REPORT ON THE MOANA HOT SPRINGS SYSTEM NEAR THE VETERANS ADMINISTRATION HOSPITAL, RENO, NEVADA

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Introduction

The Moana Hot Springs area south of Reno, Nevada has been used for space heating applications since 1935. The term "hot springs" is somewhat of a misnomer since there is presently no surface discharge. The resource is derived largely from wells drilled deeper than 100 feet. These wells now service about 40 homes and businesses (Garside and Schilling, 1975).

This report attempts to summarize the controls of the Moana system and to evaluate the possibilities of finding a low-temperature (65-80°F) resource on its northeast perimeter. The evaluation was carried out as a part of the Earth Science Laboratory/University of Utah Research Institute's User Assistance Program. This U. S. Department of Energy-funded program is designed to give potential users of geothermal energy preliminary advice on how to proceed in defining and using their resource. Dick Fry of the Engineering Services Division of the Veterans Administration Hospital in Reno requested help from the Earth Science Laboratory to aid in his decision for requesting funds to drill a geothermal well.

Scope of the Report

Much of the information given below was abstracted from references which are cited at the end of this report. In addition, approximately sixty domestic and industrial water well logs were obtained from the Nevada Division

of Water Resources Office in Carson City. The location, depth, and temperature (if given) of the sixty wells are listed in Table 1. The sixty include every well log available within a one-mile radius of the VA Hospital. Even so, some well logs from this area which were described in the literature were not on file with the Division of Water Resources, so this survey is not complete. Temperatures and depths of well logs which had a reported temperature are shown on an overlay with the enclosed geologic map.

Geology

Three geologic units are relevant to the geothermal potential near the VA Hospital in Reno. From oldest to youngest these are: relatively impermeable volcanic rocks of Tertiary age (2-65 million years old), lacustrine (deposited in a lake) sediments, also of Tertiary age, and loosely consolidated Quaternary (less than 2 million years old) sands and gravels.

The Tertiary volcanic rocks are not seen in the rock outcrops nearest to the VA hospital and they may or may not have been encountered by deep water wells in the area. The brittle nature of the volcanic rocks make them susceptible to faulting which may provide the conduits for geothermal fluids in the Moana system (Bateman and Schiebach, 1975).

The Tertiary lacustrine sedimentary unit is the most poorly defined of the three. Bateman and Schiebach (1975) speculate that a "blue clay layer" overlies the andesite and acts as an impermeable cap to transmit hot water away from faults in the andesite. Dennis Trexler of the Nevada Bureau of Mines and Geology (oral communication) believes that this blue clay is a

Table 1. Well logs from area within a one-mile radius of the VA Hospital.

