

Gasbuggy, New Mexico, Natural Gas and Produced Water Sampling and Analysis Results for 2011

September 2011

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Contents

1.0	Introduction	1
2.0	Site Location and Background	1
3.0	Sample Analytical Results	3
4.0	Conclusions	5
5.0	References	5

Figure

Figure 1.	Gasbuggy Site Location Map	2
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Tables

Table 1.	Gasbuggy Natural Gas Production Well Produced Water Sample Analysis Results	4
Table 2.	Gasbuggy Natural Gas Production Well Gas Sample Analysis Results.....	4

Map

Gas Sample Location

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1.0 Introduction

The U.S. Department of Energy (DOE) Office of Legacy Management conducted natural gas sampling for the Gasbuggy, New Mexico, site on June 7 and 8, 2011. Natural gas sampling consists of collecting both gas samples and samples of produced water from gas production wells. 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). 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 on site. All sampling locations are off of the Gasbuggy site proper. Six off-site 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 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.

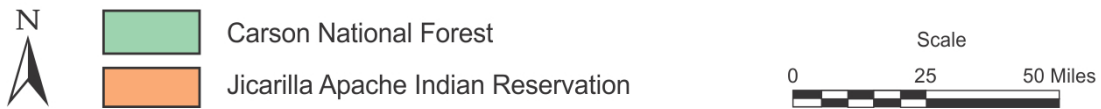
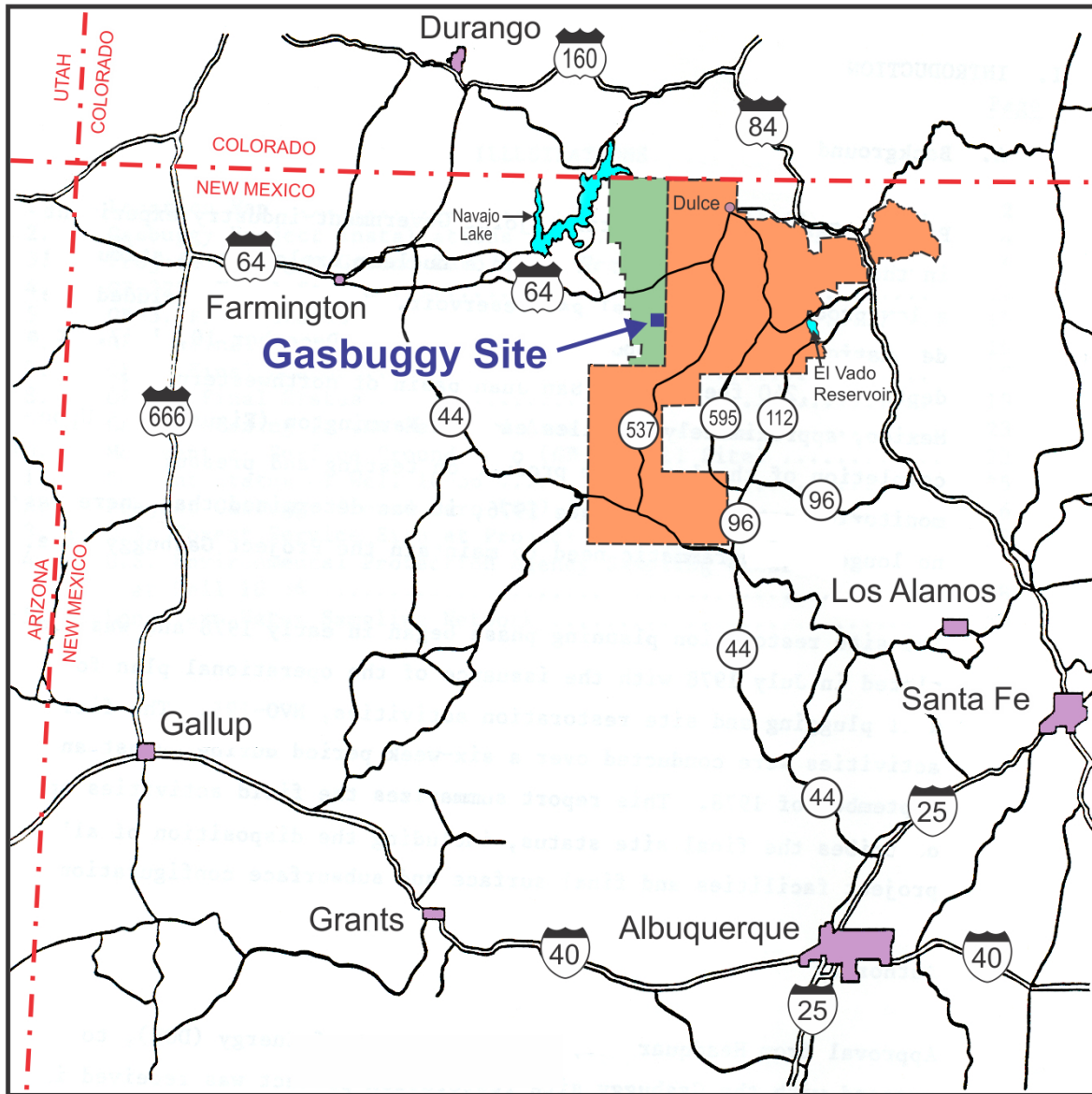


