WELL SITING ASSESSMENT FOR SUPPLEMENTAL WELL, LA MESA WATER COOPERATIVE ASSOCIATION, PLACITAS, NEW MEXICO

– Well #3

by

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Placitas, New Mexico

November 1996

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(follow text)

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INTRODUCTION

John Shomaker & Associates, Inc. (JSAI) performed a well siting study for the La Mesa Water Cooperative Association (La Mesa) supplemental well RG-49802-S-2. Four sites available to La Mesa for the supplemental well were assessed. The assessment included reviewing selected well records from the New Mexico State Engineer Office (SEO), published and unpublished geologic and hydrogeologic reports, water-quality data related to arsenic concentrations in ground water in the Santa Fe Formation aquifer near the proposed well locations, and to simulate the ground-water decline effects of an additional community water-supply well.

The four sites assessed for the supplemental well include the park in the La Mesa Subdivision (Park site), the north corner of lot 6-C in the La Mesa Subdivision (Morgan site), and lots 104 and 105 in the Sundance Subdivision (Sundance site). Lots 104 and 105 in the Sundance Subdivision were assessed as a single site because they adjoin each other and no known hydrogeologic boundaries are present between the two lots.

HYDROGEOLOGY

The geology and the hydrogeology of the area have been described by Kelley and Northrop (1975), Kelley (1977), Hawley et al. (1982), and by JSAI (Shomaker, 1987, and Newcomer, 1993). Each of the proposed sites are underlain by the Tertiary-age Santa Fe Formation, which is the principal aquifer in the Albuquerque Basin. The Santa Fe Formation thins to the south and east and is absent about 1 mile southeast and about 4.5 miles east of the La Mesa Subdivision. The Santa Fe Formation thickens west of La Mesa Subdivision and ranges up to 5,000 feet thick. The saturated portion of the Santa Fe Formation beneath the Park site probably exceeds 400 feet, and thickens to the west. The formation consists of interbedded layers of gravel, sand, silt, and clay (Newcomer, 1993, cross-sections).

Two relatively large fault zones, the Valley View and the Ranchos, and several horizontally less extensive faults, are present near the proposed well sites (Fig. 1). Faults can act as barriers to ground-water flow because low-permeability clay gouge often forms along the fault. Evidence of the faults near this area acting as barriers to ground-water flow may be the relatively low yield from La Mesa Well 2 (RG-49802-S) as compared to La Mesa Well 1 (RG-49802), and the relative steep ground-water gradient east of the faults.

YIELDS OF LA MESA WELLS 1 AND 2, AND GREVEY WELL

Little production data were available for wells in the area. La Mesa Well 1 produces about 70 gallons per minute (gpm) and Well 2 produces about 40 gpm (personal communication with La Mesa, 1996). The water column upon completion was 385 feet in Well 1 and was 415 feet in Well 2, according to SEO records. Both La Mesa wells were completed with essentially the same amount of well screen, with Well 1 having 310 feet of screen and Well 2 having 320 feet of screen.

The efficiency of Wells 1 and 2 and the transmissivity of the aquifer at the wells are not known because no pumping tests were performed. Measurements of ground-water depths have not been made since the wells were completed.

The Grevey Well was pump tested at a maximum 450 gpm with a corresponding specific capacity of 33 gallons per minute per foot of drawdown. Specific capacity refers to the quantity of water produced from a given well per foot of corresponding drawdown in the well.

REPORTED ARSENIC CONCENTRATIONS IN WELLS

Ground-water quality in the Santa Fe Formation aquifer in the La Mesa Subdivision area is generally good with moderately high total dissolved solids concentrations. Available ground-water quality data indicate fluoride has been present in concentrations exceeding the New Mexico Water Quality Control Commission standard of 1.6 milligrams per liter (mg/l) in the Grevey Well (RG-49516) and the Town of the Bernalillo Well 2 (RG-2478-S-3), which is also known as the Bernalillo North Well. The Environmental Protection Agency (EPA) maximum contaminant level for fluoride is 4.0 mg/l.

Some portions of the Santa Fe Formation aquifer near, and possibly within, the La Mesa Subdivision area have arsenic concentrations which exceed the EPA maximum contaminant level of 0.05 mg/l for drinking water. There does not appear to be a predictable trend to the arsenic concentrations in the ground water. Reported arsenic concentrations are greatest in well RG-49516 (Grevey) and RG-49802-S (La Mesa Well 2). Ranchos de Placitas well RG-12871-CD is several hundred feet east of La Mesa Well 2 and has a reported arsenic concentration below the laboratory detection limit of 0.005 mg/l. The presence of elevated arsenic levels is likely related to the deposition of arsenic-rich sediments within the Santa Fe Formation. Unfortunately, the location and extent of these sediments are unknown.

