October 10, 2005

Ms. Debbie Baldwin
Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, Colorado 80203

RE: Exploratory Excavation Summary
Bondad, Colorado

Dear Ms. Baldwin:

LT Environmental, Inc. (LTE) is pleased to provide the Colorado Oil and Gas Conservation Commission (COGCC) with this letter summarizing the results of the exploratory excavation activities recently completed in an effort to determine the source of the geophysical anomalies identified during a geophysical survey conducted at the Bondad Gas Seep (Site) in Bondad, Colorado.

BACKGROUND

The geophysical survey included magnetic and electromagnetic methods to identify potential subsurface wellheads in the seep area that may be acting as conduits for methane seep migration. The geophysical surveys were conducted at the Site during the week of April 18, 2005. The report was submitted to the COGCC on June 27, 2005.

In general, the results of the magnetic surveys identified the presence of six anomalies in the vicinity of the Nick Spatter-Bryce Farms #1 (NSBF#1) well. These areas are noted on the attached Site Map (Figure 1). Anomalies #1, #2, and #3 are located south and southeast of the NSBF#1 well. Anomalies #1 and #2 exhibit a relatively weak magnetic signal and are believed to be the steel anchors used to tie down a drilling mast, possibly used to drill the NSBF #1. Anomaly #3 exhibits a much stronger signal than #1 and #2 and has the potential to be an additional wellhead or other vertical metal feature. Anomalies #5 and #6 are in close proximity to the NSBF#1 and were determined to be near-surface anomalies using the EM61 equipment. A horizontally-shaped near-surface anomaly (Anomaly #4) was noted north of the former Yoakum residence. The anomalies are shown in green on Figure 1.

EXCAVATION FINDINGS

The exploratory excavation activities were conducted on August 17 and August 18, 2005. LTE utilized the data from the geophysical survey to identify the locations to be excavated. Using a track hoe excavator, LTE removed the unconsolidated sand and gravel alluvium in search of man-made conduits or potential pathways for the preferential migration of seeping methane gas. LTE supplied a health and safety technician to monitor the ambient air within the excavation for the presence of explosive vapors and to direct the excavation activities. LTE's technician also obtained photographic documentation of the excavation activities. Photographs are included in Attachment A.

The excavation findings have been organized based on the anomalies identified during the geophysical survey and described below. The sequence of the anomaly excavation was to excavate in the area of #5

and #6, then #4 (Yoakum residence), #3, and #2. Anomaly #1 was not excavated during this investigation. The extent of each excavation is depicted on Figure 1.

Anomalies #5 and #6

LTE began excavation activities at the area around the NSBF#1. Anomalies #5 and #6 are associated with the NSBF #1 and suspect "step-over" production wells that were reported to exist nearby. Upon unearthing of the NSBF #1 area (Anomaly #5), LTE identified the former production well and a "step-over" well. The wells were located side by side with surface casing diameters of 10 to 12 inches. The two well casings were observed to be touching each other. The area around the south side of the former production wells was excavated to a depth of approximately 12 feet below ground surface (bgs) to the bedrock surface. Concentrations of methane were detected within the excavation ranging from 3,500 parts per million (ppm: 0.35%) to 47,000 ppm (4.7%). While methane was detected within the excavation at elevated concentrations, no specific fracture or excessive gas seepage was noted adjacent to or within the plugged well casings.

Following inspection of the area around the NSBF #1 well, the excavation was trenched eastward approximately 19 feet toward Anomaly #6. Upon inspection, LTE identified the presence of an additional plugged and abandoned production well. Methane was detected within the excavation at concentrations ranging from 8,000 ppm (0.8%) to 240,000 ppm (24%). The area around the well was excavated to a depth of approximately 15 feet bgs. As was found near the NSBF#1, elevated methane concentrations were detected within the excavation and adjacent to the well casing but no specific fracture or leak near the casing of the well was noted.

