

WILLIAM E. NORK, Inc.

950 E. Greg Street • Sparks, Nevada 89431

CONSULTING SERVICES IN HYDROLOGY AND GEOLOGY
Phone [702] 358-7949

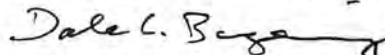
August 6, 1979

Larry J. Garside
Nevada Bureau of Mines and Geology
MacKay School of Mines
University of Nevada--Reno
Reno, NV 89557

Dear Mr. Garside:

Attached is the brief write-up you requested concerning the Shepherd of the Mountains Lutheran Church geothermal space-heating well and heating system. Due to an extremely tight work schedule we were unable to get it to you any sooner. If you have any questions regarding the write-up, do not hesitate to contact Bill Nork or me.

Sincerely,
WILLIAM E. NORK, INC.


Dale C. Bugenig

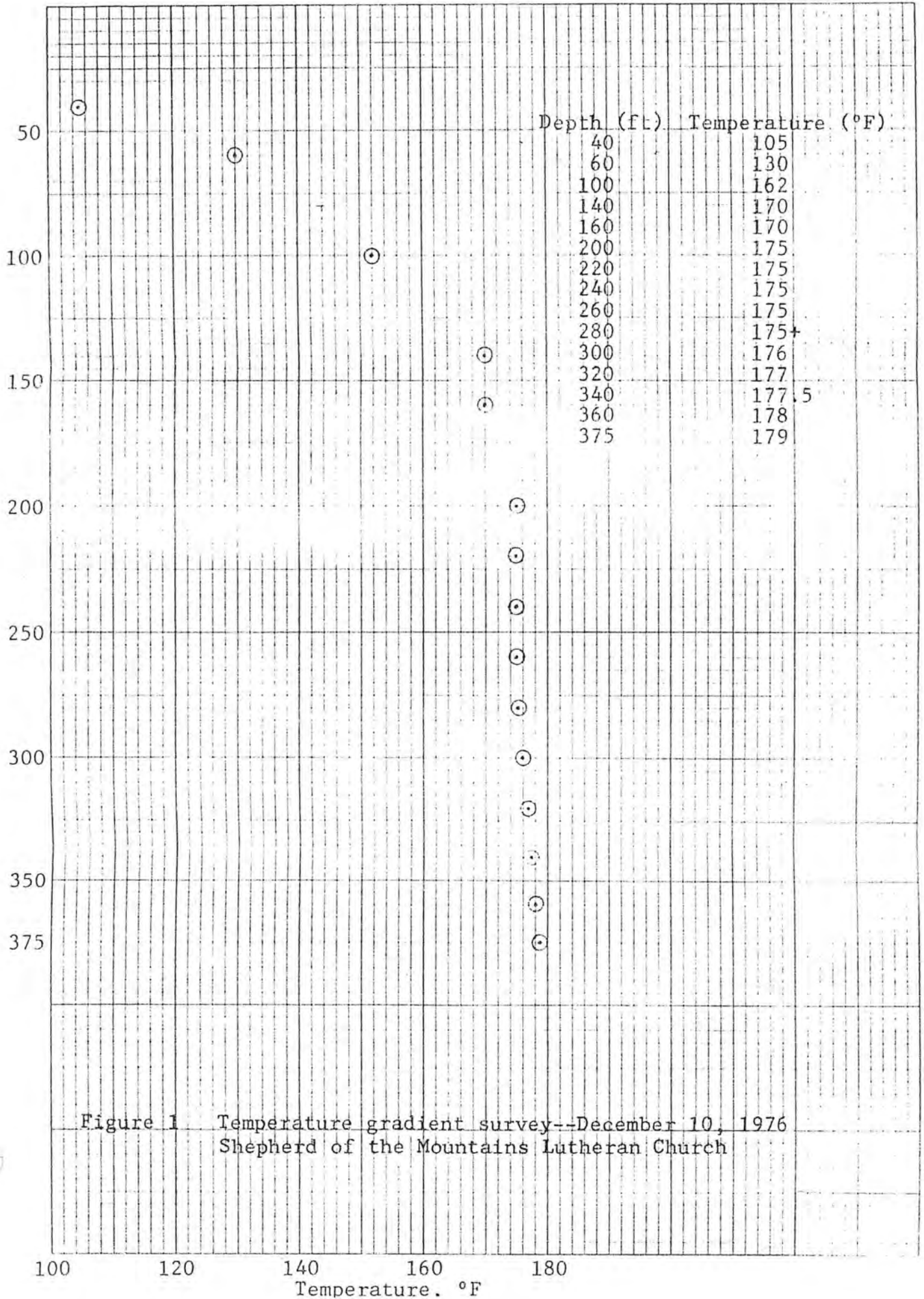
The Shepherd of the Mountains Lutheran Church space-heating well was drilled in December 1976. The well is located in the southwest corner of the church parking lot. Total depth of the well is 375 feet. Unconsolidated formations, consisting of interbedded sand, clay, and silt, were penetrated the entire depth. Hot ground water was encountered below a 30-foot thick confining blue clay layer located at approximately 100 feet depth. Upon completion of drilling a temperature survey was conducted. Bottom-hole temperature was measured at 179°F. The results of the temperature survey is illustrated in Figure 1.

