Recovery Act: Sub-Soil Gas and Fluid Inclusion Exploration and Slim Well Drilling, Pumpernickel Valley, Nevada

Final Scientific/Technical Report

United States Department of Energy – Geothermal Technologies Program
Award DE-EE0002834

Nevada Geothermal Power Company

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March 10, 2015

Executive Summary

Nevada Geothermal Power Company (NGP) was awarded DOE Award DE-EE0002834 in January 2010 to conduct sub-soil gas and fluid inclusion studies and slim well drilling at its Black Warrior Project (now known as North Valley) in Washoe and Churchill Counties, Nevada. The project was designed to apply highly detailed, precise, low-cost subsoil and down-hole gas geochemistry methods from the oil and gas industry to identify upflow zone drilling targets in an undeveloped geothermal prospect.

NGP ran into multiple institutional barriers with the Black Warrior project relating to property access and extensive cultural survey requirement. NGP requested that the award be transferred to NGP's Pumpernickel Valley project, due to the timing delay in obtaining permits, along with additional over-budget costs required.

Project planning and permit applications were developed for both the original Black Warrior location and at Pumpernickel. This included obtaining proposals from contractors able to conduct required environmental and cultural surveying, designing the two-meter probe survey methodology and locations, and submitting Notices of Intent and liaising with the Bureau of Land Management to have the two-meter probe work approved.

The award had an expiry date of April 30, 2013; however, due to the initial project delays at Black Warrior, and the move of the project from Black Warrior to Pumpernickel, NGP requested that the award deadline be extended. DOE was amenable to this, and worked with NGP to extend the deadline. However, following the loss of the Blue Mountain geothermal power plant in Nevada, NGP's board of directors changed the company's mandate to one of cash preservation. NGP was unable to move forward with field work on the Pumpernickel property, or any of its other properties, until additional funding was secured. NGP worked to bring in a project partner to form a joint venture on the property, or to buy the property. This was unsuccessful, and NGP notified the DOE on February 13, 2014 that it would not be able to complete the project objectives before the recovery act awards deadline and submitted a mutual termination request to the DOE which was accepted.

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Black Warrior Project

Nevada Geothermal Power Company (NGP) was awarded DOE Award DE-EE0002834 in January 2010 to conduct sub-soil gas and fluid inclusion studies and slim well drilling at its Black Warrior Project (now known as North Valley) in Washoe and Churchill Counties, Nevada (Figure 2). This project was designed to apply highly detailed, precise, low-cost subsoil and down-hole gas geochemistry methods from the oil and gas industry to identify upflow zone drilling targets in an undeveloped geothermal prospect. A Notice of Intent (NOI) was submitted to the Bureau of Land Management (BLM) for the two-meter probe survey in April 2010. The survey plan was as minimally invasive as possible. An all-terrain vehicle with a hammer drill and multiple steel probes approximately 2 meters in length, a generator, and two personnel was all that was required (Figure 1). The soil-gas survey involved hammering a two-meter probe to its full depth, and then removing it, leaving the hole open. A soil-gas carbon absorber would then be placed in the hole and left to collect gases for approximately 2 weeks. A return to the site was necessary to collect the absorber and collect the one-time, instant sample of air from the bottom of the bore-hole. Once sampling was completed, the hole would be reclaimed. Each hole, having only a diameter of about one inch, would have monitoring materials removed, dirt pushed back into the hole, and the ground immediately surrounding the hole returned as closely as possible to its previous condition. Existing roads would be used wherever possible to perform the probe work, and NGP estimated a total surface occupancy of ~40 acres, though the physical disturbance would be minimal.

Figure 1. 2 meter probe set up

The BLM required a broad and expensive block cultural resources survey be completed prior to the start of soil gas survey. The cultural resource field survey of the lands to be traversed for the soil-gas survey was quoted at between $135,000 and $150,000 (not including an ethnographic study). NGP decided to revise the plan and submitted a new map and project description changing from a scatter pattern (Figure 3) to linear transects (Figure 4), greatly reducing lands to be traversed and thus, the survey area. The new NOI was submitted in July 2010, reducing the area of surface occupancy to ~20 acres, again with minimal physical disturbance.

