beryllium	50	4.5	8		
Boron	250	4	18		
Cadmium	50	1	4		
Calcium	2000	12	50	-35	<2000
Chromium	50	1.5	3.5		
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	32.5	<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	50		
Silicon	250	24	42		
Silver	150	1.5	3		
Sodium	2000	37	70	-60	<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 MP19617: D86156-1A

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

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

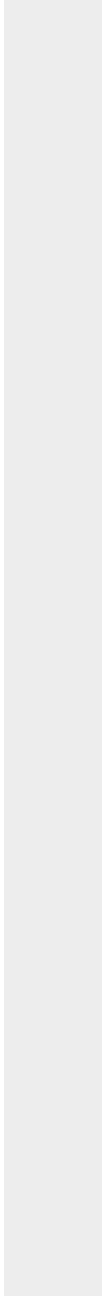
QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	RL	IDL	MDL	MB raw	final
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(anr) Analyte not requested



8.1.1

8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MS		Spikelot ICPALL2	% Rec	QC Limits
Aluminum					
Antimony					
Arsenic					
Barium					
Beryllium					
Boron					
Cadmium					
Calcium	12800	137000	125000	99.4	75-125
Chromium					
Cobalt					
Copper					
Iron					
Lead					
Lithium					
Magnesium	6440	128000	125000	97.2	75-125
Manganese					
Molybdenum					
Nickel					
Phosphorus					
Potassium					
Selenium					
Silicon					
Silver					
Sodium	545000	625000	125000	64.0 (a)	75-125
Strontium					
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP19617: D86156-1A

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

8.1.2  
8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MS	Spikelot ICPALL2 % Rec	QC Limits
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(N) Matrix Spike Rec. outside of QC limits

(anr) Analyte not requested

(a) Spike amount low relative to the sample amount. Refer to lab control or spike blank for recovery information.

8.1.2

8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MSD		Spikelot ICPALL2 % Rec		MSD RPD	QC Limit
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Calcium	12800	142000	125000	103.4	3.6	20
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Lithium						
Magnesium	6440	132000	125000	100.4	3.1	20
Manganese						
Molybdenum						
Nickel						
Phosphorus						
Potassium						
Selenium						
Silicon						
Silver						
Sodium	545000	654000	125000	87.2	4.5	20
Strontium						
Thallium						
Tin						
Titanium						
Uranium						
Vanadium						
Zinc						

Associated samples MP19617: D86156-1A

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

8.1.2  
8

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

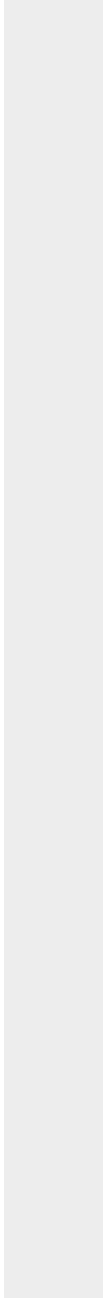
QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	D86047-1A Original MSD	SpikeLot ICPALL2 % Rec	MSD RPD	QC Limit
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(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



8.1.2  
8

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Boron				
Cadmium				
Calcium	131000	125000	104.8	80-120
Chromium				
Cobalt				
Copper				
Iron				
Lead				
Lithium				
Magnesium	131000	125000	104.8	80-120
Manganese				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silicon				
Silver				
Sodium	135000	125000	108.0	80-120
Strontium				
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP19617: D86156-1A

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

8.1.3  
8



SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

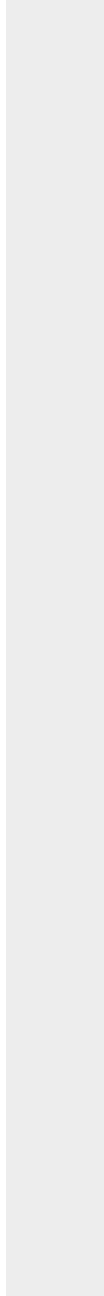
QC Batch ID: MP19617  
Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
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(anr) Analyte not requested



8.1.3

8

SERIAL DILUTION RESULTS SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19617  
 Matrix Type: AQUEOUS

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

Prep Date: 08/29/16

D86047-1A		QC		
Metal	Original	SDL 1:5	%DIF	Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Boron				
Cadmium				
Calcium	2550	2460	3.6	0-10
Chromium				
Cobalt				
Copper				
Iron				
Lead				
Lithium				
Magnesium	1290	1310	1.7	0-10
Manganese				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silicon				
Silver				
Sodium	109000	114000	4.6	0-10
Strontium				
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP19617: D86156-1A

