

# Gasbuggy, New Mexico, Natural Gas and Produced Water Sampling and Analysis Results for 2012

December 2012

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**Gasbuggy, New Mexico, Natural Gas and Produced Water  
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## Map

Gas Sample Location

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## 1.0 Introduction

The U.S. Department of Energy (DOE) Office of Legacy Management conducted annual natural gas sampling for the Gasbuggy, New Mexico, Site on June 20 and 21, 2012. This long-term monitoring of natural gas includes samples of produced water from gas production wells that are located near the site. Water samples from gas production wells were analyzed for gamma-emitting radionuclides, gross alpha, gross beta, and tritium. Natural gas samples were analyzed for tritium and carbon-14. ALS Laboratory Group in Fort Collins, Colorado, analyzed water samples. Isotech Laboratories in Champaign, Illinois, analyzed natural gas samples.

## 2.0 Site Location and Background

The Gasbuggy site comprises 640 acres in Rio Arriba County, New Mexico, approximately 55 miles east of the city of Farmington and approximately 21 miles southwest of the town of Dulce, in the Carson National Forest (see Figure 1). As part of the Plowshare program, one underground nuclear detonation was conducted at the Gasbuggy site on December 10, 1967, in an effort to stimulate natural gas production in the gas-bearing Pictured Cliffs Formation. The detonation took place at a depth of 4,240 feet below ground surface, approximately 40 feet below the Pictured Cliffs Sandstone/Lewis Shale contact. The detonation had an estimated yield of 29 kilotons.

There are no wells, springs, surface water, or gas wells onsite. All sampling locations are off of the Gasbuggy site proper. Six offsite natural gas production wells were sampled during this event. Gas sample locations (see attached map) range from 1 mile to 1.7 miles from the emplacement hole, also known as surface ground zero (SGZ). All six of the gas wells sampled are perforated for gas production from the Pictured Cliffs Formation, the same formation targeted by the Gasbuggy test. One of the six gas wells is a horizontal completion within the Pictured Cliffs Formation and is indicated on the attached map as having a different bottom hole location than the well head location at the surface. The number of natural gas production wells that are sampled can vary from year to year, due to varying production schedules for the wells that may be dictated by current natural gas prices.

The U.S. Environmental Protection Agency performed water sampling at water wells, springs, and ponds in the Gasbuggy vicinity from the inception of the Hydrologic Monitoring Program in 1972 through 2007. DOE's Office of Legacy Management performed the hydrologic sampling at these locations in 2007, 2008, and 2009.

Results of the historical hydrologic monitoring at Gasbuggy have consistently shown that groundwater and surface water at the sample locations have not been impacted by radionuclides from the nuclear test. DOE evaluated the Hydrologic Monitoring Program and concluded that the water sample locations were too shallow and too far from SGZ to realistically be impacted by detonation-related contaminants (DOE 2009a). Therefore, annual hydrologic monitoring was no longer considered necessary, and the frequency of hydrologic monitoring was reduced to once every 5 years. The next hydrologic monitoring event is scheduled for 2014.

