

2019 COLORADO RULE 608 COMPLIANCE REPORT

RATON BASIN, COLORADO

February 2020

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2019 COLORADO RULE 608 COMPLIANCE REPORT

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EXECUTIVE SUMMARY

LT Environmental, Inc. (LTE) completed the tasks for the 2019 Colorado Rule 608 Compliance Program on behalf of Timber Creek Operating, LLC. (TCO) with respect to TCO natural gas production operations in Las Animas County, Colorado (Project Area). In October 2017, TCO purchased the XTO Energy, Inc. (XTO) assets in the Project Area. LTE completed the tasks in accordance with the Colorado Oil and Gas Conservation Commission (COGCC)-approved Work Plan, submitted by XTO on 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
- 608(c) – Coal outcrop and coal mine monitoring

The 2019 Colorado Rule 608 Compliance Program meets the requirements of subsections a, b, and c of the COGCC Rule 608. The scope of work for the Colorado Rule 608 Compliance Program outlined in the May 2010 Work Plan includes four field tasks and a fifth subsequent report writing task.

The 2019 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 drilled in 2010 and 2011. Neither XTO nor TCO have drilled any new CBM wells in the Raton Basin since 2011 and, as a result, the 2019 Project Area is identical to the 2011 Project Area. Due to the absence of any proposed 2019 CBM wells, some field tasks of the May 2010 Work Plan related to new wells were omitted from the 2019 Rule 608 Compliance Program. Field tasks completed included pedestrian mapping of active seep areas within the 2019 Project Area and natural spring sampling.

LTE identified, through previous investigations, three mapping areas for surveying in 2019. Based on the findings from 2018 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 (Chavez01 and Chavez02). The water types appear to be predominately calcium in cationic composition and bicarbonate in anionic composition.

LTE recommends continued compliance with Rule 608 in Las Animas County in accordance with the COGCC-approved Work Plan as TCO development or production activities continue. Based on the findings from 2019, and a review of historical flux surveys, LTE recommends active seep areas L-1021, 32 & L-1049, and L-1030 be surveyed in 2020. LTE recommends spring sampling to be included in the 2020 survey.



1.0 INTRODUCTION

LT Environmental, Inc. (LTE) has prepared this 2019 Colorado Rule 608 Compliance Report for Timber Creek Operating LLC (TCO) to summarize the tasks completed with respect to TCO operations in Las Animas County, Colorado (Project Area, Figure 1). In October 2017, TCO purchased the XTO Energy, Inc. (XTO) assets in the Project Area. Compliance activities were conducted in accordance with the Colorado Oil and Gas Conservation Commission (COGCC)-approved Work Plan (LTE, May 2010) previously submitted by XTO on May 5, 2010. This is the ninth annual event conducted in accordance with the Colorado Rule 608 Compliance Program.

1.1 PROJECT HISTORY

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:

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

In 2010, ground surveys along the Raton Formation were conducted to meet the requirements of Rule 608(c). The survey was completed in a manner similar to an initial baseline ground survey of methane seeps completed by Apogee Scientific, Inc. (Apogee) for the COGCC in 2000 and a more detailed survey conducted by LTE and Apogee for the COGCC in 2007. The 2010 surveys were conducted using a 4-wheel drive vehicle equipped with an infrared-based gas detector developed by Apogee. This gas detector was designed to detect leaks in natural gas pipelines and is referred to as the Leak Detection System (LDS). A total of three suspect seep areas were identified and field-verified along 106 miles of roadway. Additionally, LTE conducted pedestrian mapping of six previously identified seep areas during the 2010 ground survey. LTE conducted detailed mapping to field-verify the nine suspect seep areas and confirmed the presence of methane gas near all nine areas. Color infrared imagery was collected along the Vermejo Formation within the Project Area, and field verification of suspect areas identified on the imagery occurred but was limited to those areas where access was granted. No methane was detected in any of the subsurface points within the suspect areas identified by infrared mapping.

In 2011, the survey area was expanded, and ground surveys were again conducted by Apogee and field-verified by LTE. Apogee's ground survey took over two days and identified suspect seep areas over approximately 240 miles of roadway. Through the previous 2007 and 2010 investigation and the 2011 ground survey, 39 suspect seep areas within the Project Area were identified. Of the 39 suspect seep areas, nine areas (L-1021, L-1030, 32 & L-1049, L-1050, 5, 14, L-1033, 13 & L-1026, and 19) were identified as active methane seeps during the investigation and 30 suspect seep areas did not record methane or methane was reported due to other potential sources such as fugitive gases from oil and gas equipment/production.



Based on the findings in 2011, the nine seep areas (L-1021, L-1030, 32 & L-1049, L-1050, 5, 14, L-1033, 13 & L-1026, and 19) were monitored annually from 2011 to 2014. In 2014, areas L-1033, 13 & L-1026, and 19 appeared to be diminished. As a result, LTE omitted these seep areas from future monitoring activities. The remaining six seep areas were monitored in 2015. Findings from the 2015 monitoring event identified areas L-1021, 32 & L-1049, and L-1030 to be active methane seep areas. However, areas L-1050, 5, and 14 no longer had reportable methane flux detections and had limited methane detections in previous years. These three mapping areas were characterized as diminishing methane seeps and, supported by the absence of reportable methane flux in 2015, were omitted from future monitoring activities. From 2016 through 2019, LTE surveyed areas L-1021, 32 & L-1049, and L-1030, which appear to be continually active seep areas. Summaries of the mapping areas from 2010 to present are included in Table 1.

Natural spring monitoring initially took place at Spring01 in 2010. When sampled, the water appeared to be predominately calcium and sodium + potassium in cationic composition and carbonate + bicarbonate in anionic composition. Dissolved methane was detected in the sample at a concentration of 0.109 milligrams per liter (mg/L), which is below the 2 mg/L threshold to analyze the gas composition and carbon and hydrogen isotopes of methane. Spring01 was dry in 2012 and 2013 and stagnant from 2016 to present; therefore, no samples were collected. Spring samples Chavez01, Chavez02, and Chavez03 were added to the program and collected in 2012. All Chavez samples appear to be calcium in cationic composition and carbonate + bicarbonate in anionic composition. In 2012, dissolved methane for all three spring samples were below the 2 mg/L threshold applied by the COGCC to require analysis for gas composition and for carbon and hydrogen isotopes of methane. Chavez03 has not been sampled since 2015 due to the presence of stagnant water. Spring03 (Quiet Spring) was discovered in 2014; however, water in the spring has never been sampled due to lack of access or lack of water.

Assessment and monitoring of P&A production wells and water well sampling activities (Rules 608(a) and 608(b)) are described in further detail in the subsequent Section 1.4, Deviations.

1.2 PROJECT AREA

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

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



The Vermejo Formation consists of sandstone, interbedded siltstone, shale, carbonaceous shale, and coal accumulated above the fluvial-deltaic sequences of the Trinidad Sandstone (Stevens, et al. 1992). The Vermejo Formation outcrops along the western edge of the Raton Basin syncline basin, which is on the west side of the Project Area. Of the more than 90,000-acre Project Area, the Vermejo Formation outcrop covers approximately two percent of the overall Project Area. The Raton and Vermejo formation outcrops are depicted on Figure 1.

1.3 SCOPE OF WORK

XTO originally proposed to drill CBM production wells in the Project Area of the Raton Basin over several years starting in 2010 (red outline on Figure 2). Drilling began in 2010. However, XTO did not install any CBM production wells in the Project Area in 2012, 2013, 2014, 2015, 2016, or 2017 and sold their assets in the Project Area to TCO in late 2017. As a result, the 2018 and 2019 Project Area was determined by a 2-mile buffer around the 2010 and 2011 proposed CBM production wells and CBM production wells XTO installed in 2010 and 2011. The 2019 Project Area (green outline on Figure 2), proposed 2010 and 2011 CBM production well locations, recorded P&A production well locations, groundwater well locations, topography, and mine features are illustrated on Figure 2. The scope of work for the Colorado Rule 608 Compliance Program outlined in the May 2010 Work Plan 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
- Task 5: Preparation of this report

1.4 DEVIATIONS

TCO did not propose or install any new CBM production wells in 2017 or 2018. As a result, some tasks and subtasks were omitted from the 2018 and 2019 Colorado Rule 608 Compliance Program as described below. Historical procedures and findings for these tasks are described in previous annual reports:

- There were no new P&A production wells within the Project Area to assess in 2019, and as a result, Task 1 was not conducted for the 2019 Colorado Rule 608 Compliance Program.
- A review of groundwater wells within the 2019 Project Area meeting the requirements set forth in Rule 608(b) identified 11 groundwater wells. However, no new TCO CBM production wells were installed during 2017 or 2018. As a result, Task 2 was not conducted during the 2019 Colorado Rule 608 Compliance Program. Groundwater wells will be sampled prior to drilling of any new production wells in the Project Area.
- Ground surveys to locate suspect methane seeps on the Raton Formation outcrop and color infrared (CIR) aerial imagery with 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 2019.



- 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 a 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 an associated isotopic analysis. As a result, re-sampling for isotopic analysis of these seep areas was not necessary in 2019.
- In 2011, the COGCC informed XTO and LTE that those natural springs that overlap with other oil and gas companies conducting similar activities to comply with Rule 608 did not need to be sampled. As a result, Task 4 was reduced from the original Work Plan by not sampling Spring05 (Vega Canyon), Spring07 (Spring Canyon), or Spring08 (Middle Lorencito). LTE was not granted property access for Spring02, Spring03 (Quiet Spring), Spring04, Spring06, Spring09, or Spring10. As a result, natural spring water samples from these six springs were not collected in 2019.

1.5 REPORT ORGANIZATION

This report is organized into five sections including this introduction (Section 1.0), which presents the history, objectives, and scope of work related to the project. The field methods are described in Section 2.0. The 2019 results are summarized in Section 3.0. The conclusions of the 2019 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 2018 PROJECT AREA

The 2019 Project Area was determined by a 2-mile buffer around the 2010 and 2011 proposed XTO CBM production wells and the CBM production wells that XTO installed in 2010 and 2011. The 2019 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 2019 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 2019 Project Area. LTE requested access to all properties where field work was proposed, but one property owner did not respond; as a result, no investigation activities were conducted on that property. The 2019 property owner and access information is presented in Table 2.

2.3 FLUX SURVEY

Flux surveys consist of using 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. Additional measurements are collected between grid nodes if methane seepage is observed. Where appropriate, photographs of vegetative conditions, visible seeps, and sensitive receptors are collected.

The 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/m²-day to 300 mol/m²-day. Methane fluxes below 0.2 mol/m²-day are detectable with decreased accuracy. As a result, reporting of methane fluxes will not include values less than 0.2 mol/m²-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® 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® 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® 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. Data stored in the GPS unit are downloaded later for processing and reporting.

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

Readings collected with the GPS unit can be located with 1-meter accuracy. However, the terrain and forest canopy can adversely affect GPS unit accuracy. North-facing slopes and heavily-wooded areas can



distort or block satellite signals. When satellite signals are limited, positioning accuracy decreases. In locations where the GPS unit cannot obtain a signal, field personnel will note measurement data on their field reference maps. Specifications of the GPS unit are included in Appendix A.

2.3.2 Flux Volume Estimations

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

The results were converted to volumetric flux rates common to the natural gas production industry in units of thousand cubic feet per day (MCFD). For a better perspective of the methane flux rates, LTE converted the mass flux values into volumetric flux units of cubic feet per day (CFD), assuming equal areas. The unit conversion is based on the molecular weight of the gas and the density of the gas at approximately 7,100 feet above mean sea level (amsl).

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:

ft³ – cubic feet

CH₄ – 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 spring-by-spring basis. Only natural springs identified on United States Geological Survey (USGS) topographic maps within the 2019 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. 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 Appendix 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 United States Environmental Protection Agency (EPA) Method 200.7



- Dissolved Metals [selenium (Se), manganese (Mn)] by EPA Method 200.8
- Alkalinity (carbonate/bicarbonate) by Method SM 2320B-2011
- Major Anions [chloride (Cl), sulfate (SO₄), bromide (Br), and fluoride (F)] by EPA Method 300
- SC by Method SM 2510B-2011
- Nitrate/Nitrite as Nitrogen (N) by EPA Method 300
- TDS by Method SM2540C
- Methane by Method RSK175 Modified
- pH by Method SM 4500HB
- Hydrogen Sulfide field analysis using Hach® test kit
- Sodium Adsorption Ratio (SAR) by United States Department of Agriculture (USDA) Handbook 60
- 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 (COC) documentation to Accutest Mountain States Laboratories (Accutest) in Wheat Ridge, Colorado.

LTE sampled natural springs Chavez01 and Chavez02 during the sampling event in 2019. Water samples were not collected from Spring01 and Chavez03 due to stagnation of the water from the natural springs, and water samples were not collected from Spring03 (Quiet Spring) due to lack of access.



3.0 RESULTS

3.1 FLUX SURVEY

As previously stated, LTE identified three mapping areas for surveying in 2019:

- L-1021
- 32 & L-1049
- L-1030

Reportable methane flux was detected in all three mapping areas. Total reportable volumetric methane flux was calculated as 17.8 MCFD for area L-1021, 2.2 MCFD for area L-1030, and 780.2 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 from 2010 to present are included in Table 1. 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 2019 Project Area (Figure 2). Natural springs Spring05 (Vega Canyon), Spring07 (Spring Canyon), and Spring08 (Middle Lorencito) were excluded from the sampling list as approved by the COGCC. Six natural springs were located on private property with no access granted. Two natural springs (Chavez01 and Chavez02) were sampled on October 23, 2019. Chavez03 and Spring01 were stagnant at the time of sampling, and as a result, no water samples were collected.

3.3 Field Observations

LTE collected field measurements from the Chavez01 and Chavez02 natural springs, which were documented in a field logbook. The 2019 field observations and measurements for the natural springs are consistent with previous years' sampling events. Field observations and measurements are summarized in Table 3.

3.3.1 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 in cationic composition and bicarbonate + carbonate 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 laboratory analytical reports are presented in Appendix D.



4.0 CONCLUSIONS

The 2019 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 2019. Based on the findings from 2019, the three mapping areas L-1021, 32 & L-1049, and L-1030 continue to be active seep areas.

LTE recommends continued compliance with Rule 608 in Las Animas County in accordance with the COGCC-approved Work Plan. Based on the findings from 2019 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 2020 flux survey.

Two natural springs were sampled for water quality analysis (Chavez01 and Chavez02). The water types appear to be predominately calcium in cationic composition and bicarbonate + carbonate in anionic composition. LTE recommends spring sampling to be included in the 2020 survey.



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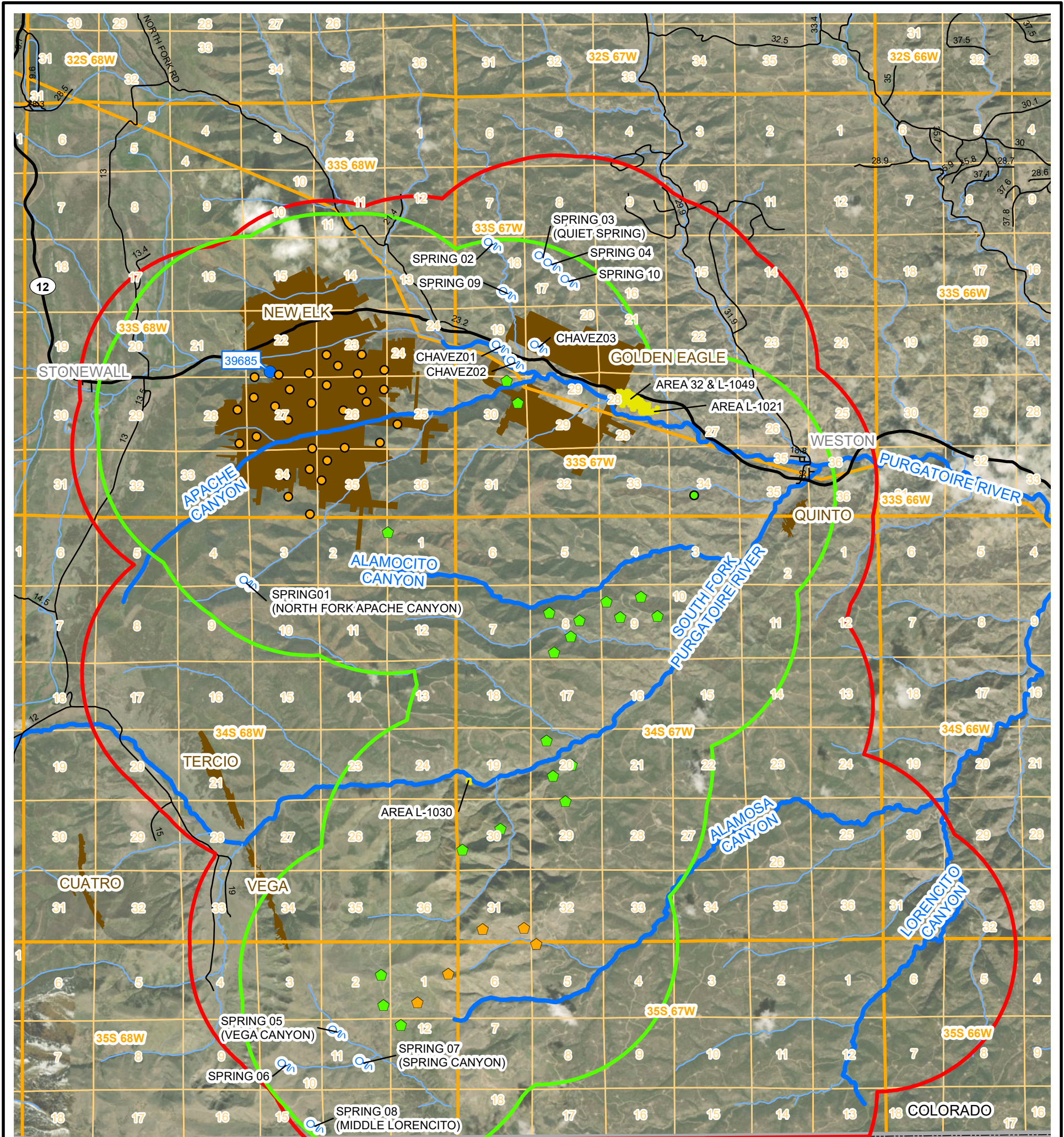
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LEGEND

- 2010 PROPOSED COALBED METHANE PRODUCTION WELL
- 2010 INSTALLED COALBED METHANE PRODUCTION WELL
- 2011 PROPOSED COALBED METHANE PRODUCTION WELL
- 2011 INSTALLED COALBED METHANE PRODUCTION WELL
- WATER WELL LABELED WITH PERMIT NUMBER
- SPRING LABELED WITH SAMPLE ID
(SPRING NAME, IF APPLICABLE)
- ROAD
- OTHER WATER SOURCE
- MAJOR DRAINAGE
- MAPPING AREA
- 2010 PROJECT AREA
- 2019 PROJECT AREA
- COLORADO STATE LINE
- TOWNSHIP AND RANGE LINES
- SECTION LINE
- MINE BOUNDARY



FIGURE 2
2019 PROJECT AREA MAP
2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO

TIMBER CREEK OPERATING, LLC





LEGEND

2019 METHANE FLUX MEASUREMENT
(mol/m² • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 371.0000

▲ 2011 SUSPECT METHANE SEEP (ID LABELED IN GREEN)

— METHANE FLUX CONTOUR (mol/m² day)
CONTOUR INTERVAL VARIES

mol/m² • day: MOLES PER SQUARE METER PER DAY
ONLY METHANE FLUX MEASUREMENTS GREATER
THAN OR EQUAL TO 0.2 mol/m² • day ARE LABELED

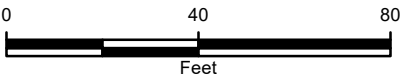


FIGURE 3
METHANE FLUX CONTOURS
MAPPING AREA L-1021
2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO
TIMBER CREEK OPERATING, LLC





IMAGE COURTESY OF ESRI

LEGEND

2019 METHANE FLUX MEASUREMENT
(mol/m² • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 371.0000

▲ 2011 SUSPECT METHANE SEEP (ID LABELED IN GREEN)