High arsenic concentrations have been reported to be associated with ground water with elevated sodium concentrations and with bicarbonate as the dominant anion. Nearby wells with this geochemical association include the Town of Bernalillo Number 2 Well (Molzen-Corbin, 1988) and well RG-49516 (Grevey Well). Wells in the Albuquerque area have also showed this association (CH2M Hill, 1990). Ground water in the area which has calcium as the dominant cation generally has lower arsenic concentrations than areas where sodium is the dominant cation. Unfortunately this relation has little value at this time because water quality of the aquifer in the area has not been defined such that the extent of the calcium dominant and the sodium dominant portions of the aquifer are known.

The table below shows arsenic concentrations in ground water for selected wells in the area. Arsenic concentrations for selected wells are also shown on Figure 2.

well	name	arsenic concentration, mg/l
RG-49802	La Mesa Well 1	<0.005 to 0.010
RG-49802-S	La Mesa Well 2	0.048
RG-63688	Sloan	0.02
RG-10032	Ranchos de Placitas	0.005
RG-10032-S	Ranchos de Placitas	<0.005
RG-12871-CD	Ranchos de Placitas	<0.005
RG-49516	Grevey	0.049
RG-2478-S-3	Bernalillo Well 2	0.044

(mg/l) milligrams per liter

PROPOSED WELL SITES

La Mesa Subdivision Park Site

The Park site is about 3,500 feet northeast of La Mesa Well 1 and 1,500 feet northeast of La Mesa Well 2 in a park in the La Mesa Subdivision. The site is about 200 feet west of the same fault near which Well 2 was completed. It is probable that the production from a well completed at this site would be similar to that of Well 2. Well yield could potentially be increased by completing the well deeper in order to increase the available saturated thickness. Approximate depth to water at the site based on the estimated potentiometric surface elevation data and the ground level elevation is 180 feet.

Morgan Site

The Morgan site is about 2,000 feet northwest of La Mesa Well 1 and 2,600 feet southwest of La Mesa Well 2. The Morgan site is located on lot 6-C in the La Mesa Subdivision, adjacent to a relatively large arroyo. The arroyo was not shown to be within a flood hazard area on the Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, 1980). However, the proposed well site does appear to be within several feet of the bottom of the arroyo. The well, well house, and controls could potentially be flooded by a large storm event and wellhead protection measures could be compromised.

The Morgan site is within a bifurcating, or branch, of the Valley View fault system and is about 200 feet from the nearest portion of the fault, and about 550 feet from the farthest portion of the fault. It is generally considered good practice to locate wells as far from faults as possible because faults can act as barriers to horizontal ground-water flow. Ironically, faults occasionally act as vertical conduits and allow ground water from deeper portions in the aquifer to migrate upward and the water may be of poorer quality. The relation of the site to the fault system would probably cause excessive drawdown in the well if the fault system is a barrier to ground-water flow. Approximate depth to water at the site based on the estimated potentiometric surface elevation data and the ground level elevation is 270 feet.

Sundance Site

The Sundance site is about 6,600 feet northwest of La Mesa Well 1, 5,300 feet northwest of La Mesa Well 2, and about 600 feet west of the Valley View fault system. This site is the greatest distance from any of the mapped faults in the area and from La Mesa Wells 1 and 2 (Fig. 1). The available saturated thickness at this site should be the greatest of the proposed locations because it is on the west side of the Valley View fault system, which is the downthrown side.

Like the Morgan site, this site is also adjacent to an arroyo, the southern-most portions appear to be a greater distance above the bottom of the arroyo channel than is available at the Morgan site. A survey could be performed to verify the elevation difference. The arroyo is not within a flood hazard area as defined on the Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, 1980). Approximate depth to water at the site based on the estimated potentiometric surface elevation data and the ground level elevation is 350 feet.

GROUND-WATER FLOW SIMULATION

The ground-water flow system at the site was simulated using JDB-2D (JDB-2D and JDB-3D, 1995), which is a two-dimensional, numerical program. The simulation of the La Mesa Well Field was performed to estimate drawdown in the aquifer resulting from pumping La Mesa Wells 1 and 2, Ranchos de Placitas well RG-10032-S, and the Grevey well RG-49516. Simulations were intended to provide a general assessment of the well interference that may occur with the addition of the supplemental well in the aquifer system in the La Mesa area. The simulation was based on available data, which, unfortunately, did not include any pumping test data or historical ground-water measurements.