Anomaly #4

Anomaly #4 exhibits a magnetic signature consistent with a buried pipeline. Based on existing information, no known pipelines were noted in this area. The significance of this pipeline is that it runs directly below the former Yoakum Residence in the area of the "vent" that was believed to have channeled seeping methane gas beneath the residence, ultimately fueling the explosion.

Prior to excavation of the area near the former Yoakum residence, LTE detected methane gas adjacent to the water spigot (located approximately 10 feet from the "vent") at a concentration of 980,000 ppm (98%). LTE excavated beneath the former Yoakum residence in the area of the "vent" to a depth of approximately eight feet bgs to the bedrock surface. Methane was detected in the excavation at concentrations ranging from non-detectable concentrations to 240,000 ppm (24%). The excavation consisted of two east-west trenches approximately 30 feet long aligned perpendicular to the north-south trending anomaly. LTE also excavated along the existing water electric service lines with no noticeable increase in methane seepage.

Based on the field observations within the area excavated, no buried pipeline or other preferential pathway or conduit was identified. It is assumed that the seeping gas identified following the explosion is migrating through fractures in the bedrock below the former residence. Fractures in the bedrock surface beneath the residence could not be observed during the excavation activities due to slough of the sand and gravel within the excavation.

Anomaly #3

LTE investigated Anomaly #3 located southeast of the NSBF #1 well location and west of the former Yoakum residence. The geophysical survey analysis suggests that this anomaly might be due to the presence of mast cable tie-down anchors in the subsurface used during the drilling of the NSBF #1. LTE excavated to a depth of approximately eight feet in this area but did not identify any subsurface structure, conduit, or preferential pathway for seeping methane gas. Small pieces of steel cable were noted nearby the excavation and may have been the source of the anomaly. Methane was detected within the excavations at concentrations ranging from 11,000 ppm (1.1%) to 50,000 ppm (5%).

Anomaly #2

LTE investigated Anomaly #2 located south of the NSBF #1 well location and northwest of the former Yoakum residence. The geophysical survey analysis suggests that this anomaly might be due to the presence of mast cable tie-down anchors in the subsurface used during the drilling of the NSBF #1. LTE excavated to a depth of approximately eight feet in this area but did not identify any subsurface structure, conduit, or preferential pathway for seeping methane gas. Methane was detected within the excavations at concentrations ranging from 10,000 ppm (1%) to 40,000 ppm (4%).

Backfill

Following the completion of excavation activities, LTE backfilled each area with the excavated sand and gravel, with the exception of the NSBF #1 area. LTE performed limited compaction of the backfill using the bucket of the excavator. Due to the presence of large cobbles and boulders, smooth surface completion was not possible.

At the NSBF #1 area, LTE was instructed by the COGCC to leave the upper surface casing of the three wells exposed for survey and re-inspection at a later date. LTE used the fill material to create a berm around the casings as a partial barrier for pedestrians. LTE also installed a sign adjacent to the wellhead that cautions people of the presence of flammable gas and to not bring open flame nearby.

CONCLUSIONS AND RECOMMENDATIONS

While the excavation activity did not encompass the entire seep area, it appears likely that no man-made preferential conduit exists beneath the former Yoakum residence. It appears that the seepage beneath the former Yoakum residence is a result of methane gas seeping through the sandstone bedrock.

As suspected following the soil gas surveys, field reconnaissance, geological data, historical information, the geophysical survey, and the recent exploratory excavations, it appears that the NSBF #1 well and associated “step-over” wells are the primary conduits for seeping methane gas. The data also supports LTE’s belief that methane gas may be trapped beneath the sandstone bedrock and migrating horizontally beneath the bedrock surface and vertically through fractures in the sandstone.

As stated in previous investigation reports prepared for this Site, LTE believes that the gas migrating vertically in and around the plugged and abandoned (PNAd) NSBF#1 is able to penetrate horizontally at different depths in the subsurface through layers of varying permeability.