The Pyramid Lake Paiute Tribe, which has ancestral lands and a large reservation to the west of the project area, has designated Black Warrior Peak as a Traditional Cultural Property. NGP met with the group to provide project details and receive feedback. However, early NGP negotiations with the Tribe to gain access through their lands from the west to the project area (a shorter route) were not successful. The BLM's archeologist suggested that we drop the west side (which is closest to Black Warrior Peak) from the soil-gas survey. The BLM has permitting authority over access to the Black Warrior site from the east. The 22 mile dirt road to the site passes through checker-boarded private and BLM lands, and operations on NGP's BLM leases there are subject to BLM permitting. NGP ultimately did receive a right-of-way to access the site in July 2011; the survey work was not included in the DOE budget and was not billed to the DOE.

By August 2010, after multiple revisions to the NOI for the soil gas survey, NGP determined that the Black Warrior DOE program was unsuitable for timely completion and requested that the award be moved to NGP's Pumpernickel Valley project area for completion. This process involved reworking project budgets, spending plans, and modifications to the award. A presentation detailing the new site characteristics and reasons for the transfer request was made on March 29, 2011 to DOE and Technical Management Team members in response to this request. The project move to Pumpernickel was approved in April 2011. NGP incurred and billed to the DOE, $30,983 for personnel and overhead (indirect rate charge, approved by the DOE) during this period.