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

8.1.4  
8



BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19628  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/31/16

Metal	RL	IDL	MDL	MB 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	20.5	<400
Chromium	10	.3	1		
Cobalt	5.0	.5	1.2		
Copper	10	.8	2.9		
Iron	10	1.5	6.9	3.7	<10
Lead	50	2.1	9.1		
Lithium	5.0	.4	1		
Magnesium	200	6.8	39	22.3	<200
Manganese	5.0	.5	.4	-0.60	<5.0
Molybdenum	10	.4	3.6		
Nickel	30	.5	2.1		
Phosphorus	100	15	47		
Potassium	1000	99	61	5.3	<1000
Selenium	50	7.1	15		
Silicon	50	4.7	6.2		
Silver	30	.3	.9		
Sodium	400	7.3	14	45.3	<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 MP19628: D86156-1F

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

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19628  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/31/16

Metal	RL	IDL	MDL	MB raw	final
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(anr) Analyte not requested

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19628  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 08/31/16

Metal	D86156-1F Original MS		Spikelot ICPAL2	% Rec	QC Limits
Aluminum					
Antimony					
Arsenic	anr				
Barium					
Beryllium					
Boron	anr				
Cadmium					
Calcium	56600	78400	25000	87.2	70-130
Chromium					
Cobalt					
Copper					
Iron	32.9	4910	5000	97.5	70-130
Lead					
Lithium					
Magnesium	11800	36600	25000	99.2	70-130
Manganese	0.80	455	500	90.8	70-130
Molybdenum					
Nickel					
Phosphorus					
Potassium	1540	26700	25000	100.6	70-130
Selenium	anr				
Silicon					
Silver					
Sodium	13200	37300	25000	96.4	70-130
Strontium	anr				
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP19628: D86156-1F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

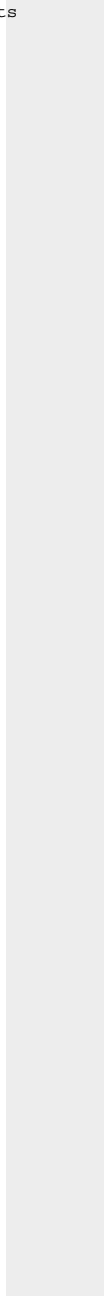
QC Batch ID: MP19628  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/31/16

Metal	D86156-1F Original MS	Spike ICPALL2	% Rec	QC Limits
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(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested





MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19628  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 08/31/16

Metal	D86156-1F Original MSD		Spikelot ICPAL2	% Rec	MSD RPD	QC Limit
Aluminum						
Antimony						
Arsenic	anr					
Barium						
Beryllium						
Boron	anr					
Cadmium						
Calcium	56600	80600	25000	96.0	2.8	20
Chromium						
Cobalt						
Copper						
Iron	32.9	4880	5000	96.9	0.6	20
Lead						
Lithium						
Magnesium	11800	36700	25000	99.6	0.3	20
Manganese	0.80	462	500	92.2	1.5	20
Molybdenum						
Nickel						
Phosphorus						
Potassium	1540	26900	25000	101.4	0.7	20
Selenium	anr					
Silicon						
Silver						
Sodium	13200	37600	25000	97.6	0.8	20
Strontium	anr					
Thallium						
Tin						
Titanium						
Uranium						
Vanadium						
Zinc						

Associated samples MP19628: D86156-1F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

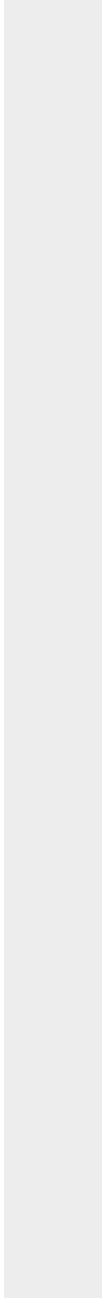
QC Batch ID: MP19628  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/31/16

Metal	D86156-1F Original MSD	SpikeLot ICPALL2 % Rec	MSD RPD	QC Limit
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(N) Matrix Spike Rec. outside of QC limits  
(anr) Analyte not requested



8.2.2  
8

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19628  
 Matrix Type: AQUEOUS

