

Gasbuggy, New Mexico, Hydrologic and Natural Gas Sampling and Analysis Results for 2010

December 2010

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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 July 6 and 7, 2010. Additionally, a water sample was obtained at one well known as the 29-6 Water Hole, several miles west of the Gasbuggy site. 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. The one water well sample was analyzed for gamma-emitting radionuclides and tritium. 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.

Locations for this sampling event included one off-site water well and off-site natural gas production wells. There are no wells, springs, surface water, or gas wells on site. The water sample location was approximately 15 miles west from surface ground zero (SGZ). This particular well, known as the 29-6 Water Hole, is a significant water supply point for gas drilling operators in the area. Initial information suggested that the well might be completed in the Ojo Alamo Sandstone Formation. Subsequent information indicated that the well is most likely completed in the Nacimiento Formation. DOE was interested in sampling a downgradient well in the Ojo Alamo Formation; therefore, no further sampling of this well is planned.

Gas sample locations (see attached map) range from 1 mile to 1.7 miles from SGZ. All seven of the gas wells sampled are perforated for gas production from the Pictured Cliffs Formation, the same formation targeted by the Gasbuggy test. Two of the seven gas wells are horizontal completions within the Pictured Cliffs Formation and are indicated on the attached map as having different bottom hole locations 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.