Location		Owner	Depth (ft.)	Temp. (°F)
SW1/4 SE1/4	Sec 11 T19N R19E	Reno Securities Co.	360	
	Sec 11 T19N R19E	Riverside Hotel	360	56
	Sec 11 T19N R19E	Lee Hale	80	50
	Sec 11 T19N R19E	Union Ice Co.	366	55
	Sec 11 T19N R19E	Sierra Pacific	482	
NE1/4 SE1/4	Sec 11 T19N R19E	Bell Telephone	352	57
NW1/4 SE1/4	Sec 11 T19N R19E	Washoe County	482	59
NW1/4 SE1/4	Sec 11 T19N R19E	Kaiser Apts.	231	
	Sec 11 T19N R19E	Hardy Coffman	45	45
	Sec 11 T19N R19E	L. S. Van	51	40
	Sec 11 T19N R19E	W. Kennedy	50	40
	Sec 11 T19N R19E	Hale Dehning	60	
	Sec 11 T19N R19E	W. B. Sears (?)	40	
	Sec 11 T19N R19E	V. Harshbarger	65	
	Sec 11 T19N R19E	Lee Hale	63	
	Sec 11 T19N R19E	Bell Telephone	21	
SE1/4	Sec 11 T19N R19E	American Elevator	68	
	Sec 12 T19N R19E	Sierra Pacific	667	
	Sec 12 T19N R19E	Sierra Pacific	588	81
SW1/4	Sec 12 T19N R19E	Peter Di Granza	180	62
	Sec 12 T19N R19E	Emerson Wilson	150	
NE1/4 NE1/4	Sec 12 T19N R19E	Sierra Pacific	490	
	Sec 12 T19N R19E	H. F. Linnecke	275	
SW1/4	Sec 12 T19N R19E	Lee Edmondson	181	
	Sec 12 T19N R19E	George Grossman	125	
NW1/4 SE1/4	Sec 12 T19N R19E	Smith Peterson	358	
SE1/4 E 1/2	Sec 13 T19N R19E	A. Avanzino	42	
	Sec 13 T19N R19E	Dr. McCleary	120	
	Sec 13 T19N R19E	A. Avanzino	42	
	Sec 13 T19N R19E	Savage and Son	32	
NW1/4 SE1/4	Sec 13 T19N R19E	Charles Haverland	82	60
	Sec 13 T19N R19E	Ben Hallmark	80	70
SE1/4 NE1/4	Sec 24 T19N R19E	George Caulde	53	
	Sec 24 T19N R19E	John Champion	145	
SE1/4 NE1/4	Sec 24 T19N R19E	Mr. Bailey	40	
SW1/4 NW1/4	Sec 24 T19N R19E	Edward Kerty	540	110
SW1/4 NW1/4	Sec 24 T19N R19E	Edward Kerty	1022	122
	Sec 24 T19N R19E	Sierra Pacific	226	
NE1/4	Sec 24 T19N R19E	W. L. Walker	40	
NE1/4	Sec 24 T19N R19E	Domthy Hoover	31	
SW1/4 SW1/4	Sec 24 T19N R19E	Gean Goodfellow	93	

Location		Owner	Depth (ft.)	Temp. (°F)
SW1/4 SW1/4	Sec 7 T19N R20E	Sierra Pacific	508	60
	Sec 7 T19N R20E	Isobell Construction	297	
	Sec 7 T19N R20E	Garibaldi Brothers	157	
	Sec 7 T19N R20E	Mr. Peterson	33	
	Sec 18 T19N R20E	Sierra Pacific	660	65
NW1/4 NW1/4	Sec 18 T19N R20E	Leslie Smith	50	
NW1/4	Sec 18 T19N R20E	Humane Society	73	
NW1/4	Sec 18 T19N R20E	John Ferretto	205	
NW1/4 NW1/4	Sec 18 T19N R20E	Andrew Pedretti	65	
NW1/4 SW1/4	Sec 18 T19N R20E	Ray Peterson	65	
SE1/4 NW1/4	Sec 18 T19N R20E	Jack Avanzino	37	
	Sec 18 T19N R20E	Martha Matley	35	58
NE1/4 NW1/4	Sec 18 T19N R20E	Paul Muran	40	58
NE1/4 SW1/4	Sec 18 T19N R20E	Leo Saner	45	58
NE1/4 SW1/4	Sec 18 T19N R20E	Lee Morton	186	
NW1/4 NW1/4				

diatomaceous (very fine silica grains) facies of the Tertiary Truckee formation, a sedimentary unit well described in areas surrounding the Truckee Meadows (Thompson and White, 1964). A thick section of the diatomaceous rock crops out in the mountains west of Reno, but its thickness below the valley fill to the east is not generally known. Trexler expressed some doubts that the blue clay layer is as much of a controlling influence in the Moana system as Bateman and Schiebach (1975) seem to imply.

In the water well logs which were examined, the blue clay layer was often not named as such and had to be inferred by comparing very inexact lithologic descriptions. The liberty of this inference was taken since Bateman and Schiebach's (1975) model suggests that the blue clay layer controls the hot water horizon. The depth to the blue clay layer is shown on an overlay to the enclosed maps. In general the layer is found at depths of 200-300 feet. This is much deeper than the 50-100 foot depths reported for the Moana system (Bateman and Schiebach, 1975).