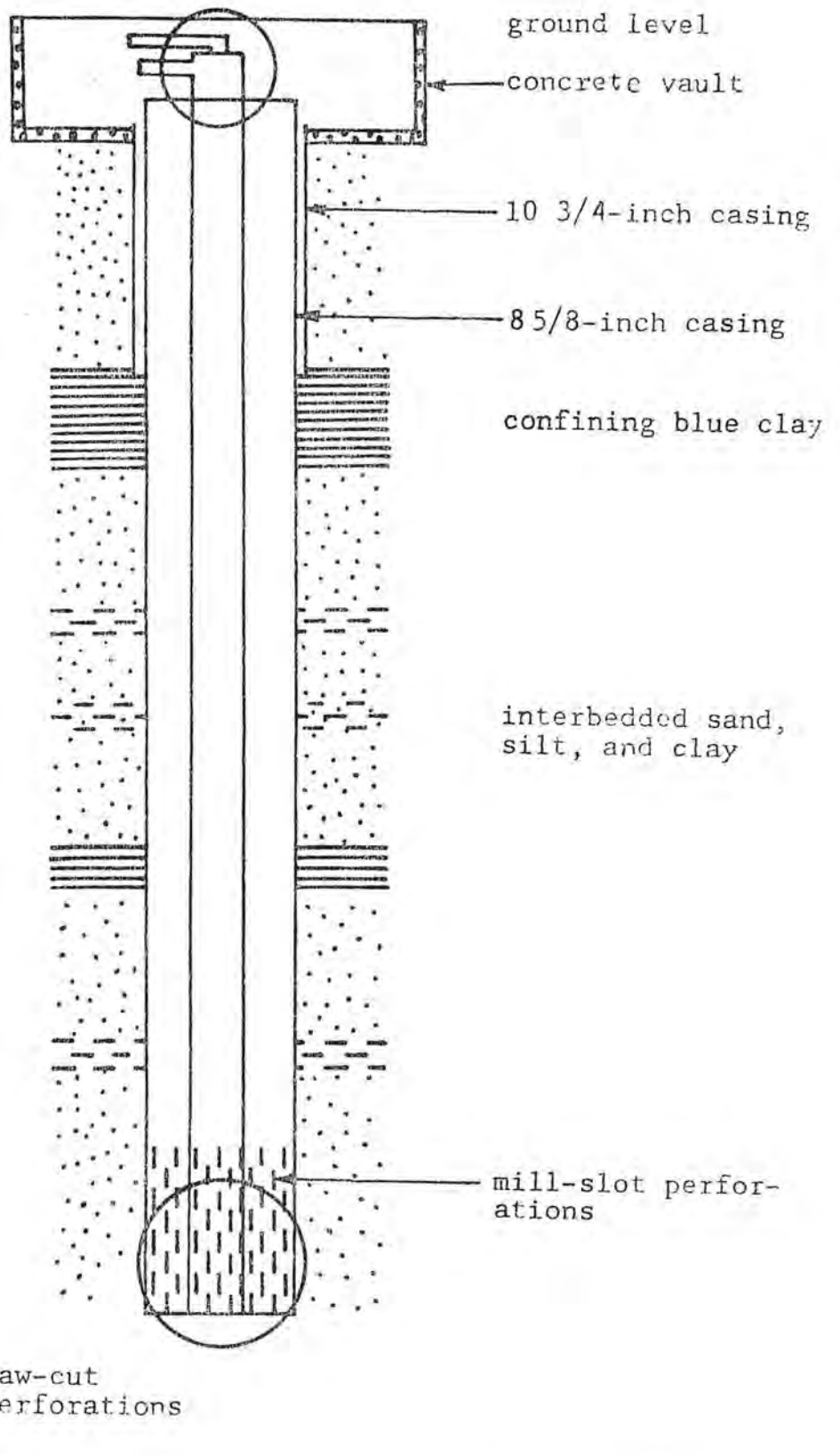
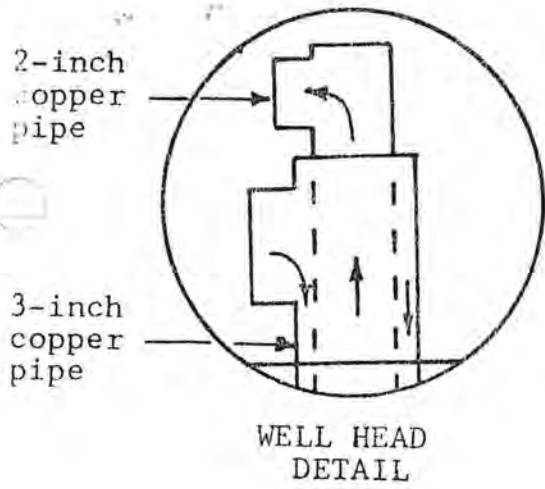
The upper 100 feet of the well was cased with 10 3/4-inch O.D. blank steel casing. The casing was set firmly into the confining clay layer to effectively isolate the hot water zone from cooler shallow ground water. Blank 8 5/8-inch O.D. 1/4-inch sidewall casing was installed to 325 feet depth, and from 325 to 375 feet depth factory mill-slot perforations was installed (Figure 2.).

