COMPLIANCE / ENGINEERING / REMEDIATION

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October 1, 2010

Ms. Karen Spray
Colorado Oil and Gas Conservation Commission
PO Box 2651
Durango, Colorado 81302

**RE: September 23, 2010 Methane Seep Survey and Other Activities**
**Bondad, Colorado**

Dear Ms. Spray:

LT Environmental, Inc. (LTE) is pleased to provide the Colorado Oil and Gas Conservation Commission (COGCC) with this letter summarizing the results of the 20th methane seep survey conducted on September 23, 2010, at the Bondad Gas Seep Site (Site) located in Bondad, Colorado. This is the 12th survey since drilling and re-completion activities were conducted at the Bryce 1-X (API #05-067-09087) well between late July 2006 and early August 2006.

## BACKGROUND

At the request of the COGCC, LTE conducted an initial methane gas seep survey of the Site in response to an explosion of a residence located at 4034 US Highway 550 (the former Yoakum residence). The results of the initial soil gas survey are presented in the *Methane Seep Survey Report* (March 2005). Additional soil gas surveys were performed on the following dates:

April 19, 2005;

June 10, 2005;

November 1, 2005;

December 2, 2005;

January 30, 2006;

April 6, 2006;

June 28, 2006;

August 28, 2006;

September 21, 2006;

December 13, 2006;

April 20, 2007;

July 20, 2007;

September 24, 2007;

January 22, 2008;

May 13, 2008;

October 14, 2008;

February 3, 2009; and

July 28, 2009.

All project reports are available on the COGCC website at www.oil-gas.state.co.us.

LTE conducted a geophysical survey of the seep area in April 2005 which identified several areas suspected of containing buried structures with the potential to act as conduits for methane gas. Exploratory excavation activities were conducted in these suspect areas in August 2005 and the abandoned Bryce 1-X well was uncovered in the main gas seep area. In November 2005, LTE provided oversight during the excavation, inspection, and initial remediation of the Bryce 1-X well and sandstone bedrock surface. Reports summarizing the geophysical survey, exploratory excavation activities, and the Bryce 1-X well remediation activities are also available on the COGCC website.

## SITE DESCRIPTION

The Site is located in Bondad, Colorado, approximately 20 miles south of Durango, Colorado (Figure 1). The Site, located approximately 0.25 miles north of the confluence of the Animas River and the Florida River, consists of several tracts of land covering more than 100 acres. The surrounding land use consists of several residential properties, agricultural properties, a fire station, U.S. Highway 550, the Animas River to the west, and the Florida River to the east. The majority of the land in the area is privately owned.

## METHODOLOGY

### Methane Soil Gas Survey

On September 23, 2010, LTE was on site to conduct the 20$^{th}$ methane gas seep survey of the Site. The scope of the survey was similar to the previous surveys conducted at the Site. During the soil gas survey, tubing was lowered into each borehole and gas measurements were collected directly from the shallow surface soil approximately one foot below ground surface (bgs). LTE measured the concentration of methane, carbon monoxide, hydrogen sulfide, and oxygen at each sampling location.

LTE created a sampling grid to cover the mapping area systematically and to provide a means to delineate the extent of the gas seepage. LTE collected a soil gas measurement at the corners of each square in the grid. Each sample location was recorded using a Trimble GeoXT® global positioning system (GPS) instrument.

LTE measured the methane concentration in the soil around the exterior of the three houses in the mapping area and near the water wells associated with each of the structures. LTE also measured for methane outside of the fire station.

**Bryce 1-X Gas Sampling**

LTE collected three gas samples from the Bryce 1-X to determine the gas composition and isotopic composition of the gas venting from the surface casing, production casing, and production tubing of the well. Each of the three well vents were shut-in for 48 hours prior to the sampling event. The surface casing was sampled prior to blowing down the well. The surface casing was sampled by inserting a section of tubing into the surface casing vent and slowly opening the surface casing shut-off valve. No blow down pressure was observed for the surface casing. Blow down pressure for the production casing was observed for 6 seconds. The well was shut-in again for 24 hours after the blow down event. After the second shut-in period, LTE collected samples from the ball-valve attachments of the production casing and production tubing. There was no blow down pressure observed after the second shut-in period.