— METHANE FLUX CONTOUR (mol/m² day)
CONTOUR INTERVAL VARIES

mol/m² • day: MOLES PER SQUARE METER PER DAY
ONLY METHANE FLUX MEASUREMENTS GREATER
THAN OR EQUAL TO 0.2 mol/m² • day ARE LABELED

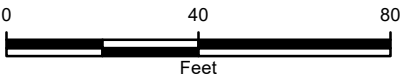
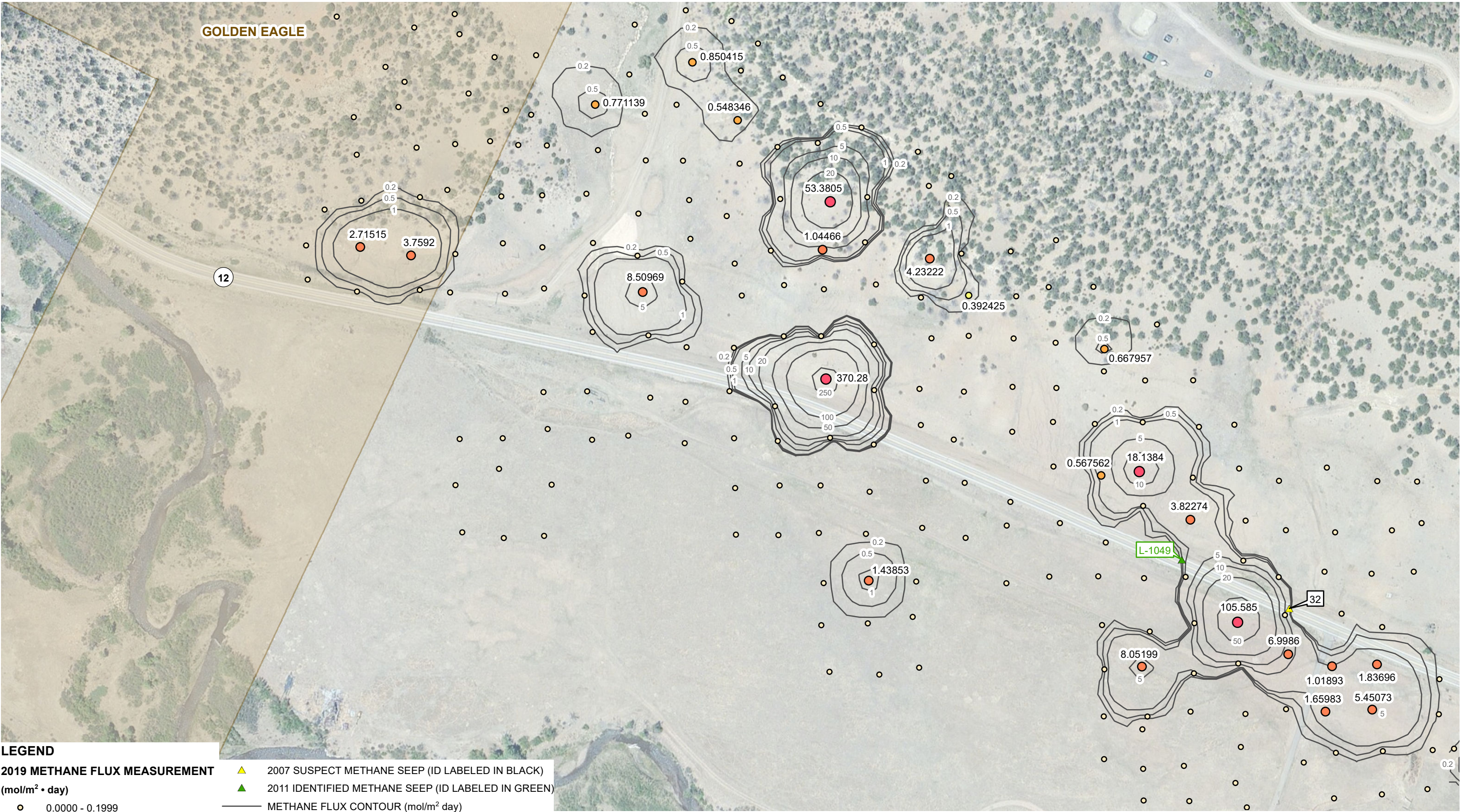


FIGURE 4
METHANE FLUX CONTOURS
MAPPING AREA L-1030
2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO
TIMBER CREEK OPERATING, LLC





LEGEND

2019 METHANE FLUX MEASUREMENT
(mol/m² • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 371.0000

- 2007 SUSPECT METHANE SEEP (ID LABELED IN BLACK)
- 2011 IDENTIFIED METHANE SEEP (ID LABELED IN GREEN)
- METHANE FLUX CONTOUR (mol/m² day)
CONTOUR INTERVAL VARIES
- mol/m² • day: MOLES PER SQUARE METER PER DAY
ONLY METHANE FLUX MEASUREMENTS GREATER
THAN OR EQUAL TO 0.2 mol/m² • day ARE LABELED
- LEWICKI MINE BOUNDARY

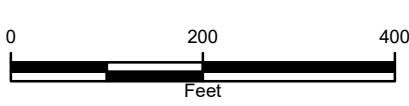
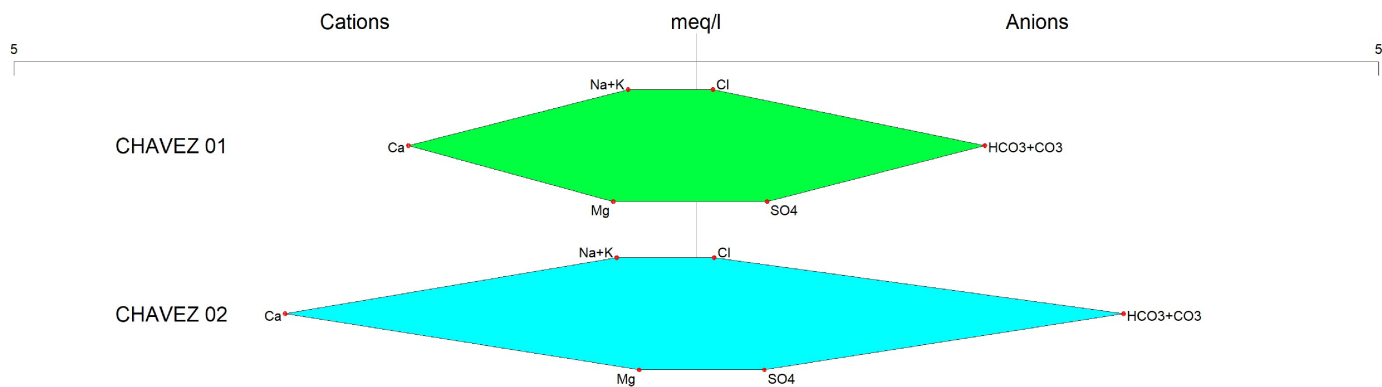


FIGURE 5
METHANE FLUX CONTOURS
MAPPING AREAS 32 & L-1049
2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO
TIMBER CREEK OPERATING, LLC





LEGEND

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

FIGURE 6
 STIFF DIAGRAMS
 OCTOBER 23, 2019
 2019 COLORADO RULE 608 COMPLIANCE REPORT
 RATON BASIN, LAS ANIMAS COUNTY, COLORADO
 TIMBER CREEK OPERATING, LLC



TABLE 1
MAPPING AREA SUMMARIES

2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO
TIMBER CREEK OPERATING, LLC

Area IDs	2007	2010			2011			2012			2013			2014			2015			2016			2017			2018			2019		
	Subsurface Methane Gas Detected	Total Number of Flux Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**	Total Number of Sample Points	Reportable CH ₄ Flux Points*	Total CH ₄ Flux (MCFD)**
L-1021	-	-	-	-	44	10	129.71	47	6	6.7	46	2	2.2	51	4	1.9	35	4	6.8	35	6	14.1	35	2	7.5	35	3	193.6	35	5	17.8
L-1030	-	-	-	-	17	3	2.19	17	3	2.2	18	1	1	18	4	56.9	18	2	12.7	18	3	5.4	22	7	19.4	22	4	25.4	18	3	2.2
32 & L-1049	x	-	-	-	372	146	304.12	217	55	720.4	234	37	332.4	233	33	150.7	239	25	668.4	238	32	204.3	239	29	74.3	240	35	739.3	238	23	780.2
L-1050	-	-	-	-	22	4	0.69	22	2	1.0	22	0	0.0	25	1	1	22	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	167	16	2.16	83	6	1.9	83	0	0.0	80	3	0.8	76	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-
14	-	94	16	0.563808	50	7	0.34	46	0	0.0	58	3	0.2	66	4	0.4	58	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-
L-1033	-	-	-	-	26	1	0.02	40	4	0.1	40	0	0.0	38	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 & L-1026	-	29	8	10.74	56	2	0.03	61	1	1	61	0	0.0	38	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	23	0	0.00	15	1	1	15	0	0.0	14	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
CH₄ - methane
moles/m²·day - moles per meter squared per day
MCFD - thousand cubic feet per day
NA - not applicable
- - not measured
1 - not contoured, only one data point
** - volume includes only gridded values > 0.2 moles/m²·day
* - only points where flux values were above the reporting limit of 0.2 moles/m²·day



TABLE 2
PROPERTY OWNER AND ACCESS INFORMATION

2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO
TIMBER CREEK OPERATING, LLC

LANDOWNER	PARCEL ID	SECTION	TOWNSHIP	RANGE	PERMISSION GRANTED
Timber Creek Operating, LLC	14533300	28	33	67	Yes
	14533405	27, 28	33	67	
	14533200	27	33	67	
Bill R. and Rossana T. Chavez	13940200	19	33	67	Yes
Donald Mounier	NA	17	33	67	No Response
Bill Toupal	NA	28	33	67	Yes
		27, 28	33	67	
		27	33	67	
Veronica Law	NA	19	33	67	Yes

TABLE 3
NATURAL SPRING WATER QUALITY MEASUREMENTS
2019 COLORADO RULE 608 COMPLIANCE REPORT
RATON BASIN, LAS ANIMAS COUNTY, COLORADO
TIMBER CREEK OPERATING, LLC

Natural Spring	Location	Latitude	Longitude	Inspection Date	Specific Electrical Conductance (µS/cm)	pH (Units)	ORP (mV)	Temperature (°C)	TDS (mg/l)
Spring01	North Fork Apache Canyon	-104.991708	37.108089	8/13/2010	381.0	9.2	140.5	22.4	247.0
				8/19/2011	408.0	7.1	-99.5	13.3	432.0
				9/4/2012	DRY - NOT MEASURED				
				8/15/2013	DRY - NOT MEASURED				
				8/21/2014	515.9	9.1	-61.8	12.4	337.2
				8/13/2015	562.4	8.8	-38.9	11.0	368.8
				8/25/2016	STAGNANT WATER - NOT MEASURED				
				9/6/2017	STAGNANT WATER - NOT MEASURED				
				8/20/2018	STAGNANT WATER - NOT MEASURED				
				10/23/2019	STAGNANT WATER- NOT MEASURED				
Chavez01	Rancho Escondido	-104.9265768	37.15615866	9/4/2012	391.0	6.8	106.5	15.7	200.7
				8/15/2013	356.0	7.0	12.0	14.9	NM
				8/21/2014	329.0	7.7	200.9	16.3	579.0
				8/12/2015	420.8	6.8	279.5	14.7	275.4
				8/25/2016	284.6	7.1	25.5	14.1	233.4
				9/6/2017	383.6	7.6	610	16.15	249.2
				8/20/2018	711	8.8	-83	18.34	494.3
				10/23/2019	216.8	8.5	-89.3	9.8	197.3
Chavez02	Rancho Escondido	-104.922814480	37.152863914	9/4/2012	414.0	6.5	105.5	16.0	207.7
				8/15/2013	417.0	6.9	NM	14.1	NM
				8/21/2014	399.3	7.5	169.7	14.4	260.2
				8/12/2015	550.6	7.1	323.4	14.1	361.2
				8/25/2016	381.4	7.6	44.8	17.5	291.7
				9/6/2017	554.9	7.04	544	16.1	358.75
				8/20/2018	390	8.67	-82.9	18.9	245.58
				10/23/2019	368.8	8.09	-90.6	12.8	309.40
Chavez03	Rancho Escondido	-104.916708750	37.156096546	9/4/2012	1,864.0	7.0	104.7	14.1	921.9
				8/15/2013	1,464.0	7.3	47.3	14.7	NM
				8/21/2014	1,922.9	7.6	-40.1	16.3	1,255.3
				8/12/2015	STAGNANT WATER - NOT MEASURED				
				8/25/2016	DRY - NOT MEASURED				
				9/6/2017	STAGNANT WATER- NOT MEASURED				
				8/20/2018	STAGNANT WATER- NOT MEASURED				
				10/23/2019	STAGNANT WATER- NOT MEASURED				
Spring03 - Quiet Spring	Rancho Escondido	-104.915474	37.174474	8/21/2014	STAGNANT WATER - NOT MEASURED				
				8/13/2015	STAGNANT WATER - NOT MEASURED				
				8/25/2016	STAGNANT WATER - NOT MEASURED				
				9/6/2017	NO ACCESS GRANTED - NOT MEASURED				
				8/20/2018	NO ACCESS GRANTED - NOT MEASURED				
				10/23/2019	NO ACCESS GRANTED - NOT MEASURED				

Notes:

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

TABLE 4 NATURAL SPRING ANALYTICAL RESULTS																										
2019 COLORADO RULE 608 COMPLIANCE REPORT RATON BASIN, LAS ANIMAS COUNTY, COLORADO TIMBER CREEK OPERATING, LLC																										
Natural Spring	Location	Sample Date	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Potassium (mg/l)	Manganese (mg/l)	Selenium (mg/l)	Methane (mg/l)	Iron (mg/l)	Sodium Adsorption Ratio	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 Sulphide (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	0.10900	1.59	11.4	<5.0	205	280	364	10.13	2.9	3.3	<0.20	0.74	<0.50	<0.23	<0.061	500	>350,000	700,000
		8/15/2011	2.2	0.52	136.0	1.64	0.1260	<0.00080	0.277	3.660	22.2	<5.0	332	420	428	8.16	2.7	3.7	<0.20	1.40	NA	<0.045	<0.011	9,000	350,000	700,000
		9/4/2012	DRY - NOT SAMPLED																							
		8/15/2013	DRY - NOT SAMPLED																							
		8/21/2014	1.4	0.35	129.0	<1.0	0.0063	<0.00080	1.00	<0.010	25.0	<5.0	251	338	406	NA	3.5	3.7	<0.050	1.00	0.5	<0.010	<0.0040	<25	<500	<200
		8/13/2015	1.8	0.47	128.0		0.0111	<0.00080	1.09000	0.0212	20.1	10.9	227	304	402	8.64	7.4	3.9	<0.050	0.97	<0.50	<0.020	<0.0080	<25	<500	<200
		8/25/2016	STAGNANT WATER - NOT SAMPLED																							
		9/6/2017	STAGNANT WATER - NOT SAMPLED																							
		8/20/2018	STAGNANT WATER - NOT SAMPLED																							
		10/23/2019	STAGNANT WATER- NOT SAMPLED																							
Chavez01	Rancho Escondido	9/4/2012	44.5	8.12	20.4	<1.0	<0.0050	<0.0020	0.0012	<0.070	0.738	<5.0	157	194	323	7.28	19.3	3.4	<0.050	0.27	0.0	0.011	<0.0040	74,500	350,000	359,000
		8/15/2013	50.2	8.59	20.8	1.07	NA	<0.0020	NA	<0.070	0.755	<5.0	171	224	358	7.4	28.7	5.8	<0.050	0.27	NA	0.012	<0.0040	74,500	66,500	1,200
		8/21/2014	49.8	8.92	15.0	1.23	<0.0050	<0.00080	0.0035	<0.010	0.490	<5.0	141	210	278	NA	21.6	5.1	<0.050	0.23	0.0	<0.010	<0.0040	9,000	66,500	700
		8/12/2015	53.6	9.92	15.4	<1.0	<0.0050	<0.00080	0.00250	0.0147	0.507	<5.0	139	220	285	7.19	27.5	15.7	<0.050	0.23	<0.50	<0.010	<0.0040	74,500	350,000	<200
		8/25/2016	41.7	8.09	13.4	<1.0	8.090	0.0011	0.0022	<0.010	0.519	<5.0	141	200	291	7.13	24.6	6.7	<0.050	0.21	0.0	<0.050	<0.0054	74,500	66,500	1,200
		9/6/2017	50.0	9.42	15.0	<1.0	0.0023	<0.00080	0.00260	<0.010	0.510	<5.0	137	202	325	7.80	25.1	8.8	<0.050	0.22	0.0	<0.010	<0.0040	74,500	350,000	5,000
		8/20/2018	43.4	8.07	12.1	<1.0	0.003	<0.00080	0.00049	<0.010	0.442	<5.0	131	188	287	7.97	26.1	3.3	<0.050	0.25	NA	0.024	0.024	35,000	440,000	6,000
		10/23/2019	47.9	8.35	11.5	<1.0	<0.002	<0.00080	0.0038	<0.01	0.403	<5.0	129	183	299	7.49	24.9	4.3	<0.050	0.23	NA	0.015	<0.0040	2,200	440,000	27,000
		9/4/2012	49.3	9.56	18.2	1.43	<0.0050	<0.0020	0.00030	<0.070	0.621	<5.0	163	206	330	7.17	20.3	4.0	<0.050	0.30	0.0	0.088	<0.0040	74,500	350,000	359,000
		8/15/2013	59.7	11.00	20.2	1.51	0.0055	<0.0020	NA	<0.070	0.670	<5.0	201	264	428	7.28	31.3	8.1	<0.050	0.29	NA	1.800	1.800	75,500	12,500	5,000
Chavez02	Rancho Escondido	8/21/2014	57.7	11.20	15.9	1.77	<0.0050	<0.00080	0.00054	0.264	0.489	<5.0	167	242	318	NA	24.0	5.8	<0.050	0.29	0.0	0.400	<0.0040	9,000	<500	5,000
		8/12/2015	71.7	13.30	14.9	1.61	<0.0020	<0.00080	<0.00080	0.0473	0.472	<5.0	196	291	405	7.45	29.8	14.5	<0.050	0.27	<0.50	0.940	0.940	74,500	350,000	5,000
		8/25/2016	56.6	11.80	13.2	15.4	<0.0050	<0.00080	<0.00080	0.0329	0.447	<5.0	195	262	382	7.26	26.7	9.6	<0.050	0.25	0.0	0.42	0.42	74,500	66,500	18,000
		9/6/2017	73.0	14.4	16.8	1.620	0.0041	<0.00080	0.00052	0.022	0.470	<5.0	223	290	471	7.51	27.5	9.5	<0.050	0.27	0.0	0.16	<0.0040	74,500	350,000	700
		8/20/2018	46.0	9.11	12.5	1.380	0.0023	<0.00080	<0.00080	0.013	0.440	<5.0	143	208	310	8.10	28.1	4.1	<0.050	0.27	NA	0.17	0.17	35,000	440,000	6,000
		10/23/2019	72.1	13.30	12.8	1.560	0.0051	<0.00080	0.00097	0.036	0.363	<5.0	191	246	394	7.26	23.9	4.6	<0.050	0.26	NA	0.062	<0.0040	9,000	440,000	115,000
		9/4/2012	117.0	43.20	20.8	6.25	<0.0050	<0.0020	0.0119	0.235	4.17	<5.0	495	990	160	7.44	63.7	254.0	2.0	0.35	0.0	0.083	0.024	74,500	66,500	359,000
		8/15/2013	113.0	48.20	22.3	5.50	<0.0050	<0.0020	NA	0.200	3.91	<5.0	536	1,090	1,850	7.38	47.4	324.0	2.6	0.72	NA	0.260	0.260	9,000	350,000	359,000
		8/21/2014	117.0	53.30	241.0	5.81	0.3730	<0.00080	0.0285	0.122	4.22	<5.0	539	1,160	1,660	NA	42.5	342.0	2.7	<0.50	0.0	0.063	<0.020	2,300	66,500	359,000
		8/12/2015	STAGNANT WATER - NOT SAMPLED																							
Chavez03	Rancho Escondido	8/25/2016	DRY - NOT SAMPLED																							
		9/6/2017	STAGNANT WATER - NOT SAMPLED																							
		8/20/2018	STAGNANT WATER - NOT SAMPLED																							
		10/23/2019	STAGNANT WATER- 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																							
		9/6/2017	NO ACCESS GRANTED - NOT SAMPLED																							
		8/20/2018	NO ACCESS GRANTED - NOT SAMPLED																							
		10/23/2019	NO ACCESS GRANTED - NOT SAMPLED																							

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





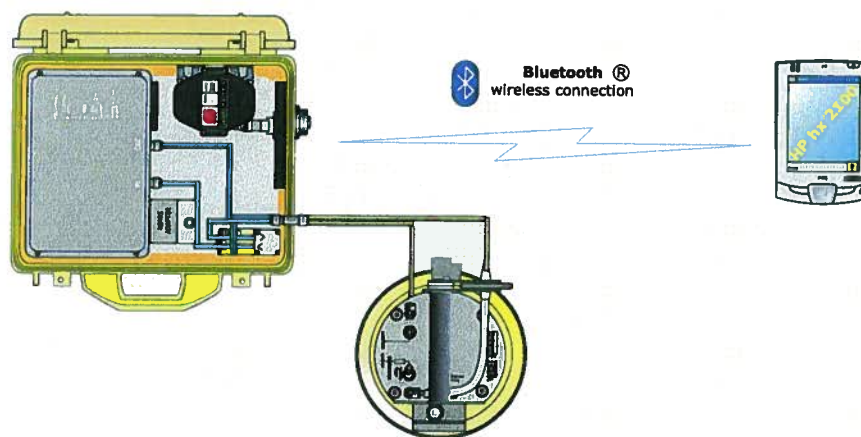
APPENDIX A: EQUIPMENT APECIFICATIONS

APPENDIX A
EQUIPMENT SPECIFICATIONS



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

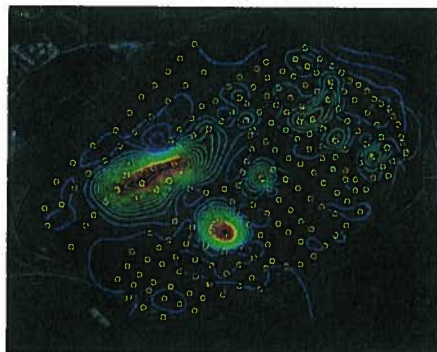
The WEST Systems Fluxmeter is a portable instrument for the measurement of soil gas diffuse degassing phenomena that uses the accumulation chamber method.