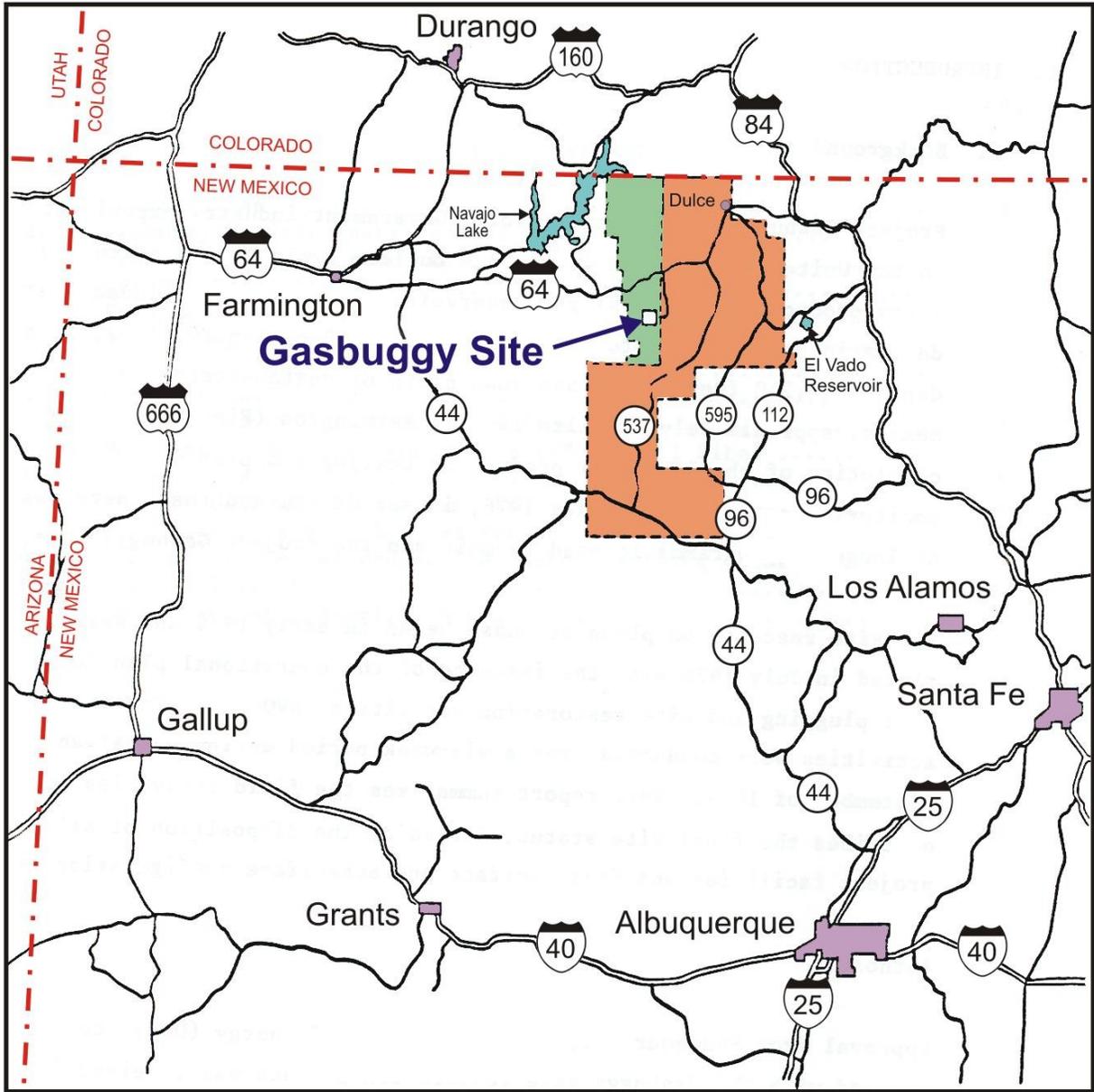


Figure 1. Gasbuggy Site Location Map

Results of the historical hydrologic monitoring at Gasbuggy have consistently shown that groundwater and surface water at the sample locations have not been affected 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 July 6–7, 2010, sampling event are shown in Tables 1, 2, and 3. Tritium, the most mobile detonation-related contaminant, was not detected in any of the water or natural gas samples. Table 1 shows the groundwater sample analytical results for the 29–6 water hole.

Table 1. Gasbuggy Hydrologic Sample Analysis Results

Sample Location	Collection Date	Tritium (pCi/L)	Gamma Spectroscopy (pCi/L)
29–6 Water Hole	07/07/2010	ND	ND

pCi/L = picocuries per liter

ND = result below laboratory method detection limit

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. Three of the four wells showing gross beta activity had similar concentrations during the 2009 sampling event (DOE 2009b). The fourth well did not show detectable gross beta activity in 2009. Produced water from one well also showed a low level (estimated value) of gross alpha activity. No wells showed gross alpha activity in 2009. The low levels are representative of natural background radioactivity and do not indicate the presence of detonation-related radionuclides. Gas well Indian A No. 002 did not have sufficient produced water to support the gamma spectroscopy analysis. Gas well Many Canyons 29–04–25 No. 123 did not have any produced water for sample analyses because the well was shut in at the time of sampling. Refer to Table 2 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 2. Gasbuggy Natural Gas Production Well Produced Water Sample Analysis Results

Sample Location (API #)	Collection Date	Tritium (pCi/L)	Gamma Spectroscopy (pCi/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)
Indian A No. 002 (30-039-07525)	07/06/2010	ND	NA	ND	ND
Many Canyons 29-04-25 No. 123 (30-039-30161)	07/07/2010	NA	NA	NA	NA
Many Canyons 29-04-26 No. 133 (30-039-29988)	07/07/2010	ND	ND	ND	43.5 ^a
Schalk 29-4 No. 007 (30-039-21620)	07/07/2010	ND	ND	4.89 ^a	41.0
Schalk 29-4 No. 014 (30-039-21744)	07/07/2010	ND	ND	ND	ND
Schalk 29-4 No. 017 (30-039-21743)	07/07/2010	ND	ND	ND	24.2 ^a
Valencia Canyon Unit No. 037 (30-039-21647)	07/07/2010	ND	ND	ND	38.9 ^a

^aEstimated value.

pCi/L = picocuries per liter

ND = result below laboratory method detection limit

NA = not analyzed

A low concentration of carbon-14 was detected in one of the natural gas samples. In 2009, four of the gas samples showed detectable carbon-14 concentrations. None of the four wells showing carbon-14 in 2009 had detectable carbon-14 during the 2010 sampling event. The detected carbon-14 is most likely attributed to the evaporation of water introduced to the formation during drilling or the well development process. For comparison, carbon-14 concentrations measured in the gas produced from the Gasbuggy chimney after the detonation (Tewes 1979) were on the order of 1,000 picocuries per liter, five orders of magnitude greater than the currently detected concentrations. This indicates that the carbon-14 detected in neighboring gas wells is not associated with the detonation. Refer to Table 3 for natural gas sample analytical results.

Table 3. Gasbuggy Natural Gas Production Well Gas Sample Analysis Results

Sample Location (API #)	Collection Date	Tritium (pCi/L)	Carbon-14 (pCi/L)
Indian A No. 002 (30-039-07525)	07/06/2010	ND	ND
Many Canyons 29-04-25 No. 123 (30-039-30161)	07/07/2010	ND	ND
Many Canyons 29-04-26 No. 133 (30-039-29988)	07/07/2010	ND	ND
Schalk 29-4 No. 007 (30-039-21620)	07/07/2010	ND	0.03
Schalk 29-4 No. 014 (30-039-21744)	07/07/2010	ND	ND
Schalk 29-4 No. 017 (30-039-21743)	07/07/2010	ND	ND
Valencia Canyon Unit No. 037 (30-039-21647)	07/07/2010	ND	ND

ND = result below laboratory method detection limit

Concentrations are in picocuries per liter (pCi/L) of methane.