LTE also believes that the sandstone layer beneath the surface gravel deposit may be acting as a vertical barrier resulting in the horizontal migration of methane gas. Fractures in the sandstone results in vertical seepage of the methane gas. It seems plausible that the bottom of the low permeability sandstone layer (relative to the overlying sand and gravel deposit) has trapped gas originating from the NSBF #1 well cluster conduit(s). The horizontal migration of methane gas from the NSBF#1 more than 600 feet to the north-northwest may be explained by methane gas trapped beneath the sandstone migrating up-dip, then vertically through fractures into the gravel layer and to the ground surface.

LTE recommends continued operation and maintenance (O&M) of the existing methane detection systems in the four houses and the fire station located within the project area. The monthly O&M will continue to be conducted by Standby Safety of Cortez, Colorado.

LTE also recommends continued soil gas surveys to monitor changes in methane seep activity over time. The surveys should be performed in a manner similar to the April 2005 survey using a grid pattern and including the areas around the residences and the area along the Animas River Valley.

If the COGCC is interested in evaluating the potential for the sandstone bedrock to be acting as a barrier for the vertical migration of seeping gas, LTE recommends the installation of a series of vent wells within the seep area that are sealed within the unconsolidated sand and gravel interval; penetrate the sandstone bedrock; and screened below the sandstone bedrock.

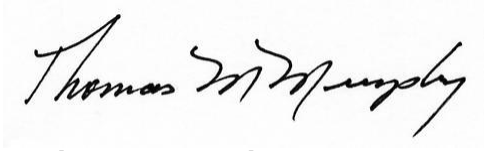
POTENTIAL MITIGATION MEASURES

LTE has conceptualized a potential mitigation method for the surface seep activity at the Bondad site. LTE believes that if a series of vent wells arranged around the former production wells were installed, it may vent the suspected trapped gas beneath the sandstone bedrock and reduce the lateral extent of surface methane seepage. While this method will not address continual seepage from the NSBF #1 cluster of wells, it may reduce the surface seepage and provide a reduced risk for the accumulation of explosive vapors in nearby structures. The vent wells should be installed to a depth of approximately 50 feet bgs and screened below the sandstone bedrock. Special attention to the grouting process though the sandstone bedrock would be required to increase the efficiency of the vents. In addition, it may be prudent to attach a blower for active vacuum rather than simply passively venting the gas. The recovered gas could be vented to the atmosphere; collected and transported for sale off site; or used to fuel the active blower system. An additional mitigation consideration may completed through institutional controls such as land purchase with use restrictions.

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 (303) 433-9788.

Sincerely,
LT ENVIRONMENTAL, INC.