Heat from the well is extracted from a heat exchanger within the well placed to 375 feet depth. The heat exchanger is constructed of a two-inch copper pipe inside of a three-inch copper pipe (Figure 2.). Water flows down the annular space between the two pipes and returns via the inner two-inch pipe.

Shepherd of the Mountains Lutheran Church is a two-story structure. The upstairs contains approximately 40,000 cubic feet of space; the basement about 30,000 cubic feet. Heating of the upstairs and downstairs is accomplished by 170,000 BTUH and 101,000 BTUH forced-air furnaces respectively, located in the northwest corner of the basement. Each heating unit operates independently of the other.

A closed-loop system supplies heating coils within the furnaces with hot water from the well's heat exchanger. Water is recirculated through the system by two 3/4-horsepower circulating





HEAT EXCHANGER DETAIL

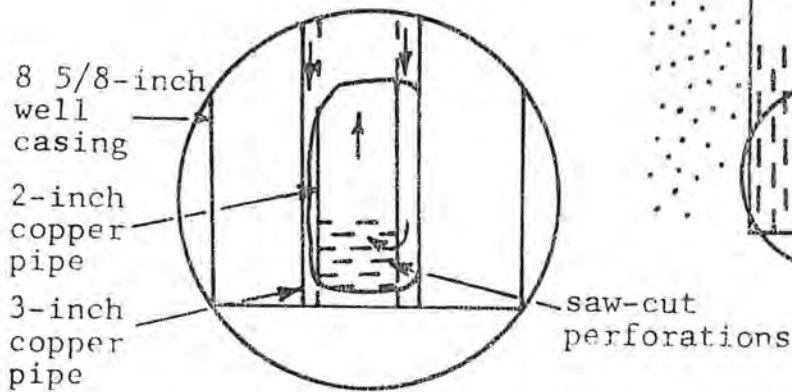


Figure 2. Well construction and generalized lithologic log for Shepherd of the Mountains Lutheran Church space heating well

and booster pumps at a flow rate of 60 gpm.

The temperature of the water entering the 'furnaces' varies between 90° and 140°F depending on the time of year and the church schedule. In the winter when the system operates virtually continuously the temperature may drop to 90°F without affecting the performance of the heating units. In the summer the temperature hovers near 140°F. Return-water temperatures approaching the 179°F measured in the well during the temperature survey have never been realized, possibly because the 60 gpm circulating rate may be too high to allow maximum heat transfer through the heat exchanger located in the well. No significant temperature drop of the returning fluid has been measured between the well head and the church approximately 120 feet apart.

During the two and one-half years that the system has been in operation it has performed trouble-free. A very constant 65°F room temperature has been maintained by the system. Until recently the system has been allowed to operate continuously at a substantial savings to the church. Presently the system is turned down when the facilities are unoccupied in an effort to cut electricity consumption even further.