The model was adjusted to simulate the aquifer based on the ground-water elevations available from SEO well records and data from Newcomer (1993). One simulation was performed for each of the three potential new well sites. The faults previously discussed (shown on Figure 1) were accounted for in the simulation process by reductions of aquifer transmissivity in the model grid. In addition to the faults acting as barriers to ground-water flow, it is possible that the aquifer transmissivity increases from the eastern portion of the La Mesa Subdivision to the west. Aquifer transmissivity for the simulation was assumed to increase from the eastern portion of La Mesa Subdivision to the western portion of Sundance Subdivision. Las Huertas Creek was not included in the simulation.

Four simulations of the aquifer system were performed. The first simulation included pumping only La Mesa Wells 1 and 2, and Ranchos de Placitas wells RG-10032-S and RG-12871-CD-S, which will be referred to as the four existing wells. The remaining three simulations included pumping the four existing wells and pumping at each of the proposed sites. The following assumptions were included as inputs for each of the simulations.

1. La Mesa Wells 1 and 2, and Ranchos de Placitas wells RG-10032-S and RG-12871-CD-S pump at a constant rate of 20 gpm.
2. New La Mesa supplemental well pumps at a constant rate of 30 gpm.
3. Aquifer thickness is 400 feet.
4. Aquifer transmissivity values from 50 to 2,000 ft^2/day.
5. Aquifer specific yield is 10 percent.

RESULTS OF GROUND-WATER FLOW SIMULATION

The simulation indicates the greatest ground-water declines would result from an additional well being pumped at the Park site. Figures 3 through 6 show the 40-year ground-water declines from the above simulations, and results of the simulation are shown below.

simulation	location of 40-year maximum ground-water decline (feet)	40-year maximum ground-water decline (feet)	40-year ground-water decline at proposed well (feet)
4 existing wells	La Mesa Well 2	37	--
4 existing wells and Park site	600 feet southwest of Park site	59	33
4 existing wells and Morgan site	La Mesa Well 2	39	11
4 existing wells and Sundance site	La Mesa Well 2	38	6

RANKING OF POTENTIAL SUPPLEMENTAL WELL SITES

JSAI developed a simple ranking system in order to assess the best location for the supplemental well. Each site was ranked for various parameters on a scale of 1 to 3, with 1 being the least favorable. JSAI selected the highest score for the potential sites as the location for the proposed supplemental well. Unfortunately, neither arsenic nor fluoride were included in the ranking because JSAI was unable to assess the potential concentrations at the sites with the current database. The ranking system includes both hydrogeologic and non-hydrogeologic considerations and is shown in the table below.

parameter	Park site	Morgan site	Sundance site
40 year ground-water decline	1	2	3
potential boundary effect from fault(s)	1	1	3
estimated aquifer yield	2	2	3
wellhead protection considerations	3	1	2
access for drilling equipment	3	2	2
proximity to three-phase power	2	3	1
total score	12	11	14

The Sundance site is the most favorable site based on the above ranking. The Park site ranks second when considering both hydrogeologic and non-hydrogeologic parameters. However, when considering only hydrogeologic parameters, the Morgan site ranks slightly higher than the Park site.

CONCLUSIONS

JSAI assessed the Park, Morgan, and Sundance sites for a supplemental well for La Mesa Subdivision. The potential for drawdown, well yields, proximity to faults, wellhead protection, drilling access, and the proximity to three-phase power were considered for each site. JSAI ranked the sites based on these parameters and the Sundance site ranked the most favorable for the proposed supplemental well.

DISCLAIMER

This well siting assessment report has been prepared for the exclusive use of La Mesa Water Cooperative. Any other use of this report may be inappropriate. All work has been performed in accordance with generally accepted hydrogeologic assessment practices. No warranty is expressed or implied.

The assessment results are based on the observations of JSAI personnel at the time of site visits, on reviews of selected publicly available information, and on information provided by persons familiar with the sites and surroundings. The information and conclusions in this report are subject to the accuracy, completeness, and availability of such data.