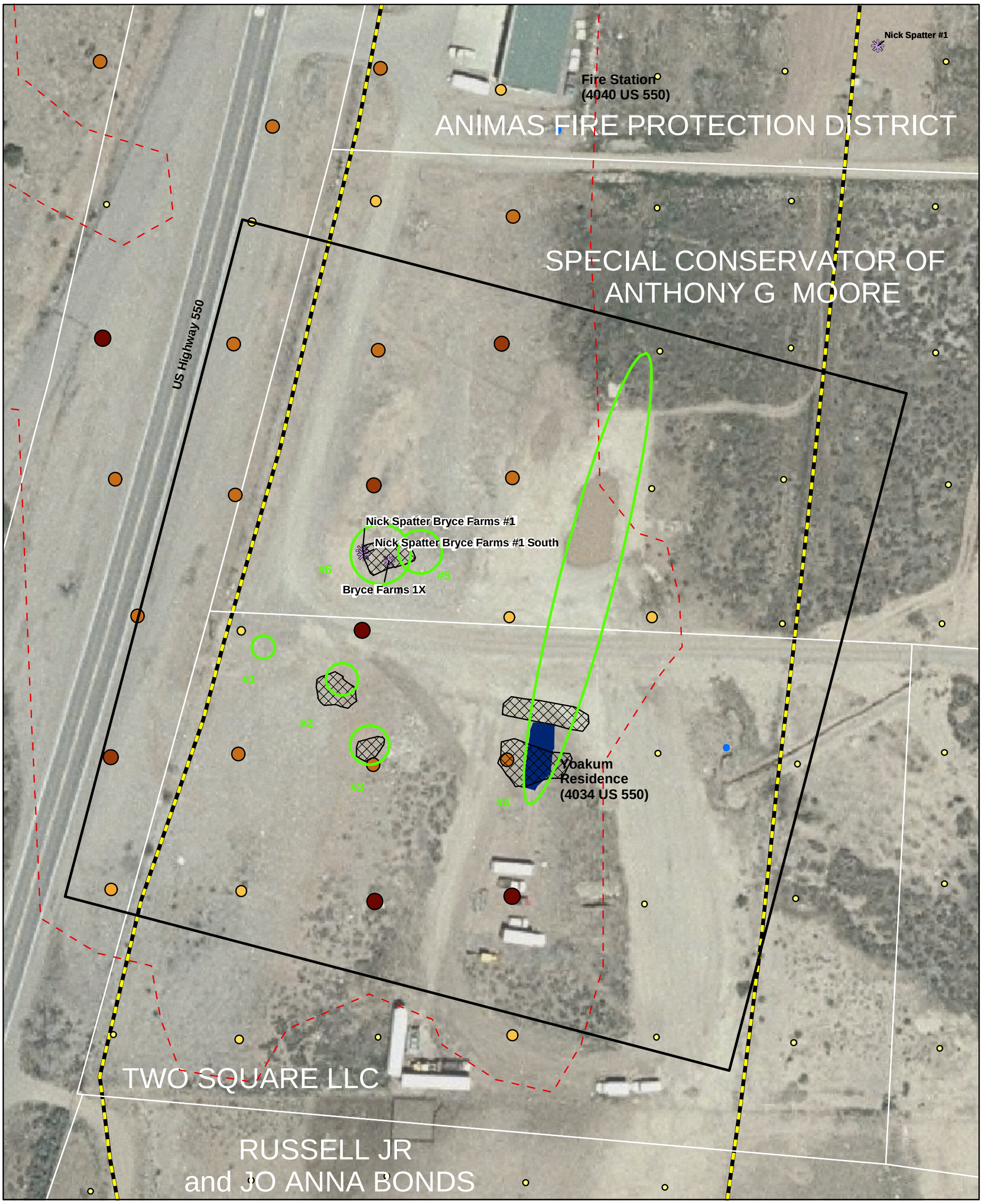
John D. Peterson, P.G.
Project Manager



Thomas M. Murphy, P.G.
Vice President

Attachments (2)

FIGURE



LEGEND

- Water Supply Well
- Gas Well
- Former Oil and Gas Well
- Yoakum Residence
- Geophysical Survey Area
- Geophysical Anomaly #1
- Extent of Methane Seepage April 19, 2005
- Extent of Excavation

Utilities
- Buried Gas Pipeline

Landowner and Property Boundaries Labeled in White

Subsurface Methane Gas
- 0 ppm
- 500 ppm - 5%
- 6% - 15%
- 16% - 25%
- 26% - 50%
- 51% - 75%
- 76% - 100%

N

0 140

Feet

1 INCH = 70 FEET

FIGURE 1
EXTENT OF EXCAVATIONS
AUGUST 2005
BONDAD GAS SEEP
BONDAD, CO

COLORADO OIL AND GAS CONSERVATION COMMISSION

Excavations 08/05

ATTACHMENT 1

EXCAVATION PHOTOGRAPHS

Photograph 1: NSBF #1 and “step-over” well, view north.

Photograph 2: Former production well east of NSBF #1, view east.

Photograph 3: Excavation at former Yoakum residence, view north.

Photograph 4: Excavation at Anomaly #3, view east.

Photograph 5: Excavation at Anomaly #2, view south.

Photograph 6: Former Yoakum residence area following backfill, view south.