The rest of the Truckee formation lacustrine sediments are largely silts, sands, gravels and pumiceous material. In the imprecise well log lithologic descriptions, it is almost impossible to differentiate between these facies of the Truckee formation and the much younger, overlying Quarternary sediments.

The third and youngest geologic unit consists of unconsolidated Quaternary sands and gravels. These sediments are aquifers for many domestic cold water wells in Reno. On the enclosed geologic map, the four symbols (Qd, Qt, Qa, Qfl) are various subdivisions of this one unit. Excellent descriptions of the composition and hydrologic properties of these aquifers

are given by Cohen and Loeltz (1964). They say that the overall thickness of the Quaternary units is highly variable - sometimes as much as 1000 feet is present. In the vicinity of the VA Hospital and the Moana hot Springs system, there seems to be considerably less of the Quaternary unit. A successful geothermal well would probably have to be drilled through these sediments and the cold water aquifers cased off to minimize the effects of mixing.

Geothermal Potential

Deep faults play an important role in many low- to moderate-temperature geothermal resources because they transmit the hot water to the surface from greater depths. Faults in unconsolidated sediments such as the Truckee Meadows are often difficult to delineate, however. This is particularly so in an area that is urbanized. The most thorough publication on the Truckee Meadows faults was made by Bingler (1975). His mapping has been recopyed and is shown in Figure 2a.

The bulk of the Moana system is two miles to the southwest of the VA Hospital (see Figure 1). The characteristics and geothermal controls of the Moana and Steamboat Hills geothermal systems are described by Bateman and Schiebach (1975) and Garside and Schilling (1979). Wells with temperatures of over 100°F (38°C) have been drilled closer to the VA Hospital. The Peppermill well on the east side of Virginia Lake has a temperature of 122°F (50°C) at 1022 feet and the Mark Twain Motel well has a temperature of 108°F (42°C) at 900 feet. As shown on the enclosed geologic map (Figure 2a) both of these wells lie along a hypothesized fault. This fault seems to be the northern portion of a graben (fault block which has dropped down relative to its