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ILLUSTRATIONS

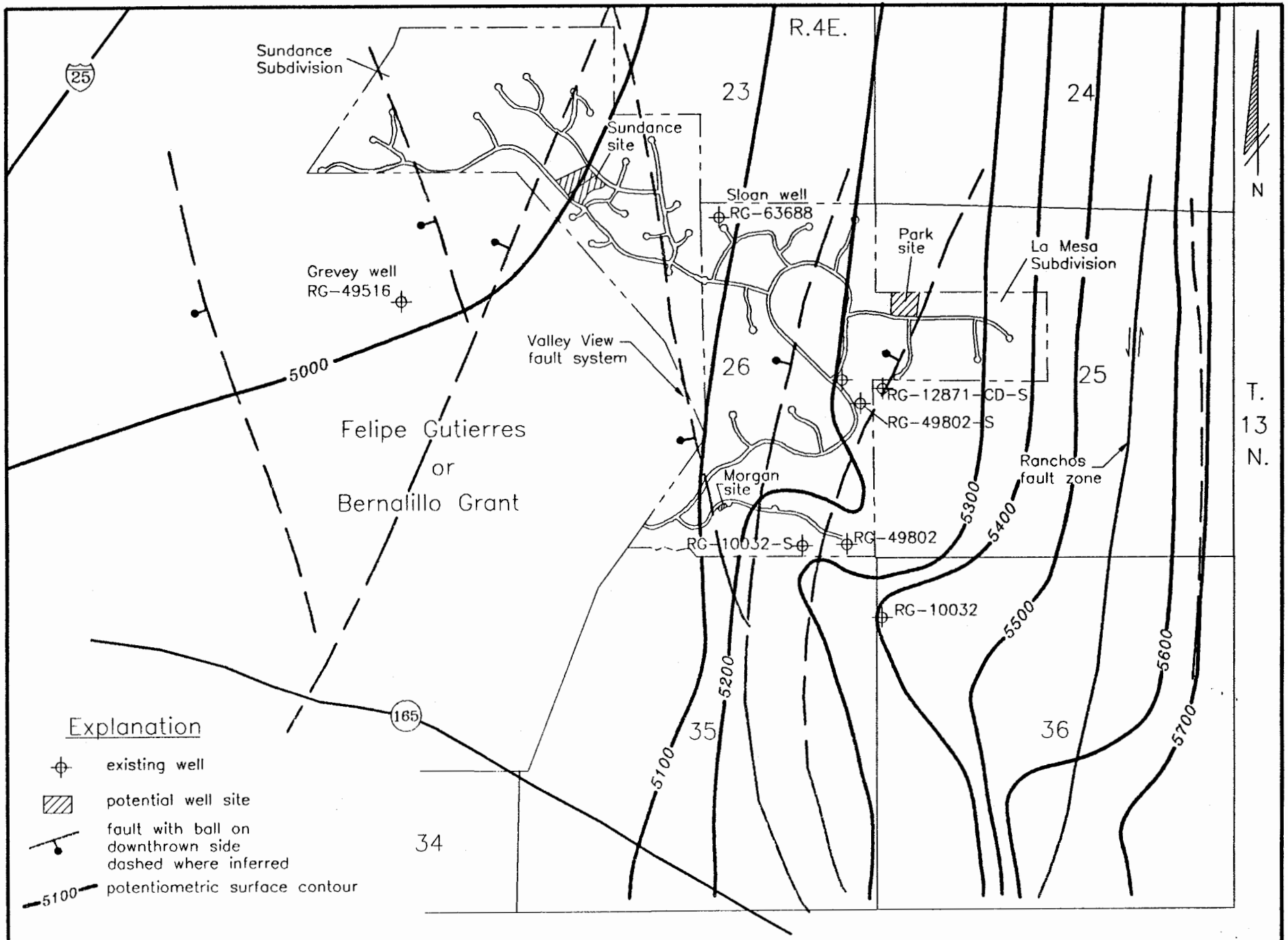

Figure 1. Map showing proposed well sites, existing wells, potentiometric surface elevation contours, and faults in the area near the La Mesa and Sundance Subdivisions.