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
Fax +39 0587 296068 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").

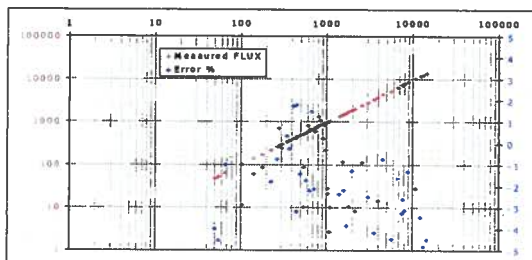
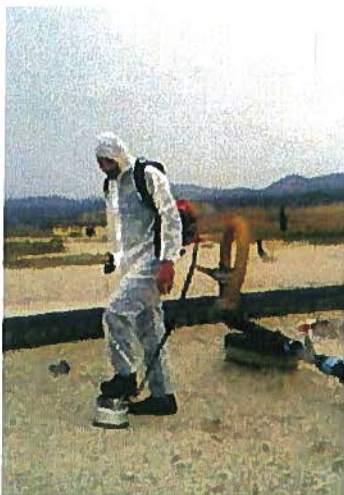
Software The instrument is supplied with a custom software, FluxManager, which allows recording and visualization of the increase in concentration of the target gas in the accumulation chamber, and then the flux calculations. The obtained measurements can be saved on the palmtop computer and then transferred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

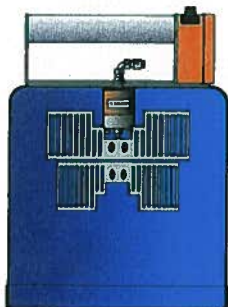
The standard flux meter configuration is supplied with a single gas detector, normally the carbon dioxide detector. The fluxmeter can host two sensors by the way special releases, based on specific customer request, it can be supplied with a maximum of 3 sensors.

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.

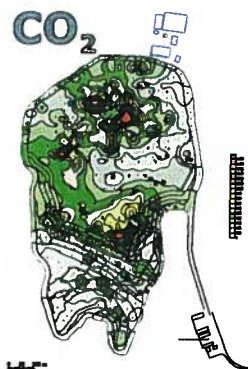


Accumulation Chamber Type B

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



CO₂ - LI820

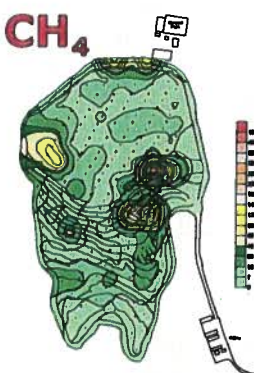
LI820 based Carbon dioxide fluxmeter

The CO₂ 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 ± 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⁻² day⁻¹.

CO₂ FLUX Measurement range:
from 0 up 600 moles m⁻² day⁻¹

The accuracy depends on the measured flux:

0 to 0.5 moles m ⁻² day ⁻¹	25% (Acc.ch.A)
0.5 to 1 moles m ⁻² day ⁻¹	15% (Acc.ch.A or B)
1 to 150 moles m ⁻² day ⁻¹	10% (Acc.ch.B)
150 to 300 moles m ⁻² day ⁻¹	10% (Acc.ch.B)
300 to 600 moles m ⁻² day ⁻¹	20% (Acc.ch.B)



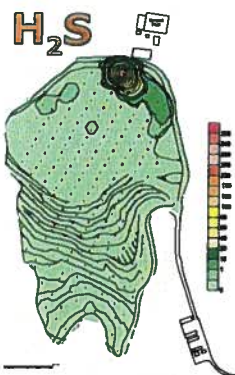
WS-DRAGER CO₂

WS-DRAGER: CO₂ 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/m² per day.

The precision depends on the measured flux:

range: 0.5 – 5 moles/m ² per day	25% (Acc. chamber A)
5-350 moles/m ² /day	10% (Acc. chamber B)
350-600 moles/m ² /day	25% (Acc. chamber B)
600-1500 moles/m ² /day	25% (Acc.Ch.B/ F.S.=10%)



WS-HC CH₄

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/m²/day detection limit is acceptable.

Methane Flux measurement range

from 0.2 up 300 moles m⁻² day⁻¹

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

0.2 to 10 moles m ⁻² day ⁻¹	25% (Acc.Ch.A)
10 to 150 moles m ⁻² day ⁻¹	15% (Acc.Ch.A)
150 to 300 moles m ⁻² day ⁻¹	20% (Acc.Ch.B)

H₂S - WEST

Hydrogen sulfide

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

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

H₂S Flux measurement range: from 0.0025 to 0.5 moles/m² per day.

The precision depends on the measured flux:

0.0025 – 0.05 moles/m ² per day	$\pm 25\%$ (Acc. Chamber A)
0.05 – 0.5 moles/m ² 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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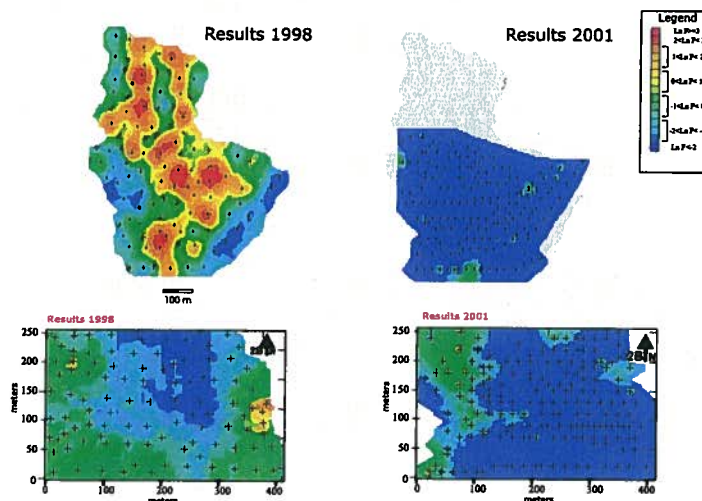
WEST
Systems

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

Local sales representative

H.Q.

West Systems Srl

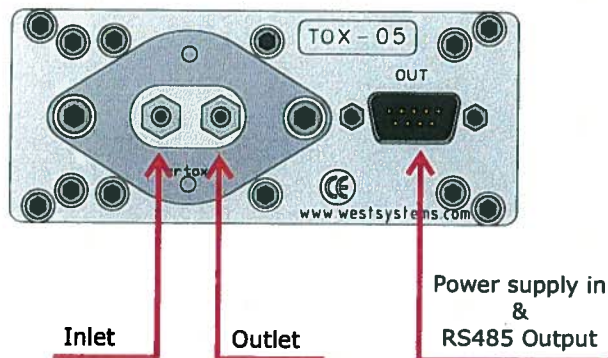
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WEB SITE <http://www.shoko.co.jp>
e-mail s-isotope@shoko.co.jp

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

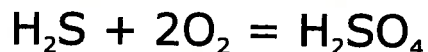
Legenda

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 H2S 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/m² per day.

The precision depends on the measured flux:

range	0.1	5	moles/ m ² per day	±25%
	5	- 150	moles/ m ² per day	±10%

The measurement of very low fluxes (< 0.1 moles/m²/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

CO₂ 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

¹**Zero Drift:** < 0.15 ppm / °C

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

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

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

¹ Zero drift is the change with temperature at 0 concentration

² Span drift is the change after re-zeroing following a temperature change

³ 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

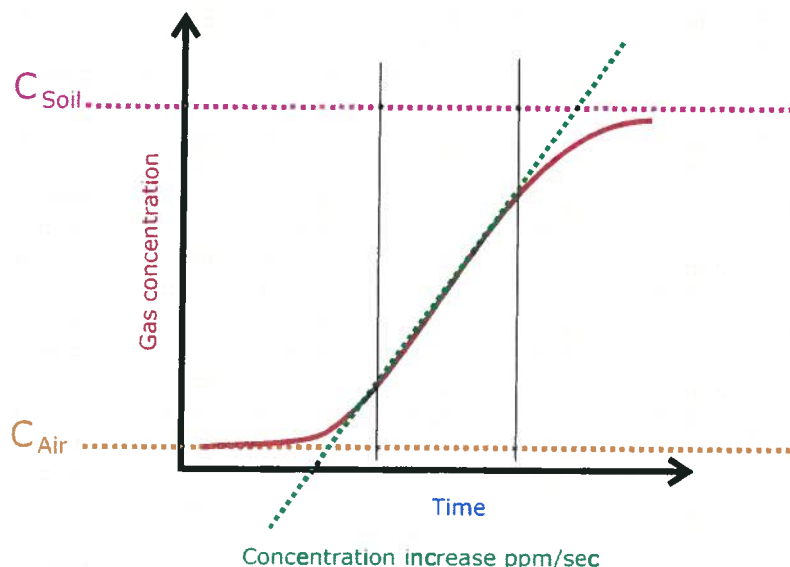
Relative Humidity Range: 0 to 95% RH, Non-Condensing

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⁻¹ mol⁻¹
- **T_k** 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.

Gasport® Gas Tester

MSA

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 ₄	1 % LEL or 0.1% CH ₄
Methane	5-100% CH ₄	1% CH ₄
Oxygen	0-25%	0.1%
Carbon Monoxide	0-1000 ppm	1 ppm
Hydrogen Sulfide	0-100 ppm	1 ppm

Battery types:	NiCd and Alkaline
Case material:	Impact resistant, stainless-steel-fiber-filled polycarbonate
Operating temperature:	normal -10 to 40°C; extended -20 to 50°C
Operating humidity:	Continuous: 15-95% RH, non-condensing Intermittent duty: 5-95% RH, non condensing
Warm up time:	Less than 20 seconds to initial readings
Datalog capacity:	12 hours
Input:	3 clearly marked, metal domed keys
Warranty:	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 ₂
812389	CO
812390	H ₂ 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 ₂ 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 ₂	CO	H ₂ S	Alarms Always	Alarms Optional	Leak Detect Page	Peak	Alkaline Battery	NiCd Battery	5ft Coiled Line	1ft Probe	Part No.
4-Gas, Selectable, NiCd	•	•	•	•	•	•	•	•	•	•	•	•	711489
4-Gas, Selectable, Alkaline	•	•	•	•	•	•	•	•	•	•	•	•	711490
3-Gas, Selectable, NiCd	•	•	•	•	•	•	•	•	•	•	•	•	711493
3-Gas, Selectable, Alkaline	•	•	•	•	•	•	•	•	•	•	•	•	711494
2-Gas, Selectable, NiCd	•	•	•	•	•	•	•	•	•	•	•	•	711495
2-Gas, Selectable, Alkaline	•	•	•	•	•	•	•	•	•	•	•	•	711496
4-Gas, Alarms On, NiCd	•	•	•	•	•	•	•	•	•	•	•	•	711491
4-Gas, Alarms On, Alkaline	•	•	•	•	•	•	•	•	•	•	•	•	711492

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

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

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

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For further information:



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

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

GeoXT

The total GPS platform for all your GIS field requirements

The GeoXT™ handheld, from the GeoExplorer® series, is an essential tool for maintaining your GIS. It's all you need to collect location data, keep existing GIS information up to date, and even mobilize your GIS.

The unique GeoExplorer series combines a Trimble® GPS receiver with a rugged field-ready handheld computer running the Microsoft® Windows Mobile™ 2003 software for Pocket PCs. Plus there's an internal battery that easily lasts for a whole day of GPS operation. The result is tightly integrated, tough, and incredibly powerful.

High-accuracy Integrated GPS

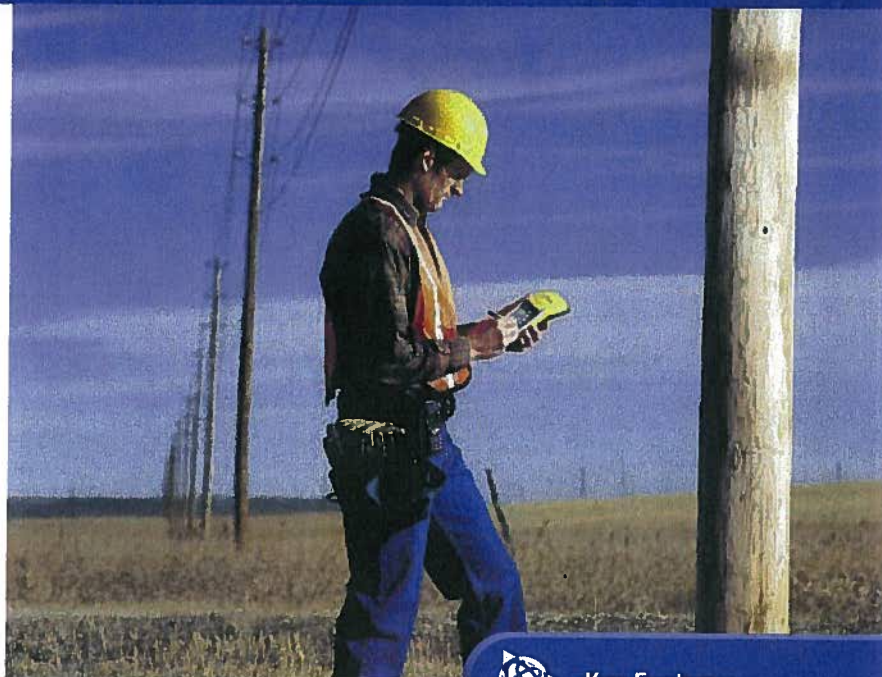
The GeoXT is optimized to provide the reliable, high-accuracy location data you need. Advanced features like EVEREST™ multipath rejection technology let you work under canopy, in urban canyons, or anywhere where accuracy is crucial.

Need submeter accuracy in real-time? Use corrections from a satellite-based augmentation system (SBAS) like WAAS¹ or EGNOS². Want to get that extra edge in precision? Collect data with Trimble's TerraSync™ or GPSCorrect™ software, and then postprocess back in the office.

Because the GPS receiver and antenna are built into the handheld computer, it's never been easier to use GPS in your application. The system is more than just cable-free: it's a totally integrated solution.

Optimized productivity

Take advantage of the power and flexibility of Windows Mobile software for Pocket PCs by choosing from the most comprehensive range of field software available—whether off-the-shelf or purpose-built. Whatever your needs, Windows



Key Features

- High-performance submeter GPS with integrated WAAS/EGNOS
- Windows Mobile 2003 software for Pocket PCs, allowing maximum flexibility in software choice
- Rugged handheld with all-day battery
- Advanced color TFT display with backlight
- Integrated Bluetooth for wireless connectivity

Mobile lets you choose a software solution to match your workflow.

Windows Mobile includes familiar Microsoft productivity tools, including Pocket Word, Pocket Excel, and Pocket Outlook®. Pocket Outlook lets you synchronize e-mails, contacts, appointments, and data with your office computer, so whether you're in the office or in the field, you're always up to date.

Go wireless with integrated Bluetooth®* for connection to other Bluetooth-enabled devices, including cell phones and PCs. You also have the option to use the USB support module to connect to a desktop computer, or use the optional serial clip for cabled connections in the field.

Receive a free copy of Microsoft Streets & Trips** 2004 software with your GeoXT handheld, and take advantage of comprehensive map and travel information for easy navigation and route planning.

All the memory you need

There's plenty of storage space in the GeoXT for all your GIS data. The fast processor and large memory mean even big graphics files load quickly—and they're crisp and crystal-clear on the advanced TFT outdoor color screen.

From data collection to data maintenance, to mobile GIS and beyond ... the GeoXT is the handheld of choice.

* Bluetooth type approvals are country specific. GeoExplorer series handhelds are approved for use with Bluetooth in the USA. For a complete list of other countries with Bluetooth approval please refer to:

www.trimble.com/geo_bluetooth.html
** Microsoft Streets & Trips 2004 software available in US/Canada; Microsoft AutoRoutes® 2004 in Europe.



GeoXT

The total GPS platform for all your GIS field requirements

Standard features

System

- Microsoft Windows Mobile 2003 software for Pocket PCs
- 206 MHz Intel StrongARM processor
- 512 MB non-volatile Flash data storage
- Outdoor color display
- Ergonomic cable-free handheld
- Rugged and water-resistant design
- All-day internally rechargeable battery
- Bluetooth wireless

GPS

- Submeter accuracy
- Integrated WAAS¹/EGNOS²
- RTCM real-time correction support
- NMEA and TSIP protocol support
- EVEREST multipath rejection technology

Software

- GPS Controller for control of Integrated GPS and in-field mission planning
- GPS Connector for connecting Integrated GPS to external ports
- File Explorer, Internet Explorer, Pocket Outlook (Inbox, Calendar, Contacts, Tasks, Notes), Sprite Pocket Backup, Transcriber, Pocket Word, Pocket Excel, Pictures, Windows[®] Media Player, Bluetooth File Transfer, Calculator, ActiveSync[®]
- Microsoft Streets & Trips/AutoRoute 2004 software

Accessories

- Support module with power supply and USB data cable
- Getting Started Guide
- Companion CD Includes Outlook 2002 and ActiveSync 3.7.1
- Hand strap
- Pouch
- Stylus

Optional Features

Software

- TerraSync
- GPScorrect for ESRI[®] ArcPad[®]
- GPS Pathfinder[®] Tools Software Development Kit (SDK)
- GPS Pathfinder Office
- Trimble GPS Analyst extension for ArcGIS[®]

Accessories

- Serial clip for field data and power input
- Vehicle power adaptor³
- Portable power kit³
- Hurricane antenna
- External patch antenna
- Pole-mountable ground plane
- Baseball cap with antenna sleeve
- Beacon-on-a-Belt (BoB[™]) differential correction receiver³
- Hard carry case
- Null modem cable³
- Backpack kit

Specifications subject to change without notice.