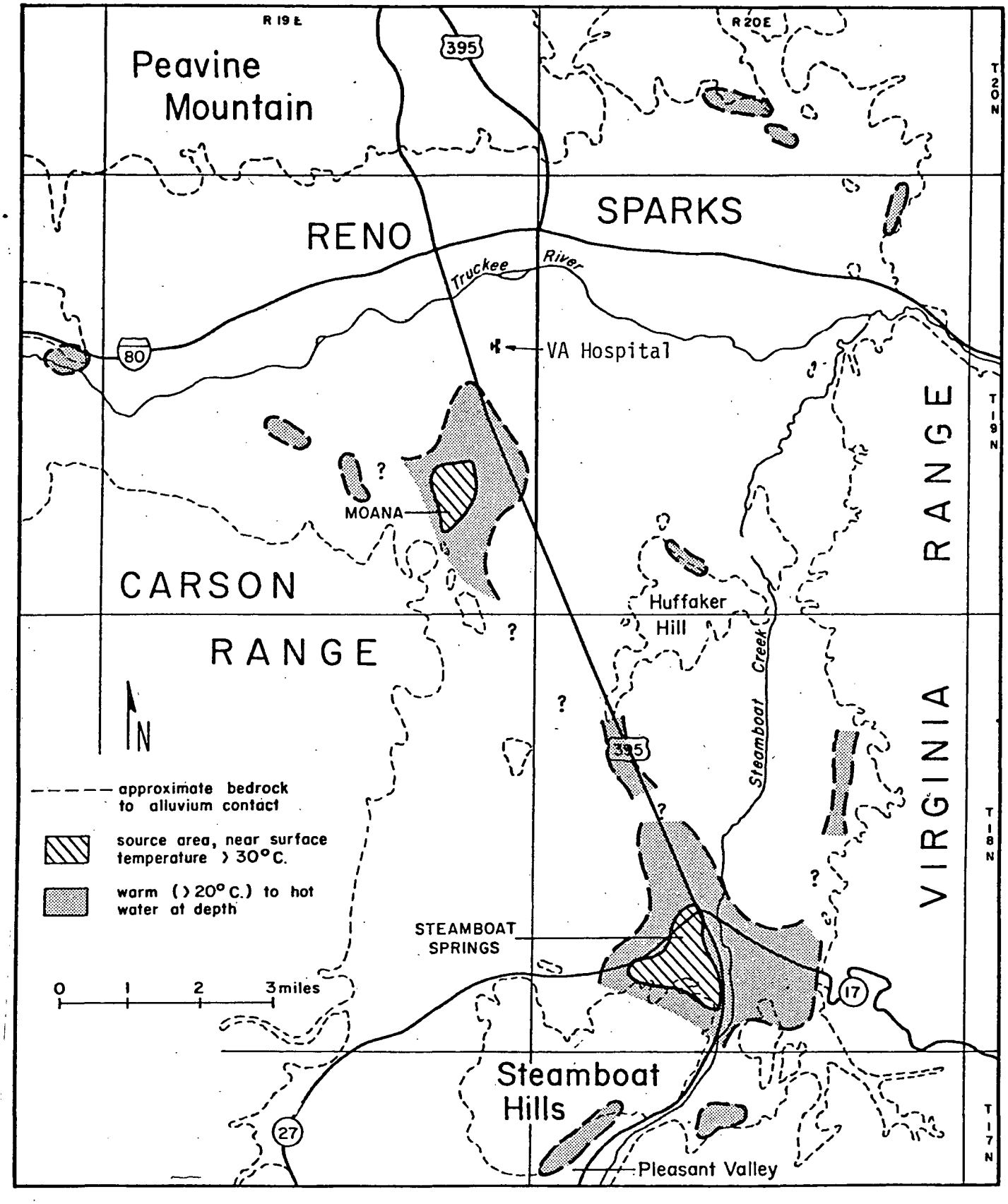


FIGURE 1. Areas of known thermal ground-water occurrence in the Truckee Meadows. (from Bateman and Schiebach, 1975)

surroundings). Dennis Trexler (oral communication) believes this graben to be the dominant control of the Moana system.

Several wells shown on the overlay with the enclosed geologic map should be discussed. The Ben Hallmark well three blocks southwest of the VA Hospital has a 70°F temperature at only 80 feet. This well is near a minor fault that was mapped by Bingler (1975).

Two wells with different depths (213 and 785 feet) and temperatures (65°F and 86°F) were reported at the same location on Virginia Street by two different sources (Cohen and Loeltz, 1964; Bateman and Scheibach, 1975). It is not specified whether these are two separate wells or if the 213 foot was later deepened to 785 feet. No records of these wells were found in Carson City. Wells of this depth are often drilled by Sierra Pacific Power Company and the well logs kept on file with the Office of the State Engineer rather than the Division of Water Resources. The location of these wells also seems to correspond to a known fault.

Several other Sierra Pacific wells of 600-800 foot depths show modest water temperatures (up to 75°F). It should be noted that these are located northeast of the VA Hospital, farther from the Moana system than the VA Hospital. They do not appear to be near any known faults.

A temperature versus depth plot of all well log data discovered in this study is shown in Figure 3. For depths of less than 300 ft. there is a scattering of points with no clear cut correlation. For wells deeper than 300 feet, the geothermal gradient seems to be approximately the 1.6°C per 100 feet