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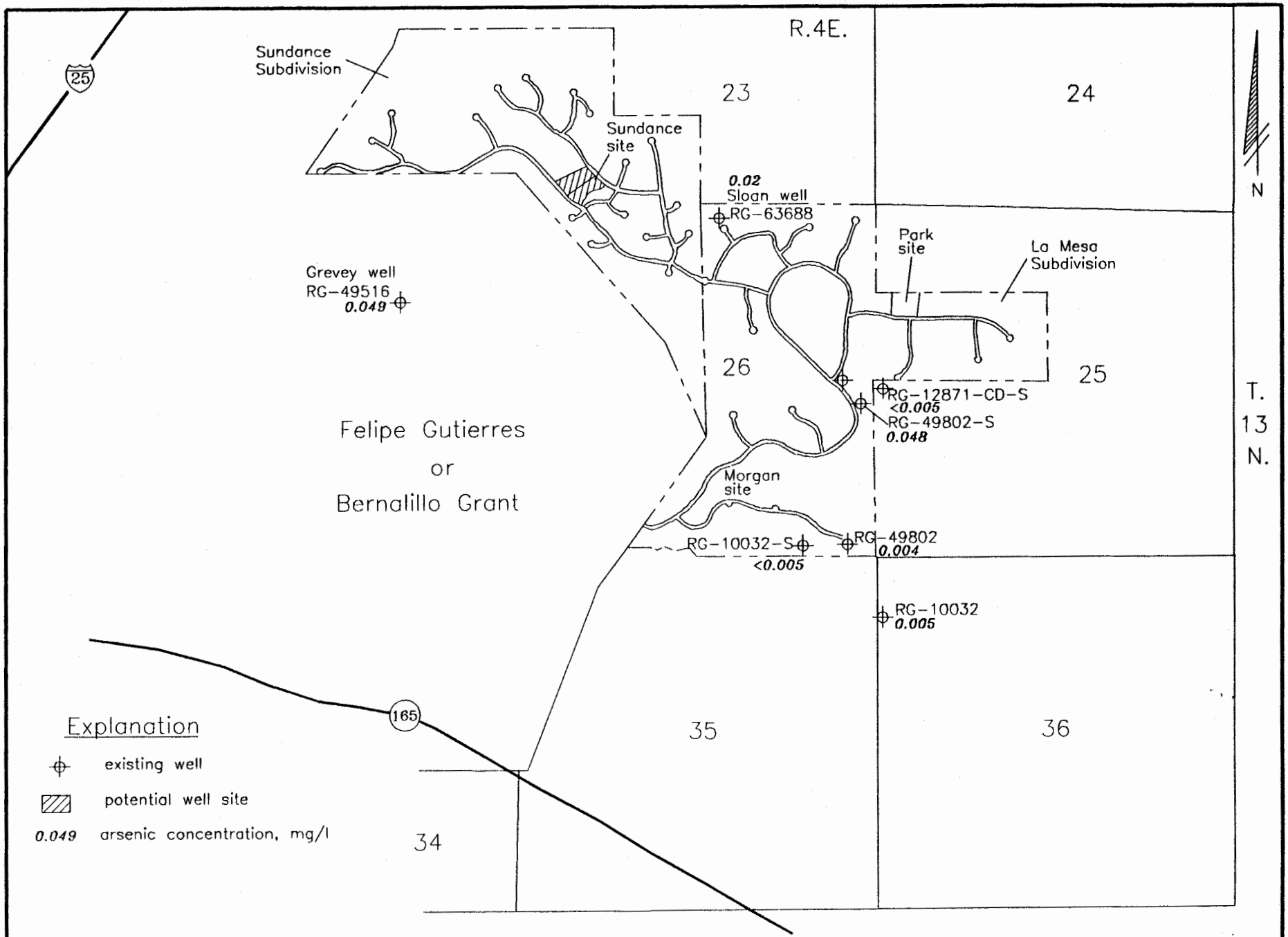

Figure 2. Map showing proposed well sites, existing wells, and known dissolved arsenic concentrations in the La Mesa and Sundance Subdivisions area.

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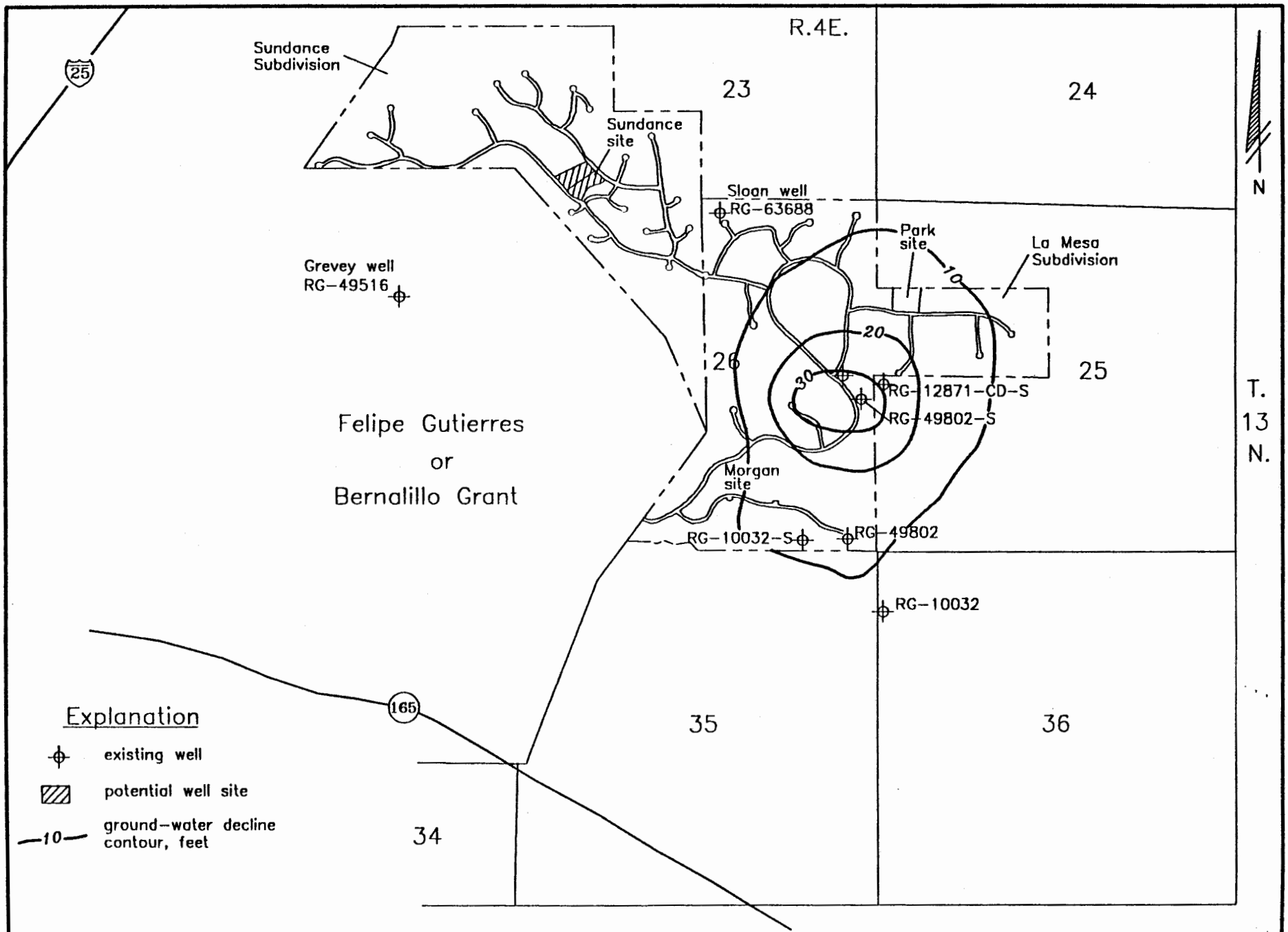