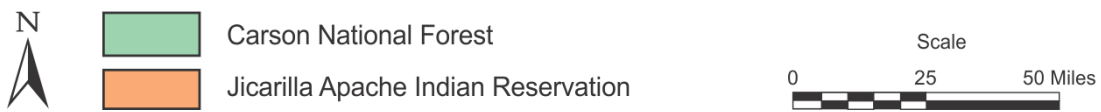
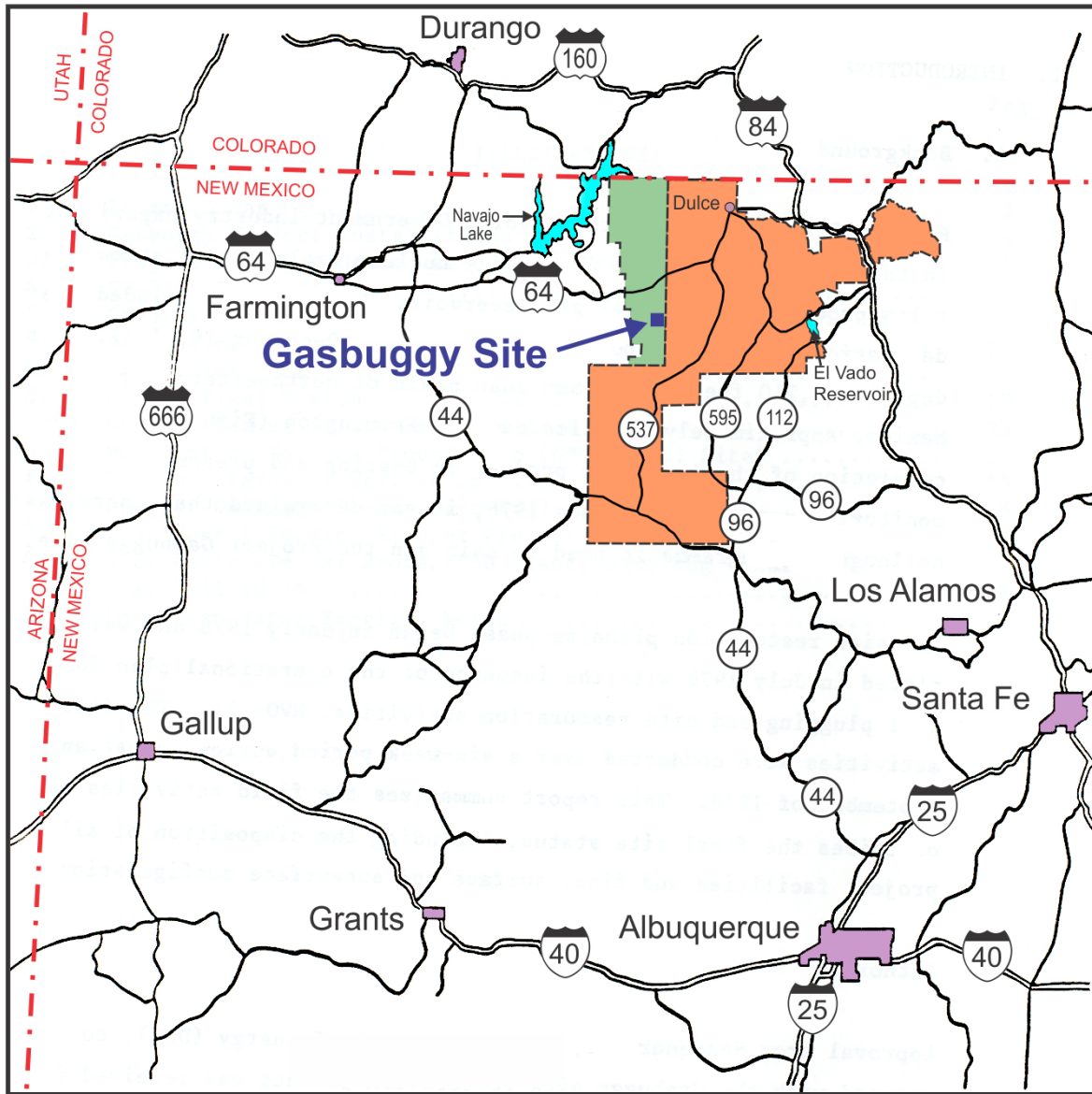


Figure 1. Gasbuggy Site Location Map



Sampling of natural gas and produced water from nearby producing gas wells was conducted for the first time during the 2009 sampling event. Nearby gas wells that are producing gas from the same formation affected by the Gasbuggy test represent a more plausible contaminant migration pathway. Therefore, DOE will sample natural gas production wells annually or as determined necessary. DOE will also sample new natural gas wells that are drilled in the vicinity of Gasbuggy. DOE has established notification agreements with the U.S. Bureau of Land Management and the U.S. Forest Service, whereby DOE will be notified of new gas well permitting activity in the area.

### 3.0 Sample Analytical Results

Analytical results from the June 20–21, 2012, sampling event are shown in Tables 1 and 2. Tritium, the most mobile detonation-related contaminant and consequently the contaminant of greatest concern to DOE, was not detected in any of the water or natural gas samples.