Figure 1. Gasbuggy Site Location Map

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.

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 7–8, 2011, 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 four of the natural gas production wells; three of the results were estimated values¹. The fourth well, Schalk 29-4 No. 007, had a gross beta activity level of 474 picocuries per liter (pCi/L). This well also had a gamma spectrometry result of 458 pCi/L from potassium-40. Potassium-40 decays by beta emission along with a gamma ray and is likely the source of most 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.

Produced water from well Indian A No. 002 had a gamma spectrometry result of 254 pCi/L. Thorium-234, actinium-228, and lead-212 all contributed to this result. Thorium-234 is a naturally occurring radioisotope that is part of the uranium-238 decay chain. Actinium-228 and lead-212 are naturally occurring radioisotopes that are part of the thorium-232 decay chain. None of these radioisotopes are byproducts of a nuclear detonation, and therefore, they are not attributable to the Gasbuggy test.

Produced water from one well also showed a low level (estimated value) of gross alpha activity. The low levels are representative of natural background radioactivity and do not indicate the presence of detonation-related radionuclides. 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. Refer to Table 1 for produced water sample analytical results.

¹ 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)	06/07/2011	ND	254	ND	69.6 ^a
Many Canyons 29-04-25 No. 123 (30-039-30161)	06/08/2011	NA	NA	NA	NA
Schalk 29-4 No. 007 (30-039-21620)	06/08/2011	ND	458	ND	474
Schalk 29-4 No. 014 (30-039-21744)	06/08/2011	NA	NA	NA	NA
Schalk 29-4 No. 017 (30-039-21743)	06/08/2011	ND	ND	14.9 ^a	23.3 ^a
Valencia Canyon Unit No. 037 (30-039-21647)	06/08/2011	ND	ND	ND	28.1 ^a

^a Estimated value.

API = American Petroleum Institute

pCi/L = picocuries per liter

ND = not detected

NA = not analyzed

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.

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

Sample Location (API #)	Collection Date	Tritium (pCi/L) ^a	Carbon-14 (pCi/L)
Indian A No. 002 (30-039-07525)	06/07/2011	ND	ND
Many Canyons 29-04-25 No. 123 (30-039-30161)	06/08/2011	ND	ND
Schalk 29-4 No. 007 (30-039-21620)	06/08/2011	ND	ND
Schalk 29-4 No. 014 (30-039-21744)	06/08/2011	ND	ND
Schalk 29-4 No. 017 (30-039-21743)	06/08/2011	ND	ND
Valencia Canyon Unit No. 037 (30-039-21647)	06/08/2011	ND	ND

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

API = American Petroleum Institute

pCi/L = picocuries per liter

ND = not detected

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.