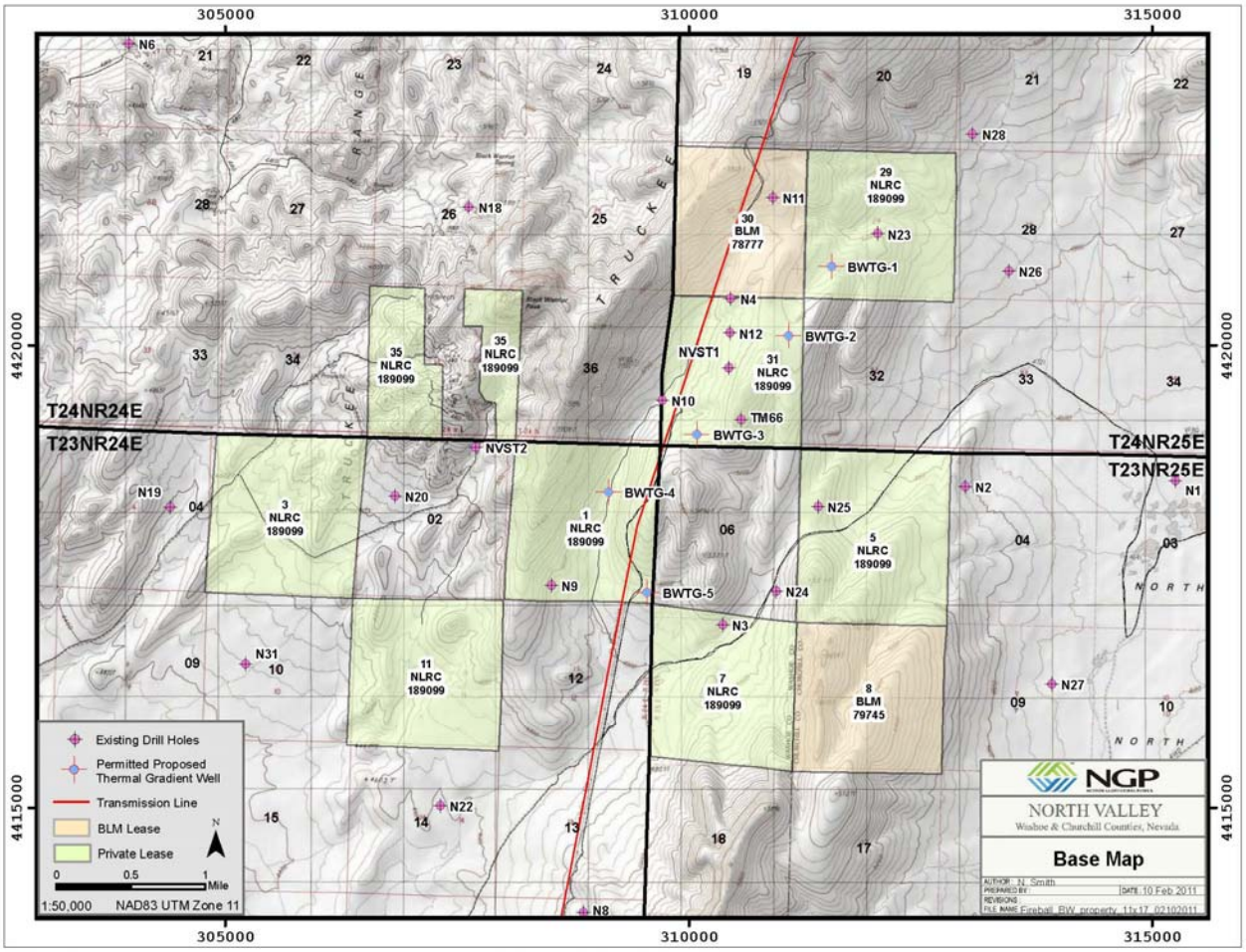

Figure 2. Black Warrior (aka North Valley) Project Area

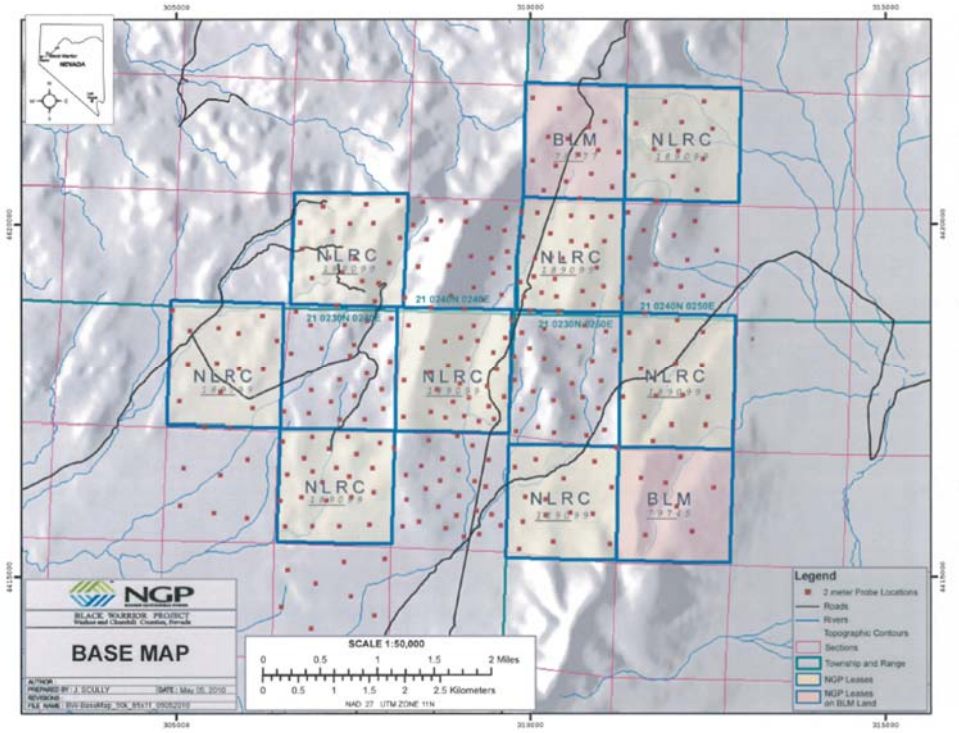

Figure 3. Initial 2m probe survey design

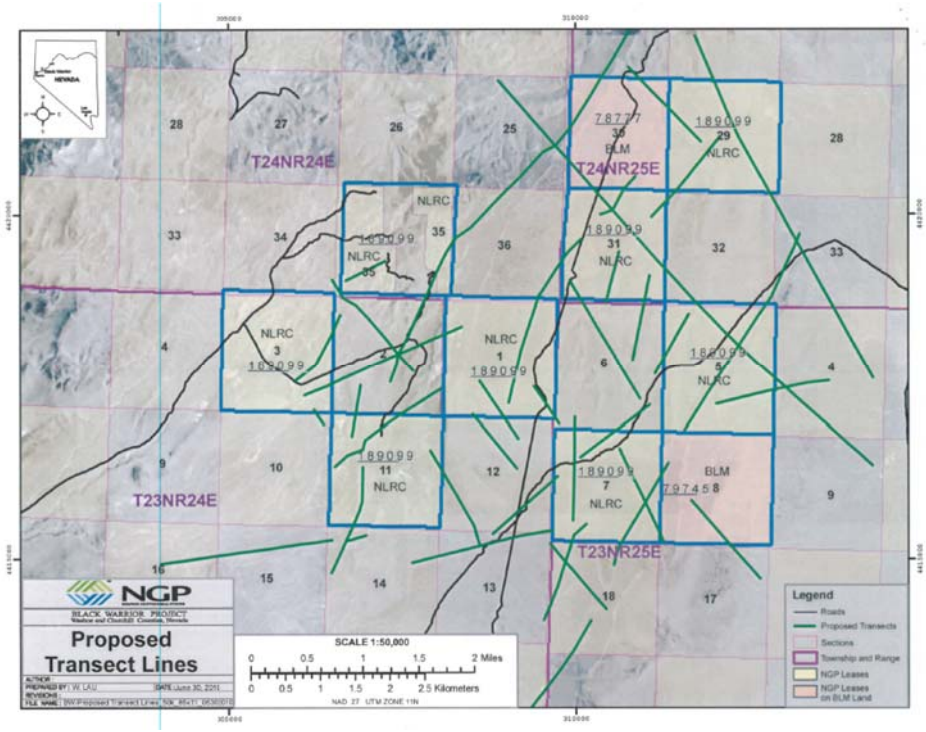

Figure 4. Revised 2m probe survey design

Pumpernickel Project

The Pumpernickel Valley site is located in north-central Nevada, approximately 17 miles southeast of Winnemucca (Figure 5). Unlike the Black Warrior prospect, Pumpernickel is accessible by well-maintained county dirt roads over a distance of approximately eight miles from their intersection with Interstate 80. In addition, numerous pre-existing spur roads, including two-tracks, diverge from or cross the major roads which would aid in accessing probe site with minimal disruption of existing vegetative and soil conditions. Pumpernickel also has ready access to water for field operations and drilling.

The Pumpernickel project area has been the subject of previous intermittent interest in geothermal exploration. Efforts have included the drilling of a several hundred foot deep exploration well by the original Magma Energy in the 1970s, a soil radon gas survey in 2005, drilling of seven temperature gradient (TG) holes, a resistivity study, a gravity survey, seismic reflection survey, and a two-meter depth temperature survey conducted by NGP. Figure 6 shows the project area and thermal gradient wells drilled by NGP prior to receiving the DOE award.

The first task in the award Statement of Project Objectives for Pumpernickel was to perform a cultural resources and biological survey, which was required by the BLM prior to commencing any subsoil gas studies on the property. Panorama Environmental Inc. was selected to conduct this work, and a proposed scope of work was submitted to the BLM for initial review. The project experienced a delay due in part to the inability to mobilize survey contractors