The samples were collected using CaliBond sample bags from Isotech Laboratories, Inc. (Isotech). All gas samples were packaged according to the Federal Department of Transportation (DOT) regulations with a completed chain-of-command (COC) form and submitted to Isotech in Champaign, Illinois. Gas samples were submitted for the following parameters:

- ***Fixed Gas Chromatography***: Hydrogen ($H_2$), Argon (Ar), Nitrogen ($N_2$), Oxygen ($O_2$), Carbon Dioxide ($CO_2$), and Hydrogen Sulfide ($H_2S$);
- ***Hydrocarbon Gas Chromatography***: Methane, Ethane, Propane, i-Butane, n-Butane, i-Pentane, and Hexane+; and
- ***Stable Isotopic Analysis***: Carbon and Hydrogen isotopes of Methane, Carbon isotopes of $CO_2$, and Carbon isotopes of Ethane and Propane.

**RESULTS**

**Methane Soil Gas Survey**

LTE personnel advanced a total of 64 subsurface probes across the Site. Results of this survey indicate that methane gas was not detected at any of the measurement locations. To ensure that equipment was working properly, the gas meter was tested once during the survey with a known concentration of methane calibration gas. The gas meter was not properly detecting known oxygen concentrations at the time of the soil gas survey. The gas meter was accurately detecting methane, carbon monoxide, and hydrogen sulfide as tested against the calibration mixture.

Methane was not detected around the residences or near the water wells associated with these structures. Methane was not detected outside of the fire station. Figure 1 shows all the methane survey locations monitored during the September 23, 2010 methane seep survey.

**Methane Seep Survey Comparison**

LTE has prepared a map illustrating the historical areal extent of methane seepage identified during previous gas survey events (Figure 2). Comparison of the September 23, 2010 data to the historical information indicates that methane is no longer present in the shallow soil of the primary seep area.

The table below presents the number of points reporting detectable concentrations of methane, the average methane concentrations, and the estimated size of the primary seep area during each of the soil gas survey events.

**Table 1. Primary Seep Area Size Comparison**

| Survey Date | Number of Survey Points With Methane | Estimated Seep Area (acres) | Average Subsurface Methane Concentration (%) |
|---|---|---|---|
| Feb-05 | 112 | 10.3 | 23 |
| Apr-05 | 45 | 10.6 | 33 |
| Jun-05 | 37 | 8.1 | 21 |
| Nov-05 | 45 | 8.8 | 32 |
| Dec-05 | 25 | 5.7 | 21 |
| Jan-06 | 31 | 7.3 | 10 |
| Apr-06 | 32 | 7.7 | 29 |
| Jun-06 | 23 | 5.7 | 25 |
| Aug-06 | 13 | 2.7 | 2 |
| Sep-06 | 13 | 2.4 | 3 |
| Dec-06 | 10 | 2.2 | 0.63 |
| Apr-07 | 14 | 3.1 | 0.96 |
| Jul-07 | 1 | 0.08 | 1 |
| Sep-07 | 0 | 0.0 | 0.0 |
| Jan-08 | 0 | 0.0 | 0.0 |
| May-08 | 0 | 0.0 | 0.0 |
| Oct-08 | 0 | 0.0 | 0.0 |
| Feb-09 | 0 | 0.0 | 0.0 |
| Jul-09 | 0 | 0.0 | 0.0 |
| Sept-10 | 0 | 0.0 | 0.0 |

**Bryce 1-X Gas Sampling**

LTE collected three gas samples from the Bryce 1-X to determine the gas composition and to measure the isotopic signature of the gas. Laboratory analytical results of this sampling event will be sent directly to the COGCC upon analysis. The standards laboratory turn-around time for this analysis is 25 to 30 business days.