Technical specifications

Physical

Size	21.5 cm × 9.9 cm × 7.7 cm (8.5 in × 3.9 in × 3.0 in)
Weight	0.72 kg (1.59 lb) with battery
Processor	206 MHz Intel StrongARM SA-1110
Memory	64 MB RAM and 512 MB Internal Flash disk
Power	
Low (no GPS)	0.6 Watts
Normal (with GPS)	1.4 Watts
High (with GPS, backlight, and Bluetooth)	2.5 Watts
Battery	Internal lithium-Ion, rapidly rechargeable in unit, 21 Watt-hours

Environmental

Temperature

Operating	-10 °C to +50 °C (14 °F to 122 °F)
Storage	-20 °C to +70 °C (-4 °F to 158 °F)

Humidity 99% non-condensing

Casing Wind-driven rain and dust-resistant per IP 54 standard
Slip-resistant grip, shock- and vibration-resistant

Input/output

Communications Bluetooth for wireless connectivity
USB via support module, serial via optional DE9 serial clip adaptor

Bluetooth

Certification Bluetooth type approvals are country specific.
GeoExplorer series handhelds are approved for use with Bluetooth in the USA.
For a complete list of other countries with Bluetooth approval please refer to www.trimble.com/geoxt_ts.asp.

Profiles

Both client and host support Serial Port, File Transfer (using OBEX)
Client support only Dial-Up Networking, Lan Access
Host support only Basic Imaging, Object Push

Display Advanced outdoor TFT, 240 × 320 pixel, 65,536 colors, with backlight

Audio Microphone and half duplex speaker, record and playback utilities

Interface Anti-glare coated touch screen, Soft Input Panel (SIP) virtual keyboard
2 hardware control keys plus 4 programmable permanent touch buttons

Handwriting recognition software, Audio system events, warnings, and notifications

GPS

Channels 12

Integrated real-time WAAS¹ or EGNOS²

Update rate 1 Hz

Time to first fix 30 sec (typical)

Protocols NMEA (GGA, VTG, GLL, GSA, ZDA, GSV, RMC),
TSIP (Trimble Standard Interface Protocol)

Accuracy (RMS)⁴ after differential correction

Postprocessed⁵ Submeter

Carrier postprocessed⁶ Submeter

With 10 minutes tracking satellites 30 cm

Real-time Submeter

¹ WAAS (Wide Area Augmentation System). Available in North America only.

For more information, see <http://gps.faa.gov/programs/index.htm>.

² EGNOS (European Geostationary Navigation Overlay System). Available in Europe only.

For more information, see <http://www.esa.int/export/esaSA/navigation.html>.

³ Serial clip also required.

⁴ Horizontal accuracy. Requires data to be collected with minimum of 4 satellites, maximum PDOP of 6, minimum SNR of 4, minimum elevation of 15 degrees, and reasonable multipath conditions. Ionospheric conditions, multipath signals or obstruction of the sky by buildings or heavy tree canopy may degrade precision by interfering with signal reception. Accuracy varies with proximity to base station by +1 ppm for postprocessing and real-time, and by +5 ppm for carrier postprocessing.

⁵ Postprocessing with GPS Pathfinder Office software or GPS Analyst extension for ArcGIS.

⁶ Requires collection of carrier data. (Only available with the GPS Pathfinder Office software).

NORTH & SOUTH AMERICA

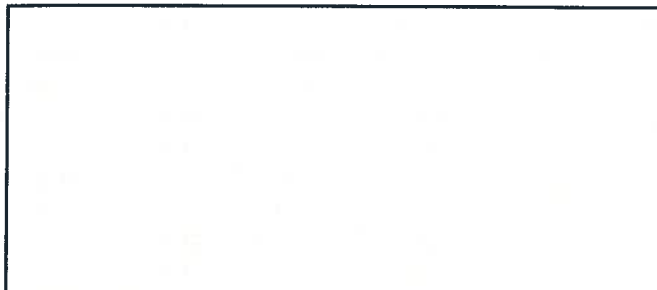
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Operator's Manual

SMARTROLL™ MP Handheld Instrument



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.

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	± 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

Conductivity Sensor Specifications

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

Dissolved Oxygen RDO Fast Cap (Optical Sensor) Specifications

Accuracy	± 0.1 mg/L; ± 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

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

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

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 DATA

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingAreaL-1030_01	1146091	3164863	A	779.0	22.1	10/22/2019	0	-0.001	0.136	0.2467736	0.000000	0.000000	0.033561
MappingAreaL-1030_02	1146198	3164823	A	779.1	22.2	10/22/2019	0	-0.003	0.047	0.2467217	0.000000	0.000000	0.011596
MappingAreaL-1030_05	1146201	3164673	A	779.4	22.9	10/22/2019	0	0	0.027	0.2462331	0.000000	0.000000	0.006648
MappingAreaL-1030_03	1146206	3164778	A	779.3	22.3	10/22/2019	0	-0.002	0.013	0.2467015	0.000000	0.000000	0.003207
MappingAreaL-1030_04	1146212	3164707	A	779.3	22.6	10/22/2019	0	-0.001	0.076	0.2464513	0.000000	0.000000	0.018730
MappingAreaL-1030_08	1146251	3164753	A	779.5	24.3	10/22/2019	15.584	-0.002	0.371	0.2451056	3.819726	0.000000	0.090934
MappingAreaL-1030_07	1146257	3164718	A	779.4	23.8	10/22/2019	1.652	0	1.912	0.2454868	0.405544	0.000000	0.469371
MappingAreaL-1030_06	1146259	3164664	A	779.4	23.3	10/22/2019	0	-0.001	0.189	0.2459009	0.000000	0.000000	0.046475
MappingAreaL-1030_10	1146264	3164817	A	779.5	25.3	10/22/2019	-0.138	-0.002	0.088	0.2442843	0.000000	0.000000	0.021497
MappingAreaL-1030_09	1146272	3164752	A	779.7	24.8	10/22/2019	30.725	-0.001	1.206	0.2447571	7.520161	0.000000	0.295177
MappingAreaL-1030_11	1146305	3164806	A	779.6	25.7	10/22/2019	0	-0.001	0.541	0.2439887	0.000000	0.000000	0.131998
MappingAreaL-1030_14	1146308	3164768	A	779.4	27.4	10/22/2019	0	-0.003	1.112	0.2425464	0.000000	0.000000	0.269712
MappingAreaL-1030_18	1146310	3164654	A	779.5	29.2	10/22/2019	-0.298	0	0.234	0.2411333	0.000000	0.000000	0.056425
MappingAreaL-1030_15	1146316	3164727	A	779.7	27.9	10/22/2019	0	-0.004	0.339	0.2422367	0.000000	0.000000	0.082118
MappingAreaL-1030_13	1146355	3164761	A	779.8	26.6	10/22/2019	0	-0.001	0.089	0.2433185	0.000000	0.000000	0.021655
MappingAreaL-1030_17	1146358	3164662	A	779.5	28.7	10/22/2019	0	-0.002	0.253	0.2415328	0.000000	0.000000	0.061108



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingAreaL-1030_16	1146358	3164714	A	779.8	28.3	10/22/2019	0	0	0.123	0.2419463	0.000000	0.000000	0.029759
MappingAreaL-1030_12	1146363	3164820	A	779.8	26.2	10/22/2019	0	-0.002	0.112	0.2436436	0.000000	0.000000	0.027288
MappingArea32&L-1049102219_41	1173756	3177868	A	787.8	40.1	10/22/2019	0	-0.005	0.031	0.235221	0.000000	0.000000	0.007292
MappingArea32&L-1049102219_42	1173770	3177743	A	787.8	40.2	10/22/2019	0	-0.001	0.053	0.2351459	0.000000	0.000000	0.012463
MappingArea32&L-1049102219_43	1173771	3177644	A	787.6	40.2	10/22/2019	0	-0.007	0.102	0.2350862	0.000000	0.000000	0.023979
MappingArea32&L-1049102219_23	1173776	3178057	A	789.3	39.3	10/22/2019	0	-0.001	0.082	0.2362722	0.000000	0.000000	0.019374
MappingArea32&L-1049102219_22	1173784	3178160	A	789.3	39.2	10/22/2019	0	-0.001	0.2	0.2363479	0.000000	0.000000	0.047270
MappingArea32&L-1049102219_21	1173796	3178259	A	789.0	39.1	10/22/2019	0	-0.001	0.037	0.2363337	0.000000	0.000000	0.008744
MappingArea32&L-1049102219_16	1173801	3178406	A	789.4	38.4	10/22/2019	-2.552	-0.013	0.024	0.2369848	0.000000	0.000000	0.005688
MappingArea32&L-1049102219_17	1173802	3178357	A	789.3	38.5	10/22/2019	0	-0.008	0.128	0.2368787	0.000000	0.000000	0.030320
MappingArea32&L-1049102219_12	1173807	3178516	A	789.6	37.8	10/22/2019	-0.201	-0.001	0.152	0.2375022	0.000000	0.000000	0.036100
MappingArea32&L-1049102219_40	1173809	3177843	A	787.6	40.2	10/22/2019	0	-0.013	0.038	0.2350862	0.000000	0.000000	0.008933
MappingArea32&L-1049102219_13	1173812	3178449	A	789.5	37.9	10/22/2019	0	0	0.239	0.2373958	0.000000	0.000000	0.056738
MappingArea32&L-1049102219_45	1173840	3177643	A	787.4	40.3	10/22/2019	0	-0.004	0.224	0.2349515	0.000000	0.000000	0.052629
MappingArea32&L-1049102219_46	1173846	3177732	A	787.5	40.4	10/22/2019	0	-0.005	0.641	0.2349064	0.000000	0.000000	0.150575
MappingArea32&L-1049102219_15	1173848	3178423	A	789.4	38.1	10/22/2019	3.28	0.006	5.898	0.2372132	0.778059	0.001423	1.399083



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102219_24	1173853	3177991	A	789.1	39.4	10/22/2019	0	-0.002	0.698	0.2361368	0.000000	0.000000	0.164823
MappingArea32&L-1049102219_11	1173854	3178511	A	789.5	37.7	10/22/2019	0	0	0.116	0.2375485	0.000000	0.000000	0.027556
MappingArea32&L-1049102219_18	1173855	3178361	A	789.1	38.6	10/22/2019	0	-0.001	0.177	0.2367427	0.000000	0.000000	0.041903
MappingArea32&L-1049102219_14	1173860	3178447	A	789.4	38.0	10/22/2019	-0.135	0	2.286	0.2372894	0.000000	0.000000	0.542444
MappingArea32&L-1049102219_44	1173861	3177559	A	787.5	40.2	10/22/2019	0	-0.01	0.022	0.2350563	0.000000	0.000000	0.005171
MappingAreaL-1021102219_19	1173866	3178874	A	790.2	34.1	10/22/2019	-0.226	-0.006	0.036	0.2405449	0.000000	0.000000	0.008660
MappingArea32&L-1049102219_25	1173874	3178061	A	788.8	39.5	10/22/2019	0	-0.001	0.634	0.2359715	0.000000	0.000000	0.149606
MappingAreaL-1021102219_20	1173877	3178821	A	790.2	34.2	10/22/2019	-0.004	-0.002	0.573	0.2404667	0.000000	0.000000	0.137787
MappingArea32&L-1049102219_26	1173878	3178163	A	788.7	39.6	10/22/2019	0	-0.002	0.204	0.2358662	0.000000	0.000000	0.048117
MappingArea32&L-1049102219_20	1173880	3178271	A	789.0	38.9	10/22/2019	0	-0.001	0.144	0.2364852	0.000000	0.000000	0.034054
MappingArea32&L-1049102219_19	1173884	3178317	A	789.0	38.7	10/22/2019	0	-0.002	0.73	0.2366368	0.000000	0.000000	0.172745
MappingArea32&L-1049102219_39	1173887	3177855	A	787.6	40.1	10/22/2019	0	-0.002	0.272	0.2351612	0.000000	0.000000	0.063964
MappingAreaL-1021102219_21	1173890	3178770	A	790.1	34.4	10/22/2019	-0.278	-0.001	0.23	0.2402799	0.000000	0.000000	0.055264
MappingAreaL-1021102219_22	1173900	3178712	A	789.9	34.5	10/22/2019	0	-0.003	1.421	0.240141	0.000000	0.000000	0.341240
MappingArea32&L-1049102219_09	1173902	3178516	A	789.5	37.4	10/22/2019	0	-0.007	-0.016	0.237778	0.000000	0.000000	0.000000
MappingArea32&L-1049102219_08	1173904	3178472	A	789.5	37.3	10/22/2019	0	-0.002	0.463	0.2378546	0.000000	0.000000	0.110127



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102219_10	1173904	3178564	A	789.5	37.6	10/22/2019	0	-0.001	0.113	0.237625	0.000000	0.000000	0.026852
MappingArea32&L-1049102219_07	1173910	3178412	A	789.5	37.2	10/22/2019	0	-0.005	0.267	0.2379313	0.000000	0.000000	0.063528
MappingAreaL-1021102219_23	1173912	3178663	A	789.8	34.7	10/22/2019	0	-0.002	1.292	0.2399546	0.000000	0.000000	0.310021
MappingArea32&L-1049102219_06	1173918	3178352	A	789.4	37.1	10/22/2019	0	-0.001	0.279	0.2379778	0.000000	0.000000	0.066396
MappingAreaL-1021102219_18	1173920	3178866	A	789.4	33.8	10/22/2019	8.046	-0.006	9.302	0.2405363	1.935355	0.000000	2.237468
MappingAreaL-1021102219_24	1173923	3178615	A	789.8	34.9	10/22/2019	-0.231	-0.002	3.232	0.2397988	0.000000	0.000000	0.775030
MappingArea32&L-1049102219_49	1173925	3177642	A	787.1	40.7	10/22/2019	0	0.002	0.397	0.2345627	0.000000	0.000469	0.093121
MappingAreaL-1021102219_14	1173934	3178833	A	790.1	32.3	10/22/2019	85.424	-0.008	7.657	0.2419318	20.666790	0.000000	1.852472
MappingArea32&L-1049102219_01	1173935	3178569	A	789.8	35.3	10/22/2019	-0.748	-0.008	4.18	0.2394878	0.000000	0.000000	1.001059
MappingArea32&L-1049102219_48	1173953	3177653	A	787.2	40.6	10/22/2019	-0.063	-0.007	0.686	0.2346672	0.000000	0.000000	0.160982
MappingArea32&L-1049102219_50	1173953	3177558	A	787.1	40.8	10/22/2019	0	-0.006	0.16	0.234488	0.000000	0.000000	0.037518
MappingAreaL-1021102219_12	1173956	3178676	A	790.1	31.4	10/22/2019	-0.491	0	0.087	0.2426468	0.000000	0.000000	0.021110
MappingArea32&L-1049102219_04	1173958	3178284	A	789.1	36.7	10/22/2019	0	-0.005	-0.103	0.2381945	0.000000	0.000000	0.000000
MappingAreaL-1021102219_16	1173958	3178826	A	789.8	33.1	10/22/2019	0	-0.003	0.724	0.2412082	0.000000	0.000000	0.174635
MappingArea32&L-1049102219_38	1173959	3177865	A	787.5	40.2	10/22/2019	0	-0.001	0.07	0.2350563	0.000000	0.000000	0.016454
MappingAreaL-1021102219_15	1173960	3178785	A	790.1	32.8	10/22/2019	-0.818	-0.004	1.662	0.2415365	0.000000	0.000000	0.401434



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingAreaL-1021102219_13	1173963	3178713	A	790.1	31.8	10/22/2019	126.464	-0.004	11.079	0.2423285	30.645830	0.000000	2.684758
MappingArea32&L-1049102219_28	1173964	3178038	A	788.3	40.1	10/22/2019	7.052	-0.001	0.234	0.2353702	1.659831	0.000000	0.055077
MappingArea32&L-1049102219_47	1173964	3177746	A	787.4	40.5	10/22/2019	0	-0.012	0.328	0.2348017	0.000000	0.000000	0.077015
MappingArea32&L-1049102219_27	1173968	3178140	A	788.4	39.8	10/22/2019	23.133	-0.001	3.243	0.2356258	5.450730	0.000000	0.764134
MappingArea32&L-1049102219_35	1173969	3177953	A	787.5	40.5	10/22/2019	-0.539	-0.005	0.8	0.2348315	0.000000	0.000000	0.187865
MappingAreaL-1021102219_11	1173970	3178619	A	789.9	31.0	10/22/2019	27.723	-0.001	6.437	0.2429044	6.734039	0.000000	1.563576
MappingArea32&L-1049102219_05	1173974	3178341	A	789.4	37.0	10/22/2019	0	0	0.041	0.2380545	0.000000	0.000000	0.009760
MappingAreaL-1021102219_17	1173979	3178880	A	789.6	33.4	10/22/2019	0	-0.002	0.232	0.2409112	0.000000	0.000000	0.055891
MappingAreaL-1021102219_10	1173987	3178568	A	789.5	30.7	10/22/2019	0	-0.003	0.716	0.2430211	0.000000	0.000000	0.174003
MappingAreaL-1021102219_07	1174012	3178668	A	789.5	28.9	10/22/2019	0	-0.003	0.086	0.2444693	0.000000	0.000000	0.021024
MappingAreaL-1021102219_06	1174012	3178724	A	789.5	28.2	10/22/2019	0	-0.002	0.035	0.2450372	0.000000	0.000000	0.008576
MappingAreaL-1021102219_09	1174013	3178560	A	789.3	30.0	10/22/2019	0	-0.001	0.593	0.2435206	0.000000	0.000000	0.144408
MappingAreaL-1021102219_08	1174013	3178611	A	789.2	29.3	10/22/2019	0	-0.002	0.133	0.2440532	0.000000	0.000000	0.032459
MappingAreaL-1021102219_04	1174013	3178819	A	789.3	27.2	10/22/2019	0	-0.001	0.208	0.2457908	0.000000	0.000000	0.051124
MappingAreaL-1021102219_05	1174017	3178777	A	789.3	27.7	10/22/2019	0	-0.001	0.052	0.2453823	0.000000	0.000000	0.012760
MappingAreaL-1021102219_03	1174022	3178870	A	787.9	26.7	10/22/2019	0	-0.002	0.651	0.2457639	0.000000	0.000000	0.159992



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102219_03	1174034	3178285	A	789.1	36.3	10/22/2019	0	-0.001	0.742	0.2385024	0.000000	0.000000	0.176969
MappingArea32&L-1049102219_66	1174044	3177071	A	786.4	42.0	10/22/2019	0	-0.004	0.076	0.2333874	0.000000	0.000000	0.017737
MappingArea32&L-1049102219_53	1174047	3177753	A	786.7	41.0	10/22/2019	-0.969	-0.017	0.183	0.2342196	0.000000	0.000000	0.042862
MappingArea32&L-1049102219_67	1174050	3176964	A	786.3	42.0	10/22/2019	0	-0.003	0.091	0.2333577	0.000000	0.000000	0.021236
MappingArea32&L-1049102219_02	1174053	3178365	A	789.6	35.9	10/22/2019	-0.097	-0.003	0.838	0.2389624	0.000000	0.000000	0.200250
MappingArea32&L-1049102219_51	1174055	3177559	A	787.0	40.9	10/22/2019	0	-0.017	0.169	0.2343835	0.000000	0.000000	0.039611
MappingArea32&L-1049102219_65	1174059	3177158	A	786.3	42.0	10/22/2019	0	-0.012	0.114	0.2333577	0.000000	0.000000	0.026603
MappingArea32&L-1049102219_52	1174061	3177641	A	786.7	40.9	10/22/2019	34.367	0.012	11.265	0.2342942	8.051988	0.002812	2.639324
MappingArea32&L-1049102219_29	1174062	3178053	A	788.2	40.2	10/22/2019	4.331	-0.008	0.151	0.2352653	1.018934	0.000000	0.035525
MappingArea32&L-1049102219_30	1174066	3178150	A	787.8	40.4	10/22/2019	7.817	-0.001	1.519	0.2349959	1.836963	0.000000	0.356959
MappingArea32&L-1049102219_37	1174068	3177849	A	787.4	40.3	10/22/2019	-1.921	-0.005	0.768	0.2349515	0.000000	0.000000	0.180443
MappingArea32&L-1049102219_34	1174088	3177958	A	787.2	40.5	10/22/2019	29.814	0.01	4.659	0.2347421	6.998600	0.002347	1.093663
MappingArea32&L-1049102219_55	1174137	3177657	A	786.3	41.2	10/22/2019	0	-0.001	0.308	0.2339516	0.000000	0.000000	0.072057
MappingArea32&L-1049102219_31	1174147	3178161	A	787.6	40.5	10/22/2019	0	-0.003	0.464	0.2348613	0.000000	0.000000	0.108976
MappingArea32&L-1049102219_68	1174151	3176946	A	786.1	42.0	10/22/2019	-0.286	-0.001	0.021	0.2332983	0.000000	0.000000	0.004899
MappingArea32&L-1049102219_56	1174151	3177554	A	786.3	41.4	10/22/2019	-1.328	-0.017	0.132	0.2338028	0.000000	0.000000	0.030862