Methods: EPA 200.7  
 Units: ug/l

Prep Date: 08/31/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony				
Arsenic	anr			
Barium				
Beryllium				
Boron	anr			
Cadmium				
Calcium	23800	25000	95.2	85-115
Chromium				
Cobalt				
Copper				
Iron	4820	5000	96.4	85-115
Lead				
Lithium				
Magnesium	24700	25000	98.8	85-115
Manganese	461	500	92.2	85-115
Molybdenum				
Nickel				
Phosphorus				
Potassium	24900	25000	99.6	85-115
Selenium	anr			
Silicon				
Silver				
Sodium	24000	25000	96.0	85-115
Strontium	anr			
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP19628: D86156-1F

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

8.2.3  
8

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

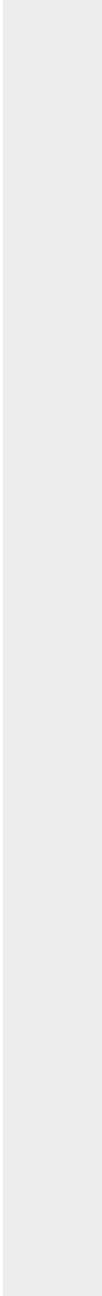
QC Batch ID: MP19628  
Matrix Type: AQUEOUS

Methods: EPA 200.7  
Units: ug/l

Prep Date: 08/31/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
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(anr) Analyte not requested



8.2.3  
8

BLANK RESULTS SUMMARY  
Part 2 - Method Blanks

Login Number: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
Matrix Type: AQUEOUS

Methods: EPA 200.8  
Units: ug/l

Prep Date: 08/31/16

Metal	RL	IDL	MDL	MB 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		
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	.06	.21	0.030	<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 MP19629: D86156-1F

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: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 08/31/16

Metal	D86155-1F Original MS	Spikelot ICPALL2	% Rec	QC Limits
Aluminum	anr			
Antimony				
Arsenic	anr			
Barium	anr			
Beryllium				
Boron				
Cadmium	anr			
Calcium				
Chromium				
Cobalt				
Copper	anr			
Iron	anr			
Lead	anr			
Magnesium				
Manganese	anr			
Molybdenum				
Nickel	anr			
Phosphorus				
Potassium				
Selenium	1.1	218	200	108.5 70-130
Silver	anr			
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Uranium	anr			
Vanadium				
Zinc				

Associated samples MP19629: D86156-1F

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: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 08/31/16

Metal	D86155-1F Original MSD		Spikelot ICPALL2 % Rec		MSD RPD	QC Limit
Aluminum	anr					
Antimony						
Arsenic	anr					
Barium	anr					
Beryllium						
Boron						
Cadmium	anr					
Calcium						
Chromium						
Cobalt						
Copper	anr					
Iron	anr					
Lead	anr					
Magnesium						
Manganese	anr					
Molybdenum						
Nickel	anr					
Phosphorus						
Potassium						
Selenium	1.1	218	200	108.5	0.0	20
Silver	anr					
Sodium						
Strontium						
Thallium						
Tin						
Titanium						
Uranium	anr					
Vanadium						
Zinc						

Associated samples MP19629: D86156-1F

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: D86156  
 Account: LTENCODE - LT Environmental  
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP19629  
 Matrix Type: AQUEOUS

Methods: EPA 200.8  
 Units: ug/l

Prep Date: 08/31/16

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum	anr			
Antimony				
Arsenic	anr			
Barium	anr			
Beryllium				
Boron				
Cadmium	anr			
Calcium				
Chromium				
Cobalt				
Copper	anr			
Iron	anr			
Lead	anr			
Magnesium				
Manganese	anr			
Molybdenum				
Nickel	anr			
Phosphorus				
Potassium				
Selenium	224	200	112.0	85-115
Silver	anr			
Sodium				
Strontium				
Thallium				
Tin				
Titanium				
Uranium	anr			
Vanadium				
Zinc				

Associated samples MP19629: D86156-1F

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

8.3.3  
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## 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: D86156  
Account: LTENCODE - LT Environmental  
Project: Colo Rule 608 Compliance Raton Basin CO