to the site during the appropriate seasonal window. Unless the survey design was modified to avoid all off-road areas, the soil-gas survey could not be completed without a cultural survey, despite that the planned survey would entail less than a one inch hole per 4 to 10 acres. Nevada BLM has an agreement with the State Historic Preservation Office that disturbance of one square meter (cumulatively) will require a cultural survey.

While waiting for the survey crew to mobilize, NGP's senior project geologist did additional planning and preparation with W.L. Gore & Associates for the subsoil gas sampling. Plans for Pumpernickel included the ATV mounted drilling rig drilling roughly 300 probe holes in the 10 square mile prospect area. Gore Sorber gas sample packages would be placed in each hole for 17 days. Upon return to each sample hole the Gore Sorber would be retrieved and then the gases in the hole will be sampled for gas chromatographic and helium isotope analyses. The Sorbers, gas samples, and isotope samples would be sent to laboratories for analysis. One of the key issues in this work was to control sampling and analyses errors. Consequently a program of duplicate and blank samples was designed. Chemical results would first be reviewed for noise and errors. Once the data had been validated, the results would be run through Gore Corporation statistical finger print analysis. The processing results would allow the geochemical data to show multivariable similarity to a geothermal process model assembled from hydrocarbon geothermometers, high temperature geothermal system gas signatures or to groups of stations selected based on high temperatures measured in the probe holes, gas

chromatography, or isotopic results. A total of $40,966 was paid by the DOE for costs relating to the planning and preparation for cultural and biological and the two meter gas probe surveys.