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102219_69	1174155	3177047	A	786.1	42.0	10/22/2019	0	0	0.421	0.2332983	0.000000	0.000000	0.098219
MappingArea32&L-1049102219_54	1174155	3177754	A	786.4	41.1	10/22/2019	0	-0.001	0.139	0.2340558	0.000000	0.000000	0.032534
MappingArea32&L-1049102219_36	1174158	3177848	A	787.8	40.4	10/22/2019	449.306	0	5.237	0.2349959	105.585100	0.000000	1.230674
MappingArea32&L-1049102219_64	1174169	3177144	A	786.3	42.0	10/22/2019	0	-0.005	0.436	0.2333577	0.000000	0.000000	0.101744
MappingArea32&L-1049102219_33	1174173	3177950	A	787.2	40.5	10/22/2019	0	0	0.231	0.2347421	0.000000	0.000000	0.054225
MappingArea32&L-1049102219_32	1174176	3178073	A	787.5	40.5	10/22/2019	-0.836	-0.003	0.918	0.2348315	0.000000	0.000000	0.215575
MappingAreaL-1021102219_02	1174211	3178909	A	788.3	25.9	10/22/2019	0	-0.003	0.43	0.2465465	0.000000	0.000000	0.106015
MappingAreaL-1021102219_01	1174240	3178837	A	788.8	25.3	10/22/2019	0	-0.006	-0.223	0.2471988	0.000000	0.000000	0.000000
MappingArea32&L-1049102219_60	1174242	3177347	A	785.9	41.9	10/22/2019	0	-0.003	0.167	0.233313	0.000000	0.000000	0.038963
MappingArea32&L-1049102219_71	1174242	3176951	A	786.0	42.1	10/22/2019	-0.123	-0.006	0.162	0.2331946	0.000000	0.000000	0.037778
MappingArea32&L-1049102219_63	1174246	3177151	A	786.0	42.0	10/22/2019	0	-0.002	0.162	0.2332686	0.000000	0.000000	0.037790
MappingArea32&L-1049102219_70	1174248	3177048	A	786.1	42.1	10/22/2019	6.168	-0.013	3.548	0.2332243	1.438528	0.000000	0.827480
MappingArea32&L-1049102219_92	1174253	3177645	A	785.1	40.4	10/22/2019	0	-0.002	0.528	0.2341905	0.000000	0.000000	0.123653
MappingArea32&L-1049102419_192	1174255	3177937	A	791.4	27.5	10/24/2019	0	-0.002	0.672	0.2461988	0.000000	0.000000	0.165446
MappingArea32&L-1049102219_93	1174256	3177735	A	785.1	40.4	10/22/2019	-0.527	-0.002	0.3	0.2341905	0.000000	0.000000	0.070257
MappingArea32&L-1049102219_58	1174256	3177440	A	786.0	41.9	10/22/2019	-0.07	-0.006	0.052	0.2333427	0.000000	0.000000	0.012134



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102219_57	1174257	3177546	A	786.3	41.5	10/22/2019	0	-0.004	0.195	0.2337285	0.000000	0.000000	0.045577
MappingArea32&L-1049102419_195	1174263	3178138	A	791.3	27.1	10/24/2019	0	-0.001	-0.181	0.2464956	0.000000	0.000000	0.000000
MappingArea32&L-1049102419_193	1174267	3178036	A	791.4	27.4	10/24/2019	0	-0.002	0.666	0.2462807	0.000000	0.000000	0.164023
MappingArea32&L-1049102419_196	1174267	3178230	A	791.3	27.0	10/24/2019	0	0	0.021	0.2465778	0.000000	0.000000	0.005178
MappingArea32&L-1049102419_191	1174291	3177860	A	791.3	27.6	10/24/2019	0	-0.001	0.208	0.2460859	0.000000	0.000000	0.051186
MappingArea32&L-1049102219_91	1174330	3177562	A	785.1	40.5	10/22/2019	-0.229	-0.006	1.368	0.2341158	0.000000	0.000000	0.320270
MappingArea32&L-1049102319_101	1174340	3176258	A	783.9	24.0	10/23/2019	-0.122	0	0.591	0.246738	0.000000	0.000000	0.145822
MappingArea32&L-1049102219_61	1174340	3177258	A	786.0	41.9	10/22/2019	0	-0.013	0.202	0.2333427	0.000000	0.000000	0.047135
MappingArea32&L-1049102319_100	1174345	3176345	A	783.7	23.9	10/23/2019	0	0	1.718	0.2467581	0.000000	0.000000	0.423930
MappingArea32&L-1049102219_78	1174346	3176853	A	785.6	42.8	10/22/2019	0	-0.016	1.151	0.2325596	0.000000	0.000000	0.267676
MappingArea32&L-1049102219_79	1174347	3176761	A	785.5	42.8	10/22/2019	0	-0.006	0.16	0.23253	0.000000	0.000000	0.037205
MappingArea32&L-1049102219_72	1174349	3177042	A	785.9	42.2	10/22/2019	-0.14	-0.001	0.149	0.233091	0.000000	0.000000	0.034731
MappingArea32&L-1049102219_77	1174351	3176940	A	785.5	42.7	10/22/2019	0	-0.011	1.211	0.2326036	0.000000	0.000000	0.281683
MappingArea32&L-1049102319_102	1174352	3176168	A	783.9	24.2	10/23/2019	-0.005	-0.002	0.347	0.246572	0.000000	0.000000	0.085561
MappingArea32&L-1049102419_194	1174353	3178059	A	791.3	27.2	10/24/2019	0	-0.001	0.397	0.2464136	0.000000	0.000000	0.097826
MappingArea32&L-1049102419_197	1174357	3178182	A	791.0	27.0	10/24/2019	0	-0.001	1.614	0.2464843	0.000000	0.000000	0.397826



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102419_190	1174357	3177953	A	791.3	27.6	10/24/2019	0	-0.001	0.441	0.2460859	0.000000	0.000000	0.108524
MappingArea32&L-1049102219_62	1174362	3177165	A	785.9	41.9	10/22/2019	0	-0.001	0.038	0.233313	0.000000	0.000000	0.008866
MappingArea32&L-1049102219_59	1174367	3177348	A	785.9	41.9	10/22/2019	0	-0.004	0.321	0.233313	0.000000	0.000000	0.074893
MappingArea32&L-1049102419_198	1174372	3178247	A	790.7	27.0	10/24/2019	0	-0.001	0.067	0.2463908	0.000000	0.000000	0.016508
MappingArea32&L-1049102219_90	1174372	3177463	A	785.2	40.7	10/22/2019	-0.45	-0.014	0.738	0.2339965	0.000000	0.000000	0.172689
MappingArea32&L-1049102419_189	1174378	3177865	A	791.1	27.6	10/24/2019	-0.852	-0.001	0.468	0.2460237	0.000000	0.000000	0.115139
MappingArea32&L-1049102419_188	1174380	3177746	A	791.3	27.5	10/24/2019	15.529	-0.001	20.268	0.2461677	3.822738	0.000000	4.989327
MappingArea32&L-1049102419_187	1174410	3177643	A	791.1	27.4	10/24/2019	-0.408	-0.002	2.205	0.2461874	0.000000	0.000000	0.542843
MappingArea32&L-1049102219_89	1174418	3177356	A	785.2	41.0	10/22/2019	0	-0.007	6.075	0.233773	0.000000	0.000000	1.420171
MappingArea32&L-1049102219_73	1174441	3177050	A	785.6	42.3	10/22/2019	-0.008	-0.001	0.17	0.2329282	0.000000	0.000000	0.039598
MappingArea32&L-1049102219_80	1174448	3176759	A	785.5	42.9	10/22/2019	0	-0.011	0.022	0.2324564	0.000000	0.000000	0.005114
MappingArea32&L-1049102219_76	1174454	3176944	A	785.5	42.6	10/22/2019	0	-0.016	0.102	0.2326773	0.000000	0.000000	0.023733
MappingArea32&L-1049102219_81	1174454	3176856	A	785.5	42.9	10/22/2019	0	-0.01	0.036	0.2324564	0.000000	0.000000	0.008368
MappingArea32&L-1049102319_103	1174455	3176153	A	783.6	24.3	10/23/2019	-0.06	-0.001	0.142	0.2463948	0.000000	0.000000	0.034988
MappingArea32&L-1049102319_99	1174456	3176362	A	783.6	23.8	10/23/2019	0	-0.001	0.052	0.2468097	0.000000	0.000000	0.012834
MappingArea32&L-1049102219_88	1174460	3177256	A	785.2	41.4	10/22/2019	0	-0.002	0.213	0.2334757	0.000000	0.000000	0.049730



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102419_199	1174462	3178237	A	790.5	27.0	10/24/2019	0	-0.001	0.177	0.2463285	0.000000	0.000000	0.043600
MappingArea32&L-1049102419_200	1174463	3178151	A	790.5	27.1	10/24/2019	0	-0.001	0.365	0.2462464	0.000000	0.000000	0.089880
MappingArea32&L-1049102419_202	1174464	3177938	A	790.7	27.1	10/24/2019	0	0	0.196	0.2463087	0.000000	0.000000	0.048277
MappingArea32&L-1049102219_87	1174464	3177172	A	785.2	42.7	10/22/2019	0	-0.03	0.032	0.2325148	0.000000	0.000000	0.007440
MappingArea32&L-1049102419_204	1174471	3177751	A	790.6	26.9	10/24/2019	0	0	1.306	0.2464418	0.000000	0.000000	0.321853
MappingArea32&L-1049102419_185	1174476	3177552	A	791.4	27.2	10/24/2019	2.303	-0.001	5.87	0.2464447	0.567562	0.000000	1.446630
MappingArea32&L-1049102419_186	1174484	3177635	A	791.3	27.3	10/24/2019	73.634	0	23.131	0.2463316	18.138380	0.000000	5.697896
MappingArea32&L-1049102319_104	1174490	3176247	A	783.6	24.4	10/23/2019	-0.139	-0.001	0.327	0.246312	0.000000	0.000000	0.080544
MappingArea32&L-1049102419_203	1174491	3177851	A	790.5	27.0	10/24/2019	0	0	-0.025	0.2463285	0.000000	0.000000	0.000000
MappingArea32&L-1049102419_201	1174493	3178041	A	790.6	27.1	10/24/2019	0	-0.001	0.205	0.2462776	0.000000	0.000000	0.050487
MappingArea32&L-1049102419_184	1174495	3177449	A	791.4	27.2	10/24/2019	0	-0.001	0.377	0.2464447	0.000000	0.000000	0.092910
MappingArea32&L-1049102219_74	1174543	3177059	A	785.2	42.4	10/22/2019	-0.106	-0.004	0.42	0.2327358	0.000000	0.000000	0.097749
MappingArea32&L-1049102219_86	1174546	3176650	A	785.2	42.8	10/22/2019	0	-0.012	0.112	0.2324412	0.000000	0.000000	0.026033
MappingArea32&L-1049102219_82	1174550	3176851	A	785.2	42.9	10/22/2019	0	-0.007	0.055	0.2323676	0.000000	0.000000	0.012780
MappingArea32&L-1049102319_98	1174553	3176449	A	783.3	23.6	10/23/2019	0	0	0.022	0.2468815	0.000000	0.000000	0.005431
MappingArea32&L-1049102419_181	1174553	3177233	A	791.7	27.0	10/24/2019	-0.913	-0.001	0.326	0.2467024	0.000000	0.000000	0.080425

APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m ²)	H2S flux (moles/day/m ²)	CO2 flux (moles/day/m ²)
MappingArea32&L-1049102319_105	1174555	3176162	A	783.3	24.5	10/23/2019	-0.081	0	0.355	0.246135	0.000000	0.000000	0.087378
MappingArea32&L-1049102319_106	1174556	3176256	A	783.5	24.6	10/23/2019	-0.449	-0.001	0.333	0.2461151	0.000000	0.000000	0.081956
MappingArea32&L-1049102219_85	1174556	3176757	A	785.2	42.9	10/22/2019	-0.756	-0.015	0.044	0.2323676	0.000000	0.000000	0.010224
MappingArea32&L-1049102219_75	1174557	3176965	A	785.2	42.5	10/22/2019	-0.325	-0.009	0.754	0.2326621	0.000000	0.000000	0.175427
MappingArea32&L-1049102319_97	1174562	3176527	A	783.2	23.4	10/23/2019	0	-0.001	0.067	0.2470164	0.000000	0.000000	0.016550
MappingArea32&L-1049102419_182	1174570	3177360	A	791.2	27.0	10/24/2019	0	-0.001	0.334	0.2465466	0.000000	0.000000	0.082347
MappingArea32&L-1049102319_107	1174576	3176353	A	783.5	24.7	10/23/2019	0	-0.001	0.049	0.2460325	0.000000	0.000000	0.012056
MappingArea32&L-1049102419_206	1174581	3177764	A	790.3	26.6	10/24/2019	0	0	0.034	0.2465948	0.000000	0.000000	0.008384
MappingArea32&L-1049102419_180	1174585	3177162	A	791.7	26.9	10/24/2019	-0.146	-0.001	0.079	0.2467846	0.000000	0.000000	0.019496
MappingArea32&L-1049102419_205	1174586	3177841	A	790.6	26.8	10/24/2019	-0.07	-0.001	0.637	0.2465239	0.000000	0.000000	0.157036
MappingArea32&L-1049102419_208	1174588	3177539	A	790.4	26.0	10/24/2019	-0.032	-0.001	0.431	0.2471206	0.000000	0.000000	0.106509
MappingArea32&L-1049102419_207	1174591	3177642	A	790.1	26.3	10/24/2019	0	-0.001	0.335	0.2467794	0.000000	0.000000	0.082671
MappingArea32&L-1049102419_183	1174592	3177448	A	791.1	27.1	10/24/2019	0	0	0.497	0.2464333	0.000000	0.000000	0.122477
MappingArea32&L-1049102219_83	1174626	3176846	A	784.9	42.9	10/22/2019	0	-0.011	0.25	0.2322788	0.000000	0.000000	0.058070
MappingArea32&L-1049102319_96	1174635	3176652	A	783.2	23.2	10/23/2019	0	-0.001	0.211	0.2471831	0.000000	0.000000	0.052156
MappingArea32&L-1049102319_95	1174644	3176575	A	783.0	23.1	10/23/2019	0	-0.002	0.053	0.2472034	0.000000	0.000000	0.013102

APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102319_108	1174656	3176344	A	783.2	24.8	10/23/2019	0	-0.001	0.119	0.2458558	0.000000	0.000000	0.029257
MappingArea32&L-1049102419_219	1174658	3177255	A	790.5	26.6	10/24/2019	0	-0.001	0.016	0.2466572	0.000000	0.000000	0.003947
MappingArea32&L-1049102319_94	1174658	3176438	A	783.0	22.9	10/23/2019	-1.241	-0.007	0.015	0.2473704	0.000000	0.000000	0.003711
MappingArea32&L-1049102219_84	1174658	3176747	A	784.9	42.9	10/22/2019	0	-0.013	0.261	0.2322788	0.000000	0.000000	0.060625
MappingArea32&L-1049102419_178	1174661	3177060	A	791.3	26.9	10/24/2019	0	-0.001	1.143	0.2466599	0.000000	0.000000	0.281932
MappingArea32&L-1049102419_179	1174663	3177158	A	791.1	26.9	10/24/2019	0	0	0.353	0.2465976	0.000000	0.000000	0.087049
MappingArea32&L-1049102419_217	1174665	3177455	A	789.7	27.0	10/24/2019	0	0	0.635	0.2460792	0.000000	0.000000	0.156260
MappingArea32&L-1049102419_218	1174668	3177360	A	790.3	26.8	10/24/2019	0	0	0.835	0.2464304	0.000000	0.000000	0.205769
MappingArea32&L-1049102419_210	1174682	3177648	A	789.7	25.8	10/24/2019	0	0	0.165	0.247067	0.000000	0.000000	0.040766
MappingArea32&L-1049102419_211	1174682	3177751	A	789.8	25.9	10/24/2019	0	-0.001	0.753	0.2470156	0.000000	0.000000	0.186003
MappingArea32&L-1049102419_176	1174685	3176956	A	791.3	26.7	10/24/2019	1500.177	-0.002	59.605	0.2468245	370.280400	0.000000	14.711970
MappingArea32&L-1049102419_209	1174701	3177558	A	789.7	25.9	10/24/2019	0	-0.001	0.387	0.2469843	0.000000	0.000000	0.095583
MappingArea32&L-1049102419_216	1174750	3177559	A	789.9	26.7	10/24/2019	2.711	0.002	2.936	0.2463878	0.667957	0.000493	0.723395
MappingArea32&L-1049102419_173	1174752	3176757	A	791.6	25.8	10/24/2019	-6.282	-0.003	0.973	0.2476614	0.000000	0.000000	0.240975
MappingArea32&L-1049102419_172	1174754	3176654	A	791.5	25.4	10/24/2019	-0.677	-0.005	0.311	0.2479619	0.000000	0.000000	0.077116
MappingArea32&L-1049102419_177	1174760	3177060	A	791.6	26.9	10/24/2019	-0.998	-0.002	7.202	0.2467535	0.000000	0.000000	1.777119

APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102419_215	1174763	3177454	A	789.9	26.7	10/24/2019	0	-0.001	0.159	0.2463878	0.000000	0.000000	0.039176
MappingArea32&L-1049102419_222	1174773	3177363	A	789.9	26.3	10/24/2019	0	-0.001	0.689	0.2467169	0.000000	0.000000	0.169988
MappingArea32&L-1049102419_220	1174773	3177185	A	790.6	26.5	10/24/2019	0	0	0.811	0.2467707	0.000000	0.000000	0.200131
MappingArea32&L-1049102419_174	1174778	3176865	A	791.6	26.3	10/24/2019	-0.623	-0.003	-0.08	0.2472479	0.000000	0.000000	0.000000
MappingArea32&L-1049102419_175	1174778	3176946	A	791.1	26.5	10/24/2019	-0.018	-0.001	0.04	0.2469268	0.000000	0.000000	0.009877
MappingArea32&L-1049102419_221	1174778	3177265	A	789.9	26.3	10/24/2019	0	0	-0.259	0.2467169	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_167	1174779	3176571	A	784.4	26.7	10/23/2019	-2.454	-0.004	0.272	0.2446722	0.000000	0.000000	0.066551
MappingArea32&L-1049102319_109	1174787	3176450	A	783.2	25.0	10/23/2019	0	-0.001	0.05	0.2456909	0.000000	0.000000	0.012285
MappingArea32&L-1049102419_212	1174803	3177673	A	789.6	26.0	10/24/2019	0	0	-0.049	0.2468705	0.000000	0.000000	0.000000
MappingArea32&L-1049102419_225	1174861	3177162	A	789.5	26.3	10/24/2019	0	-0.001	0.317	0.246592	0.000000	0.000000	0.078170
MappingArea32&L-1049102419_223	1174864	3177368	A	789.6	26.3	10/24/2019	0	-0.001	0.017	0.2466232	0.000000	0.000000	0.004193
MappingArea32&L-1049102419_248	1174866	3176774	A	790.2	24.7	10/24/2019	-0.334	-0.001	0.936	0.2481364	0.000000	0.000000	0.232256
MappingArea32&L-1049102319_110	1174866	3176433	A	782.8	25.2	10/23/2019	0	-0.002	0.029	0.2454008	0.000000	0.000000	0.007117
MappingArea32&L-1049102419_224	1174866	3177265	A	789.2	26.3	10/24/2019	1.592	-0.001	1.708	0.2464983	0.392425	0.000000	0.421019
MappingArea32&L-1049102319_112	1174870	3176260	A	782.9	25.3	10/23/2019	0	-0.001	-0.036	0.2453499	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_168	1174872	3176141	A	784.5	26.6	10/23/2019	0	-0.004	-0.002	0.244785	0.000000	0.000000	0.000000

APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102319_166	1174873	3176559	A	784.3	26.8	10/23/2019	34.796	0	1.948	0.2445595	8.509691	0.000000	0.476402
MappingArea32&L-1049102319_170	1174874	3175940	A	785.1	26.3	10/23/2019	-1.921	-0.002	-0.001	0.2452177	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_169	1174878	3176076	A	784.9	26.5	10/23/2019	0	-0.001	0.016	0.2449916	0.000000	0.000000	0.003920
MappingArea32&L-1049102419_246	1174880	3176951	A	789.6	24.9	10/24/2019	0	-0.001	0.152	0.2477816	0.000000	0.000000	0.037663
MappingArea32&L-1049102319_111	1174881	3176345	A	782.9	25.2	10/23/2019	0	-0.002	-0.107	0.2454321	0.000000	0.000000	0.000000
MappingArea32&L-1049102419_214	1174884	3177438	A	788.7	26.6	10/24/2019	0	0	1.089	0.2460956	0.000000	0.000000	0.267998
MappingArea32&L-1049102419_213	1174885	3177535	A	788.6	26.3	10/24/2019	0	-0.002	0.82	0.2463109	0.000000	0.000000	0.201975
MappingArea32&L-1049102419_247	1174888	3176865	A	790.2	24.8	10/24/2019	0	-0.001	2.963	0.2480531	0.000000	0.000000	0.734981
MappingArea32&L-1049102419_245	1174890	3177064	A	789.5	24.9	10/24/2019	0	-0.001	0.365	0.2477503	0.000000	0.000000	0.090429
MappingArea32&L-1049102419_249	1174896	3176644	A	790.6	24.4	10/24/2019	-0.361	0	0.335	0.2485123	0.000000	0.000000	0.083252
MappingArea32&L-1049102319_171	1174900	3175833	A	785.3	26.2	10/23/2019	0	-0.002	0.072	0.2453621	0.000000	0.000000	0.017666
MappingArea32&L-1049102419_241	1174935	3176758	A	790.1	24.9	10/24/2019	-0.135	0	0.138	0.2479385	0.000000	0.000000	0.034216
MappingArea32&L-1049102419_226	1174946	3177181	A	789.4	26.3	10/24/2019	17.165	0.002	23.803	0.2465607	4.232215	0.000493	5.868885
MappingArea32&L-1049102319_165	1174952	3176548	A	784.1	26.9	10/23/2019	0	-0.002	0.205	0.2444156	0.000000	0.000000	0.050105
MappingArea32&L-1049102319_114	1174953	3176057	A	782.8	25.5	10/23/2019	15.334	-0.002	1.07	0.2451542	3.759195	0.000000	0.262315
MappingArea32&L-1049102319_113	1174956	3176153	A	783.0	25.4	10/23/2019	0	-0.001	1.68	0.245299	0.000000	0.000000	0.412102

APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102419_227	1174957	3177249	A	789.0	26.3	10/24/2019	0	0	0.535	0.2464358	0.000000	0.000000	0.131843
MappingArea32&L-1049102419_228	1174961	3177356	A	788.4	26.4	10/24/2019	0	0	0.335	0.2461662	0.000000	0.000000	0.082466
MappingArea32&L-1049102419_242	1174963	3176837	A	790.2	24.9	10/24/2019	-1.149	0	1.453	0.2479699	0.000000	0.000000	0.360300
MappingArea32&L-1049102419_243	1174965	3176949	A	789.8	24.9	10/24/2019	4.215	-0.001	12.417	0.2478444	1.044664	0.000000	3.077484
MappingArea32&L-1049102319_143	1174970	3176341	A	783.0	26.0	10/23/2019	0	-0.001	0.01	0.244807	0.000000	0.000000	0.002448
MappingArea32&L-1049102319_115	1174971	3175947	A	782.8	25.6	10/23/2019	11.079	0.004	5.214	0.2450722	2.715155	0.000980	1.277806
MappingArea32&L-1049102319_116	1174974	3175830	A	782.6	25.7	10/23/2019	0	-0.002	0.314	0.2449276	0.000000	0.000000	0.076907
MappingArea32&L-1049102319_142	1174979	3176256	A	782.5	26.1	10/23/2019	0	-0.001	0.282	0.2445689	0.000000	0.000000	0.068968
MappingArea32&L-1049102319_144	1174980	3176451	A	783.0	26.1	10/23/2019	0	-0.002	0.13	0.2447252	0.000000	0.000000	0.031814
MappingArea32&L-1049102419_244	1174981	3177040	A	789.4	24.9	10/24/2019	-0.306	-0.001	1.878	0.2477189	0.000000	0.000000	0.465216
MappingArea32&L-1049102419_229	1174986	3177455	A	788.2	26.6	10/24/2019	0	-0.001	0.1	0.2459395	0.000000	0.000000	0.024594
MappingArea32&L-1049102419_240	1174989	3176662	A	790.3	24.8	10/24/2019	0	-0.001	0.393	0.2480845	0.000000	0.000000	0.097497
MappingArea32&L-1049102419_239	1175038	3176741	A	790.0	24.9	10/24/2019	0	0	4.426	0.2479072	0.000000	0.000000	1.097237
MappingArea32&L-1049102319_164	1175043	3176549	A	783.9	27.0	10/23/2019	0	-0.002	0.315	0.2442719	0.000000	0.000000	0.076946
MappingArea32&L-1049102319_117	1175052	3175869	A	782.4	25.8	10/23/2019	0	-0.001	0.013	0.2447831	0.000000	0.000000	0.003182
MappingArea32&L-1049102419_234	1175069	3176965	A	788.6	26.0	10/24/2019	216.503	0.003	3.86	0.2465579	53.380520	0.000740	0.951713



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102319_118	1175072	3175949	A	781.7	25.9	10/23/2019	0	0	0.734	0.2444823	0.000000	0.000000	0.179450
MappingArea32&L-1049102419_238	1175073	3176660	A	790.0	24.9	10/24/2019	0	0	1.042	0.2479072	0.000000	0.000000	0.258319
MappingArea32&L-1049102419_235	1175075	3176857	A	789.1	25.5	10/24/2019	0	-0.001	0.71	0.2471272	0.000000	0.000000	0.175460
MappingArea32&L-1049102419_233	1175079	3177045	A	786.9	26.3	10/24/2019	0	0	0.237	0.2457799	0.000000	0.000000	0.058250
MappingArea32&L-1049102319_134	1175079	3176076	A	780.8	26.0	10/23/2019	0	-0.001	0.46	0.2441192	0.000000	0.000000	0.112295
MappingArea32&L-1049102319_141	1175081	3176252	A	782.2	26.1	10/23/2019	0	-0.001	0.317	0.2444752	0.000000	0.000000	0.077499
MappingArea32&L-1049102319_140	1175083	3176341	A	781.7	26.0	10/23/2019	0	-0.002	-0.044	0.2444006	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_145	1175086	3176437	A	783.0	26.0	10/23/2019	0	-0.002	0.523	0.244807	0.000000	0.000000	0.128034
MappingArea32&L-1049102319_135	1175095	3176136	A	781.4	25.9	10/23/2019	0	-0.001	0.254	0.2443885	0.000000	0.000000	0.062075
MappingArea32&L-1049102419_232	1175103	3177179	A	786.3	26.6	10/24/2019	0	-0.001	0.165	0.2453467	0.000000	0.000000	0.040482
MappingArea32&L-1049102419_230	1175125	3177228	A	787.8	26.8	10/24/2019	0	-0.002	1.146	0.2456508	0.000000	0.000000	0.281516
MappingArea32&L-1049102419_236	1175152	3176769	A	789.0	25.2	10/24/2019	0	-0.002	9.133	0.2473444	0.000000	0.000000	2.258996
MappingArea32&L-1049102419_237	1175158	3176646	A	789.6	25.0	10/24/2019	0	-0.001	0.096	0.2476985	0.000000	0.000000	0.023779
MappingArea32&L-1049102319_163	1175159	3176566	A	783.5	27.0	10/23/2019	0	-0.002	0.174	0.2441472	0.000000	0.000000	0.042482
MappingArea32&L-1049102319_119	1175171	3175939	A	781.4	26.0	10/23/2019	0	-0.003	0.209	0.2443068	0.000000	0.000000	0.051060
MappingArea32&L-1049102419_231	1175177	3177155	A	786.1	26.7	10/24/2019	0	0	0.719	0.2452025	0.000000	0.000000	0.176301



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102319_146	1175181	3176462	A	782.5	26.0	10/23/2019	0	0	1.937	0.2446507	0.000000	0.000000	0.473888
MappingArea32&L-1049102319_133	1175186	3176069	A	780.2	26.0	10/23/2019	0	-0.002	0.535	0.2439316	0.000000	0.000000	0.130503
MappingArea32&L-1049102319_157	1175188	3176851	A	780.7	26.9	10/23/2019	0	-0.001	0.279	0.2433558	0.000000	0.000000	0.067896
MappingArea32&L-1049102319_139	1175191	3176351	A	781.0	26.0	10/23/2019	-5.769	-0.002	-0.109	0.2441817	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_138	1175192	3176289	A	781.0	25.9	10/23/2019	0	-0.001	1.03	0.2442634	0.000000	0.000000	0.251591
MappingArea32&L-1049102319_136	1175194	3176153	A	781.4	25.9	10/23/2019	0	-0.001	0.18	0.2443885	0.000000	0.000000	0.043990
MappingArea32&L-1049102319_156	1175196	3176938	A	779.5	26.8	10/23/2019	0	-0.001	0.243	0.2430627	0.000000	0.000000	0.059064
MappingArea32&L-1049102319_137	1175201	3176228	A	781.3	25.9	10/23/2019	0	-0.001	0.437	0.2443572	0.000000	0.000000	0.106784
MappingArea32&L-1049102319_155	1175230	3177033	A	779.1	26.5	10/23/2019	0	-0.002	-0.031	0.2431812	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_158	1175246	3176765	A	781.4	27.0	10/23/2019	2.252	-0.002	0.424	0.2434928	0.548346	0.000000	0.103241
MappingArea32&L-1049102319_120	1175252	3175933	A	780.0	26.1	10/23/2019	-1.283	-0.002	-0.094	0.2437876	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_130	1175258	3176317	A	779.8	26.1	10/23/2019	0	-0.001	1.016	0.2437251	0.000000	0.000000	0.247625
MappingArea32&L-1049102319_162	1175260	3176564	A	783.3	27.1	10/23/2019	0	-0.001	0.194	0.2440036	0.000000	0.000000	0.047337
MappingArea32&L-1049102319_131	1175268	3176262	A	780.2	26.0	10/23/2019	0	0	0.509	0.2439316	0.000000	0.000000	0.124161
MappingArea32&L-1049102319_121	1175274	3176029	A	779.1	26.2	10/23/2019	0	-0.003	0.236	0.2434249	0.000000	0.000000	0.057448
MappingArea32&L-1049102319_161	1175279	3176632	A	782.8	27.1	10/23/2019	0	-0.002	0.95	0.2438478	0.000000	0.000000	0.231655

APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m^2)	H2S flux (moles/day/m^2)	CO2 flux (moles/day/m^2)
MappingArea32&L-1049102319_147	1175280	3176456	A	782.5	26.0	10/23/2019	3.152	-0.003	10.253	0.2446507	0.771139	0.000000	2.508404
MappingArea32&L-1049102319_154	1175281	3176944	A	779.1	26.3	10/23/2019	0	-0.001	0.012	0.2433436	0.000000	0.000000	0.002920
MappingArea32&L-1049102319_132	1175304	3176181	A	780.2	26.0	10/23/2019	0	-0.001	0.156	0.2439316	0.000000	0.000000	0.038053
MappingArea32&L-1049102319_122	1175329	3176043	A	779.4	26.2	10/23/2019	0	-0.002	0.387	0.2435187	0.000000	0.000000	0.094242
MappingArea32&L-1049102319_153	1175338	3176862	A	779.7	26.1	10/23/2019	0	-0.002	0.1	0.2436938	0.000000	0.000000	0.024369
MappingArea32&L-1049102319_148	1175345	3176530	A	782.4	26.0	10/23/2019	0	-0.003	0.389	0.2446194	0.000000	0.000000	0.095157
MappingArea32&L-1049102319_159	1175353	3176772	A	781.7	27.1	10/23/2019	0	-0.001	0.117	0.2435052	0.000000	0.000000	0.028490
MappingArea32&L-1049102319_123	1175361	3176002	A	779.0	26.3	10/23/2019	0	-0.003	-0.04	0.2433124	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_160	1175371	3176666	A	781.6	27.2	10/23/2019	3.494	0	0.144	0.243393	0.850415	0.000000	0.035049
MappingArea32&L-1049102319_128	1175383	3176238	A	777.9	26.2	10/23/2019	-1.971	-0.001	-0.006	0.24305	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_129	1175387	3176328	A	778.9	26.2	10/23/2019	0	-0.001	1.034	0.2433624	0.000000	0.000000	0.251637
MappingArea32&L-1049102319_152	1175412	3176808	A	780.4	26.0	10/23/2019	0	-0.001	0.168	0.2439941	0.000000	0.000000	0.040991
MappingArea32&L-1049102319_127	1175432	3176162	A	777.7	26.2	10/23/2019	-1.089	-0.002	0.442	0.2429875	0.000000	0.000000	0.107400
MappingArea32&L-1049102319_124	1175447	3176064	A	778.6	26.3	10/23/2019	0	-0.002	-0.014	0.2431875	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_149	1175453	3176542	A	782.4	26.0	10/23/2019	0	-0.001	-0.002	0.2446194	0.000000	0.000000	0.000000
MappingArea32&L-1049102319_151	1175461	3176751	A	781.8	26.0	10/23/2019	0	-0.001	0.002	0.2444318	0.000000	0.000000	0.000489



APPENDIX B FLUX DATA (Continued)

Site Point ID	Northing	Easting	Accum Chamber	Pressure (HPa)	Temp (DegC)	Date	CH4 slope	H2S slope	CO2 slope	AcK factor	CH4 flux (moles/day/m ²)	H2S flux (moles/day/m ²)	CO2 flux (moles/day/m ²)
MappingArea32&L-1049102319_125	1175470	3175896	A	777.5	26.3	10/23/2019	-0.174	-0.001	0.215	0.2428439	0.000000	0.000000	0.052211
MappingArea32&L-1049102319_126	1175476	3176151	A	777.0	26.2	10/23/2019	0	-0.001	0.759	0.2427688	0.000000	0.000000	0.184262
MappingArea32&L-1049102319_150	1175484	3176652	A	782.4	26.0	10/23/2019	0	-0.001	0.203	0.2446194	0.000000	0.000000	0.049658



Grid Volume Computations

Tue Oct 29 12:15:59 2019

Upper Surface

Grid File Name:	C:\LTE\Rule608\2019_TimberCreek\SURFER\L1021_CH4_notail.grd
Grid Size:	87 rows x 100 columns
X Minimum:	3178306.381
X Maximum:	3179009.363
X Spacing:	7.1008282828267
Y Minimum:	1173700.559
Y Maximum:	1174339.757
Y Spacing:	7.432534883722
Z Minimum:	-8.1121466308043
Z Maximum:	28.124445781909

Lower Surface

Level Surface defined by $Z = 0$

Volumes

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

Total Volumes by:

Trapezoidal Rule:	8054.3138658815
Simpson's Rule:	7929.3812382089
Simpson's 3/8 Rule:	8071.574191172

Cut & Fill Volumes

Positive Volume [Cut]:	15850.54419941
Negative Volume [Fill]:	7796.2303335282
Net Volume [Cut-Fill]:	8054.3138658815

Areas

Planar Areas

Positive Planar Area [Cut]:	73323.75830975
Negative Planar Area [Fill]:	120869.77952207

Blanked Planar Area:	255151.15060414
Total Planar Area:	449344.68843596

Surface Areas

Positive Surface Area [Cut]:	73337.223388249
Negative Surface Area [Fill]:	120880.85707035

Grid Volume Computations

Tue Oct 29 12:16:32 2019

Upper Surface

Grid File Name:	C:\LTE\Rule608\2019_TimberCreek\SURFER\L1030_CH4.grd
Grid Size:	100 rows x 77 columns
X Minimum:	3164554.239
X Maximum:	3164963.416
X Spacing:	5.3839078947387
Y Minimum:	1145990.841
Y Maximum:	1146463.172
Y Spacing:	4.7710202020203
Z Minimum:	-1.0914563423062
Z Maximum:	7.3035050406737

Lower Surface

Level Surface defined by $Z = 0$

Volumes

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

Total Volumes by:

Trapezoidal Rule:	1095.9785325774
Simpson's Rule:	1091.11159737
Simpson's 3/8 Rule:	1096.275849966

Cut & Fill Volumes

Positive Volume [Cut]:	1927.3987468654
Negative Volume [Fill]:	831.42021428802
Net Volume [Cut-Fill]:	1095.9785325773

Areas

Planar Areas

Positive Planar Area [Cut]:	41448.412370226
Negative Planar Area [Fill]:	62017.749489518

Blanked Planar Area:	89800.819727325
Total Planar Area:	193266.98158707

Surface Areas

Positive Surface Area [Cut]:	41448.943507394
Negative Surface Area [Fill]:	62017.955465843

Grid Volume Computations

Tue Oct 29 12:16:54 2019

Upper Surface

Grid File Name:	C:\LTE\Rule608\2019_TimberCreek\SURFER\L1049_ch4_notail.grd
Grid Size:	68 rows x 100 columns
X Minimum:	3175729.63
X Maximum:	3178464.671
X Spacing:	27.626676767679
Y Minimum:	1173656.087
Y Maximum:	1175584.048
Y Spacing:	28.775537313431
Z Minimum:	-9.2527457707714
Z Maximum:	314.79998425325

Lower Surface

Level Surface defined by $Z = 0$

Volumes

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

Total Volumes by:

Trapezoidal Rule:	640221.84194775
Simpson's Rule:	639491.27025311
Simpson's 3/8 Rule:	639042.3300259

Cut & Fill Volumes

Positive Volume [Cut]:	696589.25519879
Negative Volume [Fill]:	56367.413251044
Net Volume [Cut-Fill]:	640221.84194774

Areas

Planar Areas

Positive Planar Area [Cut]:	1136797.3244228
Negative Planar Area [Fill]:	2115037.5566447

Blanked Planar Area:	2021217.5003335
Total Planar Area:	5273052.3814011

Surface Areas

Positive Surface Area [Cut]:	1138167.1836429
Negative Surface Area [Fill]:	2115050.6913585



The results set forth herein are provided by SGS North America Inc.

e-Hardcopy 2.0
Automated Report

Technical Report for

LT Environmental

Colo Rule 608 Compliance Raton Basin CO

081519001

SGS Job Number: DA21395

Sampling Date: 10/23/19

Report to:

LT Environmental
4600 W 60th Ave
Arvada, CO 80003
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ATTN: Devin Hencmann

Total number of pages in report: 57



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: Carissa Cumine 303-425-6021

Certifications: CO (CO00049), NE (NE-OS-06-04), ND (R-027), 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: DA21395

Colo Rule 608 Compliance Raton Basin CO
Project No: 081519001

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
DA21395-1	10/23/19	08:00	CM	10/24/19	AQ Water	CHAVEZ 01
DA21395-1A	10/23/19	08:00	CM	10/24/19	AQ Water	CHAVEZ 01
DA21395-1B	10/23/19	08:00	CM	10/24/19	AQ Water	CHAVEZ 01
DA21395-1F	10/23/19	08:00	CM	10/24/19	AQ Water Filtered	CHAVEZ 01
DA21395-2	10/23/19	10:34	CM	10/24/19	AQ Water	CHAVEZ 02
DA21395-2A	10/23/19	10:34	CM	10/24/19	AQ Water	CHAVEZ 02
DA21395-2B	10/23/19	10:34	CM	10/24/19	AQ Water	CHAVEZ 02
DA21395-2F	10/23/19	10:34	CM	10/24/19	AQ Water Filtered	CHAVEZ 02

CASE NARRATIVE / CONFORMANCE SUMMARY

2

Client: LT Environmental

Job No DA21395

Site: Colo Rule 608 Compliance Raton Basin CO

Report Date 11/6/2019 2:27:45 PM

On 10/24/2019, 2 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at SGS North America Inc. (SGS) at a temperature of 2.1 °C. The samples were intact and properly preserved, unless noted below. An SGS Job Number of DA21395 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.