Analyte	Batch ID	RL	MB Result	Units	Spike Amount	BSP Result	BSP %Recov	QC Limits
Alkalinity, Bicarbonate as CaC	GN35983	5.0	0.0	mg/l	100	101	101.0	90-110%
Alkalinity, Carbonate	GN35984	5.0	0.0	mg/l	100	101	101.0	80-120%
Alkalinity, Total as CaCO3	GN35982	5.0	0.0	mg/l	100	101	101.0	90-110%
Alkalinity, Total as CaCO3	GN35982			mg/l	10	10.0	100.0	90-110%
Bromide	GP18710/GN35839	0.050	0.0	mg/l	0.5	0.492	98.4	90-110%
Chloride	GP18710/GN35839	0.50	0.0	mg/l	5	5.01	100.2	90-110%
Fluoride	GP18710/GN35839	0.10	0.0	mg/l	1	0.999	99.9	90-110%
Iron-Related Bacteria	MB762	25	<25	CFU/ml				
Nitrogen, Nitrate	GP18710/GN35839	0.010	0.0	mg/l	0.1	0.0976	97.6	90-110%
Nitrogen, Nitrite	GP18710/GN35839	0.0040	0.0	mg/l	0.05	0.0495	99.0	90-110%
Slime Forming Bacteria	MB763	500	<500	CFU/ml				
Solids, Total Dissolved	GN35844	10	0.0	mg/l				
Solids, Total Dissolved	GN35844	10	0.0	mg/l	400	400	100.0	90-110%
Specific Conductivity	GP18730/GN35885			umhos/cm	100.8	93.8	93.2	90-110%
Sulfate	GP18710/GN35839	0.50	0.0	mg/l	5	4.91	98.2	90-110%
Sulfate Reducing Bacteria	MB764	200	<200	CFU/ml				
pH	GN35848			su	8.00	7.97	99.6	99.1-100.9%

Associated Samples:

Batch MB762: D86156-1B  
Batch MB763: D86156-1B  
Batch MB764: D86156-1B  
Batch GN35844: D86156-1  
Batch GN35848: D86156-1  
Batch GN35982: D86156-1  
Batch GN35983: D86156-1  
Batch GN35984: D86156-1  
Batch GP18710: D86156-1  
Batch GP18730: D86156-1

(\*) Outside of QC limits

DUPLICATE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D86156  
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>	GN35982	D86303-1	mg/l	12.0	12.5	4.1	0-20%
Solids, Total Dissolved	GN35844	D85962-1	mg/l	1120	1200	6.9	0-20%
Specific Conductivity	GP18730/GN35885	D86174-1	umhos/cm	2150	2180	1.4	0-20%

Associated Samples:

Batch GN35844: D86156-1

Batch GN35982: D86156-1

Batch GP18730: D86156-1

(\*) Outside of QC limits

MATRIX SPIKE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D86156  
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
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.5	99.2	80-120%
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.5	99.2	80-120%
Chloride	GP18710/GN35839	D86162-3	mg/l	449	250	702	101.2	80-120%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.44	50	51.4	102.8	80-120%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.0	50	51.4	102.8	80-120%
Nitrogen, Nitrate	GP18710/GN35839	D86162-3	mg/l	16.5	5	21.4	98.0	80-120%
Nitrogen, Nitrite	GP18710/GN35839	D86162-3	mg/l	0.0	2.5	2.4	96.0	80-120%
Sulfate	GP18710/GN35839	D86162-3	mg/l	229	25	478	99.6	80-120%

Associated Samples:  
Batch GP18710: D86156-1  
(\*) Outside of QC limits  
(N) Matrix Spike Rec. outside of QC limits

MATRIX SPIKE DUPLICATE RESULTS SUMMARY  
GENERAL CHEMISTRY

Login Number: D86156  
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
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.4	0.4	20%
Bromide	GP18710/GN35839	D86162-3	mg/l	2.7	25	27.4	0.4	20%
Chloride	GP18710/GN35839	D86162-3	mg/l	449	250	701	0.1	20%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.44	50	51.5	0.2	20%
Fluoride	GP18710/GN35839	D86162-3	mg/l	0.0	50	51.5	0.2	20%
Nitrogen, Nitrate	GP18710/GN35839	D86162-3	mg/l	16.5	5	21.4	0.0	20%
Nitrogen, Nitrite	GP18710/GN35839	D86162-3	mg/l	0.0	2.5	2.4	0.0	20%
Sulfate	GP18710/GN35839	D86162-3	mg/l	229	250	477	0.2	20%

Associated Samples:  
Batch GP18710: D86156-1  
(\*) Outside of QC limits  
(N) Matrix Spike Rec. outside of QC limits