Figure 3. Map showing ground-water declines after pumping La Mesa Wells 1 and 2, and Ranchos de Placitas wells RG-12871-CD-S and RG-10032-S for 40 years.

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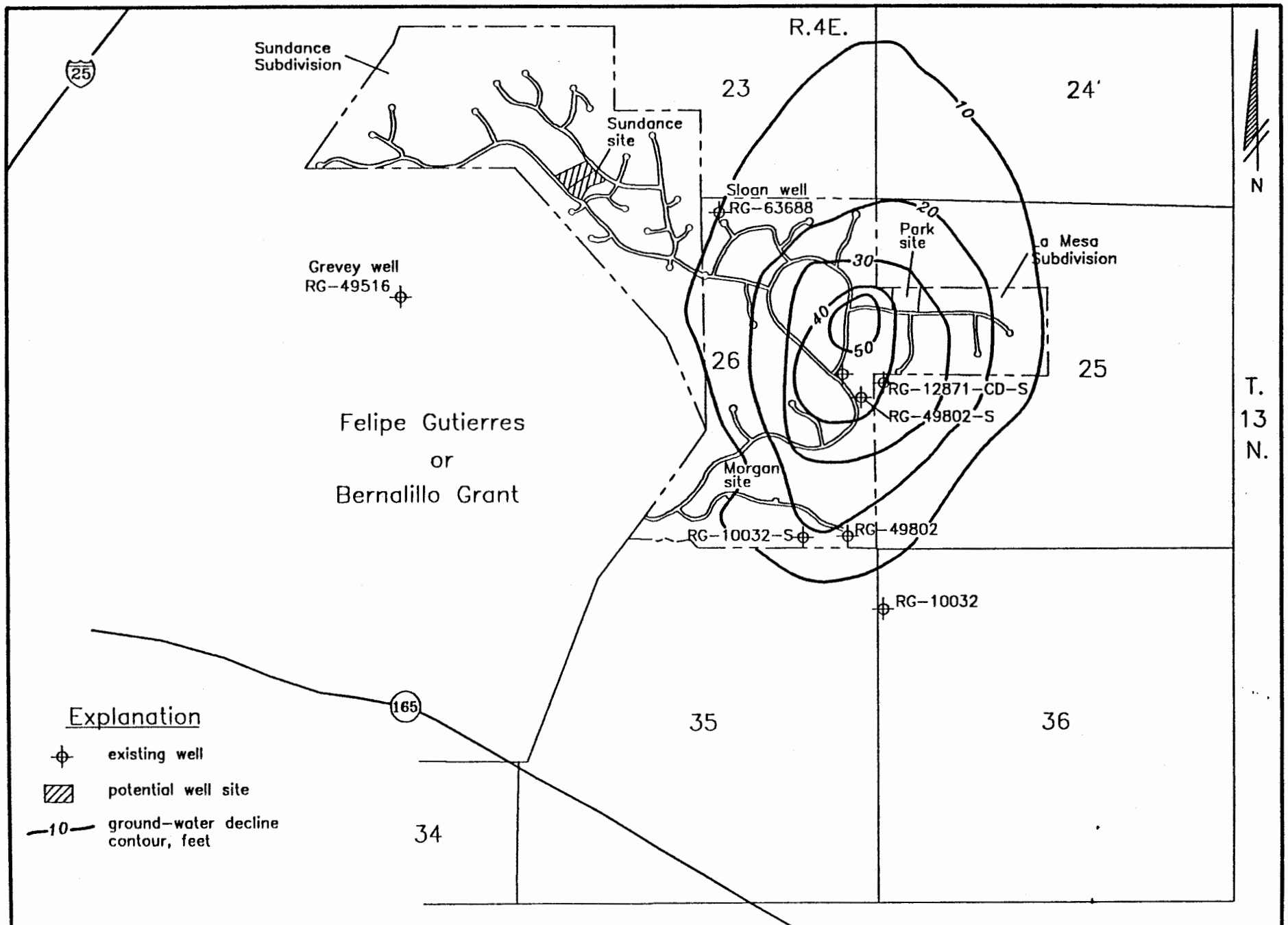