GC Volatiles By Method RSK175 MOD

Matrix: AQ

Batch ID: GFK59

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21395-1MS, DA21395-1MSD were used as the QC samples indicated.

Metals Analysis By Method EPA 200.7

Matrix: AQ

Batch ID: MP29283

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21308-2FMS, DA21308-2FMSD were used as the QC samples for the metals analysis.
- The matrix spike (MS) recovery(s) of Calcium are outside control limits. Spike amount low relative to the sample amount. Refer to lab control or spike blank for recovery information.

Metals Analysis By Method EPA 200.8

Matrix: AQ

Batch ID: MP29286

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21422-1MS, DA21422-1MSD were used as the QC samples for the metals analysis.

Metals Analysis By Method SW846 6010C

Matrix: AQ

Batch ID: MP29322

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21395-1AMS, DA21395-1AMSD, DA21395-1ASDL were used as the QC samples for the metals analysis.

General Chemistry By Method EPA300.0/SW846 9056A

Matrix: AQ **Batch ID:** GP26152

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21395-1MS, DA21395-1MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate, Bromide analysis.

Matrix: AQ **Batch ID:** R49536

- The data for EPA300.0/SW846 9056A meets quality control requirements.
- DA21395-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

Matrix: AQ **Batch ID:** R49537

- The data for EPA300.0/SW846 9056A meets quality control requirements.
- DA21395-2 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

General Chemistry By Method HACH IRB-BART

Matrix: AQ **Batch ID:** MB1242

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

General Chemistry By Method HACH SLYM-BART

Matrix: AQ **Batch ID:** MB1243

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

General Chemistry By Method HACH SRB-BART

Matrix: AQ **Batch ID:** MB1244

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

General Chemistry By Method SM 2320B-2011

Matrix: AQ **Batch ID:** GN48709

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21395-1DUP, DA21455-4MS, DA21455-4MSD were used as the QC samples for the Alkalinity, Total as CaCO₃ analysis.

Matrix: AQ **Batch ID:** GN48710

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

Matrix: AQ **Batch ID:** GN48711

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

General Chemistry By Method SM 2510B-2011

Matrix: AQ **Batch ID:** GP26160

- Sample(s) DA21344-10DUP were used as the QC samples for the Specific Conductivity analysis.

General Chemistry By Method SM 2540C-2011

Matrix: AQ

Batch ID: GN48700

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) DA21458-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

General Chemistry By Method SM4500HB+-2011/9040C

Matrix: AQ

Batch ID: GN48684

- The data for SM4500HB+-2011/9040C meets quality control requirements.
- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: DA21395-1, DA21395-2
Analysis performed past recommended hold time.

General Chemistry By Method USDA HANDBOOK 60

Matrix: AQ

Batch ID: MP29322

- DA21395-1A and -2A for Sodium Adsorption Ratio: Calculated as: $(\text{Na meq/L}) / \sqrt{[(\text{Ca meq/L}) + (\text{Mg meq/L})/2]}$

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

SGS 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 SGS indicated via signature on the report cover.

Summary of Hits

Job Number: DA21395
Account: LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO
Collected: 10/23/19

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

DA21395-1 CHAVEZ 01

Methane	0.0038	0.00080	0.00070	mg/l	RSK175 MOD
Alkalinity, Bicarbonate as CaCO ₃	129	5.0		mg/l	SM 2320B-2011
Alkalinity, Total as CaCO ₃	129	5.0		mg/l	SM 2320B-2011
Chloride	4.3	0.50		mg/l	EPA300.0/SW846 9056A
Fluoride	0.23	0.10		mg/l	EPA300.0/SW846 9056A
Nitrogen, Nitrate	0.015	0.010		mg/l	EPA300.0/SW846 9056A
Nitrogen, Nitrate + Nitrite ^a	0.015	0.014		mg/l	EPA300.0/SW846 9056A
Solids, Total Dissolved	183	10		mg/l	SM 2540C-2011
Specific Conductivity	299	1.0		umhos/cm	SM 2510B-2011
Sulfate	24.9	0.50		mg/l	EPA300.0/SW846 9056A
pH ^b	7.49			su	SM4500HB+ -2011/9040C

DA21395-1A CHAVEZ 01

Calcium	47.9	2.0		mg/l	SW846 6010C
Magnesium	8.35	1.0		mg/l	SW846 6010C
Sodium	11.5	2.0		mg/l	SW846 6010C
Sodium Adsorption Ratio ^c	0.403			ratio	USDA HANDBOOK 60

DA21395-1B CHAVEZ 01

Iron-Related Bacteria	2200	25		CFU/ml	HACH IRB-BART
Slime Forming Bacteria	440000	500		CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	27000	200		CFU/ml	HACH SRB-BART

DA21395-1F CHAVEZ 01

Calcium	42300	400		ug/l	EPA 200.7
Magnesium	7400	200		ug/l	EPA 200.7
Sodium	11500	400		ug/l	EPA 200.7

DA21395-2 CHAVEZ 02

Methane	0.00097	0.00080	0.00070	mg/l	RSK175 MOD
Alkalinity, Bicarbonate as CaCO ₃	191	5.0		mg/l	SM 2320B-2011
Alkalinity, Total as CaCO ₃	191	5.0		mg/l	SM 2320B-2011
Chloride	4.6	0.50		mg/l	EPA300.0/SW846 9056A
Fluoride	0.26	0.10		mg/l	EPA300.0/SW846 9056A
Nitrogen, Nitrate	0.062	0.010		mg/l	EPA300.0/SW846 9056A
Nitrogen, Nitrate + Nitrite ^a	0.062	0.014		mg/l	EPA300.0/SW846 9056A
Solids, Total Dissolved	246	10		mg/l	SM 2540C-2011
Specific Conductivity	394	1.0		umhos/cm	SM 2510B-2011
Sulfate	23.9	0.50		mg/l	EPA300.0/SW846 9056A

Summary of Hits

Page 2 of 2

Job Number: DA21395
Account: LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO
Collected: 10/23/19

Lab Sample ID Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
pH ^b		7.26			su	SM4500HB+ -2011/9040C
DA21395-2A CHAVEZ 02						
Calcium		72.1	2.0		mg/l	SW846 6010C
Magnesium		13.3	1.0		mg/l	SW846 6010C
Sodium		12.8	2.0		mg/l	SW846 6010C
Sodium Adsorption Ratio ^c		0.363			ratio	USDA HANDBOOK 60
DA21395-2B CHAVEZ 02						
Iron-Related Bacteria		9000	25		CFU/ml	HACH IRB-BART
Slime Forming Bacteria		440000	500		CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria		115000	200		CFU/ml	HACH SRB-BART
DA21395-2F CHAVEZ 02						
Calcium		60400	400		ug/l	EPA 200.7
Iron		36.0	10		ug/l	EPA 200.7
Magnesium		11200	200		ug/l	EPA 200.7
Manganese		5.1	2.0		ug/l	EPA 200.8
Potassium		1560	1000		ug/l	EPA 200.7
Sodium		12500	400		ug/l	EPA 200.7

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

(b) Analysis performed past recommended hold time.

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

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	CHAVEZ 01	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-1	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Method:	RSK175 MOD		
Project:	Colo Rule 608 Compliance Raton Basin CO		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FK636.D	1	10/29/19 16:28	GN	n/a	n/a	GFK59
Run #2							

	Initial Volume	Headspace Volume	Volume Injected	Temperature
Run #1	39.0 ml	4.0 ml	500 ul	20.0 Deg. C
Run #2				

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	0.0038	0.00080	0.00070	mg/l	

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

Report of Analysis

Client Sample ID: CHAVEZ 01**Lab Sample ID:** DA21395-1**Matrix:** AQ - Water**Project:** Colo Rule 608 Compliance Raton Basin CO**Date Sampled:** 10/23/19**Date Received:** 10/24/19**Percent Solids:** n/a

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Bicarbonate as CaC	129	5.0	mg/l	1	10/29/19	JD	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	10/29/19	JD	SM 2320B-2011
Alkalinity, Total as CaCO ₃	129	5.0	mg/l	1	10/29/19	JD	SM 2320B-2011
Bromide	< 0.050	0.050	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
Chloride	4.3	0.50	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
Fluoride	0.23	0.10	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
Nitrogen, Nitrate	0.015	0.010	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
Nitrogen, Nitrate + Nitrite ^a	0.015	0.014	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
Nitrogen, Nitrite	< 0.0040	0.0040	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
Solids, Total Dissolved	183	10	mg/l	1	10/29/19	AK	SM 2540C-2011
Specific Conductivity	299	1.0	umhos/cm	1	10/28/19	SK	SM 2510B-2011
Sulfate	24.9	0.50	mg/l	1	10/24/19 13:10	JB	EPA300.0/SW846 9056A
pH ^b	7.49		su	1	10/25/19 10:30	SK	SM4500HB+ -2011/9040C

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

(b) Analysis performed past recommended hold time.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 01	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-1A	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

SAR Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Calcium	47.9	2.0	mg/l	1	10/30/19	10/30/19 JM	SW846 6010C ¹	SW846 3010A/M ²
Magnesium	8.35	1.0	mg/l	1	10/30/19	10/30/19 JM	SW846 6010C ¹	SW846 3010A/M ²
Sodium	11.5	2.0	mg/l	1	10/30/19	10/30/19 JM	SW846 6010C ¹	SW846 3010A/M ²

(1) Instrument QC Batch: MA11930
(2) Prep QC Batch: MP29322

RL = Reporting Limit

4.2
4

Report of Analysis

Client Sample ID:	CHAVEZ 01	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-1A	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Sodium Adsorption Ratio ^a	0.403		ratio	1	10/30/19 14:59	JM	USDA HANDBOOK 60

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

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 01	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-1B	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Iron-Related Bacteria	2200	25	CFU/ml	1	10/28/19 16:00	SK	HACH IRB-BART
Slime Forming Bacteria	440000	500	CFU/ml	1	10/28/19 16:00	SK	HACH SLYM-BART
Sulfate Reducing Bacteria	27000	200	CFU/ml	1	10/28/19 16:00	SK	HACH SRB-BART

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 01	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-1F	Date Received:	10/24/19
Matrix:	AQ - Water Filtered	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Calcium	42300	400	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴
Iron	< 10	10	ug/l	1	10/25/19	10/31/19 JM	EPA 200.7 ³	EPA 200.7 ⁴
Magnesium	7400	200	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴
Manganese	< 2.0	2.0	ug/l	2	10/25/19	10/28/19 JM	EPA 200.8 ¹	EPA 200.8 ⁵
Potassium	< 1000	1000	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴
Selenium	< 0.80	0.80	ug/l	2	10/25/19	10/28/19 JM	EPA 200.8 ¹	EPA 200.8 ⁵
Sodium	11500	400	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴

- (1) Instrument QC Batch: MA11921
- (2) Instrument QC Batch: MA11927
- (3) Instrument QC Batch: MA11933
- (4) Prep QC Batch: MP29283
- (5) Prep QC Batch: MP29286

RL = Reporting Limit

4.4
4

Report of Analysis

Client Sample ID:	CHAVEZ 02	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-2	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Method:	RSK175 MOD		
Project:	Colo Rule 608 Compliance Raton Basin CO		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FK640.D	1	10/29/19 16:48	GN	n/a	n/a	GFK59
Run #2							

	Initial Volume	Headspace Volume	Volume Injected	Temperature
Run #1	39.0 ml	4.0 ml	500 ul	20.0 Deg. C
Run #2				

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	0.00097	0.00080	0.00070	mg/l	

ND = Not detected

MDL = Method Detection Limit

J = Indicates an estimated value

RL = Reporting Limit

B = Indicates analyte found in associated method blank

E = Indicates value exceeds calibration range

N = Indicates presumptive evidence of a compound

4.5
4

Report of Analysis

Client Sample ID: CHAVEZ 02**Lab Sample ID:** DA21395-2**Matrix:** AQ - Water**Project:** Colo Rule 608 Compliance Raton Basin CO**Date Sampled:** 10/23/19**Date Received:** 10/24/19**Percent Solids:** n/a

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Bicarbonate as CaC	191	5.0	mg/l	1	10/29/19	JD	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	10/29/19	JD	SM 2320B-2011
Alkalinity, Total as CaCO ₃	191	5.0	mg/l	1	10/29/19	JD	SM 2320B-2011
Bromide	< 0.050	0.050	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
Chloride	4.6	0.50	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
Fluoride	0.26	0.10	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
Nitrogen, Nitrate	0.062	0.010	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
Nitrogen, Nitrate + Nitrite ^a	0.062	0.014	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
Nitrogen, Nitrite	< 0.0040	0.0040	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
Solids, Total Dissolved	246	10	mg/l	1	10/29/19	AK	SM 2540C-2011
Specific Conductivity	394	1.0	umhos/cm	1	10/28/19	SK	SM 2510B-2011
Sulfate	23.9	0.50	mg/l	1	10/24/19 13:24	JB	EPA300.0/SW846 9056A
pH ^b	7.26		su	1	10/25/19 10:30	SK	SM4500HB+ -2011/9040C

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

(b) Analysis performed past recommended hold time.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 02	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-2A	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

SAR Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Calcium	72.1	2.0	mg/l	1	10/30/19	10/30/19 JM	SW846 6010C ¹	SW846 3010A/M ²
Magnesium	13.3	1.0	mg/l	1	10/30/19	10/30/19 JM	SW846 6010C ¹	SW846 3010A/M ²
Sodium	12.8	2.0	mg/l	1	10/30/19	10/30/19 JM	SW846 6010C ¹	SW846 3010A/M ²

(1) Instrument QC Batch: MA11930
(2) Prep QC Batch: MP29322

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 02	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-2A	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Sodium Adsorption Ratio ^a	0.363		ratio	1	10/30/19 15:23	JM	USDA HANDBOOK 60

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

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 02	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-2B	Date Received:	10/24/19
Matrix:	AQ - Water	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Iron-Related Bacteria	9000	25	CFU/ml	1	10/28/19 16:00	SK	HACH IRB-BART
Slime Forming Bacteria	440000	500	CFU/ml	1	10/28/19 16:00	SK	HACH SLYM-BART
Sulfate Reducing Bacteria	115000	200	CFU/ml	1	10/28/19 16:00	SK	HACH SRB-BART

RL = Reporting Limit

Report of Analysis

Client Sample ID:	CHAVEZ 02	Date Sampled:	10/23/19
Lab Sample ID:	DA21395-2F	Date Received:	10/24/19
Matrix:	AQ - Water Filtered	Percent Solids:	n/a
Project:	Colo Rule 608 Compliance Raton Basin CO		

Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Calcium	60400	400	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴
Iron	36.0	10	ug/l	1	10/25/19	10/31/19 JM	EPA 200.7 ³	EPA 200.7 ⁴
Magnesium	11200	200	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴
Manganese	5.1	2.0	ug/l	2	10/25/19	10/28/19 JM	EPA 200.8 ¹	EPA 200.8 ⁵
Potassium	1560	1000	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴
Selenium	< 0.80	0.80	ug/l	2	10/25/19	10/28/19 JM	EPA 200.8 ¹	EPA 200.8 ⁵
Sodium	12500	400	ug/l	1	10/25/19	10/29/19 JM	EPA 200.7 ²	EPA 200.7 ⁴

- (1) Instrument QC Batch: MA11921
- (2) Instrument QC Batch: MA11927
- (3) Instrument QC Batch: MA11933
- (4) Prep QC Batch: MP29283
- (5) Prep QC Batch: MP29286

RL = Reporting Limit

Misc. Forms

5

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

SGS North America Inc. - Wheat Ridge
4036 Youngfield Street, Wheat Ridge, CO 80033
TEL: 303-425-6021 FAX: 303-425-6854
www.sgs.com/ehsusa

Bottle Order Control #				FED-EX Tracking #			
SGS Quote #				SGS Job # 021395			
Requested Analysis (see TEST CODE sheet)							Matrix Codes
							DW - Drinking Water GW - Ground Water WW - Water SW - Surface Water SO - Soil SL - Sludge SED - Sediment OI - Oil LIQ - Other Liquid AIR - Air SOL - Other Solid WP - Wipe FB - Field Blank EB - Equipment Blank RB - Rinse Blank TB - Trip Blank
							LAB USE ONLY
							01
							02
							TB= 03
							See 10/24
Comments / Special Instructions							
See Delivery & Pick up Request Sheet for analysis.							
Please cc: dhennan@tenv.com & cmc@inn@tenv.com							
Including courier delivery.							
Date/Time:		Received By:		Date/Time:		Received By:	
		2				4	
Term ID: 7080		On Ice <input checked="" type="checkbox"/>		http://www.sgs.com/en/terms-and-conditions			

FHSA-DAC-0027-00-FORM-Wheat Ridge - D/M COC Rev. Date: 4/10/18

DA21395: Chain of Custody

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SGS Sample Receipt Summary

Job Number: DA21395 **Client:** LT ENVIRONMENTAL **Project:** 2019 RULE608
Date / Time Received: 10/24/2019 9:00:00 AM **Delivery Method:** **Airbill #s:** fx
Cooler Temps (Initial/Adjusted): 0

<u>Cooler Security</u>	<u>Y</u>	<u>or</u>	<u>N</u>		<u>Y</u>	<u>or</u>	<u>N</u>
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"/>

<u>Cooler Temperature</u>	<u>Y</u>	<u>or</u>	<u>N</u>
1. Temp criteria achieved:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Cooler temp verification:	IR Gun		
3. Cooler media:	Ice (Bag)		
4. No. Coolers	1		

<u>Quality Control Preservation</u>	<u>Y</u>	<u>N</u>	<u>N/A</u>
1. Trip Blank present / cooler:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Trip Blank listed on COC:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Samples preserved properly:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
4. VOCs headspace free:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<u>Sample Integrity - Documentation</u>	<u>Y</u>	<u>or</u>	<u>N</u>
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"/>

<u>Sample Integrity - Condition</u>	<u>Y</u>	<u>or</u>	<u>N</u>
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		

<u>Sample Integrity - Instructions</u>	<u>Y</u>	<u>N</u>	<u>N/A</u>
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"/>

Comments Metals not listed on COC

Sample Receipt Summary - Problem Resolution

Job Number: DA21395

Initiator: tmp

CSR: Carissa Cumine

Response Date: 10/28/2019

Response: Dissolved metals targets were not specified on the COC and were logged per project history.

5.1

5

DA21395: Chain of Custody

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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: DA21395
Account: LTENCODE LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
GFK59-MB	FK634.D	1	10/29/19	GN	n/a	n/a	GFK59

The QC reported here applies to the following samples: Method: RSK175 MOD
DA21395-1, DA21395-2

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	ND	0.00080	0.00070	mg/l	

Blank Spike Summary

Job Number: DA21395
Account: LTENCODE LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
GFK59-BS	FK635.D	10	10/29/19	GN	n/a	n/a	GFK59

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

DA21395-1, DA21395-2

CAS No.	Compound	Spike mg/l	BSP mg/l	BSP %	Limits
74-82-8	Methane	0.512	0.600	117	70-130

* = Outside of Control Limits.