The award had an expiry date of April 30, 2013; however, due to the initial project delays at Black Warrior, and the move of the project from Black Warrior to Pumpernickel, NGP requested that the award deadline be extended. DOE was amenable to this, and worked with NGP to extend the deadline. However, following the loss of the Blue Mountain geothermal power plant in Nevada, NGP's board of directors changed the company's mandate to one of cash preservation. NGP was unable to move forward with field work on the PV property, or any of its other properties, until additional funding was secured. NGP worked to bring in a project partner to form a joint venture on the property, or to buy the property. This was unsuccessful as of the expiration of the award. NGP notified the DOE on February 13, 2014 that it would not be able to complete the project objectives before the recovery act awards deadline and submitted a mutual termination request to the DOE which was accepted.

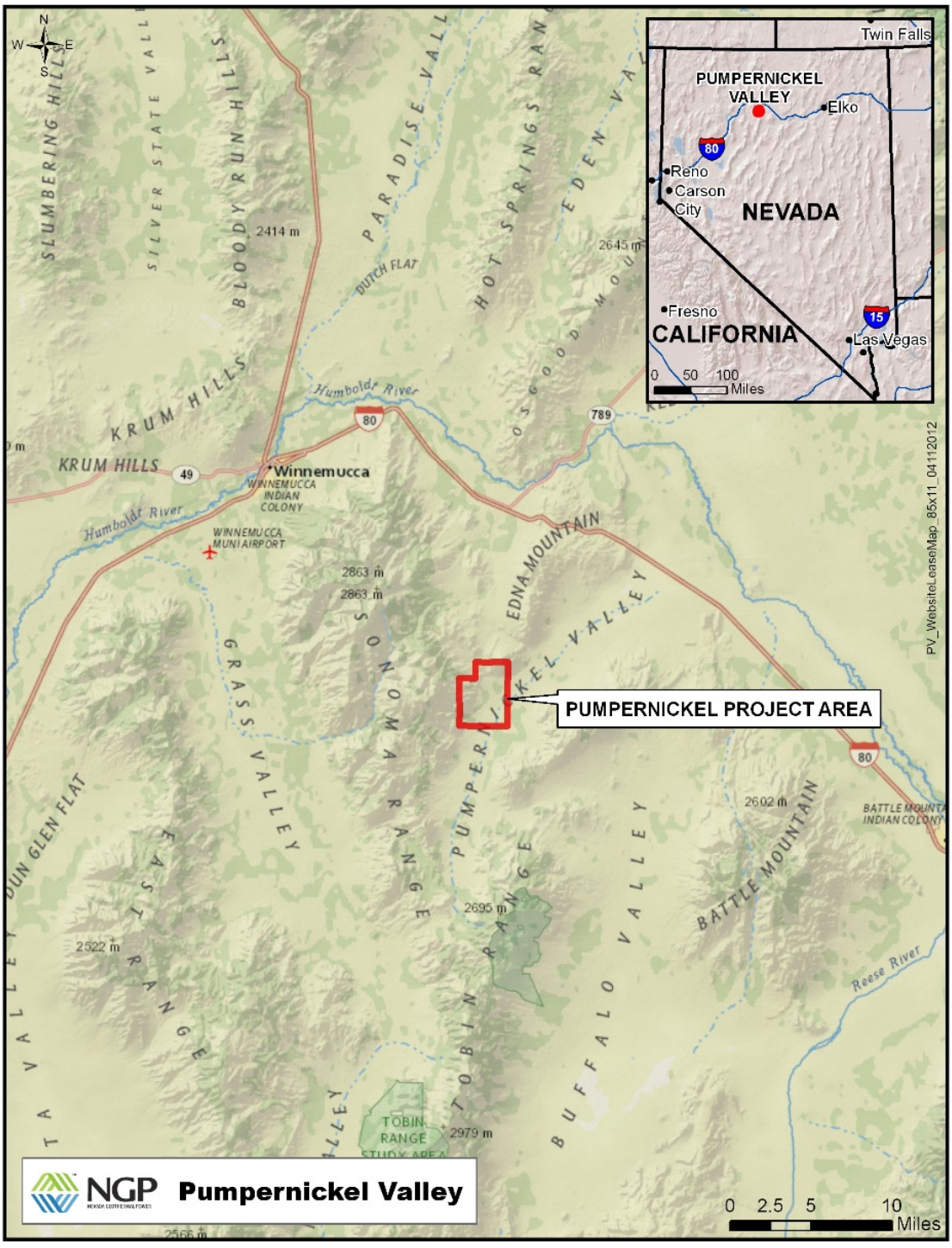

Figure 5. Pumpernickel Project Area

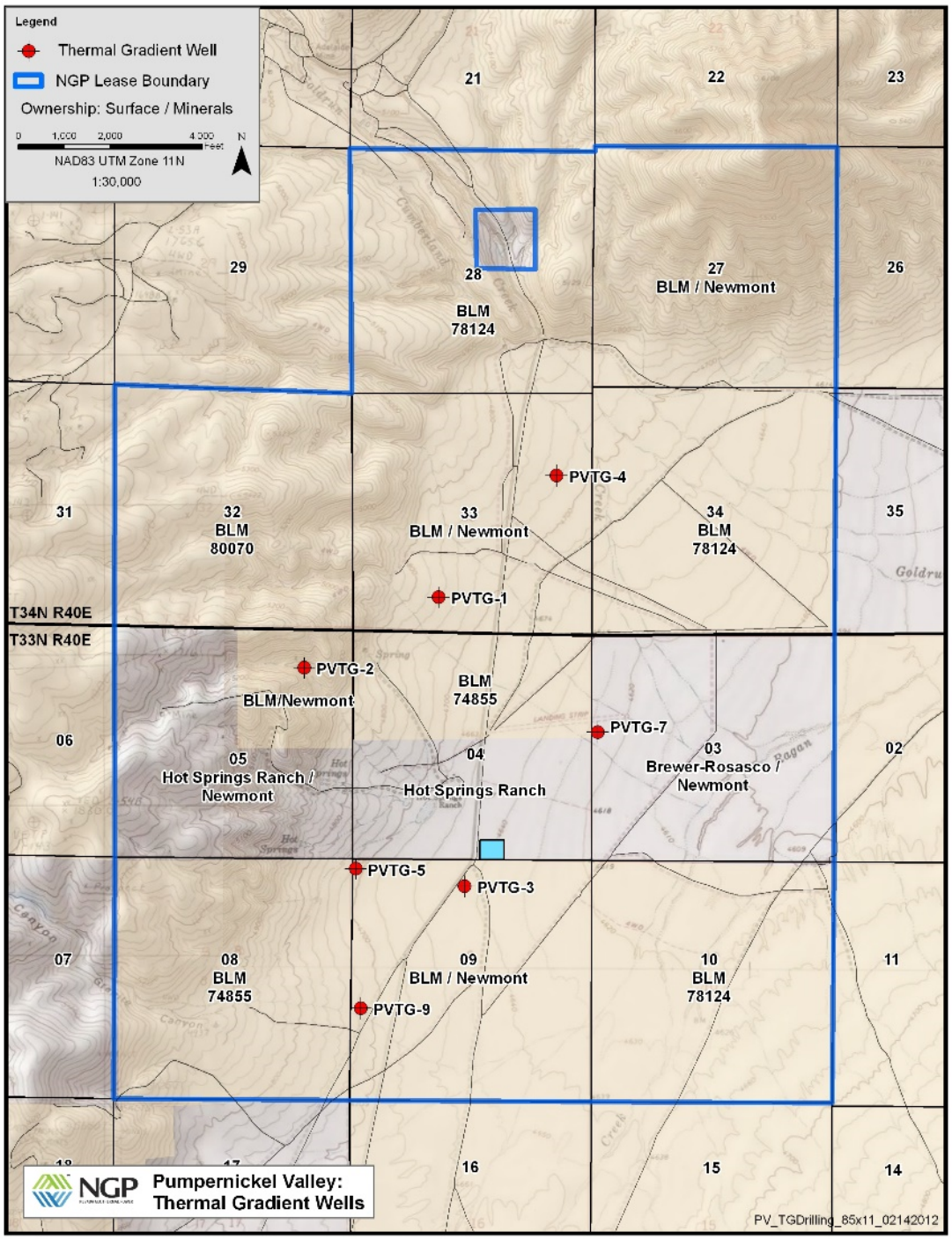

Figure 6. Pumpernickel Project Area with Thermal Gradient Wells