Low levels of gross beta activity were detected in samples of produced water from two of the natural gas production wells; one of the results was an estimated value.<sup>1</sup> The other well, Schalk 29-4 No. 007, had a gross beta activity level of 556 picocuries per liter (pCi/L). This well also had a gamma spectrometry result of 606 pCi/L from potassium-40. Similar results were obtained from this well during the 2011 sampling event (DOE 2011). Potassium-40 decays by beta emission along with a gamma ray and is likely the source of the gross beta activity detected in the well. Potassium-40 is a naturally occurring radioisotope that is not a byproduct of a nuclear detonation and, therefore, is not attributable to the Gasbuggy test.

The well identified as Valencia Canyon Unit No. 037 with the estimated value of 27.7 pCi/L for gross beta activity also had a gamma spectrometry estimated value of 18.1 pCi/L for actinium-228. Actinium-228 is a naturally occurring radioisotope that is part of the thorium-232 decay chain, and it decays by beta emission along with a gamma ray. It is likely that the gross beta activity detected in this well reflects actinium-228 decay. Actinium-228 is not a byproduct of a nuclear detonation and, therefore, is not attributable to the Gasbuggy test.

Gas wells Many Canyons 29–04–25 No. 123 and Schalk 29-4 No. 014 did not have any produced water for sample analyses at the time of sampling, which was also the case in 2011. Refer to Table 1 for produced water sample analytical results.

No tritium or carbon-14 was detected in the natural gas samples. Although tritium has never been detected, carbon-14 has been detected in low concentrations during past sampling events (DOE 2009b and DOE 2010). Refer to Table 2 for natural gas sample analytical results.

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<sup>1</sup> When a reported radionuclide concentration is less than three times the method detection limit, the result is considered an estimated value because of the high degree of uncertainty associated with very low measured concentrations.

Table 1. Gasbuggy Natural Gas Production Well Produced Water Sample Analysis Results

Sample Location (API #)	Collection Date	Tritium (pCi/L)	Gamma Spectrometry (pCi/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)
Indian A No. 002 (30-039-07525)	06/21/2012	ND	ND	ND	ND
Many Canyons 29-04-25 No. 123 (30-039-30161)	06/21/2012	NA	NA	NA	NA
Schalk 29-4 No. 007 (30-039-21620)	06/21/2012	ND	606	ND	556
Schalk 29-4 No. 014 (30-039-21744)	06/21/2012	NA	NA	NA	NA
Schalk 29-4 No. 017 (30-039-21743)	06/21/2012	ND	21.1 <sup>a</sup>	ND	ND
Valencia Canyon Unit No. 037 (30-039-21647)	06/20/2012	ND	18.1 <sup>a</sup>	ND	27.7 <sup>a</sup>

<sup>a</sup> Estimated value.

API = American Petroleum Institute

NA = not analyzed

ND = not detected

pCi/L = picocuries per liter

Table 2. Gasbuggy Natural Gas Production Well Gas Sample Analysis Results

Sample Location (API #)	Collection Date	Tritium (pCi/L) <sup>a</sup>	Carbon-14 (pCi/L)
Indian A No. 002 (30-039-07525)	06/21/2012	ND	ND
Many Canyons 29-04-25 No. 123 (30-039-30161)	06/21/2012	ND	ND
Schalk 29-4 No. 007 (30-039-21620)	06/21/2012	ND	ND
Schalk 29-4 No. 014 (30-039-21744)	06/21/2012	ND	ND
Schalk 29-4 No. 017 (30-039-21743)	06/21/2012	ND	ND
Valencia Canyon Unit No. 037 (30-039-21647)	06/20/2012	ND	ND

<sup>a</sup> All concentrations in this table are in picocuries per liter (pCi/L) of methane.

API = American Petroleum Institute

ND = not detected

pCi/L = picocuries per liter

## 4.0 Conclusions

Results from the sampling of natural gas and produced water from producing wells demonstrate that the gas wells nearest the Gasbuggy site are not currently impacted by detonation-related contaminants. Annual sampling of the gas production wells nearest the Gasbuggy site for gas and produced water will continue for the foreseeable future. The next hydrologic sampling event at water wells, springs, and ponds will be in 2014.