Matrix Spike/Matrix Spike Duplicate Summary

Job Number: DA21395
Account: LTENCODE LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
DA21395-1MS	FK637.D	10	10/29/19	GN	n/a	n/a	GFK59
DA21395-1MSD	FK638.D	10	10/29/19	GN	n/a	n/a	GFK59
DA21395-1	FK636.D	1	10/29/19	GN	n/a	n/a	GFK59

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

DA21395-1, DA21395-2

CAS No.	Compound	DA21395-1 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	0.0038	0.512	0.553	107	0.512	0.552	107	0	15-200/30

* = 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: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29283
Matrix Type: AQUEOUS

Methods: EPA 200.7
Units: ug/l

Prep Date: 10/25/19

Metal	RL	IDL	MDL	MB raw	final
Aluminum	100	46	30		
Antimony	30	14	10		
Arsenic	25	22	7		
Barium	10	.3	2		
Beryllium	10	1	1.3		
Boron	50	3.3	7.4		
Cadmium	10	1.9	1.6		
Calcium	400	6.6	53	7.2	<400
Chromium	10	1.1	1.7		
Cobalt	5.0	2.7	2.3		
Copper	10	4.6	2.3		
Iron	10	8.9	3.1	0.10	<10
Lead	50	13	6.3		
Lithium	5.0	.6	4		
Magnesium	200	50	31	-6.2	<200
Manganese	5.0	.5	1.1		
Molybdenum	10	8.5	4.3		
Nickel	30	6.2	6.1		
Phosphorus	100	91	24		
Potassium	1000	84	250	107	<1000
Selenium	50	30	21		
Silicon	50	41	45		
Silver	30	.6	4		
Sodium	400	13	51	170	<400
Strontium	5.0	.1	.6		
Thallium	10	17	7.5		
Tin	60	41	51		
Titanium	10	.5	1.9		
Uranium	50	3.9	8.5		
Vanadium	10	.9	.7		
Zinc	30	9	3.8		

Associated samples MP29283: DA21395-1F, DA21395-2F

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

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29283
Matrix Type: AQUEOUS

Methods: EPA 200.7
Units: ug/l

Prep Date: 10/25/19

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29283
 Matrix Type: AQUEOUS

Methods: EPA 200.7
 Units: ug/l

Prep Date: 10/25/19

Metal	DA21308-2F Original MS		Spikelot ICPAL2	% Rec	QC Limits
Aluminum					
Antimony					
Arsenic					
Barium					
Beryllium					
Boron	anr				
Cadmium					
Calcium	117000	149000	25000	132.0(a)	70-130
Chromium					
Cobalt					
Copper					
Iron	23.4	5140	5000	102.5	70-130
Lead					
Lithium					
Magnesium	26000	50100	25000	96.4	70-130
Manganese	anr				
Molybdenum					
Nickel					
Phosphorus					
Potassium	30400	56600	25000	105.2	70-130
Selenium					
Silicon					
Silver					
Sodium	183000	206000	25000	92.0	70-130
Strontium	anr				
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP29283: DA21395-1F, DA21395-2F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29283
 Matrix Type: AQUEOUS

Methods: EPA 200.7
 Units: ug/l

Prep Date: 10/25/19

Metal	DA21308-2F 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.

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29283
 Matrix Type: AQUEOUS

Methods: EPA 200.7
 Units: ug/l

Prep Date: 10/25/19

Metal	DA21308-2F Original MSD	Spikelot ICPAL2	% Rec	MSD RPD	QC Limit
Aluminum					
Antimony					
Arsenic					
Barium					
Beryllium					
Boron	anr				
Cadmium					
Calcium	117000	146000	25000	120.0	2.0
Chromium					
Cobalt					
Copper					
Iron	23.4	5130	5000	102.3	0.2
Lead					
Lithium					
Magnesium	26000	50500	25000	98.0	0.8
Manganese	anr				
Molybdenum					
Nickel					
Phosphorus					
Potassium	30400	57400	25000	108.4	1.4
Selenium					
Silicon					
Silver					
Sodium	183000	207000	25000	96.0	0.5
Strontium	anr				
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP29283: DA21395-1F, DA21395-2F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

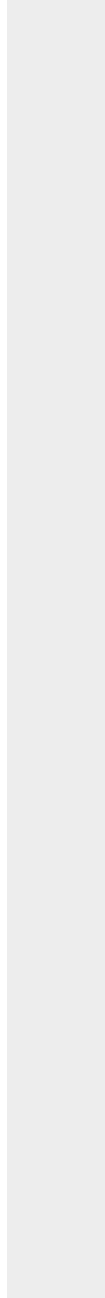
QC Batch ID: MP29283
Matrix Type: AQUEOUS

Methods: EPA 200.7
Units: ug/l

Prep Date: 10/25/19

Metal	DA21308-2F 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



SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29283
 Matrix Type: AQUEOUS

Methods: EPA 200.7
 Units: ug/l

Prep Date: 10/25/19

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Boron	anr			
Cadmium				
Calcium	24800	25000	99.2	85-115
Chromium				
Cobalt				
Copper				
Iron	4970	5000	99.4	85-115
Lead				
Lithium				
Magnesium	23600	25000	94.4	85-115
Manganese	anr			
Molybdenum				
Nickel				
Phosphorus				
Potassium	24900	25000	99.6	85-115
Selenium				
Silicon				
Silver				
Sodium	24400	25000	97.6	85-115
Strontium	anr			
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP29283: DA21395-1F, DA21395-2F

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

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

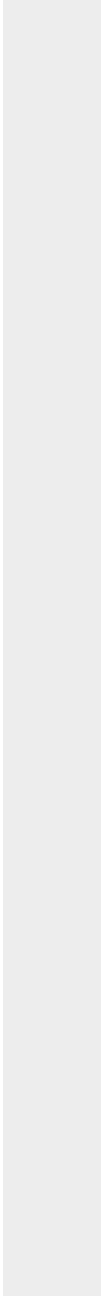
QC Batch ID: MP29283
Matrix Type: AQUEOUS

Methods: EPA 200.7
Units: ug/l

Prep Date: 10/25/19

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



BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29286
Matrix Type: AQUEOUS

Methods: EPA 200.8
Units: ug/l

Prep Date: 10/25/19

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	0.034	<1.0
Molybdenum	1.0	.049	.029		
Nickel	2.0	.0088	.027		
Phosphorus	60	2.6	4.3		
Potassium	200	2.9	2.9		
Selenium	0.40	.06	.21	-0.20	<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 MP29286: DA21395-1F, DA21395-2F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29286
 Matrix Type: AQUEOUS

Methods: EPA 200.8
 Units: ug/l

Prep Date: 10/25/19

Metal	DA21422-1 Original MS	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony	anr			
Arsenic	anr			
Barium	anr			
Beryllium	anr			
Boron				
Cadmium	anr			
Calcium				
Chromium	anr			
Cobalt				
Copper	anr			
Iron				
Lead	anr			
Magnesium				
Manganese	69.7	168	100	97.9 70-130
Molybdenum	anr			
Nickel	anr			
Phosphorus				
Potassium				
Selenium	2.4	178	200	87.8 70-130
Silver	anr			
Sodium				
Strontium				
Thallium	anr			
Tin				
Titanium				
Uranium				
Vanadium				
Zinc	anr			

Associated samples MP29286: DA21395-1F, DA21395-2F

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29286
 Matrix Type: AQUEOUS

Methods: EPA 200.8
 Units: ug/l

Prep Date: 10/25/19

Metal	DA21422-1 Original MSD		Spikelot ICPALL2 % Rec		MSD RPD	QC Limit
Aluminum						
Antimony	anr					
Arsenic	anr					
Barium	anr					
Beryllium	anr					
Boron						
Cadmium	anr					
Calcium						
Chromium	anr					
Cobalt						
Copper	anr					
Iron						
Lead	anr					
Magnesium						
Manganese	69.7	167	100	96.9	0.6	20
Molybdenum	anr					
Nickel	anr					
Phosphorus						
Potassium						
Selenium	2.4	177	200	87.3	0.6	20
Silver	anr					
Sodium						
Strontium						
Thallium	anr					
Tin						
Titanium						
Uranium						
Vanadium						
Zinc	anr					

Associated samples MP29286: DA21395-1F, DA21395-2F

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

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: DA21395

Account: LTENCODE - LT Environmental

Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29286

Methods: EPA 200.8

Matrix Type: AQUEOUS

Units: ug/l

Prep Date: 10/25/19

Metal	BSP Result	Spikelot ICPALL2	% Rec	QC Limits
Aluminum				
Antimony	anr			
Arsenic	anr			
Barium	anr			
Beryllium	anr			
Boron				
Cadmium	anr			
Calcium				
Chromium	anr			
Cobalt				
Copper	anr			
Iron				
Lead	anr			
Magnesium				
Manganese	103	100	103.0	85-115
Molybdenum	anr			
Nickel	anr			
Phosphorus				
Potassium				
Selenium	203	200	101.5	85-115
Silver	anr			
Sodium				
Strontium				
Thallium	anr			
Tin				
Titanium				
Uranium				
Vanadium				
Zinc	anr			

Associated samples MP29286: DA21395-1F, DA21395-2F

Results < IDL are shown as zero for calculation purposes

(*) Outside of QC limits

(anr) Analyte not requested

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29322
Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

Metal	RL	IDL	MDL	MB raw	final
Aluminum	500	55	75		
Antimony	150	11	34		
Arsenic	130	19	23		
Barium	50	1	6.5		
Beryllium	50	4.5	6.5		
Boron	250	4	32		
Cadmium	50	1	6.5		
Calcium	2000	12	250	-120	<2000
Chromium	50	1.5	6.5		
Cobalt	25	2.5	3.2		
Copper	50	4	6.5		
Iron	350	7.5	60		
Lead	250	11	32		
Lithium	25	2	6.5		
Magnesium	1000	34	130	10.5	<1000
Manganese	25	2.5	3.2		
Molybdenum	50	2	14		
Nickel	150	2.5	19		
Phosphorus	500	75	80		
Potassium	5000	500	630		
Selenium	250	36	110		
Silicon	250	24	75		
Silver	150	1.5	19		
Sodium	2000	37	250	30.0	<2000
Strontium	25	.05	3.2		
Thallium	50	9	22		
Tin	300	60	260		
Titanium	50	.5	6.5		
Uranium	250	15	43		
Vanadium	50	2	6.5		
Zinc	150	2	19		

Associated samples MP29322: DA21395-1A, DA21395-2A

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

BLANK RESULTS SUMMARY
Part 2 - Method Blanks

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

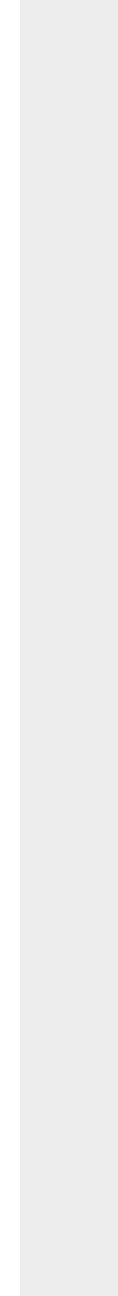
QC Batch ID: MP29322
Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

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



MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29322
 Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

Metal	DA21395-1A Original MS		Spikelot ICPALL2	% Rec	QC Limits
Aluminum					
Antimony					
Arsenic					
Barium					
Beryllium					
Boron					
Cadmium					
Calcium	47900	181000	125000	106.5	75-125
Chromium					
Cobalt					
Copper					
Iron					
Lead					
Lithium					
Magnesium	8350	128000	125000	95.7	75-125
Manganese					
Molybdenum					
Nickel					
Phosphorus					
Potassium					
Selenium					
Silicon					
Silver					
Sodium	11500	124000	125000	90.0	75-125
Strontium					
Thallium					
Tin					
Titanium					
Uranium					
Vanadium					
Zinc					

Associated samples MP29322: DA21395-1A, DA21395-2A

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

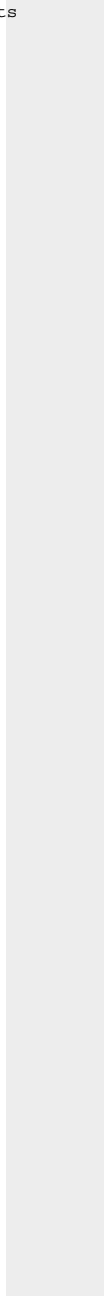
QC Batch ID: MP29322
Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

Metal	DA21395-1A 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: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29322
 Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

Metal	DA21395-1A Original	MSD	Spikelot ICPAL2	% Rec	MSD RPD	QC Limit
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Calcium	47900	183000	125000	108.1	1.1	20
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Lithium						
Magnesium	8350	129000	125000	96.5	0.8	20
Manganese						
Molybdenum						
Nickel						
Phosphorus						
Potassium						
Selenium						
Silicon						
Silver						
Sodium	11500	126000	125000	91.6	1.6	20
Strontium						
Thallium						
Tin						
Titanium						
Uranium						
Vanadium						
Zinc						

Associated samples MP29322: DA21395-1A, DA21395-2A

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

MATRIX SPIKE AND DUPLICATE RESULTS SUMMARY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

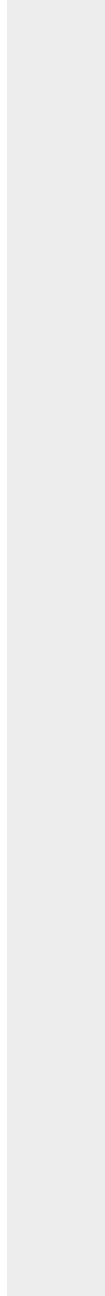
QC Batch ID: MP29322
Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

Metal	DA21395-1A 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



SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: DA21395

Account: LTENCODE - LT Environmental

Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29322

Methods: SW846 6010C, USDA HANDBOOK 60

Matrix Type: AQUEOUS

Units: ug/l

Prep Date: 10/30/19

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	121000	125000	96.8	80-120
Manganese				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silicon				
Silver				
Sodium	115000	125000	92.0	80-120
Strontium				
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP29322: DA21395-1A, DA21395-2A

Results < IDL are shown as zero for calculation purposes

(*) Outside of QC limits

SPIKE BLANK AND LAB CONTROL SAMPLE SUMMARY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

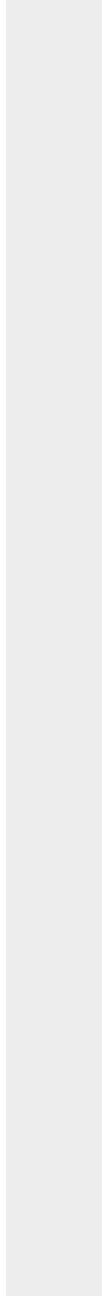
QC Batch ID: MP29322
Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

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



SERIAL DILUTION RESULTS SUMMARY

Login Number: DA21395
 Account: LTENCODE - LT Environmental
 Project: Colo Rule 608 Compliance Raton Basin CO

QC Batch ID: MP29322
 Matrix Type: AQUEOUS

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

Prep Date: 10/30/19

Metal	DA21395-1A Original SDL 1:5		%DIF	QC Limits
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Boron				
Cadmium				
Calcium	9570	9740	1.7	0-10
Chromium				
Cobalt				
Copper				
Iron				
Lead				
Lithium				
Magnesium	1670	1730	3.6	0-10
Manganese				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silicon				
Silver				
Sodium	2300	2380	3.5	0-10
Strontium				
Thallium				
Tin				
Titanium				
Uranium				
Vanadium				
Zinc				

Associated samples MP29322: DA21395-1A, DA21395-2A

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

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

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

	DA21395-1A	QC
Metal	Original SDL 1:5 %DIF	Limits

General Chemistry

QC Data Summaries

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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: DA21395
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	GN48710	5.0	2.1	mg/l	100	95.8	95.8	90-110%
Alkalinity, Carbonate	GN48711	5.0	0.0	mg/l	100	95.8	95.8	80-120%
Alkalinity, Total as CaCO3	GN48709	5.0	2.1	mg/l	100	95.8	95.8	90-110%
Bromide	GP26152/GN48679	0.050	0.0	mg/l	0.5	0.510	102.0	90-110%
Chloride	GP26152/GN48679	0.50	0.0	mg/l	5	5.13	102.6	90-110%
Fluoride	GP26152/GN48679	0.10	0.0	mg/l	1	1.01	101.0	90-110%
Iron-Related Bacteria	MB1242	25	<25	CFU/ml				
Nitrogen, Nitrate	GP26152/GN48679	0.010	0.0	mg/l	0.1	0.100	100.0	90-110%
Nitrogen, Nitrite	GP26152/GN48679	0.0040	0.0	mg/l	0.05	0.0502	100.4	90-110%
Phosphate, Ortho	GP26152/GN48679	0.050	0.0	mg/l	0.5	0.495	99.0	90-110%
Slime Forming Bacteria	MB1243	500	<500	CFU/ml				
Solids, Total Dissolved	GN48700	10	0.0	mg/l	250	250	100.0	90-110%
Specific Conductivity	GP26160/GN48698			umhos/cm	9860	9860	98.6	90-110%
Specific Conductivity	GP26160/GN48698			umhos/cm	992	992	99.4	90-110%
Sulfate	GP26152/GN48679	0.50	0.0	mg/l	5	5.09	101.8	90-110%
Sulfate Reducing Bacteria	MB1244	200	<200	CFU/ml				

Associated Samples:

Batch MB1242: DA21395-1B, DA21395-2B
Batch MB1243: DA21395-1B, DA21395-2B
Batch MB1244: DA21395-1B, DA21395-2B
Batch GN48700: DA21395-1, DA21395-2
Batch GN48709: DA21395-1, DA21395-2
Batch GN48710: DA21395-1, DA21395-2
Batch GN48711: DA21395-1, DA21395-2
Batch GP26152: DA21395-1, DA21395-2
Batch GP26160: DA21395-1, DA21395-2
(*) Outside of QC limits

DUPLICATE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: DA21395
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	GN48709	DA21395-1	mg/l	129	129	0.6	0-20%
Solids, Total Dissolved	GN48700	DA21458-1	mg/l	859	869	1.2	0-5%
Specific Conductivity	GP26160/GN48698	DA21344-10	umhos/cm	13800	14500	5.8	0-20%

Associated Samples:

Batch GN48700: DA21395-1, DA21395-2

Batch GN48709: DA21395-1, DA21395-2

Batch GP26160: DA21395-1, DA21395-2

(*) Outside of QC limits

8.2

8

MATRIX SPIKE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

Analyte	Batch ID	QC Sample	Units	Original Result	Spike Amount	MS Result	%Rec	QC Limits
Alkalinity, Total as CaCO ₃	GN48709	DA21455-4	mg/l	111	100	199	88.1	80-120%
Bromide	GP26152/GN48679	DA21395-1	mg/l	0.0	0.5	0.52	104.0	80-120%
Chloride	GP26152/GN48679	DA21395-1	mg/l	4.3	5	9.3	100.0	80-120%
Fluoride	GP26152/GN48679	DA21395-1	mg/l	0.23	1	1.2	97.0	80-120%
Nitrogen, Nitrate	GP26152/GN48679	DA21395-1	mg/l	0.015	0.1	0.11	95.0	80-120%
Nitrogen, Nitrite	GP26152/GN48679	DA21395-1	mg/l	0.0	0.05	0.048	96.0	80-120%
Phosphate, Ortho	GP26152/GN48679	DA21395-1	mg/l	0.0	0.5	0.52	104.0	80-120%
Sulfate	GP26152/GN48679	DA21395-1	mg/l	24.9	5	29.6	94.0	80-120%

Associated Samples:

Batch GN48709: DA21395-1, DA21395-2

Batch GP26152: DA21395-1, DA21395-2

(*) Outside of QC limits

(N) Matrix Spike Rec. outside of QC limits



MATRIX SPIKE DUPLICATE RESULTS SUMMARY
GENERAL CHEMISTRY

Login Number: DA21395
Account: LTENCODE - LT Environmental
Project: Colo Rule 608 Compliance Raton Basin CO

Analyte	Batch ID	QC Sample	Units	Original Result	Spike Amount	MSD Result	RPD	QC Limit
Alkalinity, Total as CaCO ₃	GN48709	DA21455-4	mg/l	111	100	201	0.9	20%
Bromide	GP26152/GN48679	DA21395-1	mg/l	0.0	0.5	0.52	0.0	20%
Chloride	GP26152/GN48679	DA21395-1	mg/l	4.3	5	9.4	1.1	20%
Fluoride	GP26152/GN48679	DA21395-1	mg/l	0.23	1	1.2	0.0	20%
Nitrogen, Nitrate	GP26152/GN48679	DA21395-1	mg/l	0.015	0.1	0.11	0.0	20%
Nitrogen, Nitrite	GP26152/GN48679	DA21395-1	mg/l	0.0	0.05	0.048	0.0	20%
Phosphate, Ortho	GP26152/GN48679	DA21395-1	mg/l	0.0	0.5	0.49	5.9	20%
Sulfate	GP26152/GN48679	DA21395-1	mg/l	24.9	5	29.6	0.0	20%

Associated Samples:

Batch GN48709: DA21395-1, DA21395-2

Batch GP26152: DA21395-1, DA21395-2

(*) Outside of QC limits

(N) Matrix Spike Rec. outside of QC limits

8.4

8