## CONCLUSIONS AND RECOMMENDATIONS

The results of the September 23, 2010 survey indicate that the methane seepage at the ground surface is no longer present and has not been present since September 2007.

The primary methane seep appears to have been caused by gas migrating from the Fruitland Formation up the well bore of the Bryce 1-X well. The gas moved vertically upward along the well bore and then migrated laterally into permeable layers and aquifers of the Nacimiento Formation where the well casing was absent and/or structurally compromised. It appears that the plugging of the Bryce 1-X well has eliminated the gas seepage at the ground surface.

LTE appreciates the opportunity to provide environmental services to the COGCC. If you have any questions regarding this report or would like additional information, please contact us at (970) 385-1096.

Sincerely,

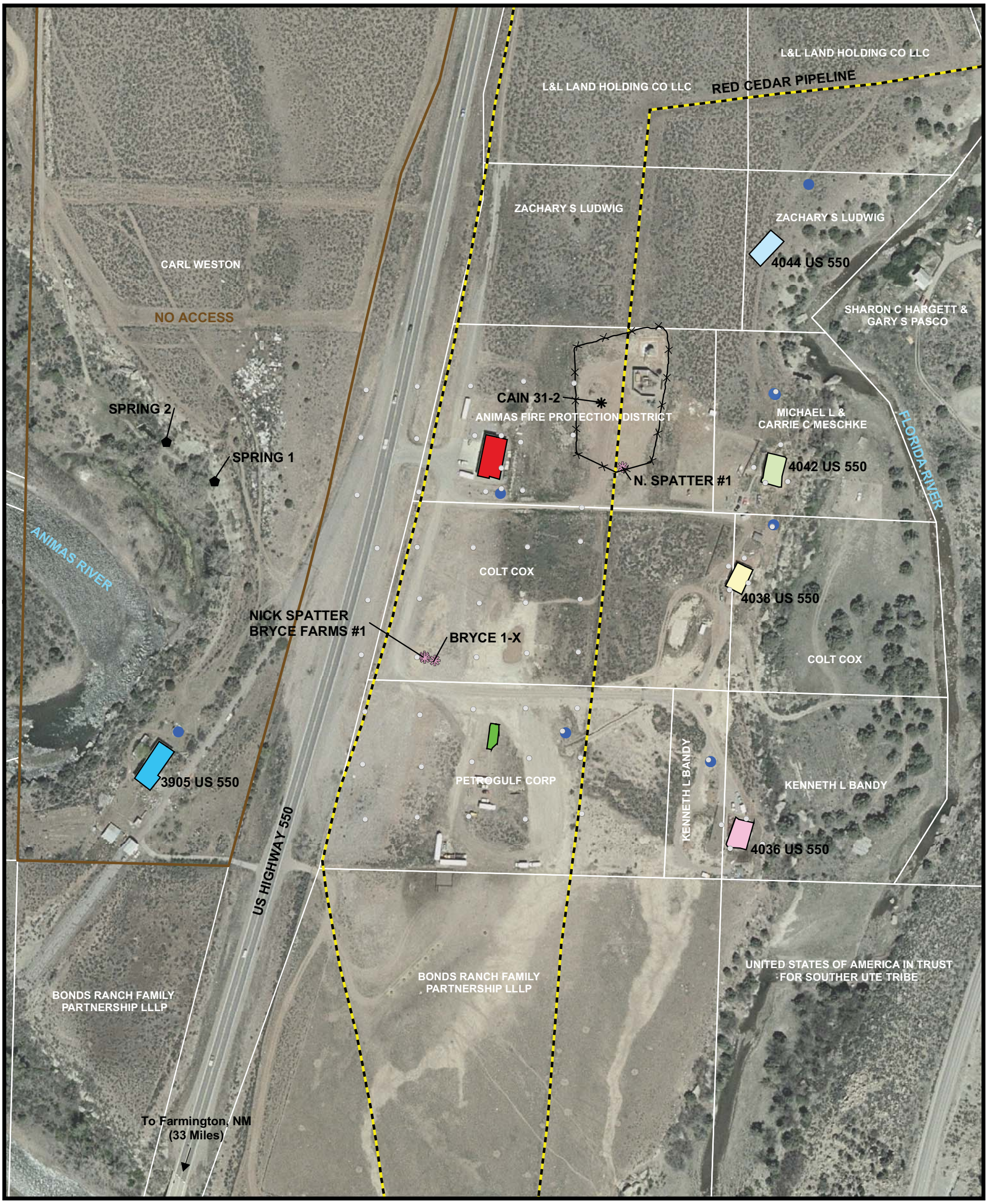
LT ENVIRONMENTAL, INC.