Figure 4. Map showing ground-water declines after pumping La Mesa Wells 1 and 2, Ranchos de Placitas wells RG-12871-CD-S and RG-10032-S, and the proposed Park site well for 40 years.

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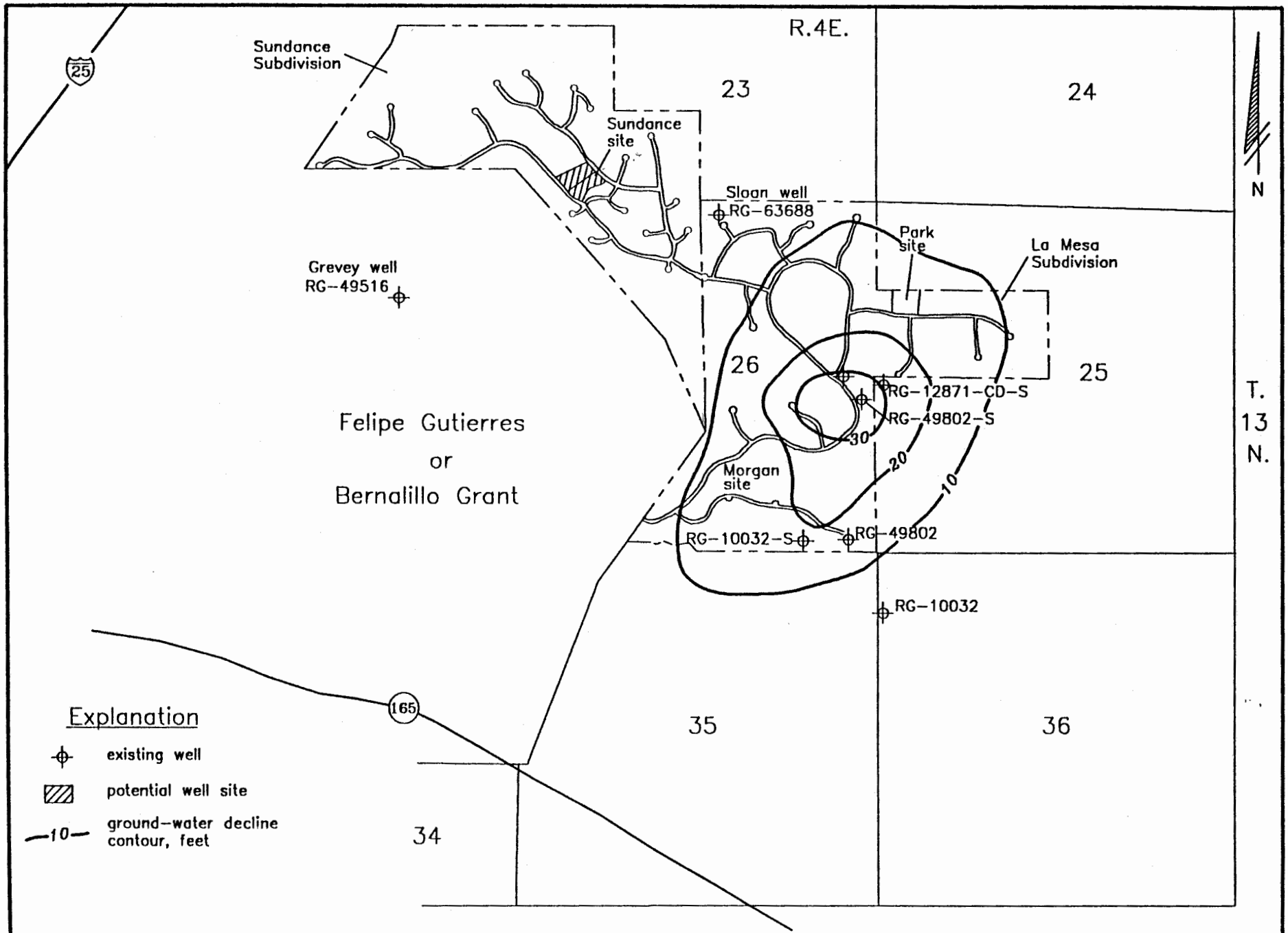

Figure 5. Map showing ground-water declines after pumping La Mesa Wells 1 and 2, Ranchos de Placitas wells RG-12871-CD-S and RG-10032-S, and the proposed Morgon site well for 40 years.