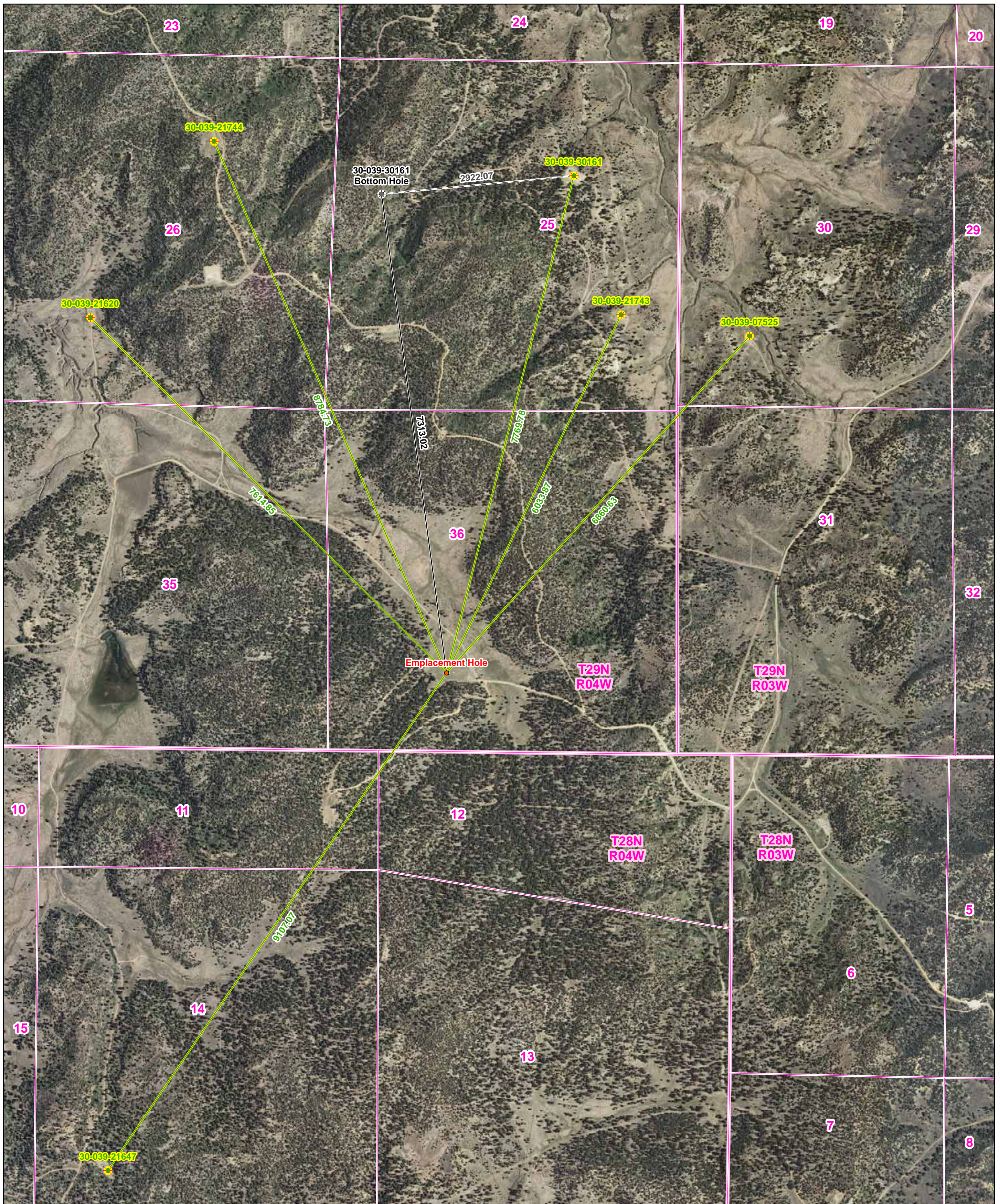
5.0 References

DOE (U.S. Department of Energy), 2009a. *Gasbuggy, New Mexico Long-Term Hydrologic Monitoring Program Evaluation Report*, LMS/GSB/S04019, Office of Legacy Management, Grand Junction, Colorado, June.

DOE (U.S. Department of Energy), 2009b. *Gasbuggy, New Mexico, Hydrologic and Natural Gas Sampling and Analysis Results for 2009*, LMS/GSB/S05869, Office of Legacy Management, Grand Junction, Colorado, November.

DOE (U.S. Department of Energy), 2010. *Gasbuggy, New Mexico, Hydrologic and Natural Gas Sampling and Analysis Results for 2010*, LMS/GSB/S07076, Office of Legacy Management, Grand Junction, Colorado, December.

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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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Work Performed by
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Distances of Sampled Natural Gas Wells,
and Bottom Hole Locations From Emplacement Hole
Gasbuggy, NM, Site
2011 Sampling Event

DATE PREPARED:
August 10, 2011

FILENAME:
S0805500