Travis Laverty
Staff Geologist

John D. Peterson, P.G.
Principal/Senior Geologist

Attachments

**FIGURES**




## LEGEND

- Water Supply Well
- Springs
- Gas Well
- Former Oil and Gas Well

Utilities

- Buried Gas Pipeline
- No Access

**Structures**

- Ludwig (former Williams) Residence
- Fire Station
- Meschke (former Wilson) Residence
- Cox (former Buddhue) Residence
- Bandy (former Grant) Residence
- Former Yoakum Residence
- Weston Residence

**Subsurface Methane Measurements**

- 0 - 500 parts per million (ppm)
- 501 ppm - 5%
- 6% - 15%
- 16% - 25%
- 26% - 50%
- 51% - 75%
- 75% - 100%

0 180 360
Feet

N

Landowner and Property Boundaries Labeled in White

FIGURE 1
SUBSURFACE METHANE MEASUREMENTS
SEPTEMBER 2010
BONDAD GAS SEEP
BONDAD, CO
COLORADO OIL AND GAS CONSERVATION COMMISSION

P:\COGCC Bondad\GIS\MXD\figure_1_NEW.mxd

L&L LAND HOLDING CO LLC
L&L LAND HOLDING CO LLC
ZACHARY S LUDWIG
ZACHARY S LUDWIG
4044 US 550
CARL WESTON
NO ACCESS
SHARON C HARGETT &
GARY S PASCO
CAIN 31-2
SPRING 2
ANIMAS FIRE PROTECTION DISTRICT
MICHAEL L &
CARRIE C MESCHKE
FLORIDA RIVER
SPRING 1
4042 US 550
N. SPATTER #1
ANIMAS RIVER
COLT COX
4038 US 550
NICK SPATTER
BRYCE FARMS #1
BRYCE 1-X
COLT COX
3905 US 550
PETROGULF CORP
KENNETH L BANDY
KENNETH L BANDY
US HIGHWAY 550
4036 US 550
BONDS RANCH FAMILY
PARTNERSHIP LLLP
BONDS RANCH FAMILY
PARTNERSHIP LLLP
UNITED STATES OF AMERICA IN TRUST
FOR SOUTHER UTE TRIBE
To Farmington, NM
(33 Miles)

**LEGEND**

**Extent of Methane Seepage**
- September 2010 - No Seep Detected
- July 2009 - No Seep Detected
- February 2009 - No Seep Detected
- October 2008 - No Seep Detected
- May 2008 - No Seep Detected
- January 2008 - No Seep Detected
- September 2007 - No Seep Detected
- July 2007
- April 2007
- September 2006
- April 2006
- November 2005
- April 2005

Landowner and Property Boundaries Labeled in White

- No Access

**Structures**
- Ludwig (former Williams) Residence
- Fire Station
- Meschke (former Wilson) Residence
- Cox (former Buddhue) Residence
- Bandy (former Grant) Residence
- Former Yoakum Residence
- Weston Residence

- Water Supply Well
- Springs
- Gas Well
- Former Oil and Gas Well

0 180 360
Feet

N

FIGURE 2
HISTORICAL SUBSURFACE METHANE MEASUREMENTS
APRIL 2005 - SEPTEMBER 2010
BONDAD GAS SEEP
BONDAD, CO
COLORADO OIL AND GAS CONSERVATION COMMISSION

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