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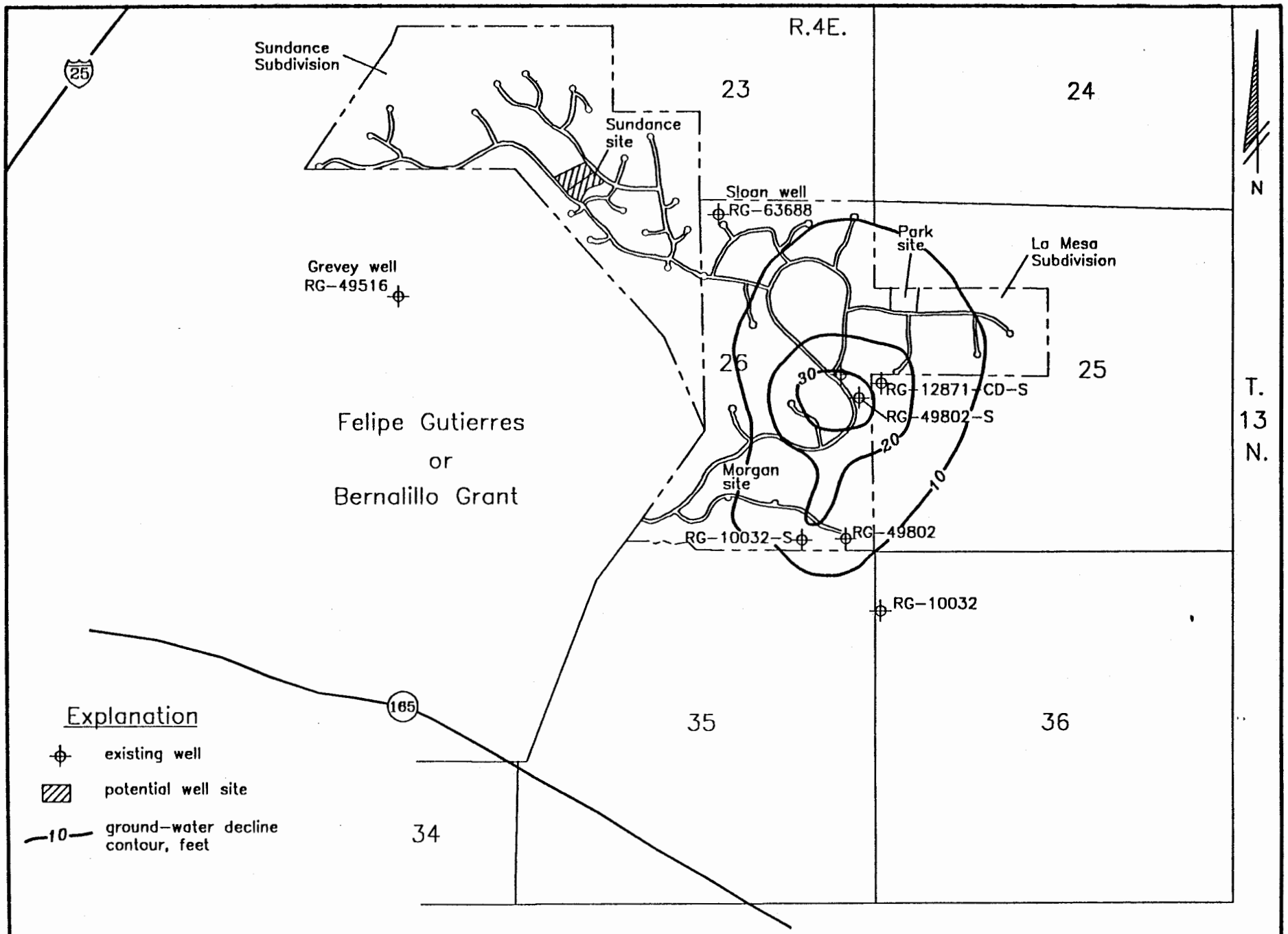

Figure 6. Map showing ground-water declines after pumping La Mesa Wells 1 and 2, Ranchos de Placitas wells RG-12871-CD-S and RG-10032-S, and the proposed Sundance site well for 40 years.

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