## 5.0 References

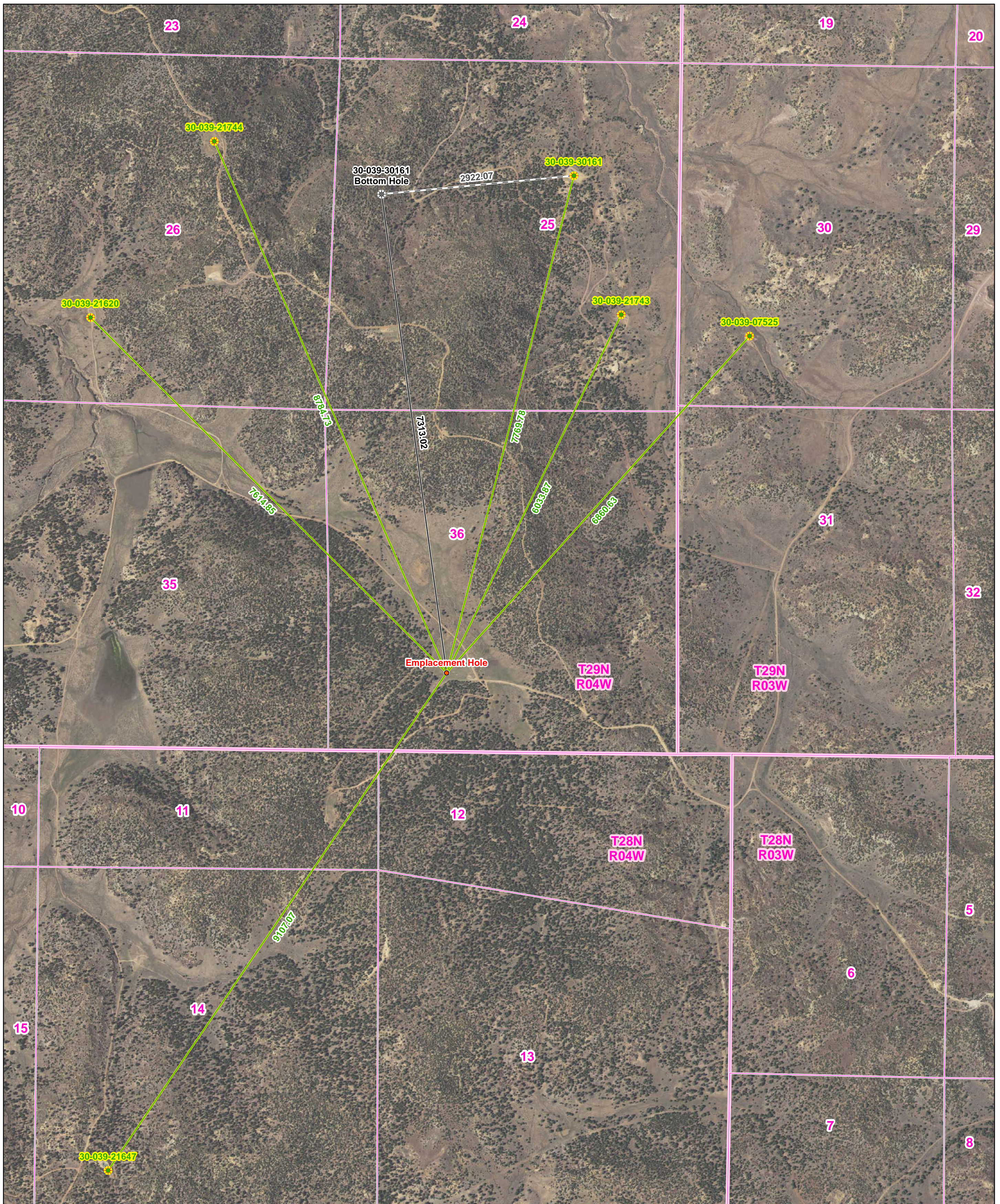
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**LEGEND**

- Natural Gas Well
- Natural Gas Well - Bottom Hole
- Emplacement Hole
- Emplacement Hole to Natural Gas Well (Feet)
- Emplacement Hole to Natural Gas Well - Bottom Hole (Feet)
- Natural Gas Well to Bottom Hole (Feet)



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Distances of Sampled Natural Gas Wells,  
and Bottom Hole Locations From Emplacement Hole  
Gasbuggy, NM, Site  
2012 Sampling Event

DATE PREPARED:

October 30, 2012

FILENAME:

S0944900