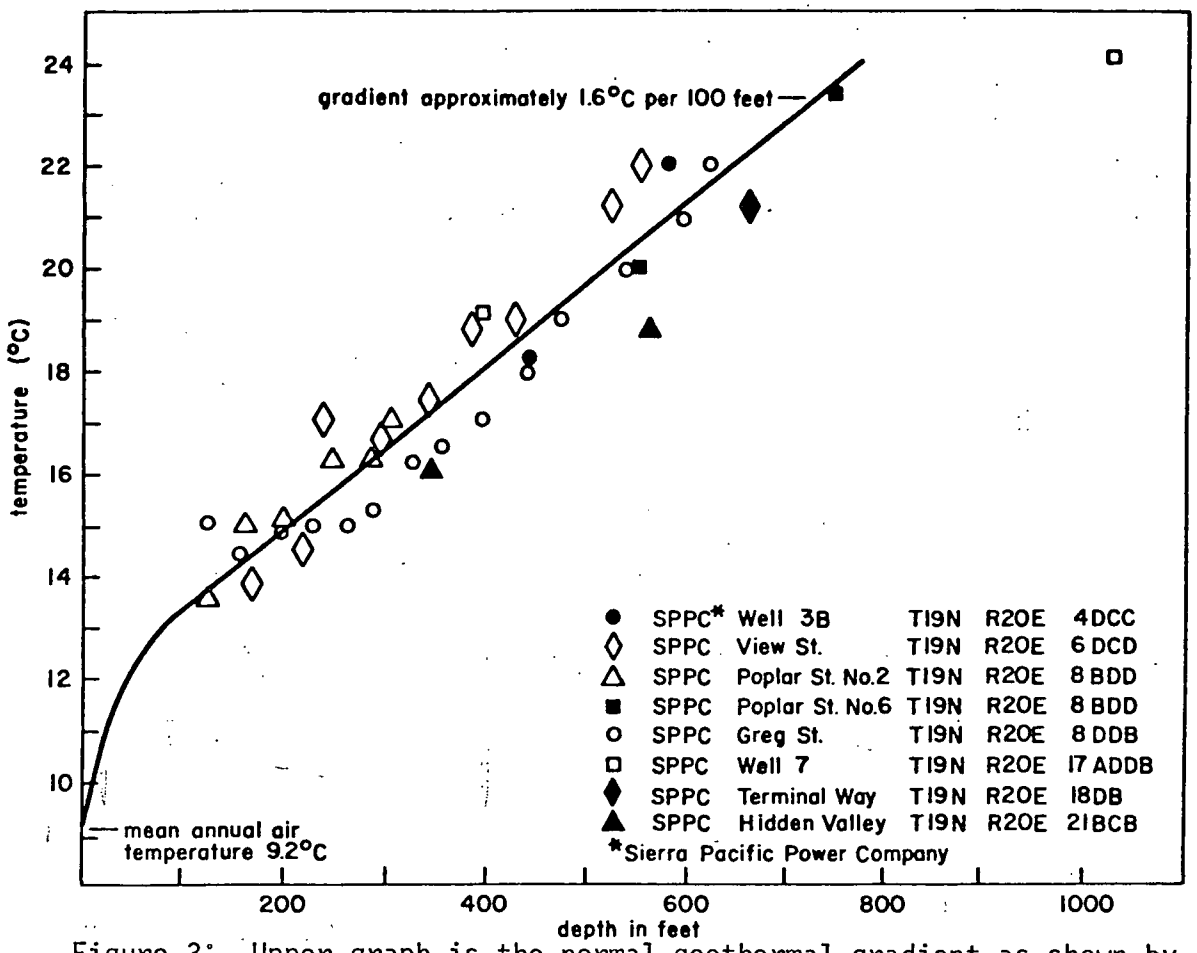