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, CO, 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, CO, November.

Tewes, Howard A., 1979. *Survey of Gas Quality Results from Three Gas-Well-Stimulation Experiments by Nuclear Explosions*, Lawrence Livermore Laboratory, UCRL-52656, January 23.

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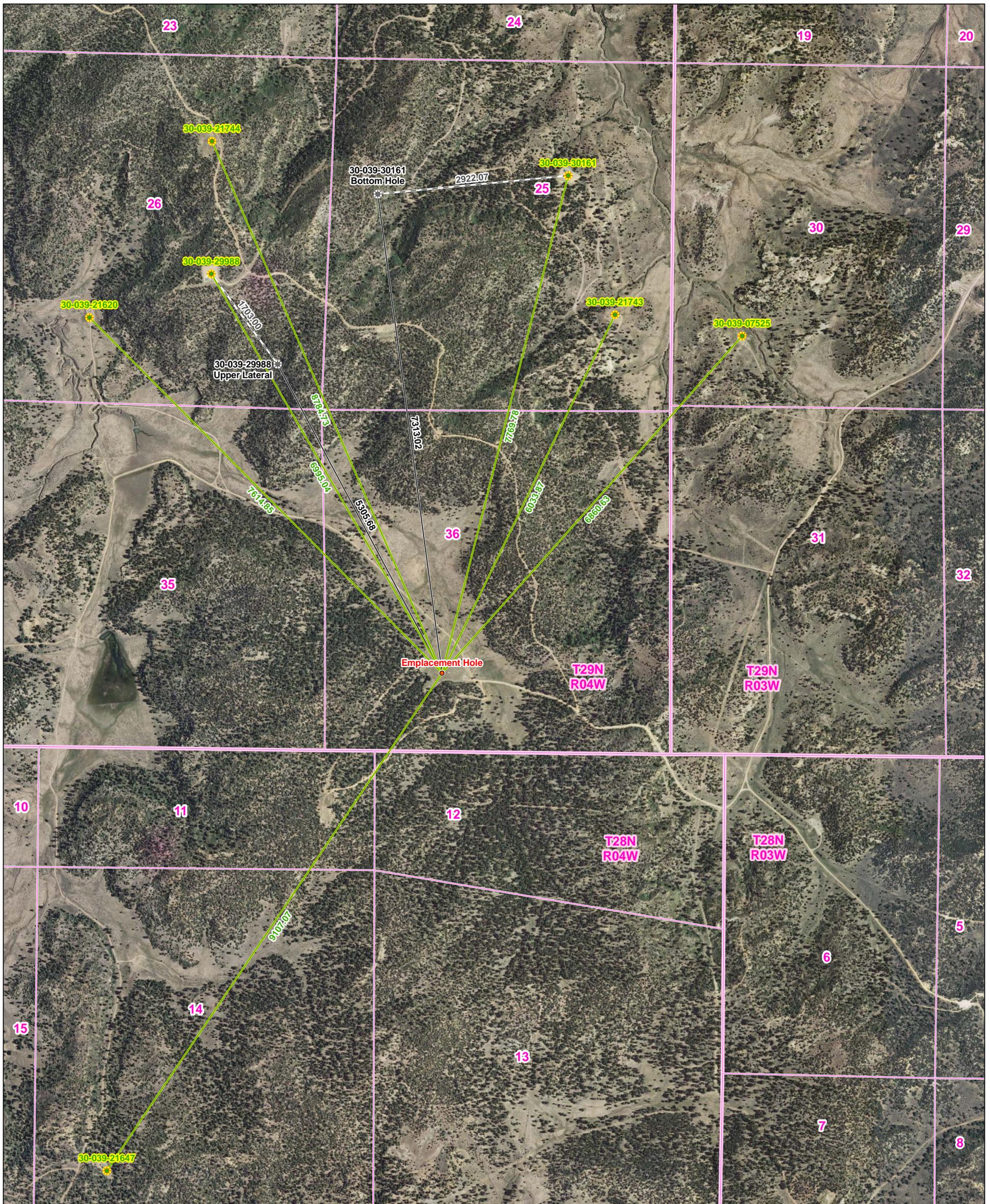
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LEGEND

- 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
Gasbuggy, NM, Site
2010 Sampling Event

DATE PREPARED:
October 4, 2010

FILENAME:
S0707700