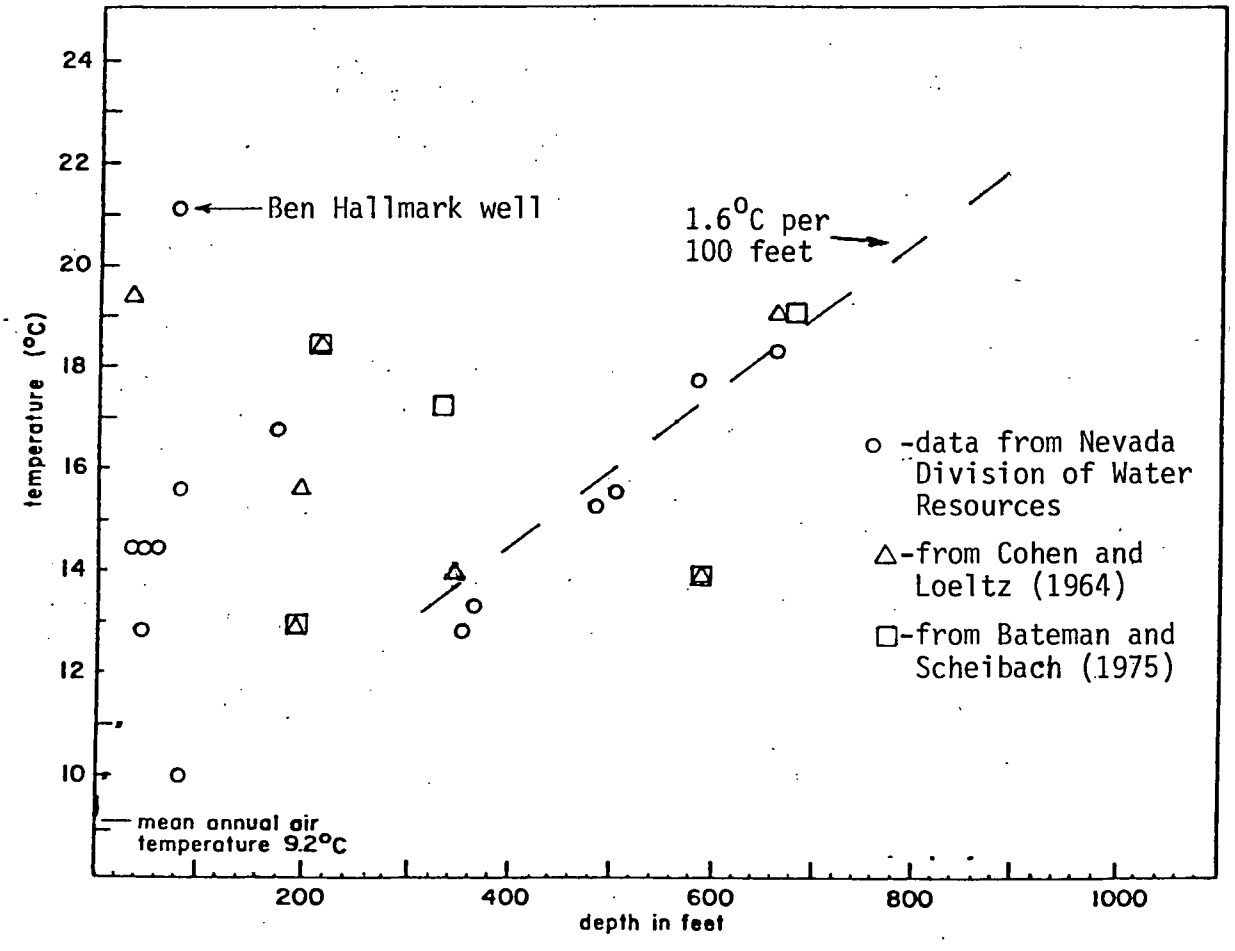


Figure 3: Upper graph is the normal geothermal gradient as shown by Bateman and Scheibach (1975). Lower graph is a temperature versus depth plot for the wells reviewed during this study.



calculated by Bateman and Scheibach (1975) although a regression analysis would be necessary to determine the gradient exactly.

Conclusion

The discussion given above can neither confirm nor disprove the existance of a geothermal resource under the VA Hospital property. If 70°F water is all that is required, a fairly deep hole may provide such a resource. The Sierra Pacific wells to east of the hospital are well outside the Moana district and not near any known fault, yet their temperatures are all greater than 70°F. The expense of drilling a 600'-800' well is considered modest in many geothermal projects, although for your purposes I realize it may be high or even prohibitive. Even at these depths there is no way to guarantee a specific temperature. There are other unknowns which should be considered. Flow rates from such deep wells could not be predicted. Pumping costs would depend on the static water level of the well and the flow rate desired. Sierra Pacific might be able to provide data from their existing wells concerning these two variables.

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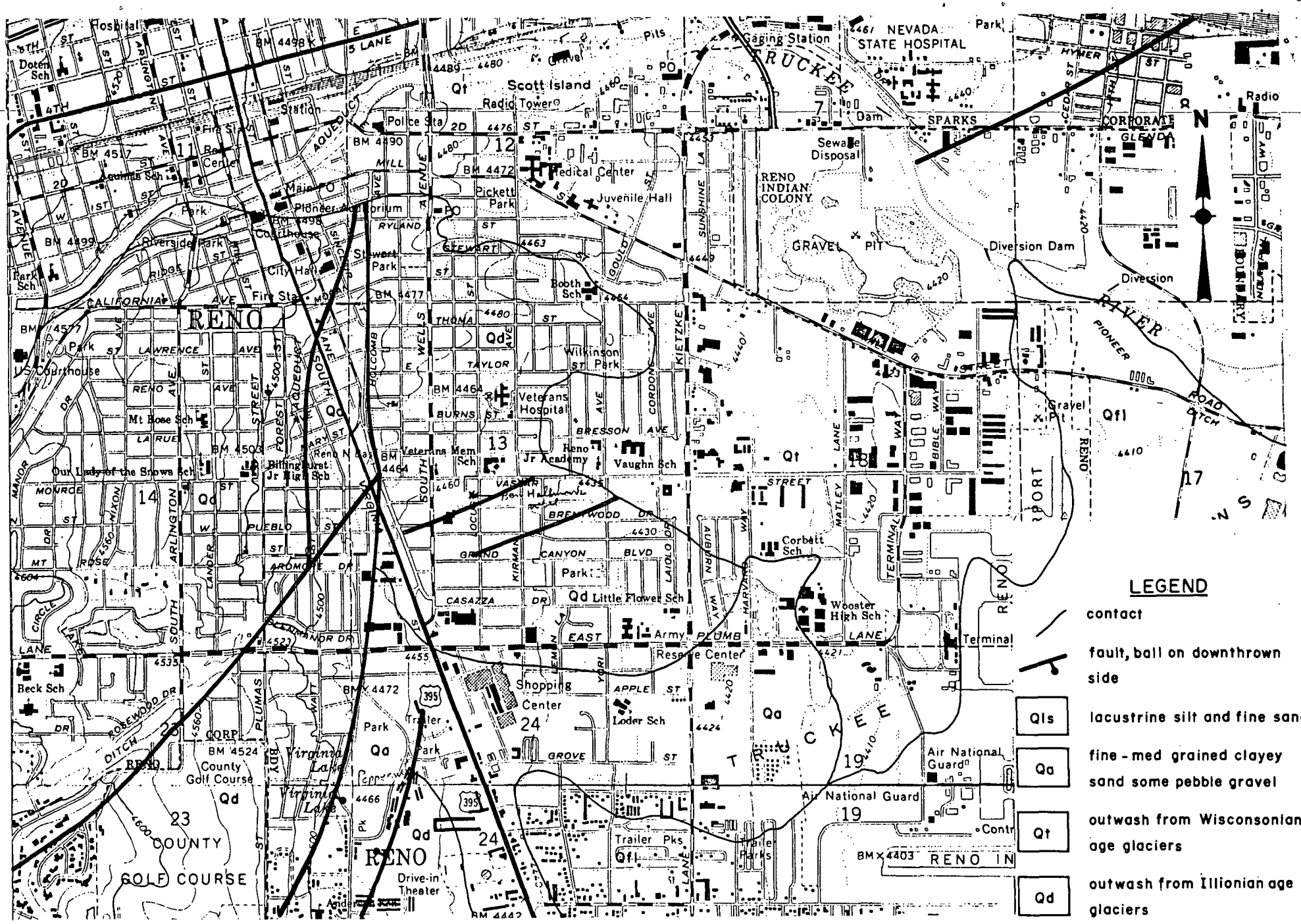

FIGURE 2A. GEOLOGY OF SOUTHEASTERN PORTION OF RENO, NEVADA

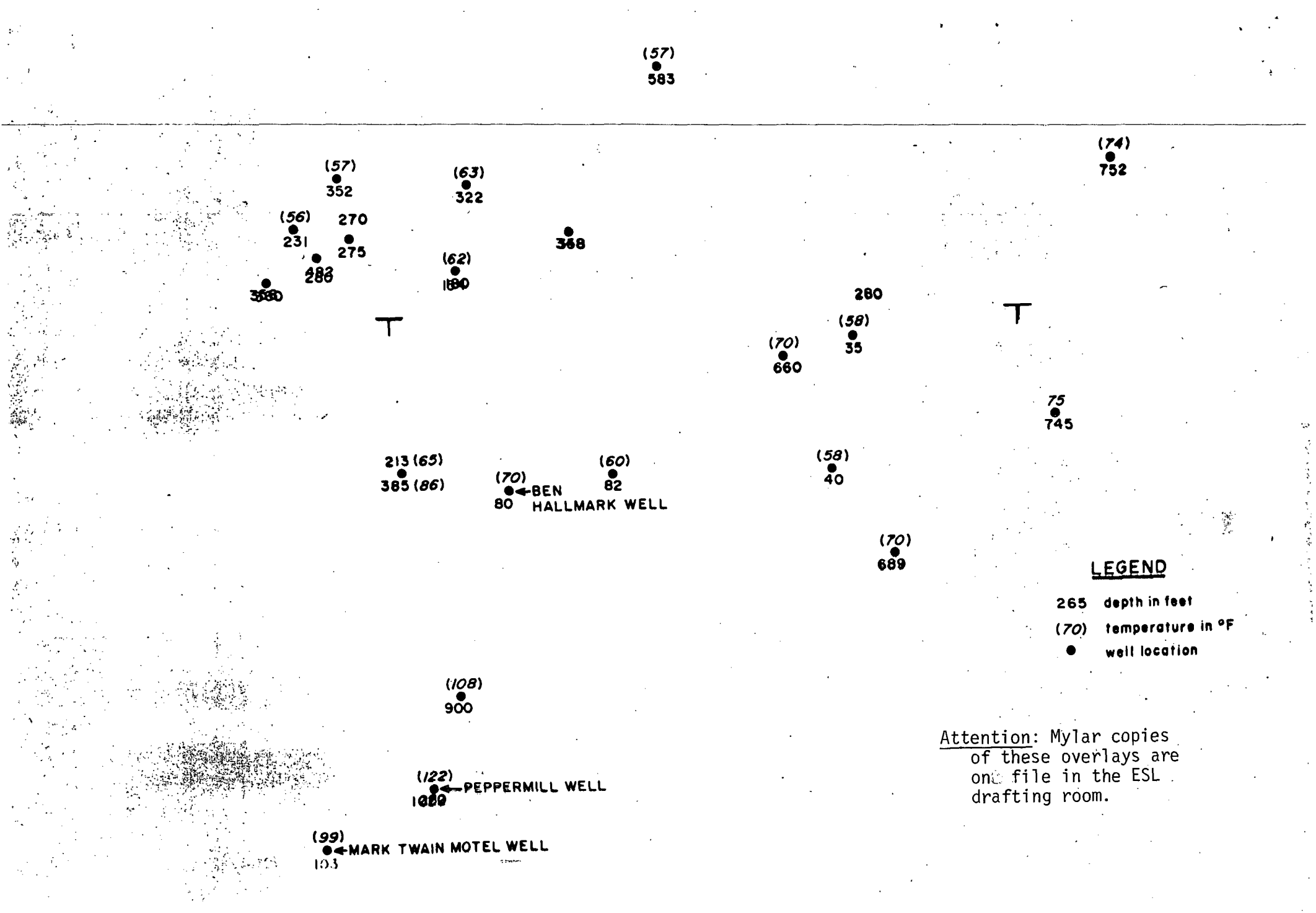

FIGURE 2C. DEPTH TO THE BLUE CLAY LAYER AS INFERRED BY WATER WELL LITHOLOGIC DESCRIPTIONS

FIGURE 2D. TEMPERATURE AND DEPTHS OF WATER WELLS